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# Effect of omega-3 fatty acids on triglycerides and BMI levels in obese children.

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## Abstract

**The prevalence and magnitude of childhood obesity are increasing in the world. There is some studies which indicate that fatty acids can reduce body fat in childrens; however, data are relatively few and have generally been conducted over short time periods with small sample sizes, making it difficult to draw definitive conclusions. Therefore, in this study the effects exerted by the omega-3 fatty acids on the concentration of glucose, triglycerides, total cholesterol and body mass index in obese children were evaluated using two experimental designs; In the first stage, a dietary intake of fish was administered to obese children: In the second stage, a dietary intake of gummies with omega-3 fatty acids was used on obese children. The results showed that dietary intake of gummies with omega-3 fatty acids induces greater changes in the levels of triglycerides, total cholesterol and body mass index compared with the dietary intake of fish. In conclusion, all these data suggest that dietary intakes of omega-3 fatty acids can decrease the degree of obesity in obese children**.

**Keywords.** Obesity, glucose, triglycerides, total cholesterol, children.

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## Introduction

Several epidemiologic data suggest that obesity influence the incidence of cardiovascular diseases [1-5]. There are reports which indicate that obesity is a chronic disease with a complex multifactorial nature which typically begins during childhood and adolescence [6, 7]. For example, a study indicates that in USA the prevalence of obesity (BMI  95th percentile) in 6- to 11-year-old children has increased from 4.2 % in the 1960s to 18.8 % in 2004 [8]. Other studies [9] showed an increase in the obesity degree on Brazil children (7 to 10 years old). In Mexico [10], the national prevalence of overweight in school age children (5-11 y-old) in 1999 was reported to be 19.5%. All these data indicate a serious problem of obesity at an early age which can result in the development of cardiovascular diseases. Therefore it is important to identify factors involved in the development of obesity and find therapeutic alternatives for its clinical treatment. In this sense, there are several studies which showed that the administration of omega-3 fatty acids can induce weight Loss in children [11]. In addition, other studies indicate that the omega-3 fatty acids are negatively associated with obesity [12]. These data indicate that the omega-3 fatty acids may modulate the lipid metabolism and promote lipolysis and consequently bring loss of weigh. For example, there are reports [13-15] which indicate that the omega-3 fatty acids reduce triglyceride concentrations when administered at higher doses (3 g per day). Other data showed that approximately 4 g per day of omega-3 fatty acids reduced serum triglyceride concentrations by 25 to 30 percent [16]. Additionally, there are reports on a population of 59 subjects who were randomly assigned to consume 4 g of EPA, DHA, or olive oil/d for 6 weeks which showed beneficial effects on lipids [17]. However, other studies suggest that omega-3 fatty acids are associated with a higher prevalence of obesity [18]. All these data indicate that exist a controversy on the effect exerted by omega-3 fatty acids on obesity. In order, to clarify this

phenomenon, the activity of the omega-3 fatty acids on the concentration of glucose, triglycerides and total cholesterol was evaluated using two experimental designs; in the first stage, a dietary intake of fish was administered to boys and girls obese: In the second stage, a dietary intake of gummies with omega-3 fatty acids was used on obese children.

## Material and Methods

Fifth and sixth graders (n = 303) in two San Francisco de Campeche Mexico schools were invited to participate in a dietary intake of fish (atun) and gummies with omega-3 fatty acids. The parents were informed about the nature and the purpose of this study, and a consent form was signed by parents. In addition, the protocol of this research was previously approved by the ethical committee at the University Autonomous of Campeche.

***Anthropometric measures***

***Body mass index***

Subjects were weighed without shoes, in their underwear. Standing height was measured without shoes to the nearest 0.5 cm with the use of a commercial stadiometer. Body mass index (BMI) was calculated by dividing weight (kg) by height squared (m2).

***Table 1.*** *Dietary intake of fish (atun) in children with obesity (11 to 12 years old)*

| Boys (n = 77) | Girls (n = 75) |
|---|---|
| Fish 6 g (73.2 mg of 3-omega fatty acids) | Fish 6 g (73.2 mg of 3-omega fatty acids) |
| Fish 7 g (85.4 mg of 3-omega fatty acids) | Fish 7 g (85.4 mg of 3-omega fatty acids) |
| Fish 8 g (97.6 mg of 3-omega fatty acids) | Fish 8 g (97.6 mg of 3-omega fatty acids) |

***Table 2.*** *Dietary intake of gummies with omega-3 fatty acids in children with obesity (11 to 12 years old)*

| Boys (n = 74) | Girls (n = 77) |
|---|---|
| 1 gummies (210 mg, omega-3 fatty acids) | 1 gummies (210 mg, omega-3 fatty acids) |
| 2 gummies (280 mg, omega-3 fatty acids) | 2 gummies (280 mg, omega-3 fatty acids) |
| 3 gummies (350 mg, omega-3 fatty acids) | 3 gummies (350 mg, omega-3 fatty acids) |

***Table 3.*** *Characteristics of obese boys after a dietary intake of fish.*

| | 6 g | | 7 g | | 8g | |
|---|---|---|---|---|---|---|
| | **Obese‡** | **Obese§** | **Obese‡** | **Obese§** | **Obese‡** | **Obese§** |
| | (n= 20) | | (n= 32) | | (n= 25) | |
| Age (yr, n = 21) | 11.15±1.4 | 11.32 ± 1.2 | 11.22 ± 1.6 | 11.42 ± 1.3 | 11.44 ± 1.7 | 11.66 ± 1.6 |
| Weight (Kg) | 66.00±1.6 | 63.00 ± 1.4 | 67.00 ± 1.4 | 64.45 ± 1.6 | 67.04 ± 1.2 | 61.02 ± 1.2 |
| Height (m) | 1.45 ±1.2 | 1.48 ± 1.3 | 1.46 ± 1.5 | 1.50 ± 1.3 | 1.46 ± 1.4 | 1.50 ± 1.3 |
| BMI (Kg/m$^2$) | 31.39±2.4 | 28.76 ± 1.2 | 31.43 ± 1.7 | 28.64 ± 1.6 | 31.45 ± 1.3 | 27.12 ± 1.7 |
| BP (mm Hg) | 110.22±1.4 | 107.60 ± 1.2 | 100.44 ± 1.6 | 109.22 ± 1.2 | 99.44 ± 1.6 | 102.40 ± 1.2 |
| Glucose (mg/dl) | 102.80±1.6 | 108.02 ± 1.4 | 98.34 ± 1.2 | 98.26 ± 1.4 | 100.00 ± 1.6 | 112.16 ± 1.4 |
| Cholesterol (mg/dl) | 168.10±1.6 | 165.14 ± 2.1 | 172.02 ± 1.3 | 167.12 ± 2.1 | 168.02 ± 1.3 | 158.14 ± 2.1 |
| Insulin, µU/L | 14.00±1.4 | 14.44 ± 1.8 | 14.00 ± 1.5 | 13.88 ± 1.6 | 14.22 ± 1.4 | 14.66 ± 1.4 |

*§ = Obese boys without treatment; ‡ = Obese boys with treatment.*

***Table 4.*** *Characteristic of obese boys after a dietary intake of gummies with omega-3 fatty acids.*

| | **210 mg** | | **280 mg** | | **350 mg** | |
|---|---|---|---|---|---|---|
| | **Obese§** | **Obese‡** | **Obese§** | **Obese‡** | **Obese§** | **Obese‡** |
| | | (n= 21) | (n= 26) | | (n= 27) | |
| Age (yr, n = 21) | 11.12±1.4 | 12.02 ±1.2 | 11.22 ±1.6 | 11.68±1.2 | 11.00±1.3 | 11.22±1.4 |
| Weight (Kg) | 66.12±2.2 | 64.16 ±1.4 | 68.00 ±1.6 | 62.45±1.6 | 67.16±1.2 | 60.02± 1.2 |
| Height (m) | 1.46±1.8 | 1.48±1 .3 | 1.46±1.4 | 1.49±1.3 | 1.46±1.4 | 1.51± 1.3 |
| BMI (Kg/m$^2$) | 31.48±1.3 | 29.29 ±1.4 | 31.90±1.2 | 28.13±1.7 | 31.50±1.3 | 26.32±1.2 |
| BP (mm Hg) | 112.00±2.1 | 99.08 ±1.2 | 102.00±1.4 | 102.00±1.2 | 100.00 ±1.6 | 100.04±1.2 |
| Glucose (mg/dl) | 124.22±1.8 | 108.00±1.7 | 101.00±1.3 | 100.20±1.3 | 98.02±1.6 | 99.00±1.4 |
| Cholesterol (mg/dl) | 212.00±1.8 | 188.14±1.6 | 167.00±1.4 | 172.12±1.8 | 168.00±1.4 | 152.10±1.9 |
| Insulin, µU/L | 14.08±1.4 | 14.02±1.2 | 14.09±1.3 | 14.88±1.8 | 13.98±1.4 | 14.00±1.2 |

*§ = Obese boys without treatment; ‡ = Obese boys with treatment.*

*Omega-3 fatty acids on triglycerides and BMI levels in obese children.*

***Table 5.*** *Characteristics of obese girls after a dietary intake of fish.*

| | 6 g | | 7 g | | 8 g | |
|---|---|---|---|---|---|---|
| | **Obese[§]** | **Obese[‡]** | **Obese[§]** | **Obese[‡]** | **Obese[§]** | **Obese[‡]** |
| | (n= 28) | | (n= 22) | | (n= 25) | |
| Age (yr, n = 21) | 11.00 ± 1.2 | 11.10 ± 1.2 | 11.20 ± 1.4 | 11.16 ± 1.2 | 11.00 ± 1.2 | 11.66 ± 1.2 |
| Weight (Kg) | 67.90 ± 2.4 | 64.38 ± 2.3 | 67.22 ± 1.6 | 61.88 ± 1.8 | 68.20 ± 1.3 | 62.16 ± 1.8 |
| Height (m) | 1.47 ± 1.8 | 1.49 ± 1.2 | 1.46 ± 1.8 | 1.50 ± 1.3 | 1.48 ± 1.8 | 1.51 ± 1.2 |
| BMI (Kg/m$^2$) | 31.42 ± 1.4 | 29.00 ± 1.8 | 31.56 ± 1.4 | 27.50 ± 1.6 | 31.13 ± 1.4 | 27.26 ± 1.6 |
| BP (mm Hg) | 108.18 ± 1.6 | 102.10 ± 2.3 | 104.00± 1.4 | 100.60 ± 1.2 | 106.00 ± 1.6 | 100.02 ± 1.2 |
| Glucose (mg/dl) | 100.63 ± 1.2 | 98.04 ± 1.6 | 103.63 ± 1.4 | 100.10 ± 1.4 | 103.63 ± 1.2 | 102.16 ± 1.4 |
| Cholesterol (mg/dl) | 170.24 ± 1.2 | 166.04 ± 1.4 | 168.24 ± 1.2 | 160.14 ± 2.1 | 166.02 ± 1.2 | 144.18 ± 2.4 |
| Insulin, µU/L | 13.20 ± 1.8 | 14.22 ± 2.1 | 13.20 ± 1.8 | 14.44 ± 1.8 | 13.20 ± 1.8 | 13.88 ± 1.6 |

*[§] = Obese girls without treatment; [‡] = Obese girls with treatment.*

***Table 6.*** *Characteristic of obese girls after a dietary intake of gummies with omega-3 fatty acids.*

| | 210 mg | | 280 mg | | 350 mg | |
|---|---|---|---|---|---|---|
| Obese[§] | Obese[‡] | Obese[§] | Obese[‡] | Obese[§] | Obese[‡] | |
| | (n= 25) | | (n= 28) | | (n= 24) | |
| Age (yr, n = 21) | 11.20 ± 1.4 | 11.44 ± 1.2 | 11.76 ± 1.4 | 11.82 ± 1.6 | 11.32 ± 1.4 | 11.64 ± 1.2 |
| Weight (Kg) | 66.60 ± 1.8 | 64.60 ± 1.4 | 67.20 ± 1.8 | 62.88 ± 1.8 | 66.60 ± 1.8 | 60.16 ± 1.8 |
| Height (m) | 1.48 ± 2.1 | 1.50 ± 2.5 | 1.47 ± 2.1 | 1.51 ± 1.3 | 1.48 ± 2.1 | 1.54 ± 1.7 |
| BMI (Kg/m$^2$) | 30.40 ± 1.6 | 28.71 ± 1.6 | 31.11 ± 1.4 | 27.57 ± 1.6 | 30.40 ± 1.6 | 25.38 ± 1.5 |
| BP (mm Hg) | 114.00 ± 1.8 | 114.20 ± 1.8 | 100.00 ± 1.8 | 102.20 ± 1.4 | 114.00 ± 1.8 | 110.02 ± 1.2 |
| Glucose (mg/dl) | 102.02 ± 1.6 | 100.00 ± 1.4 | 104.00 ± 1.3 | 100.10 ± 1.4 | 98.00 ± 1.2 | 100.16 ± 1.4 |
| Cholesterol (mg/dl) | 188.75 ± 1.3 | 176.02 ± 1.6 | 178.00 ± 1.4 | 166.04 ± 1.9 | 170.00 ± 1.3 | 144.18 ± 1.5 |
| Insulin, µU/L | 14.24 ± 1.6 | 14.66 ± 1.1 | 14.00 ± 1.3 | 14.04 ± 1.5 | 13.98 ± 1.6 | 14.02 ± 1.4 |

*[§] = Obese girls without treatment; [‡] = Obese girls with treatment.*

***Experimental Design II***

A population of obese children was subjected to a diet of gummies with omega-3 fatty acids as show in the table 2. Children were excluded if they were taking some drug or fish oil supplements.

***Blood Parameters Measured***

A fasting blood sample was obtained for determination of glucose, triglyceride and total cholesterol concentrations were determined using Accutrend Pluss (Hoffmann-La Roche, Grenzach-Wyhlen, Germany).

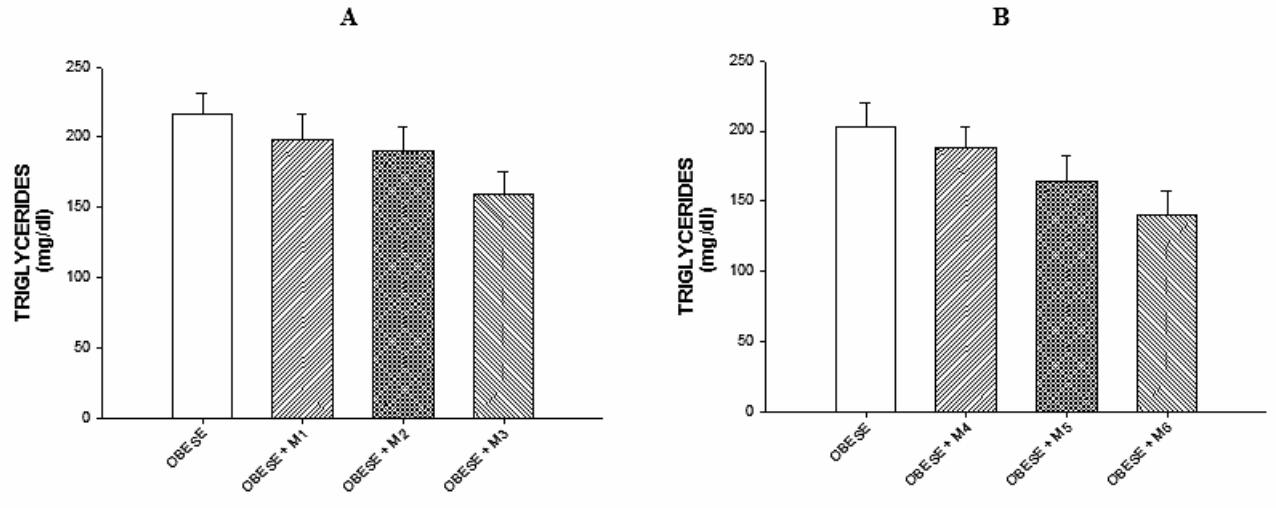


***Figure 1.*** Effects exerted by omega-3 fatty acids on triglycerides levels in obese boys. A dietary intake of fish (Figure A) showed significant changes in thetriglycerides levels for obese boys at a dose of 6 g (M1; 198.00 ± 18.0), 7 g (M2; 190 .00 ± 17.0) and 8 g (M3; 160.00 ± 15.0) in comparison with obese boys without treatment (217.40 ± 14.0). Other data (Figure B) indicate that the administration of gummies with omega-3 fatty acids in obese boys showed significantly changes on triglycerides levels at dose of 210 mg (M4; 188.00 mg/dl ± 15.0), 280 mg (M5; 164.00 mg/dl ± 18.0) and 350 mg (M6; 140.00 mg/dl ± 17.0) in comparison with the control. The effects are expressed as mean ± S.E.

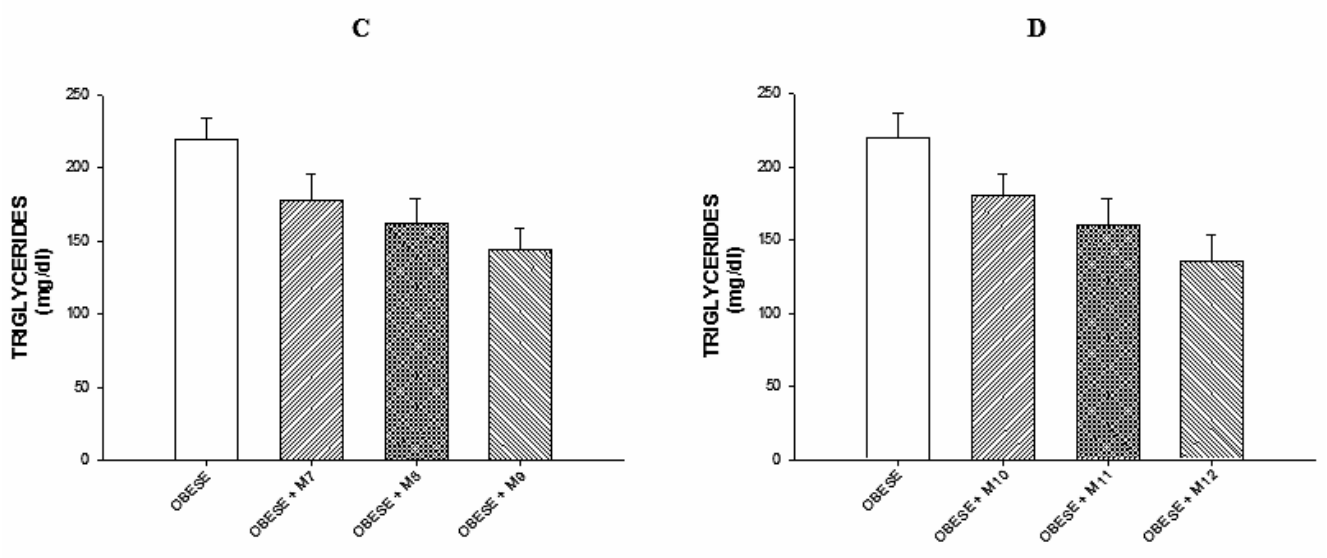


***Figure 2.*** *Scheme 2.Effects exerted by omega-3 fatty acidson triglycerides levels in obese girls. In the figure C are showed the effect induced by adietary intake of fish on the triglycerides concentration for obese girls at dose of 6 g (M7; 200.00 mg/dl ± 18.0), 7 g (M8; 178.00 mg/dl ± 17.0) and 8 g (M9; 144.00 mg/dl ± 15.0) incomparison with obese girl without treatment (220.00 mg/dl ± 14.0). Other results (Figure D) from a dietary intake of gummies with omega-3 fatty acids in obesegirls showed significant changes on triglycerides levels at dose of 210 mg (M10; 180.00 mg/dl ± 15.0), 280 mg (M11; 160.00 mg/dl ± 18.0) and 350 mg (M12; 136.00 mg/dl ± 17.0) in comparison with to control (220.00 mg/dl ± 14.0). The effects are expressed as mean ± S.E.*

***Evaluation of insulin levels***

Insulin assay was performed by enzyme-immunoassay (Human Insulin ELISA kit, Sigma-Aldrich company) according to the manufacturer's instruction.

***Statistical analysis***

The obtained values are expressed as average ± SE.

## Results

***Body Mass Indice (BMI)***

The results showed in the table 3 indicate significantly differences in BMI levels for obese after of a dietary intake from fish at a dose of 6 g (28.76 ± 1.2 Kg/m2), 7 g (31.43 ± 1.7 Kg/m2) and 8 g (28.64 ± 1.6 Kg/m2) in comparison with controls (obese boys without treatment). Other results (Table 4) indicate that administration of gummies with omega-3 fatty acids showed significantly changes on BMI at a dose of 210 mg (28.29 ± 1.4 Kg/m2), 280 mg (28.13 ± 1.7 Kg/cm2) and 350 mg (26.32 ± Kg/m2) in comparison with the controls.

On the other hand, other data (table 5) indicate that dietary intake from fish in obese girls at a dose of 6 g (29.00 ± 1.8 Kg/m2), 7 g (27.50 ± 1.6 Kg/m2) and 8 g (27.26 ± 1.6 Kg/m2) induce changes on the BMII levels in comparison with obese girls without treatment (controls). In addition, other results (Table 6) showed that a dietary intake from gummies with omega-3 fatty acids in obese girls at a dose of 210 mg (28.71 ± 1.6 Kg/m2), 280 mg (27.57 ± Kg/m2) and 350 mg (25.38 ± 1.5 Kg/m2) exert changes on BMI levels in the controls.

***Determination of Glucose levels***

The results (Table 3) that administration of dietary intake from fish to obese boys at dose of 6 g (108.02 ± 1.4 Kg/m2), 7 g (98.26 ± 1.4 Kg/m2) and 8 g (112.16 ± 1.4 Kg/m2) was not exerted changes in glucose levels in comparison with obese boys without treatment (control). Other data (Table 4) indicate that administration of gummies with omega-3 fatty acids not showed significantly changes on the glucose levels for obese boys at dose of 210 mg (108.00 ± 1.7 dg/ml), 280 mg (100.20 ± 1.3 dg/ml) and 350 mg (99.00 ± 1.4 dg/ml) in comparison with obese boys (control).

Other results (Table 5) indicate that the daily intake of fish in obese girls at doses of 6 g (100.04 ± 1.6), 7 g (100.10 ± 1.4) and 8 g (102.16 ± 1.4) no showed significant changes on the levels of glucose in comparison with the obese girls without treatment (103.63 ± 1.2 dg/ml). Also, the administration of gummies (Table 6) with omega-3 fatty acids in obese girls not showed significantly changes in the glucose levels at dose of 210 mg (112.00 ± 1.6), 280 mg (108.00 ± 1.4) and 350 mg (100.10 ± 1.0 ) in comparison with the control (116.02 ± 1.6).

***Evaluation of insulin levels***

The data found (Table 3) showed that insulin levels was not significantly difference in obese boys after of a dietary intake of fish (atun) at dose of 6 g (14.44 ± 1.4 $\mu$U/L), 7 g (14.22 ± 1.6 $\mu$U/L) and 8 g (14.66 ± 1.4 $\mu$U/L) in comparison with the controls. In addition, other results (Table 4) indicate that insulin levels was not showed significantly changes after of a dietary intake of gummies with omega-3 fatty acids in obese boys at dose of 210 mg (14.02 ± 1.2 $\mu$U/L), 280 mg (14.09 ± 1.3 $\mu$U/L) and 350 mg (14.00 ± 1.2 $\mu$U/L).

On the other hand, the results (Table 5) of administration from dietary intake of fish to girls obese at doses of 6 g (14.22 ± 1.4 $\mu$U/L), 7 g (14.44 ± 1.6 $\mu$U/L) and 8 g (133.88 ± 1.4 $\mu$U/L) showed that there are not significantly changes in insulin levels in comparison with the controls. Additionally, other data (Table 6) indicate that dietary intake of gummies with omega-3 fatty acids in obese girls at doses of 210 mg (14.66 ± 1.1 $\mu$U/L), 280 mg (14.04 ± 1.5 $\mu$U/L) and 350 mg (14.02 ± 1.4 $\mu$U/L) non exerted changes on insulin concentration in comparison with obese girls without treatment.

***Cholesterol total***

The results showed in the Table 3 indicate that administration of a dietary intake of fish (atun) in obese boys showed changes in the cholesterol concentration at dose of 6 g (165.14 ± 2.1 mg/dl), 7 g (167.12 ± 2.1 mg/dl) and 8 g (158.14 ± 2.1 mg/dl) in comparison with the controls. Other results (Table 4) showed significantly variations in the levels of cholesterol total for obese boys after of a dietary intake of gummies with omega-3 fatty acids at dose of 210 mg (188.14 ± 1.6 mg/dl), 280 mg (172.12 ± 1.8 mg/dl) and 350 mg (152.10 ± 1.9 mg/dl) in comparison with obese boys without treatment.

Other data (Table 5) indicate that dietary intake of fish in obese girl exert significantly changes on cholesterol concentration at dose of 6 g (166.04 ± 1.4), 7 g (160.14 ± 2.1 mg/dl) and 8 g (144.18 ± 2.4 mg/dl) in comparison with the controls. The administration of a dietary intake of gummies with omega-3 fatty acids in obese girls at dose of 210 mg (176.02 ± 1.3 mg/dl), 280 mg (178.00 ± 1.4 mg/dl) and 350 mg (144.18 ± 1.5 mg/dl) exert changes on cholesterol levels (Table 6) in comparison with obese girls without treatment.

***Triglycerides levels***

The results obtained after of a dietary intake of fish showed significant changes in the triglycerides levels for obese boys (Table 3) at a dose of 6 g (198.00 ± 18.0), 7 g (190 .00 ± 17.0) and 8 g (160.00 ± 15.0) in comparison with obese boys without treatment (217.40 ± 14.0). Other data (Table 4) indicate that the administration of gummies with omega-3 fatty acids in obese boys showed significantly changes on triglycerides levels at dose of 210 mg (188.00 mg/dl ± 15.0), 280 mg (164.00 mg/dl ± 18.0) and 350 mg (140.00 mg/dl ± 17.0).

On the other hand, other results (Table 5) found indicate that treatment of a dietary intake of fish showed significant changes in the triglycerides levels for obese girls at dose of 6 g (200.00 mg/dl ± 18.0), 7 g (178.00 mg/dl ± 17.0) and 8 g (144.00 mg/dl ± 15.0) in comparison with obese girl (220.00 mg/dl ± 14.0). Other

results (Table 6) from a dietary intake of gummies with omega-3 fatty acids in obese girls showed significant changes on triglycerides levels at dose of 210 mg (180.00 mg/dl ± 15.0), 280 mg (160.00 mg/dl ± 18.0) and 350 mg (136.00 mg/dl ± 17.0) with relation to control (220.00 mg/dl ± 14.0).

## Discussion

Several dietary mixtures for treatment of patients with obesity have been used [19,20]; nevertheless, the use of these dietary mixtures have a high cost or very difficult to carry out; in the search of an alternative therapy for the treatment of obesity, have been evaluated the effect exerted by omega-3 fatty acids in several models [21-23]; however, the results are very confusing, perhaps this is due to the different doses used. Therefore, in this study two methods were used; in the first method a dietary intake of fish (atun) was administered to obese children. In the second method, a dietary intake of gummies with omega-3 fatty acids was administered to children with obesity using low doses of omega-3 fatty acids.

### *Glucose levels*

The consumption of omega-3 fatty acids have been linked to reduced CVD risk [24-26], and to reduced fasting glucose levels, providing a protective effect against the development of type 2 diabetes [27]. In this sense, in this study was evaluated the effect of omega-3 fatty acids on glucose levels in obese children. The results showed that a moderate supplementation of fish or a dietary intake of gummies with omega-3 fatty acids has not effect on glucose levels in obese children. These data are similar [28] another studies which not showed changes in the glucose levels by the administration of dietary intake of omega-3 fatty acids in obese volunteers. It is important to mention that these data are contrary at the results showed in other reports [29]. This phenomenon is possibly a result of the methodology and the different doses used or the complex correlation between diet and other lifestyle factors [30].

### *Evaluation of insulin levels*

There studies which suggest that omega-3 fatty acids may influence the action of insulin and thus contribute to variations in insulin sensitivity in humans [31, 32]. To test this hypothesis, we performed two studies in which the insulin levels were evaluated using a dietary intake of fish or gummies with omega-3 fatty acids in obese children. The data showed that to diverse doses used none induce significantly changes on insulin levels; these results indicate that omega-3 fatty acids no exert activity on synthesis or release of insulin. It is important to mention that these data are contrary to reports which indicate that a dietary enrichment with omega 3 fatty acids increases the incorporation of these fatty acids into the beta cell phospholipid membrane thus enhancing insulin secretion [33].

### *Body Mass Indice (BMI)*

Some reports shown that administration of omega-3 fatty acids decreased the BMI in obese children [13, 15]; however, other studies which indicate that n-3 polyunsaturated fatty acids are negatively associated with obesity [34], Analyzing these data in this study was evaluated the activity exerted by omega-3 fatty acids on BMI levels in obese children using two models mentioned above. The results found indicate that a dietary intake of gummies with omega-3 fatty acids decreases the BMI in the boys and girls with obesity; nevertheless this phenol-menon was lower in comparison with a dietary intake of fish. It is important to mention that these results could be relationship with decrease of triglycerides in obese children by administration of omega-3 fatty acids such happening other type of studies in obese children [16]

### *Lipids concentration*

To test whether omega-3 fatty acids induce changes on triglycerides levels; several dose of fish or gummies with omega-3 fatty acids were administered to obese children. The results showed that both triglycerides and total cholesterol levels were significantly reduced by administration of a dietary intake of gummies with omega-3 fatty acids compared with a dietary intake of fish. These data suggest that the effect exerted by the omega-3 fatty acids involved in the gummies, on lipid levels is dose-dependent compared with dietary intake of fish. These assumptions are supported by other studies indicating that higher doses induced decrease in lipid levels [35, 36].

### *Blood Pressure*

The results of indicate that dietary intakes of gummies with omega-3 fatty acids or dietary intakes of fish oil not exert any significant changes in blood pressure in obese children. These data are contrary another reports which indicate that omega-3 fatty acids have multiple effects leading to improvements in blood pressure [37-39]; this phenomenon is possibly to the doses used in this study.

## Conclusions

In conclusion, all these data suggest that; 1) a dietary intakes of gummies with omega-3 fatty acids induce changes on levels of triglycerides; cholesterol and BMI in comparison with dietary intakes of fish oil; this phenomenon bring consequently a decrease the degree of obesity in children. It is important to mention that use of a dietary intake of gummies with omega-3 fatty acids can provide protection against obesity and consequently on cardiovascular disease, such as happening in other type of studies [40-41].

**Declaration of Interest**
None

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