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Dietary Factors and Changes in Blood Pressure in Adult Kazakhs: A 3-year Follow-Up Study

Raushan Tuleuova[1]*, Lazzat Zhamaliyeva[1], Andrej Grjibovski[1,2,3,4]

[1]Department of Family Medicine, West Kazakhstan Marat Ospanov Medical University, Aktobe, Kazakhstan; [2]Central Scientific Research Laboratory, Northern State Medical University, Arkhangelsk, Russia; [3]Department of Biology, Ecology and Biotechnology, Northern (Arctic) Federal University, Arkhangelsk, Russia; [4]Department of Health Policy and Management, Al-Farabi Kazakh National University, Almaty, Kazakhstan

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***Correspondence:** Raushan Tuleuova, West Kazakhstan Marat Ospanov Medical University, Kazakhstan, Aktobe City, Kazakhstan. E-mail: raushan_t88@mail.ru
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Abstract

BACKGROUND: As in the world and Kazakhstan's clinical protocols for the treatment of AH, it is proposed to limit the intake of salt to <5 g/day and alcohol as a dietary therapy, as well as an increase in the consumption of vegetables, fresh fruits, fish, nuts, and sources of unsaturated fatty acids, to reduce the consumption of meat as a source of saturated fatty acids (SFA); consumption of low-fat dairy products. However, it remains unclear how the traditional diet of Kazakhs, which is dominated by sources of carbohydrates and fats with its subspecies, affects the development of AD in the Kazakh population. Local epidemiological and clinical data are required for the successful work of doctors with the population in the prevention of diseases of the blood circulatory system and the creation of clinical recommendations.

AIM: The aim of this investigation was to evaluate an influence of fats, its subspecies, and carbohydrates on BP change after 3-year observation of adult Kazakhs.

MATERIALS AND METHODS: There is described data of 96 individuals of the Kazakh population recruited by the cluster method, living in Aktobe, the Republic of Kazakhstan. Clusters were 14 polyclinics in Aktobe, of which three outpatient municipal polyclinics were randomly selected, each of which had one attached site. From the list of attached adults, also randomly selected 96 people without a history of cardiovascular events.

RESULTS: Average age of participants of the study was 61.9 ± 10.8. None of the participants had a special diets or food restrictions for health reasons or personal beliefs. Body mass index was 27.1 ± 8.4. The over half of the study participants practice on smoking. The average level of SBP in the study's participants was initially 124.6 mmHg, after 3 years, it increased by an average of 8.6 mmHg and became 133.2, the average level of DBP was 82.2 mmHg, which became higher by 6.2 mmHg and became 88.4 mmHg. According to the regression analysis, higher consumption of carbohydrates, MUFAs, SFAs, and total fats increased SBP by 9.3, 12.3, 46.1, and 5.3 mmHg, respectively. However, with the use of PUFAs, an inverse relationship was found, an increase in PUFA sources in the diet by 100 g reduces SBP by 43.3 mmHg. An effect of all nutrients was not significantly reduced at 3 years on SBP when adjusted for age, sex, and waist circumference.

CONCLUSION: In accordance with the performed analysis in this cohort of subjects, that a significant percentage of these people are overweight or obese, the diet of the Kazakh population does not differ from the eating habits of residents of other countries. The examined individuals received an excess amount of energy from carbohydrates, fat, and SFA, an irrational diet was significantly correlated with an increase in blood pressure.

Introduction

The blood circulatory system diseases due to graded morbidity, early disability, and high mortality in economically developed countries got the prime medical and social importance. In accordance with the official data of the World Health Organization (WHO), the blood circulatory system diseases form more than 2/3 of the cases of the burden of all diseases, leading the structure of mortality [1]. Heart and vessel diseases, in particular high arterial blood pressure (BP), occupy leading position in the structure of morbidity and mortality in the Republic of Kazakhstan (RK), in recent decades, there has been a 5–7 times an incidence rate [2]. This group of incidence is called the epidemic of this century or the problem of largest economies. It is well known that the diagnosis of arterial hypertension (AH) has a significant impact on the health status, duration, and quality of life of patients, since it is a risk factor (RF) for the development of diseases such as coronary heart disease (CHD) and myocardium. It was concluded that AH doubles the risk of CHD and triples the risk of cardiac distress (CD) and stroke in the future [3].

The blood circulatory system diseases rate depends chiefly on lifestyle peculiarities and related risk factors. It was identified that in accordance with the conducted earlier investigations' results, that the main risk factors of the premature mortality are: AH (35.5%), hypercholesteremia (23%), and smoking (17.1%), followed by insufficient consumption of vegetables and fruits (12.9%), overweight (12.5%), excessive alcohol consumption (11.9%), and hypodynamia (9%) [4].

At another point, dietary habits are one of the significant RFs for the AH development, and if

the negative effect of salt intake has been proven by several systematic reviews (level of evidence A) [5], then the results of recent prospective studies on the effect of saturated fats and carbohydrates on BP did not confirm these early studies. Accordingly, recommendations for BP control to reduce saturated fat may not be effective. The authors of systematic review that included 21 prospective epidemiological studies evaluating the association between saturated fat and cardiovascular diseases found that saturated fat intake was not associated with the risk of coronary heart disease, stroke, or cardiovascular diseases or high BP [6]. Carried out by Hooper and coauthors, the systematic reviews did not reveal association between modified fat intake (replacing saturated fats with monounsaturated fatty acids (MUFAs) and polyunsaturated fatty acids (PUFAs), and development of cardiovascular morbidity (CVM)) [7]. A study of the dietary habits of a Polish cohort found that a significant number of people were overweight or obese, had an inappropriate lipid profile, and elevated blood glucose levels. Daily food rations were not properly balanced. Daily diets were deficient in energy, carbohydrates, dietary fiber, PUFAs, and folates. It was found that inadequate nutrition correlates with nutritional status, lipid profile, and blood pressure scores [8]. Early studies reported an inconsistent association of dietary carbohydrates with CVM risk factors between Asian and Western populations, which may be due to different ranges of carbohydrate intake between these populations. A recent cross-sectional study found that Korean adults consume more carbohydrates than American adults; a stronger association of dietary carbohydrates with metabolic syndrome was found in adult Koreans [9]. Seidelmann and coauthors reported a U-shaped relationship between carbohydrate consumption and mortality, with Asian populations on the right side of the curve and North American and European populations on the left. Thus, nutritional goals for the prevention of cardiovascular risk factors must be differentiated, taking into account, the different ranges of carbohydrate intake that is characteristic of Asian and Western countries. For the Asian population, whose diet is usually rich in carbohydrates, it is important to reduce carbohydrate intake to a moderate level. The food habits of the Kazakhs have their own national characteristics, the daily consumption of SFA is 12% of daily energy [10].

There were carried out many investigations all over the world, which studied impact of the nutrition on cardiometabolic health, such as large studies by Framingham, Massachusetts, that had contributed heavily on comprehension of CVM development mechanisms. Clinical nutrition is directed on investigation, preventive measures and treatment of metabolic changes, and body composition variation that occur in people with nutritional disturbance risk. Clinical nutrition uses proven strategies to assess nutritional status, nutritional therapy and rehabilitation, and behavioral and pharmacological approaches such as dietary intervention for certain pathologies, artificial, or certain nutrients [11], [12]. As you know, eating habits have national and geographical characteristics, according to the results of a large EUROASPIRE V cohort study, which included participants from Kazakhstan, patients diagnosed with AH often do not adhere to a healthy lifestyle, do not follow dietary recommendations, and do not know their target level of BP [2]. Although this study did not study specific nutrients, it can be concluded that studies in the field of nutrition of the Kazakh population are not enough to create local clinical recommendations.

As in the world and Kazakhstan's clinical protocols for the treatment of AH, it is proposed to limit the intake of salt to <5 g/day and alcohol as a dietary therapy, as well as an increase in the consumption of vegetables, fresh fruits, fish, nuts, and sources of unsaturated fatty acids, to reduce the consumption of meat as a source of saturated fatty acids (SFA); consumption of low-fat dairy products. However, it remains unclear how the traditional diet of Kazakhs, which is dominated by sources of carbohydrates and fats with its subspecies, affects the development of AD in the Kazakh population. Local epidemiological and clinical data are required for the successful work of doctors with the population in the prevention of diseases of the blood circulatory system and the creation of clinical recommendations.

The aim of this investigation was to evaluate an influence of fats, its subspecies, and carbohydrates on BP change after 3-year observation of adult Kazakhs.

Materials and Methods

There is described data of 96 individuals of the Kazakh population recruited by the cluster method, living in Aktobe, the Republic of Kazakhstan. Clusters were 14 polyclinics in Aktobe, of which three outpatient municipal polyclinics were randomly selected, each of which had one attached site. From the list of attached adults, there were also randomly selected 96 people without a history of cardiovascular events.

Criteria for inclusion were Kazakh nationality and criteria for exclusion were: Refusal to participate, absence at the moment in the city and impossibility of participation, and the presence of severe somatic pathology requiring a special diet or associated with dietary restrictions.

Belonging to the Kazakh nationality was established by questioning and checking the data of the birth certificate, which indicates the nationality of the respondent and his parents. Persons with a parent

or parents of non-Kazakh nationality did not include into investigation.

Eating habits were assessed using FFQ_KZ, a validated FFQ (Food Frequency Questionnaire) for the local population [19].

FFQ_KZ nutrition assessment questionnaire was used to assess the nature and epidemiology of nutrition. It was validated for the Russian and Kazakh speaking population, consisting of 11 food groups and 110 positions, as well as five open-ended questions, with which you can find out the types of milk (fat content, origin, or other specific milk), methods of preparing main dishes (meat), taking food supplements throughout the year, as well as their frequency and quantity. Participants' dietary intake data were collected using a validated self-administered FFQ block (EPIC-Norfolk, 2011, Cambridge, UK). This FFQ contained validated questions about 110 foods, and participants answered each question following the researcher's instructions. The validity and reliability of the FFQ have been described previously.

Participants with dietary restrictions were excluded from the study. After 3 years of follow-up, the researcher recorded data on BP levels from outpatient charts.

Anthropometric data Standing height was measured with an accuracy to 0.1 cm. Body weight was measured using a calibrated digital electric scale with an accuracy to 0.1 kg. Body mass index (BMI) was calculated as weight/height^2 (kg/m^2). The upper border of the iliac crest determined waist circumference (WC). Information on smoking status, alcohol use, physical activity, and other sociodemographic variables such as marriage, income, and educational attainment was collected through self-administered questionnaires.

The protocol of the study was approved on the 1st meeting of the Local Ethic Committee of the West Kazakhstan Medical University named after Marat Ospanov on January 28, 2018. All people gave written informed consent. The rights of participants as study subjects, possible risks, and exceptions to confidentiality were clearly explained as part of the informed consent process.

Statistical methods

The normality of the distribution of variables was checked using the Shapiro–Wilk test. The test results showed that the variables have a normal distribution. Relationships between variables were determined using regression analysis and Pearson's coefficient. Regression analysis was used to evaluate the relationship between blood pressure values and nutritional factors, anthropometric parameters, and blood biochemical parameters.

Results

Average age of participants of the study was 61.9 ± 10.8. None of the participants had a special diets or food restrictions for health reasons or personal beliefs. Body mass index was 27.1 ± 8.4. The over half of the study participants practice on smoking. The principal features of the study's participants given in Table 1.

Table 1: The principal features of the study's participants

Features	Participants (n = 96)
Age (years), mean ± SD	61.9 ± 10.8
Share of men, n (%)	83 (80)
BMI (kg/m^2), mean ± SD	27.1 ± 8.4
WC (cm) mean ± SD	91.3 ± 15.4
Share of smokers, n (%)	50 (52.5)
Education, n (%)	
Secondary	42 (43.7)
High	54 ± 56.3
SBP_2018, mean ± SD	124.6 ± 12.2
DBP_2018, mean ± SD	82.2 ± 8.5
Cholesterin (mmol/L), mean ± SD	6.8 ± 9.7
Triglycerides (mmol/L), mean ± SD	1.5 ± 1.2
Glucose (mmol/L), mean ± SD	6.8 ± 9.7
Omega 3 index, mean ± SD	3.2 ± 1.8
Apo A1 , mean ± SD	1.04 ± 1.2

SD: Standard deviation, BMI: Body mass index, WC: Waist circumference, SBP: Systolic blood pressure, DBP: Diastolic blood pressure.

The average level of SBP in the study's participants was initially 124.6 mmHg, after 3 years, it increased by an average of 8.6 mmHg and became 133.2, the average level of DBP was 82.2 mmHg, which became higher by 6.2 mmHg and became 88.4 mmHg.

According to the regression analysis, higher consumption of carbohydrates, MUFAs, SFAs, and total fats increased SBP by 9.3, 12.3, 46.1, and 5.3 mmHg, respectively (Table 2). However, with the use of PUFAs, an inverse relationship was found, an increase in PUFA sources in the diet by 100 g reduces SBP by 43.3 mmHg. An effect of all nutrients was not significantly reduced at 3 years on SBP when adjusted for age, sex, and waist circumference (Model 1).

Table 2: Associations between changes in systolic blood pressure and selected factors

Variable	Crude difference	95% CI	p	Model 1	95% CI	p
Carbohydrates (100 g)	9.3	6.4–12.3	≤ 0.001	8.8	6.1–11.5	≤0.001
MUFA	12.3	−7.3–31.9	0.217	9.2	−9.1–27.5	0.317
PUFA	−43.3	−86.8–0.1	0.051	−38.5	−78.4–1.5	0.059
SFA	46.1	22.4–69.8	≤ 0.001	41.2	19.1–63.3	≤0.001
Total fat	5.3	−3.3–13.9	0.223	4.0	−4.0–12.0	0.318

CI: Confidence interval, MUFA: Monounsaturated fatty acid, PUFA: Polyunsaturated fatty acid, SFA: Saturated fatty acid.

Table 3 shows that increasing carbohydrate, MUFA, saturated, and total fat per 100 g increase DBP by 4.9, 4.9, 23.4, and 1.8 mmHg, respectively, after 3 years, and when adjusted for age, sex, and WC by

Table 3: Associations between changes in diastolic blood pressure and selected factors

Variable	Crude difference	95% CI	p	Model 1	95% CI	p
Carbohydrates (100 g)	4.9	2.5–7.3	<0.001	4.5	2.2–6.7	<0.001
MUFA	4.9	−9.5–19.2	0.503	2.3	−11.4–16.1	0.737
PUFA	−29.0	−60.7–2.8	0.073	−25.9	−56.1–4.2	0.091
SFA	23.4	0.1–0.4	0.011	19.4	2.1–36.8	0.029
Total fat	1.8	−4.5–8.1	0.581	0.6	−5.4–6.7	0.836

Model 1: Adjusted for age, gender, WC. CI: Confidence interval, MUFA: Monounsaturated fatty acid, PUFA: Polyunsaturated fatty acid, SFA: Saturated fatty acid, WC: Waist circumference.

4.5, 2.3, 19.4, and 0.6 mmHg. An inverse relationship was also found with PUFA intake, and increasing PUFA intake by 100 g would lower DBP by 29 mmHg. When adjusted for confounding factors, the effect of PUFA intake on DBP change is reduced to 25.9 mmHg.

Model 1 adjusted for age, gender, and waist circumferences

Discussion

The study shows that the vast majority of the study's participants have inappropriate life style, levels of BP, and target glycemic indexes, identified on JES 2016 recommendations on prevention of cardiovascular morbidities in clinical experience.

The effect of consumption of carbohydrates and dietary fats with subspecies on the change in AH parameters in our country has not been previously studied, the analysis of published works did not reveal similar studies. Our results are consistent with those of numerous nutritional studies that have reported beneficial effects of modified fat intake on systolic or diastolic BP. The results of the previous prospective studies and randomized controlled trials prove that the replacement of SFAs in the diet with unsaturated fatty acids MUFAs and PUFAs, and carbohydrates from high-fiber whole grains has a beneficial effect on the course of AH [13], [14], [15]. As doctors recommend patients to reduce the amount of SFAs in diet, it is critical that they offer isocaloric SFA calorie substitutes that will have the greatest impact on improving patient health [16]. Although the benefits of MUFAs have not been as strongly documented as those of PUFAs, there is growing evidence that replacing SFAs with MUFAs from plant sources reduce the risk of CVM [17], [18], [19]. Other dietary SFA substitutes to reduce the risk of cardiovascular morbidities include carbohydrates from whole grains. SFAs should not be replaced with refined carbohydrates, as they provide no benefit [20]. We obtained similar results, according to which, an increase in carbohydrate intake per 100 g can lead to an increase in SBP by an average of 9.3 mmHg. When adjusted for putative confounding factors such as age, WT, and sex, the risk of increased SBP increases in by an average of 8.8 mmHg after 3 years of observation. In addition, SFAs have a statistically significant effect on the increase in SBP after 3 years, with an increase in their consumption by 100 g by an average of 46.1 mmHg.

The consumption of refined carbohydrates has shown a negative direct effect on hypertension. It is important to note that carbohydrate intake had a significant and negative indirect effect on all metabolic traits: TG, glucose, BMI, type 2 diabetes mellitus, hypertension, and metabolic syndrome, with p values ranging from 0.0289 to 1.35. This observation suggests that consumption of simple carbohydrates increases the risk of metabolic diseases [21], [22].

Modified fats favorably affect on systolic and diastolic blood pressure [23], [24]. Authors of several systematic reviews have reported beneficial effects of a low-fat diet on blood pressure [25], [26], [27]. In our study, the energy share of SFAs turned out to be too high, while at the same time, the PUFA energy share was normal. In the population of adult Americans, an excess proportion of energy was recorded at the expense of SFA [28].

Early studies reported an inconsistent association of dietary carbohydrates with CVM risk factors between Asian and Western populations, which may be due to different ranges of carbohydrate intake between these populations. A recent cross-sectional study found that Korean adults consume more carbohydrates than American adults; a stronger association of dietary carbohydrates with metabolic syndrome was found in adult Koreans [29]. Ebbeling and coauthors reported a U-shaped relationship between carbohydrate consumption and mortality, with Asian populations on the right side of the curve and North American and European populations on the left. Thus, nutritional goals for the prevention of cardiovascular risk factors must be differentiated, taking into account, the different ranges of carbohydrate intake that are characteristic of Asian and Western ccountries [30]. For the Asian population, whose diet is usually rich in carbohydrates, it is important to reduce carbohydrate intake to a moderate level. The analysis of the structure of the diet, carried out in our work, allows us to make conclusions about the consumption of which nutrients have the greatest effect on the likelihood of having AH, which is important, since they should be paid attention to when correcting the diet and planning preventive measures [31], [32], [33], [34]. Definitely, individual levels of consumption can differ significantly in patients of different ages, genders, and with different levels of physical activity [35]. The eating habits of the study participants had significant differences from the consumption structure proposed in the concept of the "healthy eating pyramid." Absolutely, these differences can be explained by a number of factors – for example, the fact that the "healthy eating pyramid" formula was formed on the basis of data from those countries where climatic, cultural, and agrotechnical features differ significantly from our country, for example, in the USA, China, Korea, Holland, Australia, etc. [36]. [37], [38], [39], [40]. It is known that similarly to the data of our study, significant differences were found in the studies of a number of countries, for example, South Korea or China [41], [42]. Based on the data obtained, several options for modifying the diet were proposed, including those to reduce the risks associated with the development of AH (for example, healthy diet, prudent diet, Mediterranean diet, etc.).

The retrospective nature of this study does not fully guarantee the absence in the database of patients

coded as AH without specifying the reasons that cause it. The effectiveness of dietary modification approaches based on data from national studies has been confirmed in a number of studies. A recent systematic review and meta-analysis of the effect of nutrition on BP, which included 5014 participants, found that the DASH diet, the Mediterranean diet, and the Scandinavian diet significantly reduced both systolic and diastolic BP [42]. Adherence to the Mediterranean diet is associated with a reduced risk of cardiovascular and all-cause mortality. A randomized controlled clinical trial in high-risk patients following a Mediterranean diet for 5 years found a 29% reduction in cardiovascular risk compared with a low-fat control group and a 39% reduction in stroke risk [43]. Compliance with the Mediterranean diet also contributes to a significant decrease in BP, glucose levels, and blood lipids [44]. The Mediterranean diet is characterized by regular consumption of olive oil, fruits, nuts, vegetables, and cereals; moderate consumption of fish and poultry and low consumption of dairy products, red meat; wine is consumed in moderate quantity [42]. The traditional diet (Prudent diet), characterized by a large amount of fruits, vegetables, legumes, whole grains, fish, and poultry, can reduce the risk of cardiovascular disease by 31% in those who adhere to it. Conversely, adherence to a Western diet that includes high amounts of processed meats, French fries, desserts, red meat, and high-fat dairy products may increase CVM risk by 14% [44]. The differences that we have identified from the structure of the "healthy diet pyramid" require additional study to form the concept of a diet structure that can reduce the risks of AH in our country.

Probably, the results presented in this article can serve as a basis for the development of dietary recommendations for patients with hypertension and for planning clinical trials, based on which it would be possible to conduct a more accurate selection of patients with the exclusion of secondary hypertension and other factors.

Findings

In accordance with the performed analysis in this cohort of subjects, that a significant percentage of these people are overweight or obese, the diet of the Kazakh population does not differ from the eating habits of residents of other countries. The examined individuals received an excess amount of energy from carbohydrates, fat, and SFA, an irrational diet was significantly correlated with an increase in blood pressure.

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