Supplementation of Catfish (Clarias gariepinus) Oil Enriched with Omega-3 Soft Capsule Improves Oxidative Stress and Cognitive Function in Elderly

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Summary Elderly is defined as an age group that is susceptible to various diseases. The aging process in the elderly is associated with an increase in oxidative stress activity which can lead to various health problems which are a major cause of high mortality and morbidity. This study aimed to analyze the effect of supplementation of catfish (Clarias gariepinus) oil enriched with omega-3 soft capsule on oxidative stress and cognitive function of elderly people. The design of this study was a single blind randomized control trial. A total of 29 elderly subjects were chosen following these inclusion criteria: aged >60 y; had dyslipidemia; and signed the informed consent. Subject were divided into three groups i.e. SO (soybean oil), CFO (commercial fish oil), and CO with omega-3 (catfish oil enriched with omega-3). The intervention was 1,000 mg oil/d administered for 90 d. The results showed that different supplementation groups had significant effects on oxidative stress and cognitive function (p<0.05). Supplementation of catfish oil enriched with omega-3 was able to significantly decreased malondialdehyde (MDA) level (p<0.05) and significantly increased mini mental state examination (MMSE) score (p<0.05). Overall, CO with omega-3 supplementation for 90 d was able to improve oxidative stress and cognitive function of the elderly better than other groups.

Key Words elderly, catfish oil, oxidative stress, cognitive function

The population of elderly in Indonesia is increasing every year. Based on the results of Susenas 2016, the number of elderly in Indonesia reached 22.4 million or 8.69% of the population and in 2018 it is estimated that the number of elderly people will reach 24.7 million. This indicates that there is an increase in life expectancy. On the other hand, the elderly is defined as an age group susceptible to disease and is associated with high mortality and morbidity. Old age can affect several aspects of life, including physical, biological, psychological, and social changes as a result of the aging process or the occurrence of degenerative diseases (1).

The aging process in the elderly is associated with an increase in oxidative stress activity which can induce health problems which is a cause of high mortality and morbidity (2, 3). Health problems that are often experienced by the elderly include dyslipidemia, atherosclerosis, diabetes mellitus, hypertension, dementia, heart disease, and cognitive disorders (4, 5). Cognitive impairment is a major clinical problem in people with dementia and is most often experienced by the elderly. Nutritional factors can accelerate the decline in cognitive function (6, 7).

Essential fatty acids have a role as antioxidants (8). The high circulation of essential fatty acids, especially omega-3 in the body, is associated with low levels of proinflammation (9–11). Fish consumption containing high essential fatty acids can reduce oxidative stress in the body by decreasing the levels of F2-isoprostan and malondialdehyde (12–14). Several studies have shown that high concentrations of PUFA can affect membrane neurons and neurotransmission in the brain (15).

Previous research showed that giving catfish oil containing high PUFA was able to reduce beta amyloid concentration of cerebrospinal fluid in long-tailed monkeys (Macaca fascicularis) as a biological marker associated with increased cognitive function (16). The objective of this study was to analyze the effect of supplementation of catfish (Clarias gariepinus) oil enriched with omega-3 soft capsule on oxidative stress and cognitive function of elderly people.

MATERIALS AND METHODS

Participants. Population of this study were elderly people who lived in Ciherang District, Bogor, Indonesia (n=100) (Fig. 1). Screening data was conducted for all subjects to select those who met the inclusion and exclusion criteria: (1) people aged >60 y old; (2) had dyslipidemia; (3) did not suffer from other disease except dyslipidemia; (4) did not consume any supplements that have similar materials with the intended treatment; (5) was not part of other research; (6) signed informed consent. After data screening, about 30 participants were selected (6 men and 23 woman with a mean age...
of 66.1±5.3 [±SD] y). As many as 70 participants were excluded on the basis of the criteria. Participants were randomly allocated into three groups i.e. SO (soybean oil), CFO (commercial fish oil), and CO with Omega-3 (catfish oil enriched omega-3). The first group (n=10; men, n=2; women, n=8; mean age, 64.9±4.7 y) received soybean oil (SO), the second group (n=10; men, n=2; women, n=8; mean age, 65.9±5.4 y) received commercial fish oil (CFO), whereas the third group ((n=10; men, n=3; women, n=7; mean age, 68.3±6.4 y) received CO with Omega-3 (catfish oil enriched omega-3).

Study design. The study was designed as a single blind randomized controlled trial. This research has received ethical approval from Health Research Ethics Committee of the Faculty of Medicine, University of Indonesia (No.991/UN2.F1/ETIK/2016).

Intervention. The supplementation was conducted for 90 d. The capsule contained 1,000 mg oil based on the group which consumed 1 capsule/d. The fatty acids contained in SO was SF A (13.38%), MUF A (21.38%) and PUF A (49.81%), CFO was SF A (15.53%), MUF A (16.14%) and PUF A (28.05%); CO+Omega-3 was SF A (26.08%), MUFA (37.40%) and PUA (17.37%). Before supplementation period was started, all participants were gathered to receive the research introduction, sign informed consent, and have instruction on how to consume the capsules. In order to control the capsule consumption, subjects were given a compliance card to prove that they have consumed the capsules.

Cognitive function and oxidative stress of subjects were assessed at baseline and after 90-d supplementation. The tube containing the supplement was visible to the participants. However, the participants in each group were blinded in the sense that they could not distinguish between the supplements.

Cognitive function. Estimation of cognitive function were conducted by using Mini-Mental State Examination (MMSE), in which the participants had to answer several questions by themselves with the help of examiner. The MMSE was used as a dementia screening. The MMSE (total 30 points) measured several cognitive areas, including orientation (10 points), registration (3 points) attention and calculation (5 points), recall (3 points), and language (9 points) (17, 18).

Oxidative stress. Oxidative stress were analyzed using malondialdehyde (MDA) parameters. MDA estimation was performed by spectrophotometric method of Monnier et al. (19). Venous blood was drawn by nurse, and the serum was carefully separated, transferred to micro tubes, and stored until analysis.

Statistical analysis. All data were expressed as mean±SD. The change value between 90-d intervention and baseline for each groups was assessed with analysis of paired t-test while the difference in changes (change value=90-d intervention value–baseline value) among the groups was assessed using analysis of variance (ANOVA). When ANOVA result was significant, Duncan post hoc test was performed to compare the changes among the groups.

All statistical analysis were carried out using SPSS 16.0 software program. p≤0.05 was used to determine statistical significance.

RESULTS

In this study, 30 subjects were participated but one man dropped out during the study. Thus, the total number of participants was 29 subjects.

In regard to oxidative stress, the differences in changes among groups in malondialdehyde levels were significant (p=0.001) (Table 1). Only in SO and CO+Omega-3 that decrease are significant. The level of malondialdehyde of subjects in the CO+ Omega-3 groups decreased from 3.37±0.60 µg/mL to 2.39±0.50 µg/mL.

In regard to cognitive function, the differences in changes among groups in MMSE score were also significant (p=0.003) (Table 2). MMSE scores were only increased in the CO+ Omega-3 group (p<0.05). After the 90-d supplementation, The MMSE score in the CO+
Supplementation of Catfish Oil

The results are in line with previous studies, which indicated that consumption of fish oil high in essential fatty acids can significantly improve cognitive abilities in aspects of verbal fluidity and memory. PUFA in fish oil is able to maintain cognitive function by maintaining membrane fluidity, increasing synaptic and neurotransmitter functions, improving learning and memory performance and supplying neuroprotective effect (21).

In addition, the administration of essential fatty acids derived from PUFA can reduce the concentration of β-amyloid in blood vessels and in the cerebrospinal fluid. The decrease in β-amyloid concentration is one of the biological markers to improve cognitive function (22).

Essential fatty acids play a role in maintaining brain health (23). Several studies have shown that PUFA can affect membrane neurons and neurotransmission. Omega-6 fatty acids function as precursors in arachidonic acid (AA) formation while omega-3 is the precursor to form eicosapentanoic acid (EPA) and DHA, both of which are molecules involved in maintaining the integrity of brain cells. DHA is a key component of the phospholipid membrane in the brain, and adequate status of PUFA n-3 can help maintain nerve integrity and function. DHA is thought to be directly involved in improving nerve health in the brain through a variety of potential mechanisms. In addition, DHA can also alter the expression of genes that regulate various biological functions important for cognitive health, including neurogenesis and neuronal function (15).

Our study has some limitations. One of this study’s limitations is the small number of participants, although still met the minimum of sample size requirement. Moreover, 90-d supplementation may be too short to observe the full effects especially in cognitive function and this study did not examine the other vari-

Table 1. Malondialdehyde (MDA) level at baseline and after the 90-d supplementation and their change in SO, CFO, and CO+Omega-3.

<table>
<thead>
<tr>
<th>Group</th>
<th>Baseline</th>
<th>90-d</th>
<th>Change</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO</td>
<td>2.99±0.56</td>
<td>2.24±0.47**</td>
<td>−0.75±0.76&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.01</td>
</tr>
<tr>
<td>CFO</td>
<td>2.98±0.66</td>
<td>2.82±0.87</td>
<td>−0.16±1.07&lt;sup&gt;bc&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>CO+Omega-3</td>
<td>3.37±0.60</td>
<td>2.39±0.50&lt;sup&gt;***&lt;/sup&gt;</td>
<td>−0.98±0.57&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
</tr>
</tbody>
</table>

Values are means±SD; Means of the changes in a column without a common letter differ, p<0.05. Different from baseline by paired t-test, *p<0.05, **p<0.01, ***p<0.001. p value represent the differences in the change of MDA among groups assessed by ANCOVA. SO, soybean oil; CFO, commercial fish oil; CO+Omega-3, catfish oil + omega-3.

Table 2. Mini-Mental State Examination (MMSE) at baseline and after the 90-d supplementation and their change in SO, CFO, and CO+Omega-3.

<table>
<thead>
<tr>
<th>Group</th>
<th>Baseline</th>
<th>90-d</th>
<th>Change</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO</td>
<td>21.60±3.47</td>
<td>19.80±4.44</td>
<td>−1.80±3.96&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.01</td>
</tr>
<tr>
<td>CFO</td>
<td>21.55±6.26</td>
<td>21.22±5.58</td>
<td>−0.32±2.34&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>CO+Omega-3</td>
<td>14.70±3.23</td>
<td>19.20±5.13</td>
<td>4.50±4.17&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
</tr>
</tbody>
</table>

Values are means±SD; Means of the changes in a column without a common letter differ, p<0.05. Different from baseline by paired t-test, *p<0.05, **p<0.01, ***p<0.001. p value represent the differences in the change of MMSE among groups assessed by ANCOVA. SO, soybean oil; CFO, commercial fish oil; CO+Omega-3, catfish oil + omega-3.

Omega-3 increased from 14.70±3.23 points to 19.20±5.13 points.

DISCUSSION

In this study, we found that daily supplementation of SO and CO+Omega-3 (1,000 mg) for 90-d improved malondialdehyde level in elderly people. The results are in line with previous studies, which showed that consumption of fish oil high in essential fatty acids can reduce oxidative stress levels. Catfish oil used in this study contained monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA) although the PUFA is the lowest but the MUFA is highest, which also acted as antioxidants (13). Antioxidant is a molecule which can prevent the negative effects of oxidation and protect the cells and tissues in the body from the damage caused by free radicals (20).

Previous study revealed that supplementation with 50 g of catfish biscuit/d and 1 g of catfish oil/d for 60 d could significantly reduce TG levels by 15%, MDA levels by 14%, and tended to suppress the increased LDL-c and ox-LDL levels (14). These results were consistent with another study, which indicated that consumption of essential fatty acids was able to reduce the rate of inflammation as well as inhibited the occurrence of oxidative stress in the body (9–11).

At the basic level, MMSE scores in all group were not the same. This is suspected because there are other factors that influence the assessment of MMSE including the subject’s educational history. CO+Omega-3 supplementation for 90-d increased MMSE scores significantly. The results are in line with previous studies, which exhibited that supplementation of monounsaturated fatty acids (MUFA) in subjects aged 55–80 y significantly improved cognitive abilities in aspects of verbal fluidity and memory. PUFA in fish oil is able to maintain cognitive function by maintaining membrane fluidity, increasing synaptic and neurotransmitter functions, improving learning and memory performance and supplying neuroprotective effect (21).

In addition, the administration of essential fatty acids derived from PUFA can reduce the concentration of β-amyloid in blood vessels and in the cerebrospinal fluid. The decrease in β-amyloid concentration is one of the biological markers to improve cognitive function (22).

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Our study has some limitations. One of this study’s limitations is the small number of participants, although still met the minimum of sample size requirement. Moreover, 90-d supplementation may be too short to observe the full effects especially in cognitive function and this study did not examine the other vari-
ables that might influence the cognitive function of the subjects. Sampling site was also chosen purposively, hence the results of this study could not be generalized in other populations.

Disclosure of state of COI

No conflicts of interest to be declared.

REFERENCES