Sys Rev Pharm 2019;10(2):27-30
A multifaceted review journal in the field of pharmacy

A CORRELATION STUDY OF PUFA INTAKE BY A FFQ VALIDATED IN KAZAKH LANGUAGE AND OMEGA-3 INDEX IN ADULT KAZAKH POPULATION

TULEUOVA RAUSHAN[1], ZHAMALIYEVA LAZZAT[1]
[1] WEST KAZAKHSTAN MARAT OSPANOV MEDICAL UNIVERSITY, KAZAKHSTAN, AKTOBE CITY, SNAIPERSKAYA STREET, 14, PHONE NUMBER +77028866288,
raushan_t88@mail.ru, lzhamalieva@mail.ru

Article History: *Submitted: 14.07.2019* *Revised: 15.09.2019* *Accepted: 18.10.2019*

ABSTRACT
W. Harris and C. von Schacky suggested that the levels of PUFA in erythrocyte membranes could be considered a new risk factor for sudden cardiac death. This marker has been called the omega-3 index. In large-scale scientific research, effective subjective dietary assessment methods that are easy to use are needed. A reliable assessment of the relationship between diet and health in population-based studies requires accurate and frequently repeated measurements of diet.
The aim of this study is to determine the relationship between the consumption of omega-3 PUFA sources determined using the FFQ validated for the Kazakh population and the omega-3 index. Recruiting study participants 195 people took part in a cross-sectional study based on written informed consent. To assess the nature and epidemiology of nutrition, we used the nutrition assessment questionnaire FFQ_KZ validated for Kazakh population. The characteristics of the study participants were estimated using descriptive statistics. The relationship between food intake from the questionnaire and the omega-3 index was evaluated using the Spearman correlation coefficient. The study involved 195 people, average age 61.2 ± 10.4 years
A statistically significant correlation of weak strength between the omega-3 blood index and the use of PUFA was found in both men and women (r = 0.11 at p≥0.05, r = 0.17 at p≥0.05), respectively. No correlation was found between the consumption of PUFA sources and other blood counts. The problem of creating an algorithm for laboratory control of therapy for patients taking omega-3 PUFAs remains relevant and requires further study.

Key Words: omega-3 index, polyunsaturated fatty acids, Kazakh population, food frequency questionnaire.

Correspondance:
Dr TULEUOVA RAUSHAN1,
WEST KAZAKHSTAN MARAT OSPANOV MEDICAL UNIVERSITY, KAZAKHSTAN, AKTOBE CITY, SNAIPERSKAYA STREET, 14, PHONE NUMBER
Tel: +77028866288,
Email: raushan_t88@mail.ru
DOI: 10.5530/srp.2019.2.05

INTRODUCTION

Essential fatty acids, especially their long chain polyunsaturated derivatives, are the main structural components of cell membranes and are necessary for the body, since they are not produced endogenously, being essential nutrients [1]. Currently, there are no adequate, widely available methods for assessing the content of polyunsaturated fatty acids (PUFAs) in the body. W. Harris and C. von Schacky suggested that the levels of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) in erythrocyte membranes (expressed as a percentage of total fatty acids) could be considered a new risk factor for sudden cardiac death [2]. This marker has been called the omega-3 index.
According to the results of the study, to determine the target value of the omega-3 index, a formula for its calculation was proposed, expressed in%: omega-3 index = plasma EPA + DHA (%) × 0.97 + 3.43. The average high level of the omega-3 index was 6.9% (6.1-10.1%), the average the low level is about 3.8% (2.4–4.5%). According to the results of the Cardiovascular Health Study, R. Lemaitre et al. also showed a significant level of correlation between blood EPA + DHA and the risk of sudden death from coronary heart disease [3]. The calculations made by Harris and C. Von Schacky [4] determined that as a result of taking 900 mg of EPA and DHA per day, the omega-3 index should be about 9.5%.
The rationality in calculating the omega-3 index is that it is difficult to practically determine how much EPA and DHA are consumed by a person with food.
The content of EPA and DHA in fish products varies and depends on the season, the maturity of the fish, nutrition, processing methods after the catch and cooking. On the other hand, even if the content of omega-3-PUFA in fish products were known, the body of each person is individual in terms of metabolism and the characteristics of the digestive system. Individual fluctuations in the conversion of α-linoleic acid to EPA and DHA in vivo, dietary features (for example, omega-6 fatty acids, the total level of kilocalories) can also affect the content of EPA and DHA in tissues [5].
Objective methods for estimating food intake exist in the form of biomarkers, but only for a few nutrients or foods. In large-scale scientific research, effective subjective dietary assessment methods that are easy to use are needed. A reliable assessment of the relationship between diet and health in population-based studies requires accurate and frequently repeated measurements of diet [6].The method of accounting for food, in which all consumed food and drinks are recorded in detail for one or several days, is considered the optimal method for subjective assessment of consumption with food, since it is based on actual consumption and provides information on absolute rather than relative consumption [7] . Unlike the food report, the Food Frequency Questionnaire (FFQ) method requires less effort from participants and researchers. Here, participants answer how often they consume predefined foods, thereby reflecting their consumption over a longer period of time. This gives relative information on consumption and accuracy at the individual level below [7]. Frequency Eating Questionnaires (FFQs), which are often selected in large population studies, provide a convenient assessment of a regular, longer-term diet. Many assumptions are made using FFQ, including lists of products that can be consumed, serving sizes and frequency of consumption [8].
Several adult studies compared dietary fatty acid intake with a biomarker such as the erythrocyte membrane fatty acid content [9-11], serum phospholipids [12], platelet

phospholipids [13], or adipose tissue [14-18]. Overall, significant correlations were found between PUFA intake and these biomarkers. However, no study to date has investigated the ability of FFQ to measure PUFA intake in the Kazakh population. Using estimates of the composition of fatty acids in erythrocyte membranes as the "gold standard", we conducted a nutritional study comparing the intake of omega-3 fatty acids estimated by the filled FFQ with biomarker data evaluating them. **The aim** of this study is to determine the relationship between the consumption of omega-3 PUFA sources determined using the FFQ validated for the Kazakh population and the omega-3 index.

MATERIALS AND METHODS

Recruiting study participants 195 people took part in a cross-sectional study based on written informed consent approved on a 1st meeting of ethical committee of the West Kazakhstan state medical university on 28th of January 2018.

Nutrition rating

To assess the nature and epidemiology of nutrition, we used the nutrition assessment questionnaire FFQ_KZ validated for the Russian and Kazakh-speaking population, consisting of 11 food groups and 119 items, as well as 5 open questions with which you can find out the types of milk (fat content, origin or other specific milk), methods of cooking main dishes (meat), taking food additives throughout the year, as well as their frequency and quantity [19].Socio-demographic, anthropometric and biochemical indicators.

Socio-demographic characteristics and health behavior were evaluated using a structured questionnaire. The smoking status was determined by finding out whether he smokes daily or sometimes with the number of pieces per day or does not smoke and did not smoke at all. Respondents who answered "yes" were classified as current smokers. During the clinical examination, qualified specialists measured standardized weight, height, waist circumference and blood pressure. Blood pressure was measured three times, and the average of the last two values was used. Body mass index (BMI) was calculated as the ratio of weight in kilograms to height in meters squared (kg/m^2). Blood samples were taken from participants who fasted for at least 8 hours to determine triglycerides (TG), glucose, and total cholesterol levels. To determine the omega-3 index and apolipoprotein A1, whole venous blood was taken on an empty stomach (at least 3 hours after the last meal) in test tubes with a purple cap and a white or black ring in a sterile tube containing the EDTA anticoagulant. Blood samples were separated by centrifugation for 5 minutes at 3000 rpm immediately after collection and stored at -40 ° C in the INVIVO laboratory, Aktobe. Then the samples were packed with dry ice and carefully delivered to an external laboratory for analysis (Moscow, Russian Federation). Serum phospholipids were extracted using a mixture of chloroform-methanol (2:1 by volume) followed by acid hydrolysis. After etherification in boron trifluoride-methanol, the serum fatty acid composition was analyzed by gas chromatography using an Agilent GC-7890B gas chromatograph, Germany, equipped with an Omegawax capillary polyethylene glycol column (length 30 m, internal 0.25 mm), film thickness 0.25 μm, Sigma-Aldrich Co. LLC, St. Louis, Missouri, USA).The concentrations of each fatty acid were expressed as the proportion of all whey fatty acids.

Statistical analysis

To analyze the results, we used the Statistica 10 statistical software package (Statsoft.inc). The characteristics of the study participants were estimated using descriptive statistics. The relationship between food intake from the questionnaire and the omega-3 index was evaluated using the Spearman correlation coefficient. A weak correlation was considered r, which is in the range of 0.01-0.29, medium - 0.3-0.69, strong - 0.7-0.99.

RESULTS

The study involved 195 people. 158 men and 37 women, average age 61.2 ± 10.4 years. Average weight 79.2 ± 14.7, height 168.5 ± 9.2, BMI 28.07 ± 7.02, WC 97.93 ± 16.7 cm. Higher education in 47%, secondary - in 51.5 %, 1.5% of participants with secondary specialized education. 82 people smoke from 10 to 20 cigarettes a day, 24 people 20 or more cigarettes a day, 1 person up to 10 pieces a day, 88 people do not smoke.

Both men and women consume PUFAs above the recommended daily intake. However, the average level of the omega-3 index does not reach the norm in either men or women. A statistically significant correlation of weak strength between the omega-3 blood index and the use of PUFA was found in both men and women (r = 0.11 at p≥0.05, r = 0.17 at p≥0.05), respectively (Table 1). No correlation was found between the consumption of PUFA sources and other blood counts.

Table 1. The dependence of blood counts on the use of sources of PUFA in men and women
***p≥0,05**

Gender	PUFA				
Male	158				
	n-3 index	Apo A1	Cholesterol	Glucose	TG
	2,7±1	1,8±0,3	6±1,4	6±2,4	1,4±0,6
r Spearmen	0,11*	-0,05	0,07	0,06	0,05
Female	37				
	n-3 index	Апо A1	Cholesterol	Glucose	TG
	2,1±0,7	0,9±0,2	5,2±1,2	8,03±3,8	1,6±0,9
r Spearmen	0,17*	0,05	-0,07	0,002	-0,09

DISCUSSION

Numerous scientific studies and publications have indicated a range of laboratory methods used to evaluate the multifactorial effect of omega-3 PUFAs. Routine laboratory methods and high technologies are widely used: chromatographic methods to assess the prognosis of the development of complications of cardiovascular diseases by the omega-3 PUFA index and their concentration in serum, molecular genetic methods to determine the effect of omega-3 PUFA on gene expression.

The time frame for conducting studies to evaluate the multifactorial effect of omega-3 PUFAs is largely dependent on the pathological process and the effect studied omega-3 PUFAs. Taking large doses of highly

purified omega-3 PUFAs for the treatment of hypertriglyceridemia and the occurrence of individual drug intolerance requires laboratory monitoring of transaminases and total bilirubin in the blood due to the possibility of developing cardiovascular diseases (CVD). However, omega-3 PUFAs continue to be widely used by clinicians for the treatment and prevention of cardiovascular diseases and other diseases.

The work of A. S. Galyavich, L. R. Salakhova (2006) determined the content of fatty acids in patients with coronary artery disease and evaluated the effect of the omega-3 PUFA on the levels of circulating fatty acids in patients with coronary artery disease [19]. The study included 51 people who underwent ultrasound examination of the carotid arteries and determination of total cholesterol, high density lipoproteins (HDL), low density lipoproteins (LDL), and triglycerides. In addition, the concentration of saturated fatty acids, monounsaturated fatty acids and PUFAs was determined by gas chromatography by the method of F. Marangoni (2004) [20]. As a result of 30-day treatment with Omacor®, 1 capsule per day in 28 patients with coronary artery disease significantly increased levels of EPA - by 28.8% and DHA - by 22.2%, decreased palmitic acid - by 5.4% and oleic acid - by 7.8%. The levels of stearin and fatty acids did not significantly change, and the lipid spectrum did not change either. The drug was well tolerated, and only 3 people experienced an adverse reaction - in 2 people in the form of a rash, and in 1, a serious disease was found. Using liquid chromatography, some authors determined the analysis of fatty acids (FAs) in erythrocyte lipids. E.V. Kozycheva, I.E. Slezka (1998) [21] studied the effect of alimentary omega-3 PUFAs on erythrocyte LC in boys with a hereditary predisposition to hypertension. R. I. Alekseeva et al. (2007) determined the fatty acid composition of erythrocyte cell membranes in patients with type 2 diabetes mellitus when omega-3 PUFAs were included in the diet for 1 month. Using this method, a significant increase in the total content of omega-3 PUFAs in erythrocyte membranes by 67%, an increase in the level of EPA by more than 2.3 times compared with the initial level was noted [23].

CONCLUSION

The problem of creating an algorithm for laboratory control of therapy for patients taking omega-3 PUFAs remains relevant and requires further study

AUTHOR DISCLOSURE

1. Times New Roman, font 12
2. Declare whether there's conflict of interest
3. Declare any financial support for study

REFERENCES

1. Iso H, Kobayashi M, Ishihara J, Sasaki S, Okada K, Kita Y, et al. Intake of Fish and n3 Fatty Acids and Risk of Coronary Heart Disease Among Japanese. Circulation [Internet]. Ovid Technologies (Wolters Kluwer Health); 2006 Jan 17;113(2):195–202. Available from: http://dx.doi.org/10.1161/circulationaha.105.581355
2. Harris WS, von Schacky C. The Omega-3 Index: a new risk factor for death from coronary heart disease? Preventive Medicine [Internet]. Elsevier BV; 2004 Jul;39(1):212–20. Available from: http://dx.doi.org/10.1016/j.ypmed.2004.02.030
3. Lemaitre RN, King IB, Mozaffarian D, Kuller LH, Tracy RP, Siscovick DS. n−3 Polyunsaturated fatty acids, fatal ischemic heart disease, and nonfatal myocardial infarction in older adults: the Cardiovascular Health Study. The American Journal of Clinical Nutrition [Internet]. Oxford University Press (OUP); 2003 Feb 1;77(2):319–25. Available from: http://dx.doi.org/10.1093/ajcn/77.2.319
4. W. Harris и C. Von Schacky. The Omega-3 Index: a new risk factor for death from coronary heart disease? Preventive Medicine 2004; 39(1), 212-220. Harris WS, von Schacky C. The Omega-3 Index: a new risk factor for death from coronary heart disease? Preventive Medicine [Internet]. Elsevier BV; 2004 Jul;39(1):212–20. Available from: http://dx.doi.org/10.1016/j.ypmed.2004.02.030
5. Bokeriya O. L., Bersenyova M. I., Kakuchaya T. T.. The role of polyunsaturated fatty acids in the prevention of sudden cardiac death// Annals of Arrhythmology, 2006. 39-43 p. Leaf A. Prevention of sudden cardiac death by n-3 polyunsaturated fatty acids. Fundamental and Clinical Pharmacology [Internet]. Wiley; 2006 Dec;20(6):525–38. Available from: http://dx.doi.org/10.1111/j.1472-8206.2006.00438.x
6. Schatzkin A, Subar AF, Moore S, Park Y, Potischman N, Thompson FE, et al. Observational Epidemiologic Studies of Nutrition and Cancer: The Next Generation (with Better Observation). Cancer Epidemiology Biomarkers & Prevention [Internet]. American Association for Cancer Research (AACR); 2009 Mar 31;18(4):1026–32. Available from: http://dx.doi.org/10.1158/1055-9965.epi-08-1129
7. Henderson DA. War and Public Health.Barry S. Levy and Victor W. Sidel, eds. New York: Oxford University Press, 1997, 421 pp. US$55.00. ISBN 0-19-510814-0. Oxford University Press, 198 Madison Ave., New York, NY 10016-4314, USA. Politics and the Life Sciences [Internet]. Cambridge University Press (CUP); 1998 Mar;17(1):84–5. Available from: http://dx.doi.org/10.1017/s0730938400025429
8. Cade JE, Warthon-Medina M, Albar S, Alwan NA, Ness A, et al. DIET@NET: Best Practice Guidelines for dietary assessment in health research. BMC Medicine [Internet]. Springer Science and Business Media LLC; 2017 Nov 15;15(1). Available from: http://dx.doi.org/10.1186/s12916-017-0962-x . [PMC free article] [PubMed] [CrossRef]
9. Feunekes GI, Van Staveren WA, De Vries JH, Burema J, Hautvast JG. Relative and biomarker-based validity of a food-frequency questionnaire estimating intake of fats and cholesterol. The American Journal of Clinical Nutrition [Internet]. Oxford University Press (OUP); 1993 Oct 1;58(4):489–96. Available from: http://dx.doi.org/10.1093/ajcn/58.4.489
10. Romon M, Nuttens M-C, Théret N, Delbart C, Lecerf J-M, Fruchart J-C, et al. Comparison between fat intake assessed by a 3-day food record and phospholipid fatty acid composition of red blood cells: Results from the monitoring of cardiovascular disease-Lille study. Metabolism [Internet]. Elsevier BV; 1995 Sep;44(9):1139–45. Available from: http://dx.doi.org/10.1016/0026-0495(95)90006-3
11. Parra M-S, Schnaas L, Meydani M, Perroni E, Martíanez S, Romieu I. Erythrocyte cell membrane phospholipid levels compared against reported dietary intakes of polyunsaturated fatty acids in pregnant Mexican women. Public Health Nutrition [Internet]. Cambridge

University Press (CUP); 2002 Dec;5(6a):931–7. Available from: http://dx.doi.org/10.1079/phn2002381

12. Kobayashi M, Sasaki S, Kawabata T, Hasegawa K, Tsugane S. Validity of a Self-administered Food Frequency Questionnaire Used in the 5-year Follow-up Survey of the JPHC Study Cohort I to Assess Fatty Acid Intake: Comparison with Dietary Records and Serum Phospholipid Level. Journal of Epidemiology [Internet]. Japan Epidemiological Association; 2003;13(1sup):64–81. Available from: http://dx.doi.org/10.2188/jea.13.1sup_64
13. Li D, Zhang H, Hsu-Hage B-H, Wahlqvist M, Sinclair A. The influence of fish, meat and polyunsaturated fat intakes on platelet phospholipid polyunsaturated fatty acids in male Melbourne Chinese and Caucasian. European Journal of Clinical Nutrition [Internet]. Springer Nature; 2001 Dec;55(12):1036–42. Available from: http://dx.doi.org/10.1038/sj.ejcn.1601269
14. Hunter DJ, Rimm EB, Sacks FM, Stampfer MJ, Colditz GA, Litin LB, et al. Comparison of Measures of Fatty Acid Intake by Subcutaneous Fat Aspirate, Food Frequency Questionnaire, and Diet Records in a Free-living Population of US Men. American Journal of Epidemiology [Internet]. Oxford University Press (OUP); 1992 Feb 15;135(4):418–27. Available from: http://dx.doi.org/10.1093/oxfordjournals.aje.a116302.
15. Tjønneland A, Overvad K, Thorling E, Ewertz M. Adipose tissue fatty acids as biomarkers of dietary exposure in Danish men and women. The American Journal of Clinical Nutrition [Internet]. Oxford University Press (OUP); 1993 May 1;57(5):629–33. Available from: http://dx.doi.org/10.1093/ajcn/57.5.629
16. Lemaitre RN, King IB, Patterson RE, Psaty BM, Kestin M, Heckbert SR. Assessment of frans-Fatty Acid Intake with a Food Frequency Questionnaire and Validation with Adipose Tissue Levels of frans-Fatty Acids. American Journal of Epidemiology [Internet]. Oxford University Press (OUP); 1998 Dec 1;148(11):1085–93. Available from: http://dx.doi.org/10.1093/oxfordjournals.aje.a009586
17. Knutsen SF, Fraser GE, Beeson WL, Lindsted KD, Shavlik DJ. Comparison of Adipose Tissue Fatty Acids with Dietary Fatty Acids as Measured by 24-hour Recall and Food Frequency Questionnaire in Black and White Adventists. Annals of Epidemiology [Internet]. Elsevier BV; 2003 Feb;13(2):119–27. Available from: http://dx.doi.org/10.1016/s1047-2797(02)00260-0
18. Cantwell MM, Gibney MJ, Cronin D, Younger KM, O'Neill JP, Hogan L, et al. Development and validation of a food-frequency questionnaire for the determination of detailed fatty acid intakes. Public Health Nutrition [Internet]. Cambridge University Press (CUP); 2005 Feb;8(1):97–107. Available from: http://dx.doi.org/10.1079/phn2004668
19. Tuleuova R, Zhamaliyeva L. Validation of a Kazakh food frequency questionnaire. Journal of Food Processing & Technology [Internet]. OMICS Publishing Group; 2018;09. Available from: http://dx.doi.org/10.4172/2157-7110-c1-080
20. Galyavich AS, Salakhova LR. Mo-P1:96 Fatty acids composition in patients with carotid atherosclerosis. Atherosclerosis Supplements [Internet]. Elsevier BV; 2006 Jan;7(3):67. Available from: http://dx.doi.org/10.1016/s1567-5688(06)80231-x
21. Nowak M, Lucas A, Sayegrih K, Tardivel S, Vicca S, Grynberg A, et al. E011 Monocyte apoptosis is modulated by polyunsaturated fatty acids treatment. Archives of Cardiovascular Diseases [Internet]. Elsevier BV; 2009 Mar;102:S51. Available from: http://dx.doi.org/10.1016/s1875-2136(09)72250-8
22. Marangoni F, Colombo C, Galli C. A method for the direct evaluation of the fatty acid status in a drop of blood from a fingertip in humans: applicability to nutritional and epidemiological studies. Analytical Biochemistry [Internet]. Elsevier BV; 2004 Mar;326(2):267–72. Available from: http://dx.doi.org/10.1016/j.ab.2003.12.016
23. Plasma and tissues fatty acid composition in rats fed diets containing long chain polyunsaturated fatty acids from different sources. Prostaglandins, Leukotrienes and Essential Fatty Acids [Internet]. Elsevier BV; 1997 Aug;57(2):267. Available from: http://dx.doi.org/10.1016/s0952-3278(97)90326-4