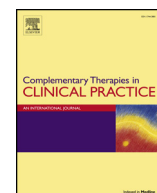




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Fish oil supplement use in New Zealand: A cross-sectional survey

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ABSTRACT

Objective: The aims of the survey were to determine: (i) the percentage of fish oil supplement users in a sample population; (ii) why people take fish oil supplements; (iii) where fish oil supplements are stored as well as the average daily dosage; (iv) what dietary and lifestyle behaviours are associated with fish oil supplement use.

Design: An online cross-sectional survey.

Setting: New Zealand.

Respondents: A total of 334 New Zealand residents over the age of 18.

Results: Fish oil supplements were taken by 21.9% of respondents. Reasons for taking fish oil supplements were - 72.6% for 'general well-being', 54.8% to 'improve brain function', 31.5% for 'pain/inflammation', 12.3% to 'lower cholesterol levels' and 11% for 'a dietary insufficiency'. Approximately 26% of fish oil users reported taking a dose of fish oil supplements that would meet the recommended daily intake of 400–600 mg combined docosahexaenoic acid and eicosapentaenoic acid, and only 6.8% of fish oil users reported storing their fish oil supplements in the refrigerator. After controlling for other characteristics including age, gender, ethnicity and body mass index, fish oil supplementation use was most likely among respondents who already eat oily fish and least likely in respondents who regularly eat nuts and seeds.

Conclusions: Fish oil supplements are a commonly used supplement in New Zealand, yet questions remain about the role of these supplements in improving health outcomes. Safety issues related to manufacturing and storage conditions indicate that there is an urgency in answering these questions.

1. Introduction

Supplement use surveys indicate that there has been an increase in the use of fish oil supplementation over the last 10–20 years [1,2]. This popularity may be due to a number of studies showing the beneficial effects of omega-3, poly-unsaturated fatty acids (*n*-3 PUFAs) on learning difficulties and developmental conditions in school age children [3–5], on mood and cognition [6–9], as well as cardiovascular and arthritic conditions [10–12] in young, middle-aged and older adults. Despite these positive results, the majority of *n*-3 PUFA clinical trials have not found a significant improvement in outcomes, and several design issues have been proposed such as an insufficient dose, an insufficient duration, unknown baseline *n*-3 PUFA status, and the lack of a uniform biomarker to explain these negative and at times contradictory results [13].

Fish oil supplements contain two types of *n*-3 PUFAs - docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA). DHA and EPA are found in oily fish such as salmon, tuna, anchovies and sardines as well as krill and some shellfish. DHA and EPA and the plant derived alpha-

linolenic acid (ALA) which is found in seeds and nuts, are important nutrients for bodily functioning, particularly brain functioning, due to their anti-inflammatory, anti-thrombotic and vaso-dilatory properties [14]. DHA is one of the most dominant structural lipids in the brain, where it plays a protective role, and improves the fluidity of the neuronal cell membrane thereby influencing neuronal cell signalling [15,16]. While the evidence for *n*-3 PUFAs, DHA and EPA as safe therapeutic agents is steadily growing, it is still unclear what role they play in maintaining brain function from childhood to older age [17].

In New Zealand (NZ), the Ministry of Health recommends an 'adequate intake' (AI) of 800 mg of ALA and 90 mg of combined DHA + EPA for women over 19 years of age and an AI of 1300 mg of ALA and 160 mg of combined DHA + EPA for men over 19 years of age, whereas the upper level at the 90th centile, which provides a 'potential benefit while still at a safe level', is set at 430 mg/day combined DHA + EPA for women and 610 mg/day for men [18]. This upper level is consistent with recommendations by the National Heart foundation to eat fish twice a week which would provide between 400 and 600 mg of combined DHA + EPA per day [19]. Most fish oil supplements in NZ contain

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between 1000 and 1500 mg of fish oil per capsule, equivalent to between 300 and 700 mg of *n*-3 PUFAs with the amount of DHA and EPA varying between 100 and 360 mg of DHA and 100–540 mg of EPA.

There has been considerable media attention in NZ regarding fish oil supplements after a study showed that of the 32 fish oil supplements tested from retail and online stores within NZ, 69% of the products contained less than 67% of the EPA and DHA content specified on the label, and that oxidation levels were higher than recommended international standards [20]. Both DHA and EPA consist of long carbon chains with multiple double bonds which makes them very sensitive to light and heat, and therefore depending on manufacturing and storage conditions they can easily become oxidised and rancid. The New Zealand Institute for Plant and Food Research state that temperature is the number one contributing factor to the oxidation of oils [21] and even though it is difficult for consumers to control or even access information about conditions during processing and transportation of supplements, it is generally recommended that *n*-3 PUFA products including fish oils and ALA containing oils such as flaxseed and hemp seed oils are stored in opaque containers in a cool dark place such as a refrigerator.

The 2008/2009 New Zealand Adult Nutrition Survey contains the most recent information about fish oil supplementation use in NZ [22]. This survey showed that 30.7% of the respondents (25.5% of males, 35.5% of females) were 'regular' users of supplements ('regular' meaning consumed a supplement at least once a week). The most frequently consumed supplements were 'oils' (fish oils, omega 3, 6 and/or 9, flax/linseed oils and evening primrose) at 16.4% (13.7% of males, 18.9% of females), followed by multi-vitamins/minerals at 14.8%. In terms of 'oils' users, age was a significant factor for female 'oils' users, where 6.9% of females aged 15–18 took oils, compared to 14.3% of females aged 19–30, 17.9% of females aged 31–50 and 24.8% of females aged 51 plus. The 2011–12 Australian Health Survey showed that 29% of respondents (33% of females, 24% of males) reported taking at least one dietary supplement on the previous day [23]. Multi-vitamin/multi-mineral supplements were the most common dietary supplement at 16%, followed by fish oil supplements by 12% of the population. The highest percentage of fish oil users were in the 51 + age groups.

The associations between supplementation use and demographics or other health behaviours have been extensively studied [24–29]. These studies have consistently found that supplement use is more common among women, older and more educated respondents, and in respondents who have a low to normal body mass index (BMI), a moderate to high level of physical activity, who drink low to moderate amounts of alcohol and who are less likely to be a current smoker of cigarettes. When studies have included dietary measures they have shown that supplement users generally report higher levels of dietary nutrient intakes and in some cases exceed the recommended daily allowances. The 'inverse supplement hypothesis' was proposed to explain why people who are most likely to take supplements were often the people that need them the least. In support of this hypothesis a study found that 43% of a sample of Australians over the age of 51 consumed fish oil supplements, and that these fish oil consumers had a higher daily intake of finfish or seafood than those who were non-supplement consumers [30]. Reasons for why people take supplements vary, generally either to 'improve overall health' or for 'general well-being' as a preventive measure or to treat a medical condition or a symptom such as cancer or pain. Respondents from the National Health and Nutrition Examination Survey indicated that they were most likely to use fish oil supplements for 'heart health or to lower cholesterol' [31].

The current survey was designed to provide an update on the use of fish oil supplementation in a sample population of New Zealanders, and to determine why people use fish oil supplements. To date very few surveys have specifically asked fish oil users what dose they take and where the fish oils are stored. These questions were addressed as well as testing the hypothesis that fish oil users are likely to be more health conscious and therefore display healthier dietary and lifestyle habits.

2. Method

2.1. Survey population

This online survey was a cross-sectional analysis of a sample of the general population in New Zealand over the age of 18. The survey was advertised for a 6-month period from June until November 2015 on the Massey University School of Psychology mailing lists, the Massey University Facebook page, as well as through posters placed in public libraries, community centres and hospitals in main cities within New Zealand. All advertisements explained the purpose of the study and specified that anyone over 18 years of age could complete the survey. Respondents were instructed to click on a link or enter a URL to access the online survey questionnaire. The survey took an average of 9 min to complete.

2.2. Questionnaire design

The survey consisted of five sections; section 1 contained an information page with a consent question, section 2 contained demographic and general health questions, section 3 questions about fish oil supplement use, section 4 about general supplementation use and section 5 contained questions about dietary habits and exercise. The demographic questions in section 2 included age, gender, city/town of residence, ethnicity, highest qualification achieved and annual salary. The general health questions included self-reported health status, whether a current tobacco smoker or not, and current height and current weight, which were used to calculate body mass index (BMI). Section 3 began with the question "Do you take fish oil supplements?". If respondents answered 'yes' they were classified as a 'fish oil user' and completed section 3 which included questions regarding frequency of fish oil supplement use, reasons for taking fish oil supplements as well as what dose of fish oils respondents used and where respondents stored their fish oil supplements. Once completed, 'fish oil users' were directed to section 4 which began with the question "Do you take any other types of supplements?". If respondents had answered 'no' to taking fish oil supplements, they were classified as a 'non-fish oil user' and were automatically directed to section 4.

Section 4 of the survey asked respondents to specify what type of other supplements they took along with questions regarding frequency, reasons for supplement use, where the supplements were purchased, how much is spent per month on supplements, what influenced the decision to select a supplement and whether respondents told their GPs that they took supplements. Respondents were able to select 'I don't take any supplements' at the beginning of section 4 and were then directed to Section 5 which asked how often respondents ate oily fish, white fish, nuts and seeds, free range eggs/chicken/grass fed meat, as well as how many portions of fruit and vegetables respondents ate per day and how often respondents engaged in exercise for longer than 30 min at a time.

2.3. Statistical analysis

Statistical analysis of the data was conducted using SPSS version 24. Chi-square tests including Fisher's exact test were performed to assess demographic differences between supplement users and non-supplement users, and between fish oil users and non-fish oil users. Logistic regression was used adjusted for age, gender, ethnicity, BMI, qualifications, smoking status, salary, self-reported health status, dietary intake of oily fish and nuts/seeds to assess what factors predict fish oil supplement use. P values equal to or less than 0.05 were considered statistically significant.

3. Results

A total of 346 New Zealand residents completed the survey, 12

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