EFFECTS OF EXERCISE ON GLUCOSE AND LIPID METABOLISM IN ELDERLY PATIENTS

OS EFEITOS DO EXERCÍCIO NO METABOLISMO DE GLICOSE E LIPÍDIOS EM PACIENTES IDOSOS

LOS EFECTOS DEL EJERCICIO EN EL METABOLISMO DE GLUCOSAS Y LÍPIDOS EN PACIENTES ANCIANOS

Original Article
Artigo Original
Artículo Original

Xianchao Bi[1]
(Physical Education Professional)
Jingfang Wang[1]
(Physician)

1. Changzhou Institute of Industry Technology, Guangzhou, China.

Correspondence
Xianchao Bi
Guangzhou, China, 213164.
bixianchao2021@163.com

ABSTRACT

Introduction: Metabolic syndrome is a condition in which multiple cardiovascular metabolic risk factors gather in the body. Objective: To explore the effects of exercise prescription on glucose and lipid metabolism in elderly patients with metabolic syndrome. Methods: A total of 85 elderly people were selected from a pension community. The influencing factors of physical activity were analyzed by the Pearson correlation analysis method, Mann-Whitneyu test and Kruskal-Wallish test. Finally, we quantitatively analyzed the influence and path of each factor on the physical activity of the elderly. Results: Among the 85 elderly people in nursing homes, 2 cases (1.1%) had a high level of physical activity, 70 cases (38.9%) had a medium level of physical activity, and 51 cases (60.0%) had a low level of physical activity. Conclusions: The improvement of glucose and lipid metabolism and healthy body fitness with the prescription of exercises of high oxygen + low resistance and that of exercises of high resistance + low oxygen is better than that with the prescription of exercises of full oxygen and full resistance. The improvement of sleep quality with the prescription of exercise with high oxygen and low resistance was better than that of exercise with complete oxygen, complete resistance and high resistance and low oxygen. ***Level of evidence II; Therapeutic studies - investigation of treatment results.***

Keywords: Athletic Performance; Glycolipids; Metabolic Syndrome.

RESUMO

Introdução: A síndrome metabólica é uma condição em que múltiplos fatores de risco metabólicos cardiovasculares se juntam no corpo. Objetivo: Explorar os efeitos da prescrição de exercícios no metabolismo de glicose e lipídios em pacientes idosos com síndrome metabólica. Métodos: Um total de 85 idosos foram selecionados de uma comunidade de pensionistas. Os fatores que influenciam a atividade física foram analisados pelo método de análise de correlação de Pearson, o teste Mann-Whitneyu e o teste Kruskal-Wallish. No final, analisamos quantitativamente a influência e o curso de cada fator na atividade física dos idosos. Resultados: entre os 85 idosos em casas de repouso, 2 casos (1,1%) apresentavam alto nível de atividade física, 70 casos (38,9%) apresentavam nível médio de atividade física, e 51 casos (60,0%) apresentavam baixo nível de atividade física. Conclusões: A melhora no metabolismo de glicose e lipídios e preparo físico saudável com a prescrição de exercícios de oxigênio alto + resistência baixa e aquela de exercícios de resistência alta + oxigênio baixo é mais eficaz do que a de prescrição de exercícios de oxigênio pleno e resistência plena. A melhora na qualidade do sono com a prescrição de exercícios de oxigênio alto e resistência baixa foi maior do que aquela de exercícios com oxigênio pleno, resistência completa e resistência alta e oxigênio baixo. ***Nível de evidência II; Estudos terapêuticos – investigação de resultados de tratamento.***

Descritores: *Desempenho no esporte; glicolipídios; síndrome metabólica.*

RESUMEN

Introducción: El síndrome metabólico es una condición en que múltiples factores de riesgo metabólicos cardiovasculares se juntan en el cuerpo. Objetivo: Explorar los efectos de la prescripción de ejercicios en el metabolismo de glucosa y lípidos en paciente ancianos con síndrome metabólico. Métodos: Se seleccionó un total de 85 ancianos de una comunidad de pensionistas. Los factores que influenciaron la actividad física fueron analizados por el método de análisis de correlación de Pearson, la prueba Mann-Whitneyu y la prueba Kruskal-Wallish. Al final, analizamos cuantitativamente la influencia y el curso de cada factor en la actividad física de los ancianos. Resultados: Entre los 85 ancianos en casas de reposo, 2 casos (1,1%) presentaban alto nivel de actividad física, 70 casos (38,9%) presentaban nivel medio de actividad física y 51 casos (60,0%) presentaban bajo nivel de actividad física. Conclusiones: La mejoría en el metabolismo de glucosa y lípidos y preparo físico saludable con la prescripción de ejercicios de oxígeno alto + resistencia baja y la de ejercicios de resistencia alta + oxígeno bajo es más eficaz que a prescripción de ejercicios de oxígeno pleno y resistencia plena. La mejoría en la calidad del sueño con la prescripción de ejercicios de oxígeno alto y resistencia baja fue mayor que la de ejercicios con oxígeno pleno, resistencia completa y resistencia alta y oxígeno bajo. ***Nivel de evidencia II; Estudios terapéuticos – investigación de resultados de tratamiento.***

Descriptores: *Rendimiento en el deporte; Glicolípidos; Síndrome metabólico.*

DOI: http://dx.doi.org/10.1590/1517-8692202127072021_0342 Article received on 07/29/2021 accepted on 08/18/2021

INTRODUCTION

Metabolic syndrome is a condition in which multiple cardiovascular metabolic risk factors (including central obesity, type 2 diabetes or impaired glucose regulation, dyslipidemia, and hypertension) gather in the body, a large number of studies have shown that the occurrence and progression of MS is closely related to human life style.[1] With the development of social economy, lifestyle changes such as high-calorie, high-fat diet and reduced physical activity have led to the increasing prevalence of MS, which has become a major global health problem. Diet and exercise are the two cornerstones for the treatment of metabolic syndrome. The survey found that 69.69% of patients with metabolic syndrome were in the inactive group or the low activity group.[2] And exercise is beneficial to the control of blood sugar (especially after meals) and reduce the incidence of cardiovascular and cerebrovascular diseases.[3] The survey found that patients have the will to exercise, but most patients have exercise errors, part of patients because of the lack of subjective initiative, it is difficult to carry out long-term effective exercise.[4] Walking is the main way of People's Daily activities. It is very important to determine a certain amount of walking for the prevention and treatment of diseases. Pedometer is an effective physical activity measurement tool. In view of this study, Cherniak A Y, Petrov I M et al investigated the effect of telmisartan on glucose metabolism in elderly patients with hypertension and metabolic syndrome.[5]

METHOD

Inclusion criteria

1. ≥60岁;
2. Meet the diagnostic criteria of metabolic syndrome (MS-CDS2013), have the following 3 or more: Central obesity and/or abdominal obesity: waist circumference ≥90cm for men and ≥85cm for women; Hyperglycemia: FPG≥6.10mmol/L (110mg/ dL) or 2hPG ≥7.80mmol/L (140mg/ dL) and/or have been diagnosed and treated with diabetes; Hypertension: ≥130/85mmHg and/or have been diagnosed with hypertension and treated; Fasting TG≥1.7mmol/L (150mg/ dL) and/or fasting HDL-C<1.0mmol/L (40mg/ dL);
3. Informed consent, voluntary participation.

Exercise intervention grouping

The random number table method was used to randomly divide 85 elderly MS patients into five groups, respectively: There were 17 patients in the complete aerobic exercise group (group A), 17 patients in the complete resistance exercise group (group R), 17 patients in the high oxygen + low resistance exercise group (group HA), 17 patients in the high resistance + low oxygen exercise group (group HR), and 17 patients in the control group (group C). The specific grouping steps of random number table method are as follows: 1) First, 85 subjects were numbered from 1 to 85. 2) Divide the random number by 5, and the remainder is 1, 2, 3, 4, 0. 3) The remaining 1 was divided into group A, the remaining 2 into group R, and the remaining 3 into group HA. The remainder of 4 was divided into HR group, and the remainder of 0 was divided into C group. 4) If there are more than 17 cases in a group, 1 case will be randomly selected from the group, and the random number will be extracted again. Divide the random number by 5, and the remainder will be 1, 2, 3, 4, 0, respectively. The remaining 1 was assigned to group A, the remaining 2 to group R, and the remaining 3 to group HA. The remainder of 4 was divided into HR group, and the remainder of 0 was divided into C group. Repeat until each group has 17 participants.

Exercise prescription

1. Exercise intensity

The intensity of aerobic exercise is that the bullseye rate during exercise reaches (220- age - resting heart rate) * (40%-60%) + resting heart rate. During the exercise, the researcher used the exercise bracelet to measure the 15-second pulse number of the subjects and determine whether their heart rate was within the range of bullseye rate.

Resistance exercise intensity is 45%-65% of the maximum single load of each event. Each event is repeated in 2 to 3 groups, with 10 to 13 groups in each group. Rest between projects is 3min, and rest between groups is 2min.

RPE level was assessed immediately after each exercise for the two kinds of sports, with a score of 12-14. Subsubjectively, "slightly fatigued" and slightly accelerated sweating and breathing did not affect the conversation. The experiment period is shown in Figure 1.

RESULTS

During the experiment, A total of 2 cases were lost to follow-up, all of which were subjects in Group A. The reasons for the loss of follow-up were as follows: One patient withdrew voluntarily, and one patient was hospitalized. Finally, all data were collected from 83 subjects, including 15 cases in group A, 17 cases in group R, 17 cases in group HA, 17 cases in group HR, and 17 cases in group C.

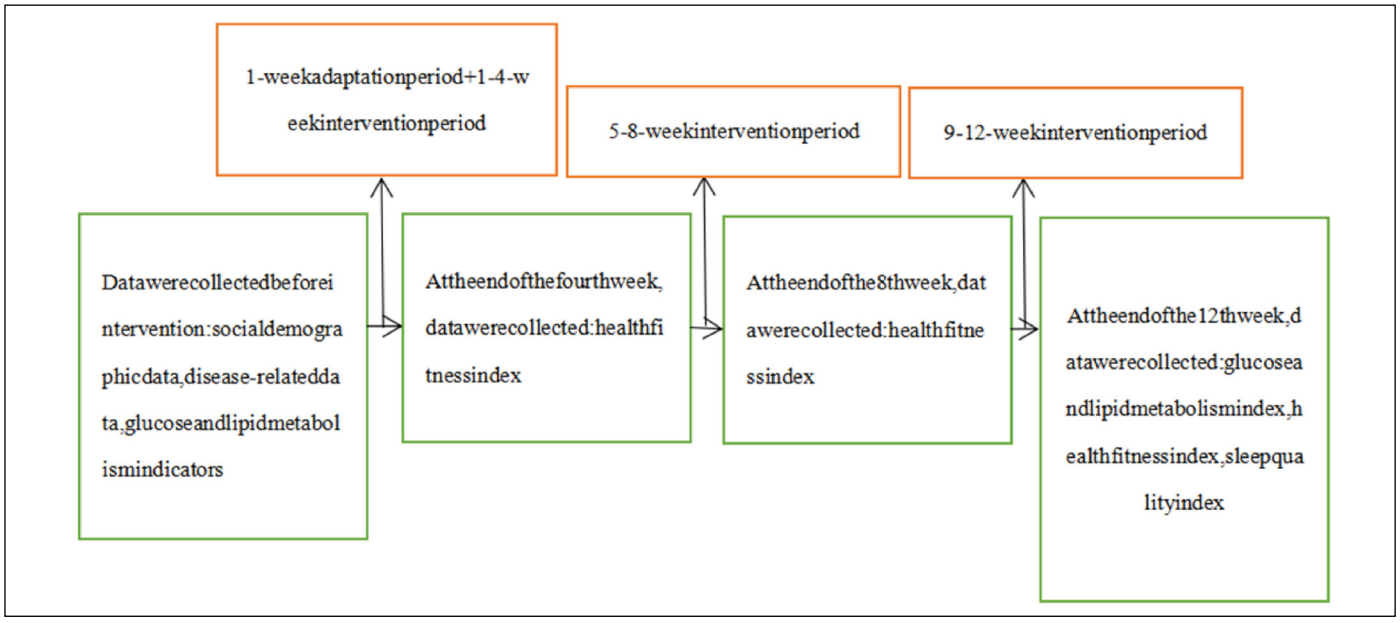

Figure 1. Periodical intervention and collection indicators.

1. Sociodemographic and disease-related data of elderly MS patients in nursing homes

The average age of the elderly was 79.83±5.13 years old, ranging from 63 to 87 years old. Males accounted for 31.3 percent; 10.8% of the elderly have primary school education or below, and 73.5% have university education or above; 68.7% were widowed; 2.2 percent of the elderly smoke; 3.6 percent of older adults drink alcohol; 72.2% of the elderly took more than two drugs; 84.3% suffer from more than 2 chronic diseases. (Table 1)

2. Glucose and lipid metabolism indexes

There were no statistically significant differences in TC, TG, HDL-C, LDL-C, FPG and 2HPG among the five groups (all P >0.05), indicating that the glucose and lipid metabolism levels of the five groups were balanced and comparable before the experiment. The results are shown in Table 2.

3.Effects of different exercise prescriptions on glucose and lipid metabolism in elderly MS patients

Fasting blood glucose

Kruskal-Wallish test showed that the difference between the five groups of patients before and after the FPG experiment was statistically significant (P<0.001). Mann-Whitney test was used for pairwise comparison between groups, and Bonferroni method was used to adjust the test level α=0.05/10=0.005: Compared with group A, there was no statistically significant difference in group R (U=108.00, P=0.478>0.005), and there was statistically significant difference in group HA (U=49.00, P=0.002<0.005), the difference in the HR group was statistically significant (U=49.50, P=0.002<0.005), while the difference in the C group was not statistically significant (U=186.50, P=0.024>0.005).[7]

Table 1. Sociodemographic and disease-related data characteristics of elderly MS patients in nursing homes (n=83).

Project	n	(%)	(Continued) Project	n	(%)
Age (years)			**Smoking**		
60~74	8	9.6	There are	2	2.4
75~84	57	68.7	There is no	81	97.6
≥85	18	21.7			
Gender			**Drinking**		
Man	26	31.3	There are	3	3.6
Woman	57	68.7	There is no	80	96.4
Level of education			**Drug species**		
Primary school and below	9	10.8	0~1	23	27.8
Junior high school	5	6.1	2~3	30	36.1
High school/technical secondary school	8	9.6	>3	30	36.1
University and above	61	73.5			
Marital status			**Number of chronic diseases**		
Married	57	68.7	0~1	13	15.7
Death of a spouse	26	31.3	2~3	45	54.2
			≥4	25	30.1

Table 2. Comparison of glucose and lipid metabolism indexes of elderly MS patients in nursing homes before experiment.

Indicators (mmol/L)	Group A	Group R	Group HA	Group HR	Group C	F	P
TC	4.99±1.14	4.40±1.08	5.08±1.18	4.87±1.16	4.70±0.84	1.029	0.398
TG	1.71±1.11	1.27±0.72	1.72±0.88	1.79±0.02	1.67±0.83	0.860	0.492
HDL-C	1.43±0.36	1.39±0.30	1.43±0.35	1.42±0.39	1.38±0.25	0.069	0.991
LDL-C	3.45±0.94	2.84±0.99	3.50±1.23	3.21±1.10	3.06±0.66	1.220	0.309
FPG	6.13±0.81	6.19±0.92	6.57±1.46	6.57±1.05	6.19±1.42	0.583	0.676
2hPG	7.78±2.20	8.27±2.53	8.30±2.12	7.78±2.17	7.06±1.62	0.920	0.457

Postprandial blood glucose at 2h

Kruskal-Wallish test showed that the differences between the 5 groups of patients before and after the 2HPG experiment were statistically significant (P<0.001), Mann-Whitney test was used for pairwise comparison between groups, and Bonferroni method was used to adjust the test level α=0.05/10=0.005: Compared with group A, there was no statistically significant difference in group R (U=141.00, P=0.628>0.005), and there was no statistically significant difference in group HA (U=77.00, P=0.058>0.005), there was no statistically significant difference in the HR group (U=88.50, P=0.142>0.005), while there was statistically significant difference in the C group (U=205.50, P=0.002<0.005); Compared with R group, there was no statistically significant difference in HA group (U=76.50, P=0.018>0.005), HR group (U=92.50, P=0.073>0.005), and C group (U=213.50, P=0.016>0.005); Compared with HA group, there was no statistically significant difference in HR group (U=153.50, P=0.760>0.005), while there was statistically significant difference in C group (U=260.50, P<0.001<0.005); Compared with the HR group, the difference in group C was statistically significant (U=257.00, P<0.001<0.005).[8]

DISCUSSION

Effects of different exercise prescriptions on health and fitness of elderly MS patients

Two-factor repeated measure analysis of variance was used to compare the change trend of SBP in HA group, HR group and C group before, 4, 8 and 12 weeks of intervention. Intergroup effect analysis: There was no significant difference between HA group and HR group and C group (both P = >0.05).[9] Time effect analysis: there were significant differences between the HA group and the HR group and the C group at different time points (all P <0.05); Interaction effect analysis: there was interaction between group and time in the analysis of HA group, HR group and C group (both P <0.05).[10] The results are shown in Figures 2 and 3.

CONCLUSION

This paper presents the effect of exercise prescription on glucose and lipid metabolism in elderly patients with metabolic syndrome. The

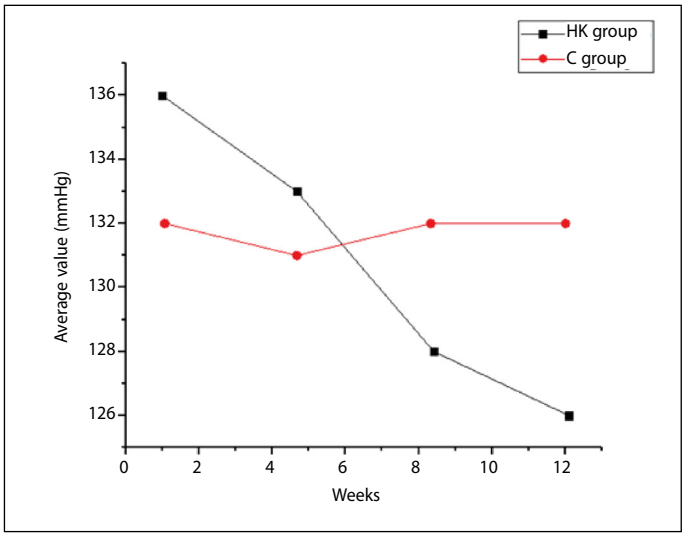

Figure 2. Change trend of SBP in elderly MS patients in HA group and C group at each time point.

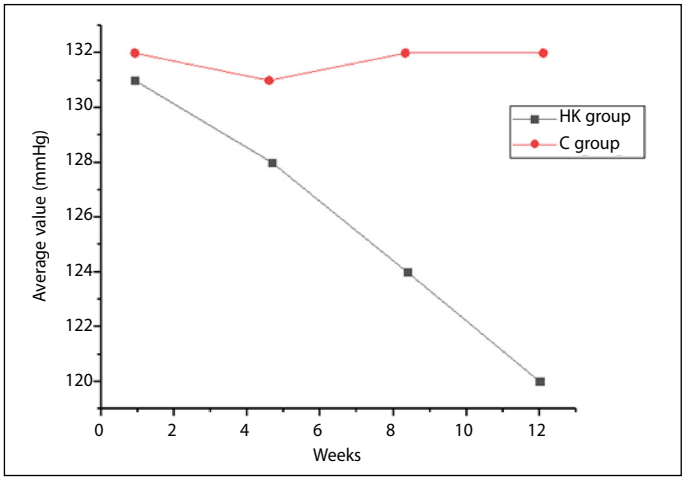

Figure 3. Change trend of SBP of elderly MS patients in HR group and C group at each time point.

specific contents of this method were selected from 85 elderly people in a pension community. The influencing factors of physical activity were analyzed by Pearson correlation analysis method, Mann-Whitneyu test and Kruskal-Wallish test. Among 85 elderly people in nursing homes, 2 cases (1.1%) had high level of physical activity, 70 cases (38.9%) had medium level of physical activity, and 51 cases (60.0%) had low level of physical activity; Univariate analysis showed that education level, marital status, self-efficacy of drinking and exercise beliefs, disease susceptibility, disease severity, behavioral benefit, behavioral disorder and behavioral cues had statistically significant effects on physical activity (all $P < 0.05$); To prove that four kinds of exercise prescription on the elderly patients with metabolic syndrome in nursing homes have different degrees of improvement in glucose and lipid metabolism, physical fitness and sleep quality.

All authors declare no potential conflict of interest related to this article

AUTHORS' CONTRIBUTIONS: Each author made significant individual contributions to this manuscript. Xianchao Bi: writing and performing surgeries; Jingfang Wang: data analysis and performing surgeries, article review and intellectual concept of the article.

REFERENCES

1. Cherniak AY, Petrov IM, Medvedeva IV. Influence of acarbose on postprandial dysmetabolism: results of an open-label randomized study. Rational Pharmacotherapy in Cardiology. 2015;9(3):217-26.
2. Chen J, Xing H, Li Q, Li M, Wang S. [Regulative effects of the acupuncture on glucose and lipid metabolism disorder in the patients of metabolic syndrome]. Zhongguo Zhen Jiu. 2017;37(4):361-5. Chinese. doi: 10.13703/j.0255-2930.2017.04.004.
3. Gomes JM, Costa JD, Alfenas RC. Effect of increased calcium consumption from fat-free milk in an energy-restricted diet on the metabolic syndrome and cardiometabolic outcomes in adults with type 2 diabetes mellitus: a randomised cross-over clinical trial. Br J Nutr. 2018;119(4):422-30. doi: 10.1017/S0007114517003956.
4. Some nutritional supplements may have modest beneficial effects on lipid levels, but the effects of most are negligible. Drugs & Therapy Perspectives. 2015;31(4):133-6.
5. Shumakov OV, Parkhomenko OM, Dovhan OV, et al. The effect of the presence of metabolic syndrome criteria on the post-infarction course in patients with acute myocardial infarction with ST-segment elevation. Ukrainian Journal of Cardiology. 2020;27(3):60-72.
6. Strelkova SN, Ovsyannicov KV, Utkina NI. Role of non-drug therapies of metabolic syndrome: Challenges and prospects. Rational Pharmacotherapy in Cardiology. 2016;12(6):725-32. doi: https://doi.org/10.20996/1819-6446-2016-12-6-725-732.
7. Chien MY, Yang CM, Lin YT, Chen CH. Dihydromyricetin-rich herbal mixture extracts as a potential prescription for treatment of metabolic syndrome in rats fed a high-fat diet and subacute toxicity assessment in rats. J Tradit Complement Med. 2018;9(3):221-226. doi: 10.1016/j.jtcme.2018.06.003.
8. Jeon YK, Ha CH. Expression of brain-derived neurotrophic factor, IGF-1 and cortisol elicited by regular aerobic exercise in adolescents. J Phys Ther Sci. 2015 Mar;27(3):737-41. doi: 10.1589/jpts.27.737.
9. Rudell K, Bobula J, Fu C, Mardekian J, Sadosky A, Essex M, et al. Comparing burden of illness of tophaceous with non-tophaceous gout patients using a large us electronic health records database. Value in Health (Elsevier Science). 2015;18(3):A158-A158. doi: https://doi.org/10.1016/j.jval.2015.03.918.
10. Cervellati C, Bergamini CM. Oxidative damage and the pathogenesis of menopause related disturbances and diseases. Clin Chem Lab Med. 2016;54(5):739-53. doi: 10.1515/cclm-2015-0807.