

# Association between Body Mass Index and Omega-3 Fatty Acid Food Intake

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**ABSTRACT**

Obesity can be determined in several ways, one of which is measurement of BMI (body mass index). The use of omega-3 supplements is known to reduce risk factors for metabolic disease, reduce the number of inflammatory mediators. The purpose was to assess the association between BMI and omega-3 fatty acid food intake. This type of research was a cross-sectional research design. The research location used in this study is around the Surabaya area starting in March-June 2022. The research location was carried out in Rungkut District, Surabaya, Indonesia. The method of data analysis in this study was to determine the relationship between BMI (body mass index) and omega-3 fatty acid food intake by using the chi-square test. There were no difference in between egg ( $p=0.203$ ), milk ( $p=0.098$ ), and supplement intake ( $p=0.060$ ) with BMI. And there was a relationship between food intake in the form of fish and BMI, the lower the fish intake, the higher the respondent's BMI ( $p=0.000$ ). Fish intake is related to BMI value, but requires further research in optimal fish processing.

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## 1. INTRODUCTION

Obesity is an important health problem worldwide, where obesity can seriously increase metabolic and cardiovascular morbidity [1]. In 2016, according to a survey conducted by WHO, about 15% of women and 11% of men from 13% of the adult population worldwide were obese [2]. Based on a survey conducted by the Indonesian Ministry of Health [3], up to 2018 there were 21.8% of the total Indonesian population aged > 18 years with obesity based on the calculation of BMI (Body Mass Index)  $27.0 \text{ kg/m}^2$ . In East Java province the percentage of obesity with age 15 years covers 16% or as many as 1,163,118 people and for the City of Surabaya covers 15.51% or 163,036 people [4]. Obesity is one of the factors that increase the risk of metabolic disease [5- 7]. Some of the risks that arise from obesity, including cardiovascular disease, diabetes mellitus, problems with skeletal muscles, such as osteoarthritis [2]. In the body of people with obesity the release of inflammatory mediators will increase and cause a chronic low-grade inflammatory condition that will increase the risk of cardiovascular disease through the process of rapidly developing atherosclerosis [8], [9].

Obesity can be determined in several ways, one of which is measurement of BMI [10], [11]. As a step to reduce the prevalence of obesity according to WHO [2], it can be done by modifying lifestyle, such as doing

150 minutes of physical activity per week, increasing the intake of vegetables, fruits, nutritious foods, consuming foods with unsaturated fats, limiting sugar, and foods containing fat. fed up. Consumption of unsaturated fats has benefits for obesity and heart conditions. These unsaturated fats are known as omega-3 [12]. As a step to reduce the prevalence of obesity according to WHO [2], it can be done by modifying lifestyle, such as doing 150 minutes of physical activity per week, increasing the intake of vegetables, fruits, nutritious foods, consuming foods with unsaturated fats, limiting sugar, and reducing obesity. foods containing saturated fat. Consumption of unsaturated fats has benefits for obesity and heart conditions. These unsaturated fats are known as omega-3 [12- 14].

Omega-3 is an essential fatty acid that cannot be synthesized by the body. One of the ways to fulfill omega-3 needs is through supplementation [15], [16]. The use of omega-3 supplements is known to reduce risk factors for metabolic disease, reduce the number of inflammatory mediators [17], and reduce waist circumference in obese adults [18]. Omega-3 is an essential fatty acid that cannot be synthesized by the body. One of the ways to fulfill omega-3 needs can be fulfilled by giving it in the form of supplements [16], [19]. The use of omega-3 supplements is known to reduce risk factors for metabolic disease, reduce the number of inflammatory mediators [17]. The mechanism is associated with the role of Nuclear Factor Kappa B Cells (NFkB) sub unit p50 encoded by NFkB1 which plays a major role in the regulation of proinflammatory mediators [20- 23]. Omega-3 is an unsaturated fatty acid with more than one double bond (PUFA), which is needed by body tissues but cannot be made by the body, so to fulfill omega-3 nutrition, it can be obtained by consuming salmon, lobster, mackerel, herring, salmon oil, cod liver oil or herring oil [17]. Natural fatty acids including omega-3 fatty acids are EPA and DHA [19], [24], [25]. The use of omega-3 supplements is still limited, due to the price side, the fishy smell [26- 28] and the large size is a barrier in itself. The purpose was to assess the association between BMI and omega-3 fatty acid food intake.

## **2. METHODS**

### ***2.1 Research Design***

This type of research was a cross-sectional research design. The research location used in this study is around the Surabaya area starting in March-June 2022. The research location was carried out in Rungkut District, Surabaya, Indonesia. Ethical test No. 43/KE/IV/2022 in Universitas Surabaya.

### ***2.2 Research variable***

Research variables in this study included: intake of foods containing omega-3 and BMI. Intake of foods containing omega-3 consisted of the number and frequency of respondents' intake of fish (type and pattern of dish), milk, and eggs (type of egg and pattern of dish).

### ***2.3 Population and Research Sample***

The population of this research was active students in a private university. The sample (subject) of the study was an active student at a private university who met the criteria: 17-30 years old, did not have a fish/milk/egg allergy disorder, did not have a special diet (vegetarian). The sampling method was purposive sampling method.

### ***2.4 Research Methods and Analysis***

The research method was by interviewing the number and frequency of fish dishes (processing method), milk, and eggs. The method of data analysis in this study was to determine the relationship between BMI (body mass index) and omega-3 fatty acid food intake by using the chi-square test.

### 3. RESULTS

The total respondents in this study were 116 people. The average age of the respondents was 23.61 years. Most of the respondents did not had drug and disease hisstory. Most of the respondents had a normal BMI (Table 1).

**Tables 1:** Characteristics of respondents

Characteristics	Frequency (n: 116)	Percentage (%)
<b>Gender</b>		
Male	68	58.62
Female	48	41.38
<b>Age (years)</b>		
Late adolescence (17-25)	93	80.17
Early adulthood (26-35)	20	17.24
Late adulthood (36-45)	2	1.72
Early seniors (46-55)	1	0.86
(Average=23.61)		
<b>Drug history</b>		
Cardiovascular medicine	1	0.86
Indigestion medicine	5	4.31
Endocrine medicine	1	0.86
Respiratory medicine	1	0.86
Vitamins-Supplements	46	39.66
Not using drugs	62	53.45
<b>BMI (Body Mass Index) (kg/m<sup>2</sup>)</b>		
Underweight ( $\leq 18.4$ )	19	16.38
Normal (18.5-25.0)	61	52.59
Overweight (25.1-27.0)	14	12.07
Obesity ( $>27$ )	22	18.97

**Table 2:** Crosstab Body Mass Index and Intake of foods containing omega-3

Foods Type	Intake of foods containing omega-3		BMI (Body Mass Index) (kg/m <sup>2</sup> )				Chi Square Pvalue
	Substance intake	Frequency	Underweight ( $\leq 18.4$ ) (n: 19)	Normal (18.5-25.0) (n: 61)	Overweight (25.1-27.0) (n: 14)	Obesity ( $>27$ ) (n: 22)	
Egg	Enough	110	18	60	12	20	0.203*
	Not enough	6	1	1	2	2	
Fish	Enough	83	17	50	8	8	0.000
	Not enough	33	2	11	6	14	
Milk	Enough	93	18	57	10	8	0.098*
	Not enough	23	1	4	4	14	
Supplement	Enough	51	15	25	4	7	0.060*
	Not enough	65	4	36	10	15	

\*P value  $>0.05$ , there was no significant difference between the two groups

Table 2 showed that there was no difference between egg, milk, and supplement intake and BMI. While the results show that there was a relationship between food intake in the form of fish and BMI, the lower the fish intake, the higher the respondent's BMI ( $p=0.000$ ).

### 4. DISCUSION

Omega-3 can be found in foods such as fish, especially deep sea fish such as salmon, mackerel, tuna, herring and sardines which contain cod liver oil which is better known as cod liver oil, nuts and seeds, additional products (such as eggs, yogurt, juice, soy milk [29]).

In this study, most of the respondents got their intake of omega-3 from fish. Although the type of fish consumed is not the type of fish that does contain high omega-3. Salmon is included in a row of foods that contain lots of omega 3. Every 100 grams of salmon contains 2,260 mg of omega-3. This amount far exceeds the recommended daily omega-3 intake of 250-500 mg [30]. Although high in fat, the healthy fat content in salmon is actually beneficial for the brain and heart. In addition, fish containing omega-3 which is often consumed by the public is tuna. Indonesia is one of the largest tuna producing countries in the world. In 2011, Indonesia even ranked first as the country with the most tuna production in the world, surpassing Japan's production. In addition to its delicious taste, tuna also has many benefits for the human body [31], [32]. That's because tuna has a variety of nutritional content such as vitamins A, B6 and B12, omega-3, high protein and rich in minerals such as selenium, phosphorus, and magnesium. Tuna is said to be good for heart health and blood pressure, even its anti-oxidants are good for preventing cancer. Tuna is high in polyunsaturated fatty acids (PUFA) consisting of omega-3 and omega-6. Dietary omega-3 and omega-6 polyunsaturated fatty acids (PUFA) have significant implications in health and disease prevention. Marine life is rich in long chain n-3 PUFAs [17], [33], [34].

But unfortunately, the Indonesian population has a low level of fish consumption, even in Southeast Asia, Indonesia is still inferior to Singapore and Malaysia, especially when compared to Japan and Korea. The low consumption of fish per capita of the population in Indonesia is inversely proportional to the region which is rich in sources of vegetable protein. To become an intelligent nation, eating fish needs to be encouraged [35], [36].

In addition, the program of processing fish food will also greatly affect the omega-3 content in the fish. One way of cooking that is not recommended for fish is by frying. Be it pan-frying or deep-frying. Deep-frying uses a large amount of oil to soak the fish. Meanwhile pan-frying uses less oil in the pan. During frying, the fish will absorb the fat in the oil. Thus increasing the number of calories in it and changing the type of fat contained. Not only that, the high temperatures used when frying can also damage omega-3 fatty acids far more severely than other cooking methods [37], [38].

Methyl mercury, a toxic organometallic cation, is found in fish. Individuals who use fish as their primary source of OM3FAs or pregnant and nursing women should limit their intake to two to four servings of fish a week and/or replace fish that are high in methyl mercury, such as swordfish, albacore tuna, dolphinfish, kingfish, and shark and replace with fish that have a lower amount of methylmercury, such as salmon, herring, sardines, and trout. Fortunately, DHA and EPA supplements do not contain methylmercury [29].

## 5. CONCLUSION

There were no difference in between egg, milk, and supplement intake and BMI. And there was a relationship between food intake in the form of fish and BMI, the lower the fish intake, the higher the respondent's BMI ( $p=0.000$ ).

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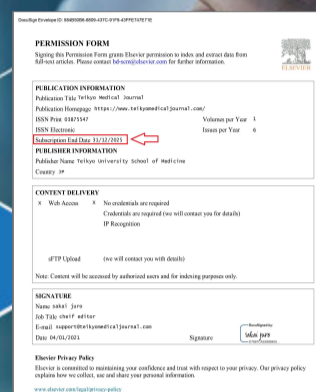
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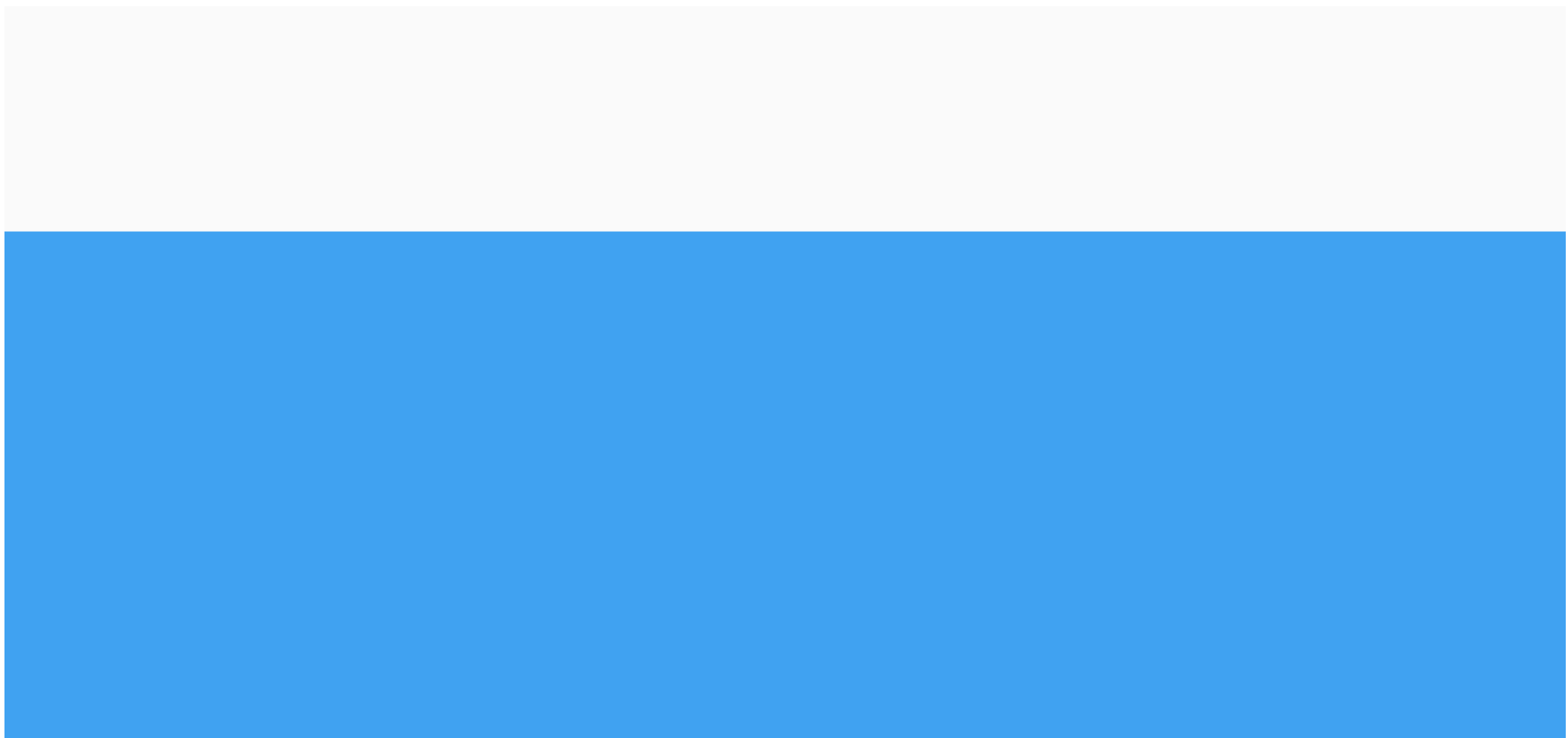
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# Association between Body Mass Index and Omega-3 Fatty Acid Food Intake

*by Amelia Lorensia*

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# Association between Body Mass Index and Omega-3 Fatty Acid Food Intake

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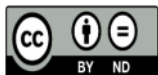


## Keywords:

BMI, food intake, omega-3

## ABSTRACT

Obesity can be determined in several ways, one of which is measurement of BMI (body mass index). The use of omega-3 supplements is known to reduce risk factors for metabolic disease, reduce the number of inflammatory mediators. The purpose was to assess the association between BMI and omega-3 fatty acid food intake. This type of research was a cross-sectional research design. The research location used in this study is around the Surabaya area starting in March-June 2022. The research location was carried out in Rungkut District, Surabaya, Indonesia. The method of data analysis in this study was to determine the relationship between BMI (body mass index) and omega-3 fatty acid food intake by using the chi-square test. There were no difference in between egg ( $p=0.203$ ), milk ( $p=0.098$ ), and supplement intake ( $p=0.060$ ) with BMI. And there was a relationship between food intake in the form of fish and BMI, the lower the fish intake, the higher the respondent's BMI ( $p=0.000$ ). Fish intake is related to BMI value, but requires further research in optimal fish processing.



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## 1. INTRODUCTION

Obesity is an important health problem worldwide, where obesity can seriously increase metabolic and cardiovascular morbidity [1]. In 2016, according to a survey conducted by WHO, about 15% of women and 11% of men from 13% of the adult population worldwide were obese [2]. Based on a survey conducted by the Indonesian Ministry of Health [3], up to 2018 there were 21.8% of the total Indonesian population aged > 18 years with obesity based on the calculation of BMI (Body Mass Index)  $27.0 \text{ kg/m}^2$ . In East Java province the percentage of obesity with age 15 years covers 16% or as many as 1,163,118 people and for the City of Surabaya covers 15.51% or 163,036 people [4]. Obesity is one of the factors that increase the risk of metabolic disease [5- 7]. Some of the risks that arise from obesity, including cardiovascular disease, diabetes mellitus, problems with skeletal muscles, such as osteoarthritis [2]. In the body of people with obesity the release of inflammatory mediators will increase and cause a chronic low-grade inflammatory condition that will increase the risk of cardiovascular disease through the process of rapidly developing atherosclerosis [8], [9].

Obesity can be determined in several ways, one of which is measurement of BMI [10], [11]. As a step to reduce the prevalence of obesity according to WHO [2], it can be done by modifying lifestyle, such as doing

150 minutes of physical activity per week, increasing the intake of vegetables, fruits, nutritious foods, consuming foods with unsaturated fats, limiting sugar, and foods containing fat. fed up. Consumption of unsaturated fats has benefits for obesity and heart conditions. These unsaturated fats are known as omega-3 [12]. As a step to reduce the prevalence of obesity according to WHO [2], it can be done by modifying lifestyle, such as doing 150 minutes of physical activity per week, increasing the intake of vegetables, fruits, nutritious foods, consuming foods with unsaturated fats, limiting sugar, and reducing obesity. foods containing saturated fat. Consumption of unsaturated fats has benefits for obesity and heart conditions. These unsaturated fats are known as omega-3 [12- 14].

Omega-3 is an essential fatty acid that cannot be synthesized by the body. One of the ways to fulfill omega-3 needs is through supplementation [15], [16]. The use of omega-3 supplements is known to reduce risk factors for metabolic disease, reduce the number of inflammatory mediators [17], and reduce waist circumference in obese adults [18]. Omega-3 is an essential fatty acid that cannot be synthesized by the body. One of the ways to fulfill omega-3 needs can be fulfilled by giving it in the form of supplements [16], [19]. The use of omega-3 supplements is known to reduce risk factors for metabolic disease, reduce the number of inflammatory mediators [17]. The mechanism is associated with the role of Nuclear Factor Kappa B Cells (NFkB) sub unit p50 encoded by NFkB1 which plays a major role in the regulation of proinflammatory mediators [20- 23]. Omega-3 is an unsaturated fatty acid with more than one double bond (PUFA), which is needed by body tissues but cannot be made by the body, so to fulfill omega-3 nutrition, it can be obtained by consuming salmon, lobster, mackerel, herring, salmon oil, cod liver oil or herring oil [17]. Natural fatty acids including omega-3 fatty acids are EPA and DHA [19], [24], [25]. The use of omega-3 supplements is still limited, due to the price side, the fishy smell [26- 28] and the large size is a barrier in itself. The purpose was to assess the association between BMI and omega-3 fatty acid food intake.

## 2. METHODS

### 2.1 Research Design

This type of research was a cross-sectional research design. The research location used in this study is around the Surabaya area starting in March-June 2022. The research location was carried out in Rungkut District, Surabaya, Indonesia. Ethical test No. 43/KE/IV/2022 in Universitas Surabaya.

### 2.2 Research variable

Research variables in this study included: intake of foods containing omega-3 and BMI. Intake of foods containing omega-3 consisted of the number and frequency of respondents' intake of fish (type and pattern of dish), milk, and eggs (type of egg and pattern of dish).

### 2.3 Population and Research Sample

The population of this research was active students in a private university. The sample (subject) of the study was an active student at a private university who met the criteria: 17-30 years old, did not have a fish/milk/egg allergy disorder, did not have a special diet (vegetarian). The sampling method was purposive sampling method.

### 2.4 Research Methods and Analysis

The research method was by interviewing the number and frequency of fish dishes (processing method), milk, and eggs. The method of data analysis in this study was to determine the relationship between BMI (body mass index) and omega-3 fatty acid food intake by using the chi-square test.

### 3. RESULTS

The total respondents in this study were 116 people. The average age of the respondents was 23.61 years. Most of the respondents did not had drug and disease history. Most of the respondents had a normal BMI (Table 1).

**Table 1:** Characteristics of respondents

Characteristics	Frequency (n: 116)	Percentage (%)
<b>Gender</b>		
Male	68	58.62
Female	48	41.38
<b>Age (years)</b>		
Late adolescence (17-25)	93	80.17
Early adulthood (26-35)	20	17.24
Late adulthood (36-45)	2	1.72
Early seniors (46-55)	1	0.86
(Average=23.61)		
<b>Drug history</b>		
Cardiovascular medicine	1	0.86
Indigestion medicine	5	4.31
Endocrine medicine	1	0.86
Respiratory medicine	1	0.86
Vitamins-Supplements	46	39.66
Not using drugs	62	53.45
<b>BMI (Body Mass Index) (kg/m<sup>2</sup>)</b>		
Underweight ( $\leq 18.4$ )	19	16.38
Normal (18.5-25.0)	61	52.59
Overweight (25.1-27.0)	14	12.07
Obesity ( $>27$ )	22	18.97

**Table 2:** Crosstab Body Mass Index and Intake of foods containing omega-3

Foods Type	Intake of foods containing omega-3		BMI (Body Mass Index) (kg/m <sup>2</sup> )				Chi Square Pvalue
	Substance intake	Frequency	Underweight ( $\leq 18.4$ ) (n: 19)	Normal (18.5-25.0) (n: 61)	Overweight (25.1-27.0) (n: 14)	Obesity ( $>27$ ) (n: 22)	
Egg	Enough	110	18	60	12	20	0.203*
	Not enough	6	1	1	2	2	
Fish	Enough	83	17	50	8	8	0.000
	Not enough	33	2	11	6	14	
Milk	Enough	93	18	57	10	8	0.098*
	Not enough	23	1	4	4	14	
Supplement	Enough	51	15	25	4	7	0.060*
	Not enough	65	4	36	10	15	

\*P value  $>0.05$ , there was no significant difference between the two groups

Table 2 showed that there was no difference between egg, milk, and supplement intake and BMI. While the results show that there was a relationship between food intake in the form of fish and BMI, the lower the fish intake, the higher the respondent's BMI ( $p=0.000$ ).

### 4. DISCUSSION

Omega-3 can be found in foods such as fish, especially deep sea fish such as salmon, mackerel, tuna, herring and sardines which contain cod liver oil which is better known as cod liver oil, nuts and seeds, additional products (such as eggs, yogurt, juice, soy milk [29]).

In this study, most of the respondents got their <sup>17</sup> intake of omega-3 from fish. Although the type of fish consumed is not the type of fish that does contain high omega-3. Salmon is included in a row of foods that contain lots of omega 3. Every 100 grams of salmon contains 2,260 mg of omega-3. This amount far exceeds the recommended daily omega-3 intake of 250-500 mg [30]. Although high in fat, the healthy fat content in salmon is actually beneficial for the brain and heart. In addition, fish containing omega-3 which is often consumed by the public is tuna. Indonesia is one of the largest tuna producing countries in the world. In 2011, Indonesia even ranked first as the country with the most tuna production in the world, surpassing Japan's production. In addition to its delicious taste, tuna also has many benefits for the human body [31], [32]. That's because tuna has a variety of nutritional content such as vitamins A, B6 and B12, omega-3, high protein and rich in minerals such as selenium, phosphorus, and magnesium. Tuna is said to be good for heart health and blood pressure, even its anti-oxidants are good for preventing cancer. Tuna is high in polyunsaturated fatty acids (PUFA) consisting of omega-3 and omega-6. Dietary omega-3 and omega-6 polyunsaturated fatty acids (PUFA) have significant implications in health and disease prevention. Marine life is rich in long chain n-3 PUFAs [17], [33], [34].

But unfortunately, the Indonesian population has a low level of fish consumption, even in Southeast Asia, Indonesia is still inferior to Singapore and Malaysia, especially when compared to Japan and Korea. The low consumption of fish per capita of the population in Indonesia is inversely proportional to the region which is rich in sources of vegetable protein. To become an intelligent nation, eating fish needs to be encouraged [35], [36].

In addition, the program of processing fish food will also greatly affect the omega-3 content in the fish. One way of cooking that is not recommended for fish is by frying. Be it pan-frying or deep-frying. Deep-frying uses a large amount of oil to soak the fish. Meanwhile pan-frying uses less oil in the pan. During frying, the fish will absorb the fat in the oil. Thus increasing the number of calories in it and changing the type of fat contained. Not only that, the high temperatures used when frying can also damage omega-3 fatty acids far more severely than other cooking methods [37], [38].

<sup>1</sup> Methyl mercury, a toxic organometallic cation, is found in fish. Individuals who use fish as their primary source of OM3FAs or pregnant and nursing women should limit their intake to two to four servings of fish a week and/or replace fish that are high in methyl mercury, such as swordfish, albacore tuna, dolphinfish, kingfish, and shark and replace with fish that have a lower amount of methylmercury, such as salmon, herring, sardines, and trout. Fortunately, DHA and EPA supplements do not contain methylmercury [29].

## 5. CONCLUSION

There were no difference in between egg, milk, and supplement intake and BMI. And there was a relationship between food intake in the form of fish and BMI, the lower the fish intake, the higher the respondent's BMI (p=0.000).

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