CALISTHENICS EXERCISES TO INTERVENE IN OBESITY AND DIABETES IN MIDDLE-AGED PEOPLE

EXERCÍCIOS CALISTÊNICOS PARA INTERVIR NA OBESIDADE E DIABETES EM PESSOAS DE MEIA IDADE

EJERCICIOS CALISTÉNICOS PARA INTERVENIR EN LA OBESIDAD Y EN LA DIABETES EN PERSONAS DE MEDIANA EDAD

Original Article
Artigo Original
Artículo Original

Ningning Kong[1]
(Physical Education Professional)
Guantong Yang[2]
(Physician)
Lixia Wang[3]
(Physical Education Professional)
Yang Li[1]
(Physical Education Professional)

1. Sports and Arts Department, HeBei Sport University, ShiJiaZhuang, China.
2. Basic Medical College, HeBei North University, ShiJiaZhuang, China.
3. Sports College, ShiJiaZhuang University, ShiJiaZhuang, China.

Correspondence:
Guantong Yang
ShiJiaZhuang, China. 075000.
GuantongYang@126.com

ABSTRACT

Introduction: There is an annual increase in type 2 diabetes (T2DM) incidence in middle-aged people. Aerobic exercise is known to influence glucose metabolic pathways positively. Few studies concerning calisthenic aerobic exercise and its influence on elderly patients with T2DM. Objective: To measure the therapeutic effect of calisthenic exercise in obese Middle-aged people with T2DM. Methods: A total of 86 patients with T2DM were selected from the physical examination of employees of the same unit. They were randomly divided into the exercise group and the control group. The exercise intervention lasted for 16 weeks, with sessions held 3-5 times per week, varying from 60 to 90 minutes per session. The markers evaluated were defined according to the literature and statistically verified. Results: After 16 weeks of calisthenic exercise intervention, compared to the control group or before the experiment, we observed significant reductions in variables VFA (visceral fat area), FPG (fasting glucose), Fins (fasting insulin), HOMA-IR (homeostasis model evaluation of insulin resistance), 2hPBG (postprandial two hours glucose) and HbAlc (hemoglobin Alc) of the exercise group were significantly reduced (P<0.01). Conclusion: Calisthenic exercise intervention can reduce the levels of VFA, FPG. FIns, HOMA-HR, 2hPBG and HbAlc in patients with T2DM. It was also found to reduce the visceral fat content of obese elderly patients with T2DM, reducing obesity risks. ***Level of evidence II; Therapeutic studies - investigation of treatment results.***

Keywords: Gymnastics; Diabetes Mellitus, Type 2; Middle Aged.

RESUMO

Introdução: Há um aumento anual na incidência de diabetes tipo 2 (T2DM) nas pessoas de meia idade. O exercício aeróbico é conhecido por influenciar positivamente as vias metabólicas da glicose. Porém há poucos estudos sobre o exercício aeróbico calistênico e sua influência em pacientes entre 40 a 60 anos com T2DM. Objetivo: Medir o efeito terapêutico do exercício calistênico em pacientes de meia idade com obesidade e T2DM. Métodos: Um total de 86 pacientes com T2DM foram selecionados a partir do exame físico dos funcionários da mesma unidade. Eles foram divididos aleatoriamente entre o grupo de exercícios e o grupo de controle. A intervenção do exercício durou 16 semanas, com sessões realizadas de 3 a 5 vezes por semana, variando de 60 a 90 minutos por sessão. Os marcadores avaliados foram definidos de acordo com a literatura e verificados estatisticamente. Resultados: Após 16 semanas de intervenção de exercício aeróbico calistênico, em comparação ao grupo controle ou antes do experimento, observamos reduções significativas nas variáveis VFA (área de gordura visceral), FPG (glicose de jejum), Fins (insulina em jejum), HOMA-IR (avaliação do modelo de homeostase de resistência à insulina), 2hPBG (glicose pós-prandial de duas horas) e HbAlc (hemoglobina Alc) do grupo exercício foram significativamente reduzidas (P<0,01). Conclusão: A intervenção de exercício aeróbico calistênico pode reduzir os níveis de VFA, FPG. FIns, HOMA-HR, 2hPBG e HbAlc em pacientes com T2DM. Também foi constatado que reduz o conteúdo de gordura visceral de pacientes idosos obesos com T2DM, reduzindo os riscos de obesidade. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Ginástica; Diabetes Mellitus Tipo 2; Pessoa de Meia-idade.*

RESUMEN

Introducción: Cada año aumenta la incidencia de la diabetes tipo 2 (T2DM) en personas de mediana edad. Se sabe que el ejercicio aeróbico influye positivamente en las vías metabólicas de la glucosa. Pero hay pocos estudios sobre el ejercicio aeróbico calisténico y su influencia en pacientes de 40-60 años con T2DM. Objetivo: Medir el efecto terapéutico del ejercicio calisténico en pacientes de mediana edad con obesidad y T2DM. Métodos: Se seleccionó un total de 86 pacientes con T2DM a partir de la exploración física de los empleados de la misma unidad. Se dividieron aleatoriamente entre el grupo de ejercicio y el grupo de control. La intervención de ejercicios duró 16 semanas, con sesiones realizadas de 3 a 5 veces por semana, de 60 a 90 minutos por sesión. Los marcadores evaluados se definieron según la literatura y se verificaron estadísticamente. Resultados: Después de 16 semanas de intervención de ejercicio aeróbico calisténico, en comparación con el grupo de control o antes del experimento, observamos reducciones significativas en las variables VFA (área de grasa visceral), FPG (glucosa en ayunas), Fins (insulina en ayunas), HOMA-IR

(evaluación del modelo de homeostasis de resistencia a la insulina), 2hPBG (glucosa postprandial de dos horas) y HbAlc (hemoglobina Alc) del grupo de ejercicio se redujeron significativamente (P<0,01). Conclusión: La intervención de ejercicio aeróbico calisténico puede reducir los niveles de AGV, FPG. FIns, HOMA-HR, 2hPBG y HbAlc en pacientes con T2DM. También se ha comprobado que reduce el contenido de grasa visceral en pacientes ancianos obesos con T2DM, reduciendo el riesgo de obesidad. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: *Gimnasia; Diabetes Mellitus Tipo 2; Persona de Mediana Edad.*

DOI: http://dx.doi.org/10.1590/1517-8692202228022021_0457 Article received on 11/03/2021 accepted on 12/23/2021

INTRODUCTION

As people's lifestyles change and the population ages, the incidence of diabetes is increasing year by year. Obesity is closely related to type 2 diabetes, it is an independent risk factor for the onset of type 2 diabetes.[1] Diabetes is a group of metabolic diseases characterized by long-term hyperglycemia. Studies have confirmed that obesity is the occurrence of type 2 diabetes, independent risk factors for development, according to the survey, the incidence of obesity in type 2 diabetes is 81.14%, among them, obesity reached 3795%, and most (95.8%) are abdominal obesity, it is more dangerous, it is more likely to cause and aggravate insulin resistance.[2] Insulin resistance refers to the decreased sensitivity and responsiveness of insulin's target organs or target tissues to insulin, as a result, a certain amount of insulin cannot produce the physiological effects it should, at this time, pancreatic islet β cells compensatoryly secrete excessive insulin, to overcome insulin resistance, maintain normal physiological effects.[3] People usually think that, insulin resistance plays a major role in the development of type 2 diabetes, and obesity-induced hyperinsulinemia, disorders of lipid metabolism and systemic inflammation are important reasons to promote the occurrence and development of insulin resistance.[4] The concept of GI was proposed by Chen W et al., it means that a food containing 50 g of carbohydrates and a considerable amount of standard food (glucose or white bread) within a certain period of time (usually 2h), the percentage value of the blood glucose response in the body.[5]

METHOD

Experimental subjects

Select 86 T2DM patients as experimental subjects from a health checkup in a certain community, the selection criteria are: Age ≥50 years; Body mass index (BMI) ≥ 28; Meet the T.DM diagnostic criteria (WHO (1999): Diabetes related symptoms + random blood sugar ≥ 11.1mmol/L or fasting blood glucose 2≥7.0mmol/L or oral glucose tolerance test, 2h postprandial blood glucose ≥ 11.1mmol/L; Application of hypoglycemic drugs for more than 1 year, blood sugar is basically stable; Normal cardiopulmonary function; The motion system can carry out this experiment smoothly; There is no habit of regular exercise except for daily life.

Experiment grouping

Sort by BMI, the above 86 subjects were randomly divided into two groups: Exercise group and control group, there were 43 cases in each group. There was no statistical difference in gender, age, BMI, etc. between the two groups. The data of the experimental subjects are shown in Table 1.

Table 1. Basic information of experimental subjects.

Group	Number of cases	Age	BMI
Sports group	43	50 ± 10	28 ± 5
Control group	43	50 ± 8	29 ± 4

Experimental method

The intervention method used in the exercise group was patting aerobics. Before the exercise experiment, let the subjects perform adaptive exercises for 1 week, start with a lower exercise intensity, gradually increase to 60%-70% of maximum heart rate (HRmax, HRmax=220-age), maintain after reaching Hrmax.[6] During the exercise experiment, the fitness instructor measures the number of heartbeats of the subjects in 10s, calculate the heart rate based on this, and compare with 60%-70%Hmax for exercise intensity adjustment. 3-5 times a week, 60-90min each time, the exercise intervention was carried out for a total of 16 weeks. Exercise is scheduled around 1h after the meal, avoid fasting exercise, so as to avoid hypoglycemia.[7] In the exercise experiment, adjust the amount of exercise and exercise time or stop the exercise according to the patient's feeling and body response after exercise, whole process monitoring, instruct the subjects to exercise, ensure the safety of subjects, the experiment went smoothly. The control group did not receive special exercise intervention.[8] In addition to the experimental group according to the exercise experimental design plan, do not arrange exercise by yourself (except for daily activities, such as general housework). All subjects had regular diet and applied hypoglycemic drugs. The subjects' dietary requirements shall be imposed from 1 week before the experiment, minimize fat, rice or noodles are about 250g per day. During the application of hypoglycemic drugs, routine blood glucose measurement regularly, if necessary, adjust the medication according to the physician's recommendation.

Index test

The two groups of subjects were tested for the following indicators: Perfect the height of all patients before the experiment, weight, BMI, waist circumference, hip circumference, fasting blood sugar, 2 hours postprandial blood glucose, glycosylated hemoglobin, total cholesterol, triglycerides, low-density lipoprotein cholesterol, high-density lipoprotein cholesterol, fasting insulin visceral fat area (VFA), calculate the insulin resistance index (HOMA-IR)=(FPGXFIns)/22.5 of the steady-state model assessment method. The test will be carried out 7 days before the experiment and the next day after the experiment is completed. In the two inspections, the inspectors, the instruments and methods are the same, and the testing personnel are trained in advance. The subject wore single clothes, bare feet, use a height and body mass measuring instrument to measure height and body mass. Use Siemens 64-slice spiral CT scanner to measure VFA, the subject took the supine position, and the scanning condition was 120kV, current 200mA, scanning layer thickness 5mm, scan the cross section of the abdomen between $L_{4\text{-}5}$ at the level of the umbilicus while holding the breath. The CT value range of selected adipose tissue is -250~-50Hu.

Data processing

The data obtained in the experiment is tested to be normally distributed, apply SPSS20.0 for data analysis, using t test, the results are expressed as mean±standard deviation. P<0.05 was statistically different.

RESULTS

Changes in body weight, BMI, waist circumference, and hip circumference of the two groups of patients before and after the experiment

Of all 86 subjects, a total of 75 cases successfully completed the whole experiment, among them, there are 35 cases in the experimental group, 40 cases in the control group, the proportion of people who withdrew from the experiment was 12.8%, the main reason for withdrawal is illness. There was no statistical difference between the basic indicators of the subjects who withdrew and those who completed the experiment in this group. Before the experiment, the differences in body weight, BMI, waist circumference, and hip circumference between the two groups of patients were not statistically significant (P>0.05): After the experiment, the above indicators of the two groups of patients were lower than before the experiment, but the exercise group dropped significantly, the difference was statistically significant (P<0.05). (Table 2)

Changes in VFA, FPG, FIns, and HOMA-IR indicators of the two groups of subjects

The VFA, FPG, FINS, HOMA-IR, 2hPBG, and HbAlc of the two groups of subjects before and after the experimental intervention are shown in Table 3, the results show that: Before the experiment, there was no statistical difference in VFA, FPG, FIns, HOMA-IR, 2hPBG, and HbAlc between the two groups of subjects (P>0.05), explain that the experiment grouping is reasonable; After the experiment, compared with the control group, VFA, FPG, FIns, HOMA-IR, 2hPBG, HbAlc in the exercise group were significantly reduced, all have extremely significant differences (P<0.01); Compared with before the experiment, VFA, FPG, FIns, HOMA-IR, 2hPBG, HbAlc are significantly reduced, all have extremely significant differences (P<0.01). The comparison of the changes of various indicators between the two groups of patients after the experiment is shown in Figure 1.

DISCUSSION

It is generally believed that insulin resistance plays a major role in the development of , the reason is that the number or affinity of insulin receptors on target cells in the patient's body is insufficient, lead to decreased insulin sensitivity, decreased blood sugar lowering effect, then insulin resistance appears.[9] Exercise therapy is one of the five cornerstones of treatment. As a non-medicinal method, exercise has the advantages of convenience, economy, good curative effect, and at the same time has a good impact on other body systems, etc., more and more attention has been paid. In addition, exercise therapy has obvious advantages in preventing.[10] A lot of information shows that, is highly correlated with factors such as obesity and insufficient exercise, regular patting aerobics has obvious effects in preventing and treating. The mechanism of Paida aerobics to prevent may be: Skeletal muscle glucose transporter 4 (GLUT4) plays an important role in glucose uptake, utilization is important, the expression or activity of GLUT4 in patients decreases, can cause skeletal muscle and fat cells to reduce the uptake and utilization of glucose, and exercise can increase the content of GLUT4, at the same time, it can increase the activity of mitogen-activated protein kinase (MAPK), MAPK is involved in insulin and glucose metabolism, further enhance the utilization of sugar by skeletal muscle and other related tissues.

Table 2. The body weight of the two groups of patients before and after treatment. BMI, waist, hip changes.

	Control group		Sports group	
	Before the experiment	After the experiment	Before the experiment	After the experiment
Weight	83 ± 12.2	78.61 ± 11.42	81.58 ± 10.78	73.03 ± 9.54
BMI	30.49 ± 2.21	28.87 ± 2.12	30.13 ± 1.95	27.21 ± 1.52
Waistline	104.13 ± 7.43	100.23 ± 6.52	103.21 ± 7.36	95.72 ± 5.01
Hips	110.45 ± 7.21	107.55 ± 6.32	109.54 ± 7.21	104.23 ± 4.57

Table 3. Comparison of indicators between the two groups of subjects before and after the experimental intervention.

	Control group		Sports group	
	Before the experiment	After the experiment	Before the experiment	After the experiment
VFA	118.1 ± 33.7	118.8 ± 32.5	117.5 ± 32.7	94.2 ± 31.7
FPG	9.62 ± 1.74	9.64 ± 1.81	9.87 ± 1.92	8.12 ± 1.89
FINS	12.88 ± 6.25	13.22 ± 6.51	13.36 ± 6.22	8.18 ± 4.55
HOMA-IR	6.33 ± 3.10	6.42 ± 3.17	13.36 ± 6.22	3.16 ± 1.78
2hPBG	13.33 ± 3.24	8.91 ± 1.24	13.15 ± 3.37	8.22 ± 1.02
HbAlc	8.86 ± 1.81	7.22 ± 1.06	9.04 ± 2.13	6.53 ± 1.20

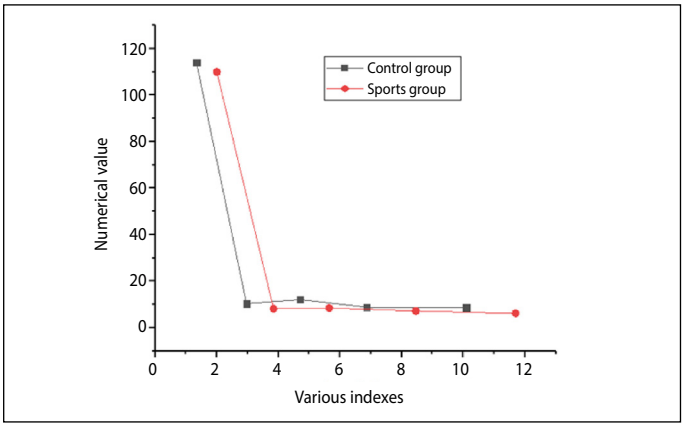

Figure 1. Changes in various indicators of the two groups of patients after the experiment.

CONCLUSION

The PASA aerobic exercise performed in this study has a significant impact in reducing the amount of visceral fat in middle-aged and elderly obese patients; at the same time, it also shows that the payment of aerobic exercise can reduce blood sugar, insulin and insulin resistance index. Relieve the high blood sugar of the body, reduce insulin resistance, and enhance the sensitivity of tissue cells on insulin. Patients for other conditions will continue to study in the future.

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

AUTHORS' CONTRIBUTIONS: Each author made significant individual contributions to this manuscript. Ningning Kong: writing and performing surgeries; Guantong Yang: data analysis; Lixia Wang: performing surgeries, Yang Li: article review and intellectual concept of the article.

REFERENCES

1. Mu, Z. P.; Wang, Y. G.; Li, C. Q. et al. Association Between Tumor Necrosis Factor-α and Diabetic Peripheral Neuropathy in Patients with Type 2 Diabetes: a Meta-Analysis. Molecular Neurobiology, v. 54, n. 2, p. 1-14, 2017.
2. Hui, P.; Zhao, L.; Xie, Y. et al. Nocturnal Hypoxemia Causes Hyperglycemia in Patients With Obstructive Sleep Apnea and Type 2 Diabetes Mellitus. American Journal of the Medical Sciences, v. 351, n. 2, p. 160-168, 2016.
3. Andrews, M.; Soto, N.; Arredondo-Olguín, M. Association between ferritin and hepcidin levels and inflammatory status in patients with type 2 diabetes mellitus and obesity. Nutrition, v. 31, n. 1, p. 51-57, 2015.
4. Nemati, R. Acute Changes in Non-esterified Fatty Acids in Patients with Type 2 Diabetes Receiving Bariatric Surgery. Obesity Surgery, v. 27, n. 3, p. 1-8, 2016.

5. Chen, W.; Balland, E.; Cowley, M. A. Hypothalamic Insulin Resistance in Obesity: Effects on Glucose Homeostasis. Neuroendocrinology, v. 104, n. 4, p. 364-381, 2017.
6. Nguyen, V. T.; Li, X.; Elli, E. F. et al. Vitamin D, inflammation, and relations to insulin resistance in premenopausal women with morbid obesity. Obesity, v. 23, n. 8, p. 1591-1597, 2015.
7. Valerie, R.; Trybula, J.; Wills, R. et al. Serum Autotaxin/ENPP2 correlates with insulin resistance in older humans with obesity. Obesity, v. 23, n. 12, p. 2371-2376, 2015.
8. Faghihzadeh, F.; Adibi, P.; Hekmatdoost, A. The effects of resveratrol supplementation on cardiovascular risk factors in patients with non-alcoholic fatty liver disease: a randomised, double-blind, placebo-controlled study. British Journal of Nutrition, v. 114, n. 05, p. 796-803, 2015.
9. Bool, C.; Rutten, E.; Franssen, F. et al. Antagonistic implications of sarcopenia and abdominal obesity on physical performance in COPD. European Respiratory Journal, v. 46, n. 2, p. 336, 2015.
10. Kelley, D.; Goodpaster, B. H. Stewing in Not-So-Good Juices: Interactions of Skeletal Muscle With Adipose Secretions. Diabetes, v. 64, n. 9, p. 3055-3057, 2015.