Relation of Body Mass Index, Waist Circumference, and Body Fat Percentage to Lipid Profile and Oxidative Stress Markers in Menopausal Women

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Summary The degenerative diseases in menopause-age women has been continued to increase every year. This study aimed to analyze the relation of body mass index, waist circumference, and body fat percentage on blood biochemical markers of lipid and oxidative stress in menopausal women. This randomized control trial (RCT) was conducted using a cross-over design. The subjects in this study were sixteen menopausal women in Ciheraing Village, Dramaga Subdistrict, Bogor, West Java, Indonesia. The data were analyzed using Microsoft Excel program and SPSS 23 software. The results showed that the subjects’ mean age was 57±4.63 y with the age range of 50–60 y. The subjects’ mean BMI was 27.55±2.11 kg/m², the mean waist circumference was 90.77±7.16 cm, and the mean body fat percentage was 35.6±3.26%. The mean cholesterol, triglycerides, HDL-c, and LDL-c levels after the intervention were 186.4 mg/dL, 119.8 mg/dL, 55.5 mg/dL, and 107 mg/dL, respectively. The mean MDA and SOD levels were 155.5 ng/mL and 27.55 U/mL, respectively. This study concluded that BMI had significant positive correlations with body fat percentage, cholesterol levels, LDL-c levels, and serum MDA levels. BMI and body fat percentage had significant negative correlations with serum SOD levels.

Key Words BMI, lipid profile, menopausal women, oxidative stress

The prevalence of cardiovascular disease in women in the United States reached 54% in 2013 with a one percent increase every month. It occurs mostly in menopausal women with inadequate health care, inadequate dietary intake, and excess weight characterized by an abnormal lipid profile. The classification of the menopausal women was as follows: 5.8% white women, 7.6% black women, and 5.6% naturalized white and black women (1). The prevalence of cardiovascular disease in Indonesia also increases from year to year. Menopausal women usually tend to be overweight and are at higher risk of having some health problems (2).

The distribution pattern of lipid profile in postmenopausal women shows that high levels of high-density lipoprotein cholesterol (HDL-c) are found in overweight or obese women observed from the abnormal waist circumference (WC). A high blood lipid profile causes hypercholesterolemia and hypertriglyceridemia because WC is related to the risk of cardiovascular disease. Thus, normal WC should be supported by foods that have the potential to prevent weight gain. Based on the previous study, it is known that larger WC is associated with an increased risk of cardiovascular disease (3).

Body mass index (BMI) is a simple index of body weight and height data commonly used to classify the underweight, overweight, and obesity in adults. BMI is defined as weight in kilograms divided by the square of height in meters (kg/m²). BMI has a positive relationship with the age of menopausal women because hormones in the body affect estrogen and follicular activity (4). Therefore, an adequate intake is needed to help stabilize hormones at the age of menopause. Besides hormones, the presence of oxidative stress in overweight menopausal women results in damage to cells, tissues, or organs. Thus, BMI is a determinant of oxidative stress conditions experienced by menopausal women. High BMI is associated with increased total cholesterol and low-density lipoprotein cholesterol (LDL-c) levels (5).

Lipid profile associated with body fat percentage will initiate a result which concludes that lipid profile and excess fat in menopausal women shows the predictors of atherogenesis; i.e., epidemiological predictions in the incidence of cardiovascular diseases in menopausal women when the lipid profile and body fat percentage are not controlled due to imbalanced intake (6). Waist-to-hip ratio is an index used to determine abdominal fat distribution.

Body fat percentage in the blood plays an important role in health and the emergence of disease. Triglycerides, lipoproteins, and cholesterol are blood lipids. Lipoproteins are classified into low-density and high-density categories. An increase in LDL-c levels along with increased cholesterol and triglyceride levels are considered as risk factors for arterial occlusion. If
this condition occurs in the coronary arteries, the artery-
iosclerosis may occur and trigger a stroke. High-den-
sity lipoproteins (HDL) are involved in the transfer of
cholesterol from the arterial wall to the liver. BMI, waist
circumference, and body fat percentage need to be com-
tended to become data describing biochemical and
anthropometric measurements to ensure the lipid pro-
file with various predictors.

Menopausal women are relatively at risk of over-
weight due to many physical changes and damages.
The excess body weight can be assessed based on the
weight-to-height ratio (BMI), WC measurement, and
total body fat evaluation. WC is one of the indicators
related to the distribution of visceral fat. The visceral fat
accumulation contributes to prooxidant and proinflam-
atory status and the changes in glucose and lipid
metabolism. BMI is an indicator of oxidative stress
which is triggered by the conditions in one's body and
the anthropometric measurements. A study on obese
menopausal patients proved that a high waist-hip ratio
caused an increase in oxidative stress resulting in many
physical and emotional complaints and damage to some
parts of several enzymes in the body.

This study aimed to identify the relation of BMI, WC,
and body fat percentage to lipid profile (total choles-
terol, triglycerides, HDL-c, and LDL-c levels) and oxida-
tive stress markers in menopausal women.

**MATERIALS AND METHODS**

This research was conducted from October to Decem-
ber 2017 in Integrated Health Service and Promotion
Post (Posbindu) built in the working area of the Dra-
maga Public Health Center (Puskesmas) in Bogor. The
subjects were menopausal women with the inclusion
criteria as follows: 1) menopause period was between
one to five years; 2) menopause occurred naturally; 3)
having an abnormal lipid profile (cholesterol >200 mg/
dl, LDL-c >130 mg/dl, triglycerides >150 mg/dl, or
HDL-c <40 mg/dl) or hypertension (systolic >140
mmHg and/or diastolic >90 mmHg); 4) aged between
50 to 60 y; 5) already familiar/used to eat cream soup;
and 6) willing to become respondents, obeying the rules
made during the study, and signing the informed con-
sent.

The exclusion criteria in this study were as follows: 1)
former smokers or active smokers and alcoholics; 2)
having history of heart disease, diabetes, asthma, can-
cer, chronic gastrointestinal disorders, and other
chronic diseases; 3) routinely consuming antioxidant
supplements and/or phytopharmaceuticals; 4) vegetari-
ans; 5) using estrogen therapy; 6) participating in other
research; and 7) taking lipid-lowering drugs or antihy-
pertensive drugs.

The study began with the selection of subjects using
a cross-over design which consisted of two treatments,
namely functional cream soup intervention and con-
trol. Sixteen subjects participated in this study. The first
phase was selecting the subjects based on the age of
menopausal women (50–60 y) in Cihoreang Village, the
working area of Puskesmas Dramaga. The blood sample
was then taken using the finger-prick method to mea-
sure one of the abnormal lipid profiles (i.e., total choles-
terol levels). The total cholesterol measurement aimed
to select prospective research subjects who met the cri-
teria. The subjects who met the criteria were given an
explanation regarding the study and asked to fill out the
informed consent to participate in the study. The next
phase was an interview using a questionnaire, the mea-
surement of body weight, height, WC, and body fat per-
centage, and blood sampling. During the interview, the
data concerning age, dietary patterns, and food con-
sumption were collected.

The data collected in this study were the subjects' gen-
eral characteristics consisting of age, sex, weight,
height, body fat percentage, food consumption patterns
and levels. The lipid profile data included total choles-
terol, triglycerides, HDL-c, and LDL-c levels while the
oxidative stress markers consisted of subjects' serum
malondialdehyde (MDA) and superoxide dismutase
(SOD) levels. Examination of systolic and diastolic blood
pressure was carried out by health personnel, and it
was performed every time before the blood sampling.

The data regarding age and sex were collected
through interviews using questionnaire aids. The data
concerning food consumption patterns were collected
using the food frequency questionnaire (FFQ), and the
consumption level data were collected using the food
recall method.

The anthropometric data were body weight, body
height, and BMI. Body weight, height, WC, and body fat
percentage data were collected through direct measure-
ments. Weight and body fat percentage were measured
using bioelectrical impedance analysis (BIA). Body fat
percentage was measured using Omron's body fat analy-
izer while the body height was measured using a
microtoise with an accuracy of 0.1 cm and a length of
200 cm. WC was measured using the measuring tape
with an accuracy of 0.1 cm and a length of 200 cm.
BMI was assessed through body weight and height indi-
cators.

Serum MDA and SOD data were obtained from the
analysis of blood samples of the research subjects.
Blood samples were taken in the morning after a 10-h
overnight fast. The blood sampling was performed by
health analysts at the biochemical laboratory of Depart-
ment of Community Nutrition of Bogor Agricultural
University. Blood samples were taken using a 5-cc dis-
posable syringe. The blood was put into a tube with alu-
mminum foil protection. The blood was then immediately
centrifuged and stored in a freezer in the biochemical
laboratory of Department of Community Nutrition. The
MDA and SOD levels in the blood serum were then ana-
alyzed in the Laboratory of Physiology of the Faculty of
Data processing was carried out for each variable examined. The data regarding age were processed descriptively. Consumption pattern data were processed by converting the frequency of weekly consumption and displaying the data in the proportion of each type of food based on its group. The nutritional intake data were processed by converting the results of food recall into total consumption in grams for each type of food, translating them into nutrients using Indonesian Food Consumption Table, and comparing them to the recommended dietary allowance (RDA). Thus, the percentage of intake fulfillment to RDA was obtained. Weight and height data were processed to obtain BMI in units of kg/m².

Data processing and analysis were performed using 2007 Microsoft Excel program and SPSS version 23.0 for Windows. Descriptive and inferential statistics were carried out with a significant level of five percent (p<0.05). Differences in mean age, BMI, WC, body fat percentage were analyzed using independent sample t-test and paired t-test.

Table 1. Subjects’ characteristics.

| Variable                  | Value Range |
|---------------------------|-------------|
| Age (y)                   | 57±4.63     |
| Weight (kg)               | 59.27±6.77  |
| Height (cm)               | 146.67±3.75 |
| BMI (kg/m²)               | 27.55±2.11  |
| Waist circumference (cm)  | 90.77±7.16  |
| Body fat percentage (%)   | 35.6±3.26   |

Table 2. Mean nutrient intake and nutritional adequacy levels in the intervention and the control groups.

| Variable                  | Nutrient intake | Nutritional Adequacy Level (%) |
|---------------------------|----------------|--------------------------------|
|                           | Intervention group | Control group | p^1 | Intervention group | Control group | p^1 |
| Energy (kcal)             | Before            | 1,098±253         | 1,050±383         | 58±13         | 55±20 |
|                           | After             | 1,078±285         | 972±366           | 57±15         | 51±19 |
|                           | p^2               | 0.90              | 0.66              | 0.904         | 0.664 |
|                           | Difference        | −19.40            | −77.60            | −1.00         | −4.10 |
| Carbohydrates (g)         | Before            | 160.5±34.7        | 139.3±48          | 56±12         | 49±17 |
|                           | After             | 130.1±48.6        | 135.2±59.0        | 46±17         | 47±21 |
|                           | p^2               | 0.18              | 0.88              | 0.18          | 0.88  |
|                           | Difference        | −30.30            | −4.70             | −10.6         | −1.40 |
| Protein (g)               | Before            | 38.30±9.70        | 37.90±13.0        | 67±17         | 67±23 |
|                           | After             | 40.90±11.5        | 33.20±12.0        | 72±20         | 58±22 |
|                           | p^2               | 0.68              | 0.48              | 0.68          | 0.48  |
|                           | Difference        | 2.60              | −4.70             | 4.50          | −8.20 |
| Fat (g)                   | Before            | 34.20±13.50       | 38.1±17.7         | 28±6          | 31±6  |
|                           | After             | 44.3±25.2         | 33.6±16.8         | 36±14         | 31±14 |
|                           | p^2               | 0.37              | 0.52              | 0.12          | 0.91  |
|                           | Difference        | 10.00             | −4.50             | 8.10          | −0.40 |
| Fiber (g)                 | Before            | 6.1±1.42          | 5.9±2.5           | 21±5          | 21±8  |
|                           | After             | 4.4±1.37          | 5.4±2.3           | 16±4.9        | 19±8  |
|                           | p^2               | 0.10              | 0.74              | 0.99          | 0.741 |
|                           | Difference        | −1.60             | −0.50             | −5.80         | −1.80 |
| Total dietary cholesterol (g) | Before         | 99.2±69.5         | 156.9±110         | —             | —     |
|                           | After             | 80.4±47.9         | 111.8±126         | —             | —     |
|                           | p^2               | 0.46              | 0.34              | —             | —     |
|                           | Difference        | −18.70            | −45.00            | 0.61          | —     |

^1 Independent sample t-test; ^2 paired t-test.
Table 3. Mean meal frequency (time/wk) of the subjects before and during the intervention in each group

| Food consumption                      | Mean meal frequency | p \(^1\) |
|---------------------------------------|---------------------|---------|
|                                       | Intervention group  | Control group |
| Staple food                           |                      |         |
| Before intervention                   | 3.22±0.52           | 3.67±0.98 |
| During intervention                   | 4.23±0.97           | 3.53±1.45 |
| \(p\)                                 | 0.07                | 0.82    |
| \(\Delta\)                            | 1.01±1.32           | −0.13±1.60 |
| Food sources of animal protein        |                      |         |
| Before intervention                   | 0.56±0.36           | 0.60±0.28 |
| During intervention                   | 0.58±0.30           | 0.60±0.31 |
| \(p\)                                 | 0.83                | 1.00    |
| \(\Delta\)                            | 0.02±0.31           | 0.00±0.21 |
| Food sources of plant protein         |                      |         |
| Before intervention                   | 1.69±1.75           | 3.4±0.15 |
| During intervention                   | 2.03±0.92           | 2.68±1.55 |
| \(p\)                                 | 0.43                | 0.26    |
| \(\Delta\)                            | 0.33±1.15           | −0.73±1.71 |
| Vegetables                            |                      |         |
| Before intervention                   | 3.63±0.89           | 3.16±0.32 |
| During intervention                   | 3.16±0.50           | 3.60±2.31 |
| \(p\)                                 | 0.08                | 0.63    |
| \(\Delta\)                            | −0.46±0.65          | 0.43±2.45 |
| Fruits                                |                      |         |
| Before intervention                   | 1.27±0.51           | 1.09±0.43 |
| During intervention                   | 1.42±0.61           | 1.48±0.59 |
| \(p\)                                 | 0.38                | 0.17    |
| \(\Delta\)                            | 0.15±0.46           | 0.38±0.71 |
| Snacks                                |                      |         |
| Before intervention                   | 1.88±1.18           | 2.48±1.14 |
| During intervention                   | 1.74±0.74           | 2.09±0.98 |
| \(p\)                                 | 0.58                | 0.03*   |
| \(\Delta\)                            | −0.14±0.67          | −0.3±0.41 |

\(^1\) Independent sample \(t\)-test; \(^2\) paired \(t\)-test.

The subjects’ characteristics observed in this study were age, weight, height, BMI, WC, and body fat percentage. Table 1 shows that the subjects’ mean age is 57±4.63 y, the mean body weight is 59.27±6.77 kg, the mean height is 146.67±3.75 cm, and the mean BMI is 27.55±2.11 kg/m² (overweight). The mean WC is 90.77±7.16 cm, and the mean body fat percentage is 35.6±3.26%.

The mean intake of energy, carbohydrates, protein, fat, fiber and dietary cholesterol of the subjects between the control and intervention groups were not significantly different (\(p>0.05\)). Table 2 shows that the subjects’ mean percentage of fat adequacy level in the intervention group is in the adequate category while the level in the control group is in the excessive category. The mean percentage of fat adequacy levels before and after the intervention did not differ significantly in both groups (\(p>0.05\)). The mean fiber adequacy level between the control and intervention groups was also not significantly different (\(p>0.05\)), and it belonged to the severe deficiency category. The results showed that the dietary cholesterol adequacy levels before and after the intervention were adequate (\(<200\) mg/d).

Table 3 shows that there are no significant differences in staple food consumption between the intervention and the control groups (\(p>0.05\)) with a mean difference of 1.01±1.32 in the intervention group and
The consumption patterns of plant-protein sources did not show significant differences between the intervention and the control groups. The consumption patterns of staple food before and after the intervention did not differ significantly in the intervention and the control groups (p<0.05). Similarly, the animal protein consumption indicated that there were no significant differences in the consumption patterns of animal-protein sources between the intervention and the control groups (p<0.05). Similary, the animal protein consumption indicated that there were no significant differences in the consumption patterns of animal-protein sources between the intervention and the control groups (p<0.05). Similarly, the animal protein consumption indicated that there were no significant differences in the consumption patterns of animal-protein sources between the intervention and the control groups (p<0.05). Similarly, the animal protein consumption indicated that there were no significant differences in the consumption patterns of animal-protein sources between the intervention and the control groups (p<0.05).

Based on the analysis results, there were no significant differences in vegetable consumption patterns between the intervention and the control groups (p>0.05) with a mean difference of −0.73±1.71 in the control group.

Table 4 shows that the cholesterol levels in the intervention group decreased significantly by 44.1±51.3 mg/dL after the intervention while the cholesterol levels in the control group increased by 0.87±32.2 mg/dL. However, there were no significant differences between the two groups (p>0.05). The mean triglyceride levels between the intervention and the control groups were not significantly different (p>0.05). The triglyceride levels decreased by 14.6±51.3 mg/dL in the intervention group and increased by 9.0±28.6 mg/dL in the control group. The mean HDL-c levels increased by 1.5±9.7 mg/dL in the intervention group but not significant. Contrarily, the control group experienced a significant decrease in HDL-c levels by 11.8±10.9 mg/dL. There were significant differences in mean HDL levels between the intervention and the control groups. The mean LDL-c levels decreased significantly by 4.2±58.7 mg/dL in the intervention group after the intervention and increased by 11.0±25.9 mg/dL in the control group. The mean difference in LDL-c levels differed significantly between the two groups (p<0.05).

Table 5 shows that there was a significant decrease in serum malondialdehyde (MDA) level in menopausal women before and after the intervention. The activity of the superoxide dismutase (SOD) increased significantly after the functional cream was given to menopausal women.

The BMI had significant positive correlations with cholesterol and LDL-c levels (p<0.05) with moderate correlation coefficients (r=0.52) in both groups. These
results showed that the higher the BMI, the higher the cholesterol and LDL-c levels. Conversely, BMI did not have significant correlations with triglycerides and HDL-c levels \((p>0.05)\). The WC did not have significant correlations with cholesterol, triglycerides, HDL-c, and LDL-c levels. The results also showed that body fat percentage had positive correlations with cholesterol and LDL-c levels \((p<0.05)\) with moderate coefficient correlations of 0.59 and 0.57, respectively (Table 6).

Table 5. Mean serum MDA and SOD levels of the subjects in the intervention and the control groups.

| Variable | Group       |  |  |  |
|----------|-------------|---------|---------|---------|
|          | Intervention group | Control group | p1 |
| MDA (ng/mL) |  |  |  |  |
| Before   | 196.75±33.06 | 321.76±20.3 | 0.050* |
| After    | 155.50±16.64 | 412.16±16.32 | 0.000* |
| SOD (U/mL) |  |  |  |  |
| Before   | 25.08±1.59   | 25.96±2.14  | 0.015* |
| After    | 27.55±4.19   | 23.22±2.15  | 0.065  |

\(^1\) Uji independent \(t\)-test; \(^2\) paired \(t\)-test; * significant \((p<0.05)\).

Table 6. Relation of BMI, WC, and body fat percentage to the subjects’ lipid profile.

| Variable                  | Parameter         | r     | p       |
|---------------------------|-------------------|-------|---------|
| BMI                       | Total cholesterol | 0.52  | 0.04*   |
|                           | Triglycerides     | −0.06 | 0.81    |
|                           | HDL-c             | −0.08 | 0.77    |
|                           | LDL-c             | 0.52  | 0.04*   |
| WC                        | Total cholesterol | −0.13 | 0.62    |
|                           | Triglycerides     | −0.05 | 0.85    |
|                           | HDL-c             | −0.08 | 0.78    |
|                           | LDL-c             | −0.11 | 0.70    |
| Body fat percentage       | Total cholesterol | 0.59  | 0.02*   |
|                           | Triglycerides     | 0.06  | 0.81    |
|                           | HDL-c             | −0.07 | 0.81    |
|                           | LDL-c             | 0.57  | 0.02*   |

\(r\)=correlation coefficient; * significant \((p<0.05)\).

Table 7. Relation of BMI, WC, and body fat percentage to the subjects’ serum MDA and SOD levels.

| Variable         | Parameter | r     | p       |
|------------------|-----------|-------|---------|
| BMI              | MDA       | 0.54  | 0.03*   |
|                  | SOD       | −0.71 | 0.00*   |
| WC               | MDA       | −0.08 | 0.85    |
|                  | SOD       | −0.29 | 0.28    |
| Body fat percentage | MDA   | 0.46  | 0.57    |
|                  | SOD       | −0.57 | 0.02*   |

\(r\)=correlation coefficient; * significant \((p<0.05)\).

DISCUSSION

Based on the mean BMI, WC, and body fat percentage, the subjects in this study were categorized as obese. This result was in line with various studies that had been carried out, including a study by Woods et al. They stated that women who had entered the menopause period would tend to be obese because the physical activity began to decline and the metabolism decreased...
characterized by no ovulation phase; thereby, there was no luteal phase (9).

The intake of energy, carbohydrates, protein, fat, fiber and dietary cholesterol of the respondents were not significantly different. This result showed that the subjects’ intakes did not change during the intervention. The subjects’ energy adequacy levels between the intervention and the control groups were not significantly different (p>0.05). The subjects’ mean energy adequacy levels were categorized as severe energy deficiency (<70% RDA). The mean adequacy levels of carbohydrates and protein also belonged to severe deficiency category (<70% RDA). The percentage data of subjects’ fat adequacy levels in the intervention group belonged to the adequate category while the ones in the control group fell in the excessive category. These results showed the eating habits of the respondents in the control group in which their fat intakes were still derived from high-fat foods. These results were in line with the results of Basic Health Research stating that the mean fat consumption in Indonesia was high (47.2 g/d) (10). According to the Balanced Nutrition Guidelines, the maximum fat requirement is 30% of total energy requirement (11).

The mean fiber adequacy levels between the intervention and the control groups were also not significantly different (p>0.05), and it belonged to the severe deficiency category. These results indicated that the research subjects consumed a small amount of fiber-containing foods. The amount of fiber suggested by the Ministry of Health for postmenopausal women is 28 grams a day according to Indonesian RDA in 2013.

The adequacy level of dietary cholesterol was classified as adequate if the amount of intake was less than 200 mg/d and excessive if more than 200 mg/d (12). The results showed that the dietary cholesterol adequacy levels before and after the intervention were adequate (<200 mg/d). These results indicated that the research subjects consumed food that did not contain high dietary cholesterol.

There were no significant differences in the mean meal frequency of staple food, animal protein, plant protein, vegetables, fruits, and snacks between the intervention and the control groups. The staple foods observed were bread, biscuits, instant noodles, rice, rice noodle, corn, sweet potato, potato, and cassava. The types of plant-based foods observed were soybean, mung bean, peanut, tempeh, and tofu. The types of vegetables observed were spinach, water spinach, mustard greens, cassava leaves, carrots, tomatoes, green beans, cabbage, pumpkin, and cucumber. The types of fruits observed were banana, mango, papaya, apple, orange, snake fruit, guava, avocado, and grapes. The types of snacks observed in this study were fried foods, sponge cake, tea, and coffee. The types of food sources of animal protein observed were meat, meatballs, sausages, shellfish, shrimp, sardines, fish, and eggs.

There were significant differences in the blood profile of menopausal women between the control group and the intervention group. These results can be explained by the mechanism of antioxidants that can improve lipid-related metabolism in the body (13).

Oxidative stress can be known through the status of MDA and SOD. MDA is one of the low-molecular-weight substances produced as the end product of lipid peroxidation in the body due to the reaction of free radicals which then form an adduct together with DNA and protein (14, 15). Oxidative stress is shown by the low antioxidant status, and the SOD is a marker for antioxidants (16). The body’s efforts to fight oxidation reactions are carried out by endogenous antioxidants (e.g., vitamins and enzymes) and exogenous antioxidants (from food). If the number of reactive oxygen species (ROS) is more than the antioxidants, the body experiences oxidative stress.

The mean value of serum MDA levels in the subjects of the intervention group after the intervention was significantly lower (p<0.05) than before the intervention. In the subjects of the control group, the mean serum MDA levels before and after the intervention were not significantly different (p>0.05). These results indicated that the functional cream soup had a significant effect on decreasing serum MDA levels in menopausal women who are given intervention using the functional cream soup. A decrease in MDA levels was possible through the presence of smears of the antioxidant content of isoflavones in the functional cream soup products that played a role in countering free radicals by cutting off the chain reaction of free-radical oxidation (17).

The results also showed that body fat percentage had positive correlations with cholesterol and LDL-c levels (p<0.05) with moderate correlation coefficients of 0.59 and 0.57, respectively. These results indicated that the higher the body fat percentage, the higher the cholesterol and LDL-c levels. Conversely, HDL-c and LDL-C levels did not show significant correlations with body fat percentage. The relation of BMI to anthropometric measurements, body fat percentage, and lipid profile should be observed at age and period of adolescence because it is an effective factor in determining obesity, predicting blood lipid-related diseases, and minimizing the risk of diseases that occur at menopause (18).

The previous study revealed that body anthropometry and body composition on the body fat percentage value were associated with oxidative stress in menopause-age women who had the cardiovascular disease if this condition was not treated medically and they did not pay attention to their intakes. An increase in adiposity that is fused to body fat percentage causes the oxidative stress to increase, and it also causes inflammation. Oxidative stress occurs when the amount of free radicals in the body exceeds the body’s ability to neutralize them (19).

This study proved that there was a significant correlation between BMI and oxidative stress markers (i.e., MDA levels and serum SOD) for women. There was also a correlation between body fat percentage and SOD levels. Oxidative stress can be corrected in several ways, including improvements in antioxidant defenses through increased intake of foods that contain antioxidants and antioxidant-rich foods (20).
CONCLUSION AND RECOMMENDATION

The administration of cream soup significantly increased serum HDL-c levels in menopausal women before and after the intervention. LDL-C levels decreased significantly after the administration of cream soup to menopausal women. BMI and body fat percentage had significant positive correlations with serum cholesterol and LDL-C levels. The higher the BMI and body fat percentage, the higher the serum cholesterol and LDL-C levels. Besides that, BMI had a significant positive correlation with serum MDA levels. The higher the BMI, the higher the serum MDA levels. Greater WC and higher body fat percentage will increase oxidative stress in menopausal women. In this study, BMI and body fat percentage had significant negative correlations with serum SOD levels. The greater the BMI, the lower the serum SOD levels. The improvement of lipid profile and the management of oxidative stress in menopausal women are issues that must be addressed, among others, by improving antioxidant defenses through increasing foods which contain lots of antioxidants.

Disclosure of state of COI

No conflicts of interest to be declared.

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