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THE RELATIONSHIP BETWEEN THE MAIN LIFESTYLE FACTORS AND METABOLIC SYNDROME

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Abstract

Introduction. Nowadays, metabolic syndrome continues to be a significant challenge in medicine. Experts from the World Health Organization have called metabolic syndrome (MetS) “the pandemic of the 21st century.” MetS is one of the cardiometabolic risk factors with a high prevalence in the adult population and a high cost to public health systems worldwide. The prevalence of MetS is very high: according to WHO, the incidence of MetS among adults is 20-40% and may increase by 50% in the next 20 years. The most threatening complications closely related to metabolic syndrome are cardiovascular diseases and type 2 diabetes mellitus. Due to the high prevalence of metabolic syndrome, its early detection is of great importance for the timely initiation of the prevention of complications.

Aim. To study the association between the main lifestyle and socio-demographic factors and the risk of developing metabolic syndrome.

Material’s and method. The present study is part of a large metabolic syndrome research project in Turkestan city (AP19676909) “Investigation of genetic aspects of nutrition, lifestyle and compliance of patients with metabolic syndrome in a 10-year prospective study”. The sample consisted of 552 patients from the attached population of the outpatient clinic of the H.A. Yasavi International Kazakh-Turkish University. Individuals with acute conditions requiring emergency care, chronic severe decompensated conditions were not included in the study.

Results: The final patient sample was 549 patients, as study participants without data on any of the sociodemographic factors and any of the lipid and carbohydrate metabolism parameters were excluded from the analysis. The association between the presence of MetS and lifestyle indicators, including time spent sitting during the working day and physical activity, was assessed using multivariate logistic regression analysis. After adjusting for the potential confounding factors, such as gender, smoking, and alcohol consumption, the association between MetS and the sitting time during the working day was maintained statistical significance. In contrast, the adjusted logistic regression analysis revealed a statistically significant inverse relationship between the metabolic syndrome and level of physical activity.

Conclusion: The results of our study suggest a significant role for modifiable risk factors, such as a sedentary lifestyle and the level of physical activity, in the development of metabolic syndrome among our study participants. Personalized management tactics for patients with metabolic syndrome, by correcting modifiable lifestyle factors, can help prevent complications.

Keywords: *metabolic syndrome, physical activity, lifestyle, sedentary behavior.*

Резюме

ВЗАИМОСВЯЗЬ МЕЖДУ ОСНОВНЫМИ ФАКТОРАМИ ОБРАЗА ЖИЗНИ И МЕТАБОЛИЧЕСКИМ СИНДРОМОМ

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Актуальность. На сегодняшний день метаболический синдром остается актуальной проблемой медицины. Эксперты Всемирной организации здравоохранения назвали метаболический синдром (МС) «пандемией XXI века». Метаболический синдром (МС) является одним из кардиометаболических факторов риска, имеющим высокую распространенность среди взрослого населения и высокую стоимость для систем общественного здравоохранения во всем мире. По данным ВОЗ частота МС среди взрослого населения составляет 20-40% и может увеличиться на 50% в ближайшие 20 лет. Наиболее грозными осложнениями, тесно связанными с метаболическим синдромом, являются сердечно-сосудистые заболевания и сахарный диабет 2 типа. В связи с высокой распространенностью метаболического синдрома его раннее выявление имеет большое значение для своевременной профилактики осложнений.

Цель: Изучить связь между основными факторами образа жизни и социально-демографическими факторами с риском развития метаболического синдрома.

Материалы и методы: Настоящее исследование является частью научного проекта по изучению метаболического синдрома в городе Туркестан «Изучение генетических аспектов питания, образа жизни и комплаентности пациентов с метаболическим синдромом в 10-летнем проспективном исследовании» (AP19676909). Выборку составили 552 пациента из прикрепленного населения поликлиники Международного казахско-турецкого университета имени Х.А. Ясави. В исследование не включались пациенты с острыми состояниями, требующими неотложной помощи, хроническими тяжелыми декомпенсированными состояниями.

Результаты: Окончательная выборка пациентов составила 549 человек, так как участники, у которых отсутствовали данные по одному из социально-демографических факторов, либо по одному из параметров липидного и углеводного обмена были исключены из статистического анализа. Связь между наличием метаболического синдрома и показателями образа жизни, включая время, проведенное сидя в течение рабочего дня, физическую активность, была оценена с помощью многомерного логистического регрессионного анализа. Выявлена положительная ассоциация между метаболичеким синдромом и временем, проведенным сидя, которая сохраняла статистическую значимость после коррекции на потенциальные конфаундинг факторы, такие как пол, курение и употребление алкоголя. Напротив, в результате скорректированного регрессионного анализа была обнаружена статистически значимая обратная связь метаболического синдрома с уровнем физической активности.

Выводы: Результаты исследования указывают на значительную роль модифицируемых факторов риска (малоподвижный образ жизни, уровень физической активности) в развитии метаболического синдрома в нашей выборке. Персонализированная тактика ведения пациентов с метаболическим синдромом путем коррекции модифицируемых факторов образа жизни может помочь предотвратить осложнения.

Ключевые слова: *метаболический синдром, физическая активность, образ жизни, малоподвижный образ жизни.*

Түйіндеме

ӨМІР САЛТЫНЫҢ НЕГІЗГІ ФАКТОРЛАРЫ МЕН ЗАТ АЛМАСУ СИНДРОМЫНЫҢ ӨЗАРА БАЙЛАНЫСЫ

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Өзектілігі. Қазіргі таңда медицинада метаболизмдік синдром өзекті мәселе болып табылады. Дүниежүзілік денсаулық сақтау ұйымының сарапшылары метаболизмдік синдромды «XXI ғасырдың пандемиясы» деп сипаттады. Метаболизмдік синдром - ересек популяциялар арасында таралуы жоғары және бүкіл әлем бойынша қоғамдық денсаулық сақтау жүйелері үшін жоғары шығындары бар кардиометаболикалық қауіп факторларының бірі. ДДҰ деректері бойынша ересек популяцияда МС жиілігі 20-40% құрайды, ал келесі 20 жылда ол 50% артуы мүмкін. Аталған синдроммен тығыз байланысты асқынулары жүрек-қан тамырлары аурулары және 2 типті қант диабеті болып табылады. Метаболизмдік синдромның жоғары жиілікте таралуына байланысты оны ерте анықтау асқынуларды уақтылы алдын алу үшін үлкен маңызға ие.

Зерттеудің мақсаты: негізгі өмір салты факторлары және әлеуметтік-демографиялық факторлары мен метаболикалық синдромның даму қаупі арасындағы байланысты зерттеу.

Зерттеудің материалдары мен әдістері. Бұл зерттеу Түркістан қаласындағы метаболикалық синдромды зерттеу жөніндегі «10 жылдық проспективті зерттеуде метаболикалық синдромы бар науқастардың тамақтану ерекшеліктерін, өмір салтын және комплаенттіліктің генетикалық аспектілерін зерттеу» (AP19676909) атты жобаның

бір бөлігі болып табылады. Іріктемеге Х.А. Ясауи атындағы Халықаралық қазақ-түрік университетінің емханасына тіркелген халықтан 552 адам қатысты. Зерттеуге шұғыл көмекті қажет ететін жедел жағдайлары, созылмалы ауыр декомпенсацияланған жағдайлары бар адамдар қатыспады.

Нәтижесі: Пациенттердің қорытынды іріктемесі 549 адамды құрады, себебі әлеуметтік-демографиялық факторлардың немесе липидтер мен көмірсулар алмасуының параметрлерінің бірі бойынша деректері жоқ қатысушылар статистикалық талдаудан алынып тасталды. Метаболикалық синдром және өмір салты көрсеткіштері арасындағы байланыс, соның ішінде жұмыс күні бойы отыру уақыты, физикалық белсенділік, көп өлшемді логистикалық регрессиялық талдау арқылы бағаланды. Метаболикалық синдром мен отыру уақыты арасындағы оң байланыс анықталды, ол жыныс, темекі шегу және алкогольді тұтыну сияқты потенциалды конфаундинг факторларға түзету жасағаннан кейін статистикалық маңыздылығын сақтап қалды. Керісінше, түзетілген логистикалық регрессиялық талдау нәтижесінде метаболикалық синдром және физикалық белсенділік деңгейі арасында статистикалық маңызды кері байланысы анықталды.

Қорытынды: Зерттеу нәтижесінде біздің іріктеме қатысушыларында метаболикалық синдром дамуында реттелетін қауіп факторлары (отырықшы өмір салты, физикалық белсенділік деңгейі) статистикалық маңызды рөлін көрсетті. Метаболикалық синдромы бар пациенттерде реттелетін өмір салты факторларын түзету арқылы жекелендірілген тактиканы ұстану асқынулардың алдын алуға көмектеседі.

Түйінді сөздер: *метаболикалық синдром, физикалық белсенділік, өмір салты, отырықшы өмір салты.*

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Introduction

Chronic non-communicable diseases are now a prevalent global health problem. According to the World Health Organization, non-communicable diseases, including cardiovascular disease (CVD), diabetes and obesity, are now responsible for about two thirds of deaths worldwide outcomes [9].

In recent years, metabolic syndrome (MetS) has become a major global health problem and has attracted much attention because it is strongly associated with various mortality[17].

Although different criteria for verification are used, the major components of MetS, including abdominal obesity, dyslipidemia, arterial hypertension, and insulin resistance, are to some extent related to sedentary lifestyle [6].

Along with the current trend of obesity worldwide, the rapid increase in the incidence and prevalence of MetS represents a major public health challenge that requires prompt and effective plans to address it [10].

Each component of the metabolic syndrome benefits to some extent from physical activity. Given that the prevalence of the metabolic syndrome and its individual components has increased significantly in recent decades, international guidelines call for greater efforts to reduce the incidence of this condition and its components. While physical activity that results in improved physical fitness cannot be expected to normalize insulin resistance, lipid abnormalities or obesity, the combined effect of a set of factors on these risk markers has been shown to have a significant impact on health outcomes associated with the metabolic syndrome [4].

According to a study conducted between 2012 and 2014 in the Southern region of Kazakhstan, the prevalence of MetS was 23.9% (95% CI 18.6–29.2) among men and 21.8% (95% CI 18.5–25.2) among women. The authors of the study explained this finding by changes in diet and physical activity due to the fairly rapid economic development of Kazakhstan. They concluded that this high prevalence of MetS is alarming and calls for increased preventive measures. The authors also emphasized the need for further research into the risk factors that contribute to MetS in Kazakhstan, particularly lifestyle factors such as diet and physical activity. They suggested that this research could provide a basis for targeted interventions to reduce the prevalence of this condition. Thus, the problem of MetS does not lose its relevance, it requires a more detailed study of risk factors for the development of this pathology in each population. The study of the role of modifiable risk factors deserves special attention, as the main preventive measures should be directed at them. In view of the above, the aim of our study was to investigate the association between the main lifestyle and socio-demographic factors and MetS.

Material's and method: The present study is part of a large metabolic syndrome research project in Turkestan city "Investigation of genetic aspects of nutrition, lifestyle and compliance of patients with metabolic syndrome in a 10-year prospective study". (AP19676909). The sample

consisted of 552 patients from the attached population of the outpatient clinic of the H.A. Yasavi International Kazakh-Turkish University. Individuals with acute conditions requiring emergency care, chronic severe decompensated conditions were not included in the study. Patients lacking any of the anthropometric or clinical and metabolic parameters were excluded from statistical analysis. The final sample amounted to 549 patients.

The study included a questionnaire, anthropometric data and laboratory examination. For the purposes of this study, only the following information was used: sex, age, data on physical activity, smoking and alcohol consumption, as well as data on anthropometric and laboratory tests required for MetS determination. Anthropometric measurements were performed according to generally accepted requirements [2]. Waist circumference was (WC) measured with a soft centimeter tape, and the results were evaluated in centimeters (cm). WC was measured midway between the last ribs and the top of the pelvis at the upper anterior iliac crest (approximately at the level of the umbilicus). Blood pressure (BP) was measured using a non-automatic sphygmomanometer with the necessary requirements for correct BP recording. According to the results of two measurements with a 5-minute interval, the average BP was determined.

Blood sampling for laboratory analysis was performed in all patients from the ulnar vein after 12-hour fasting. All laboratory tests were performed in the laboratory of the clinic of the H.A.Yasavi International Kazakh-Turkish University with obligatory external and internal control.

Biochemical studies of blood lipid spectrum parameters included determination of total cholesterol (TC), triglycerides (TG), high-density lipoprotein cholesterol (HDL-C) by standard enzymatic methods on a biochemical analyzer Cobas Integra-400 from Roche (Germany). Fasting blood glucose was determined after 12-hour fasting by taking capillary blood from the finger by express method using an Optium Xceed glucometer calibrated for venous blood plasma by Abbott Diabetes Care Ltd (UK). The results were evaluated in mmol/L.

MetS was diagnosed according to IDF (2005) criteria: abdominal obesity (waist circumference (WC) in men ≥ 94 cm, in women ≥ 80 cm) and any two of the following: 1) TG ≥ 1.7 mmol/L; 2) HDL-C in men < 1.03 mmol/L, in women < 1.29 mmol/L or hypolipidemic therapy; 3) CAD ≥ 130 or DA ≥ 85 mm Hg or antihypertensive therapy; 4) fasting glycemia ≥ 5.6 mmol/L or the fact of previously diagnosed type 2 DM [7].

Data were analyzed using the statistical software package SPSS 25 (SPSS Inc, Chicago, IL). Quantitative data were presented as mean values (M) and standard deviations (SD). Two independent samples were compared using Student's unpaired t-test. Categorical data were presented as percentages and analyzed using Pearson's chi-square test.

The association between the presence of MetS and lifestyle indicators, including sitting time during the working day and physical activity, was assessed using multivariate logistic regression analysis, in which MetS was used as a binary response variable. Independent variables were entered using the forced entry method. Gender, age, smoking, and alcohol consumption were also entered into the model as potential confounding factors. Age was entered into the regression model as a categorical variable: <40, 40-49, 50-59, and 60+ years. Smoking and alcohol use were entered as dichotomous variables. Unadjusted (uOR) and adjusted (aOR) odds ratios with 95% confidence intervals (CI) were calculated. For ranked independent variables, a test for linear trend was estimated by introducing the ranked variable categories into the model as a continuous variable. The critical level of significance (p) for statistical hypothesis testing was taken as 0.05.

The study was approved by the ethical committee of H. A. Yasawi International Kazakh-Turkish University (Protocol №30 dated 30.05.2024y.).

Results

The final patient sample was 549 patients, as study participants without data on any of the sociodemographic factors and on any of the lipid and carbohydrate metabolism parameters were excluded from the analysis.

Data from 126 men and 423 women were used for analysis. In the study population, smokers amounted to 10.0%. The proportion of alcohol drinkers amounted to 11.1%.

Socio-demographic and clinical characteristics of the study sample depending on gender are presented in Table 1. Statistically significant differences between men and women were revealed in age categories (p=0.023), smoking, and alcohol consumption. The proportion of MetS occurrence in the studied sample was statistically significantly (p=0.003) higher among men (52.4%) compared to women (37.1%). Both men and women showed comparable results in terms of time and level of physical activity (at least 150 min per week) (Table 1). The identified differences were taken into account in the subsequent regression analysis.

When comparing anthropometric and basic clinical and metabolic parameters depending on the sitting time during the working day, statistically significant differences were found in WC (p=0.001), thigh volume (p<0.001), body weight (p<0.001), triglyceride levels (p=0.011) and fasting glucose levels (p<0.001). The indicated parameters were higher in patients who spent 5 hours or more sitting during the day (Table 2).

To confirm the identified differences, a logistic regression analysis was conducted, taking into account potential confounding factors such as gender, age, smoking, and alcohol consumption. The results of the multivariate logistic regression analysis (Table 3) demonstrate a statistically significant, direct proportional relationship between sitting time and the presence of MetS, which was maintained after adjusting for confounding factors. (aOR=2.98, CI=2.01-4.42; p for trend<0.001). In contrast, a statistically significant inversely correlation was found with physical activity level after adjusted analysis (aOR =0.65, CI=0.43-0.88; p for trend=0.049). Statistically significant associations were found between the odds of having MetS according to gender (uOR=1.86, CI=1.25-2.78; p for trend=0.002), alcohol consumption (uOR =2.32, CI=1.35-3.98; p for trend=0.002), and smoking (uOR =1.87, CI=1.07-3.28; p for trend=0.028) in the unadjusted analysis.

Table 1.

Socio-demographic and clinical characteristics of the study sample.

		Total		Men (n=126)		Woman (n=423)		p
		n	%	n	%	N	%	
Age	<40	84	15,3	20	15,9	64	15,1	0,023
	40-49	134	24,4	26	20,6	108	25,5	
	50-59	166	30,2	29	23,0	137	32,4	
	> 60	165	30,1	51	40,5	114	27,0	
Alcohol Consumption	Yes	61	11,1	36	28,6	25	5,9	<0.001
	No	488	88,9	90	71,4	398	94,1	
Smoking	Yes	55	10,0	43	34,1	12	2,8	<0.001
	No	494	90,0	83	65,9	411	97,2	
Presence of MetS	Yes	223	40,6	66	52,4	157	37,1	0,003
	No	326	59,4	60	47,6	266	62,9	
Sitting time	Less than 5 hours during the working day	221	40,3	47	37,3	174	41,1	0,470
	5 hours or more during the working day	328	59,7	79	62,7	249	58,9	
Moderate-intensity physical activity (150 minutes per week or more)	No	407	74,1	87	69,0	320	75,7	0,164
	Yes	142	25,9	39	31,0	103	24,3	χ=2,207 P=0,164

Table 2.

Anthropometric and basic clinical and metabolic parameters depending on sitting time.

Clinical and metabolic parameters	Sitting during the working day		p
	less than 5 hours a day	5 hours or more	
WC	93,31 (14,63)	97,39 (14,29)	0,001
Thigh volume	105,45 (11,30)	109,16 (12,15)	<0.001
Body weight	74,06 (14,67)	79,41 (16,24)	<0.001
SBP	122,84 (19,14)	124,42 (19,99)	0,352
DBP	79,60 (11,76)	80,06 (11,04)	0,642
TG	1,55 (0,72)	1,73 (0,97)	0,011
Fasting glucose	4,94 (0,55)	6,01 (2,23)	<0.001
HDL-C	1,36 (0,47)	1,28 (0,66)	0,130
LDL-C	2,74 (0,84)	3,02 (0,77)	0,272

After adjusting for the remaining potential confounding factors, the relationship between MetS and other variables such as gender, smoking, and alcohol consumption was not statistically significant. This suggests a significant role for modifiable risk factors, such as a sedentary lifestyle and physical activity level, in the development of metabolic syndrome in our study population. Among non-modifiable risk factors, age remains statistically significant.

Table 3.

Binary logistic regression results: unadjusted (uOR) and adjusted (aOR) odds ratios with 95% confidence intervals (CI) in the study sample.

Indicator	MetS yes/no					
	uOR	95% CI	P	aOR *	95% CI	P
1	2	3	4	5	6	7
Sitting_time			<0,001			<0.001
Less than 5 hours during the working day	1,00	Reference		1,00	Reference	
5 hours or more per day during the working day	3,06	2,11; 4,44		2,98	2,01; 4,42	
Moderate-intensity physical activity (150 minutes per week or more)			0,128			0,049
No	1,00	Reference		1,00	Reference	
Yes	0,74	0,49; 1,09		0,65	0,43; 0,88	
Gender			0,002			0,156
Woman	1,00	Reference		1,00	Reference	
Men	1,86	1,25; 2,78		1,44	0,87; 2,38	
Age			<0,001			<0,001
<40	1,00	Reference		1,00	Reference	
40-49	2,24	1,12; 4,51		2,45	1,19; 5,05	
50-59	4,61	2,37; 8,97		4,74	2,38; 9,44	

Continuation of Table 3.

1	2	3	4	5	6	7
> 60	7,41	3,80; 14,44		7,15	3,57; 14,32	
Alcohol Consumption			0,002			
No	1,00	Reference		1,00	Reference	0,170
Yes	2,32	1,35; 3,98		1,56	0,84; 2,90	
Smoking			0,028			
No	1,00	Reference		1,00	Reference	0,177
Yes	1,87	1,07; 3,28		1,58	0,79; 3,19	
Note - * adjusted odds ratios were calculated with adjustment for age, gender, smoking and alcohol consumption						

Discussion

The results obtained from our study are similar to those of other similar studies. Lack of physical activity and poor cardiorespiratory fitness are consistently associated with an increased risk of chronic diseases, including type 2 diabetes and cardiovascular disease [13].

Exercise has well-described cardiovascular benefits and has been shown to improve biomarkers of MetS by reducing body weight, waist circumference and blood pressure, as well as improving circulating lipids and glucose profiles [8].

In combination with diet, physical activity is more effective in MetS compared to exercise alone or diet alone (67.4%, 23.5%, and 35.3%, respectively. The effect of a structured combined exercise program on weight loss is presumed to increase with prolonged exercise [11].

The Centers for Disease Control and Prevention (CDC) and American College of Sports Medicine (ACSM) guidelines recommend that all adults engage in at least 30 minutes of moderate-intensity physical activity per day to prevent chronic diseases, including type 2 diabetes and cardiovascular disease. These recommendations also emphasize the presence of physical activity, also its intensity and regularity. The findings suggest that men with sedentary lifestyles are more prone to metabolic syndrome than men who adhere to the CDC-ACSM recommendations, i.e., those who engage in at least 3 h-kg-1 of at least moderate-intensity physical activity or physical activity. An active lifestyle controls low plasma high-density lipoprotein cholesterol (HDL-C) levels and reduces weight, hypertriglyceridemia, and arterial hypertension [19].

New evidence shows that reducing a sedentary lifestyle may also reduce metabolic risk. The American Diabetes Association and similar organizations in other countries have recently added recommendations for sedentary lifestyle to their Physical Activity Guidelines Activity Tracker-Based Metrics as Digital Markers of Cardiometabolic Health in Working Adults: Cross-Sectional Study [13].

A recent prospective cohort study involving 16,209 participants in Amsterdam, the Netherlands, showed that the prevalence of MetS in Dutch origin was 20.6% for men and 9% for women; whereas for participants of African Surinamese origin, the prevalence was 15.4% for men and 14.9% for women [15].

A cross-sectional study of 1,000 people aged 20 to 70 years living in an urban area in northern Iran found that high FA (compared with low FA) was inversely associated with MetS similar to a large study of 10,367 participants aged 37-66 years conducted in Poland. Also found that participants who reported low FA levels had a higher risk of MetS than those who reported high FA levels. Moreover, a recent study involving 4865 adults in China found that higher levels of moderate and severe physical activity and total physical activity were associated with a lower risk of MetS [20].

A cross-sectional study of 750 patients from central rural India showed that physical activity was negatively correlated with TG and TC levels but did not correlate with HDL-CS levels [3].

Physical exercise significantly increased aerobic and muscular endurance, muscle mass and HDL. According to the results of a study conducted by Turkish scientists prolonged sitting time is associated with impaired lipid metabolism, while sufficient physical activity levels are favorably associated with fasting fat oxidation metabolic flexibilityin sedentary and physically inactive adults with MetS. Although a causal relationship could not be determined due to cross-sectional study conditions, the results suggest that reducing sedentary lifestyle time and increasing physical activity of even mild intensity may help in the prevention of metabolic diseases in at-risk groups due to their favorable effects on lipid and carbohydrate metabolism [14].

The large geographic variation in the prevalence of MetS emphasizes the importance of environmental and lifestyle factors, such as excess calories in the diet and physical inactivity, as major contributors to the disease [1]. Low physical fitness is a major risk factor for MetS and overall mortality. Convincing evidence has shown that a high amount of sedentary behavior is associated with an increased risk of developing a range of chronic diseases and mortality [12].

The WHO recommendation is to limit time in a sedentary position in favor of even low-intensity activity. More health benefits can be gained by being active for at least 300 minutes per week [19]. Each clinical component of MetS can be modified by physical activity, which is an inexpensive and therefore readily available way to prevent and treat metabolic syndrome [18].

Conclusion.

The results of the conducted research suggest a statistically significant role for modifiable lifestyle factors, such as a sedentary lifestyle and lack of physical activity, in the development of metabolic syndrome. Personalized management tactics for patients with metabolic syndrome, by correcting modifiable lifestyle factors, can help prevent complications To confirm these causal relationships, it is necessary to conduct further research. Specifically, it would be useful to analyze the influence of these lifestyle factors

on changes in clinical and metabolic parameters within a cohort over time, as part of a prospective study.

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Authors' contributions:

Nuskabayeva G.O. and Sadykova K.Zh. conceived the study;

Turmanbayeva A.A. and Nurdinov N.S. acquired the data;

Sadykova K.Zh.,Kemelbekov K.S and Nuskabayeva G.O. contributed to data analysis;

Turmanbayeva A.A.,Sarsenbayeva G.Zh. and Sadykova K.Zh. drafted the manuscript;

Nuskabayeva G.O., Seidakhmetova A.A. and Nurdinov N.S. contributed to critical evaluation and revisions of the manuscript.

All authors read and approved the final version of the paper.

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