Effect of a 5-month exercise program on blood pressure and glucose: A case study of a 68-year-old woman with diabetes mellitus type II and hypertension

Kekelekis, Afxentios ; Knechtle, Beat ; Nikolaidis, Pantelis T

Abstract: Summary<jats:italic>Introduction</jats:italic>: The aim of the present case study was to examine the effect of a 5-month exercise intervention on glucose and hypertension level of a patient with diabetes mellitus.<jats:italic>Material and methods</jats:italic>: A 68-year-old woman (weight 70 kg, height 163 cm) with diabetes mellitus and hypertension performed a 5-month exercise program (two sessions per week with each session lasting 45 min).<jats:italic>Results</jats:italic>: A decrease of blood glucose across time was observed, except for after exercise. No change was observed in pre-exercise levels of systolic and diastolic blood pressure across time.<jats:italic>Conclusions</jats:italic>: In summary, the present case study showed that an adult woman with diabetes mellitus and hypertension benefited from a 5-month exercise program combining aerobic and resistance training in terms of blood glucose regulation, physical condition and quality of life.

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Case report

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Effect of a 5-month exercise program on blood pressure and glucose: A case study of a 68-year-old woman with diabetes mellitus type II and hypertension

Afxentios Kekelekis[1], Beat Knechtle[2,3], Pantelis T. Nikolaidis[4,5]

[1] Sport Injury Clinic for Prevention and Rehabilitation, Crete, Greece; [2] Institute of Primary Care, University of Zurich, Zurich, Switzerland; [3] Medbase St. Gallen Am Vadianplatz, St. Gallen, Switzerland; [4] Exercise Physiology Laboratory, Nikaia, Greece; [5] School of Health and Caring Sciences, University of West Attica, Athens, Greece

Summary

Introduction: The aim of the present case study was to examine the effect of a 5-month exercise intervention on glucose and hypertension level of a patient with diabetes mellitus.
Material and methods: A 68-year-old woman (weight 70 kg, height 163 cm) with diabetes mellitus and hypertension performed a 5-month exercise program (two sessions per week with each session lasting 45 min).
Results: A decrease of blood glucose across time was observed, except for after exercise. No change was observed in pre-exercise levels of systolic and diastolic blood pressure across time.
Conclusions: In summary, the present case study showed that an adult woman with diabetes mellitus and hypertension benefited from a 5-month exercise program combining aerobic and resistance training in terms of blood glucose regulation, physical condition and quality of life.

Keywords: Diabetes mellitus – Hypertension – Rehabilitation – Cycling

Introduction

Diabetes mellitus type 2 (DMT2) is characterized by varying levels of insulin resistance leading to hyperglycemia due to insulin secretion defect [6]. Poor physical activity, obesity and high levels of uninterrupted sedentary time are risk factors for diabetes [12]. Hyperglycemia leads to renal, ophthalmic and cardiovascular chronic conditions resulting in increased mortality and morbidity [6]. In addition, hypertension (HTN) is associated with an increased incidence of all-cause and cardiovascular disease (CVD) mortality, stroke, coronary disease, peripheral artery disease and renal insufficiency [9]. HTN has been defined as systolic blood pressure (SBP) $\geq$ 140 and/or diastolic blood pressure (DBP) $\geq$ 90 mm Hg, or being on antihypertensive treatment [9]. The positive effects of exercise in treating and preventing DMT2 are well established [5]. Exercise improves insulin sensitivity, decreases catecholamines, total peripheral resistance, and cardiovascular risk and improves quality of life [8]. Several studies have successfully identified the beneficial effect of aerobic exercises [11], resistance exercise [4], a combination of both types [2], and high-intensive exercises [4] in the treatment, prevention and control of DMT2 and HTN. Current guidelines from the American College of Sport Medicine (ACSM) and the American Diabetes Association (ADA) recommend at least 150 min per week of moderate to vigorous aerobic exercise to prevent and treat chronic conditions, including DMT2 and hypertension [3]. Castaneda and colleagues [1] examined the effect of resistance exercise training on older individuals and clearly identified that exercise training reduced diabetes medication, abdominal adiposity, and systolic blood pressure in addition to increase in muscle strength and physical activity. Studies have successfully identified the effectiveness of low and moderate resistance exercise [2,11] while other researchers suggested that highly intensive exercises could additionally provide a beneficial effect in the treatment and prevention of DMT2 [4].

Author's address Pantelis T. Nikolaidis, Exercise Physiology Laboratory, Thermopylon 7, Nikaia 18450, Greece
pademil@hotmail.com

Case presentation

A 68-year-old woman (weight 70 kg, height 163 cm) with DMT2 and hypertension presented to a clinic of physiotherapy last January seeking assistance aiming to decrease glucose level, control pressure levels, get slimmer, and finally improve quality of life. This research was carried out fully in accordance with the ethical standards derived from the Declaration of Helsinki. The risks and benefits of the study were explained in detail and the patient provided written informed consent. The patient was advised to undergo pre-exercise medical screening and laboratory testing (cardiac examination and scanning, blood lab tests, glucose tolerance). A very careful and detailed medical history was taken focusing on screening all major objective and subjective signs. Relevant medical history revealed hypertension (maximum SBP/DBP 170/100 mmHg) controlled through medication (25 mg hydrochlorothiazide, 1 × every morning) and DMT2 (maximum 180 mg/dL) that was mainly controlled through medication (metformin hydrochloride 2 × day, 850 mg, past meals) and nutritional restrictions. Dizziness and loss of orientation were rarely present in the past when the patient was performing intensive or high-demanding physical activities, but these symptoms were mainly related to hypoglycemia. A history of previous knee arthritis had been reported, where total knee arthroplasty was recommended; nevertheless, the patient followed a specific strengthening and proprioception exercise-based program with very positive final results. No other chronic medical conditions were reported. The patient was in good mental and psychological condition. A PARQ+ questionnaire according to the Canadian Society of Exercise Physiology [7] was provided to the patient. The patient answered 'NO' to all the questions.

A specific exercise program was designed according to the patient's demands and wishes. The exercise program was performed twice a week, combining moderate resistance exercises and aerobic cycling. The duration of each session was 45 min. Three basic resistance exercises were performed: squat exercises with minimum support, bench press, shoulder pulley while sitting on a Swiss ball. Additionally, single leg bridge, and bench exercise with elbows bended were performed at low intensity. Cycling was preferred instead of treadmill. 30-min aerobic exercise of moderate intensity (60–70% of maximal heart rate) was indicated. A summary of a detailed exercise prescription is listed in Table 1. Additionally, the patient agreed to perform a home-based aerobic exercise activity (30 min moderate walking) twice a week. A heart rate (HR) monitor (Garmin forerunner 410) was used to control exercise intensity during exercise sessions in the clinic and at home. The HR monitor was provided to the patient to record and verify exercise intensity and duration of the home-based exercise sessions, where HR should be maintained between 90 and 105 bpm. Glucose and hypertension measurements were screened before the exercise, during the exercise, at the end of the exercise and 3 hours after the exercise. Pearson's correlation coefficient r was used to examine the variation of blood pressure and glucose during the exercise program. The aim of the present case study was to examine the effect of a 5-month intervention on glucose and hypertension level of the participant.

Discussion

A decrease of blood glucose across time was observed, except for after exercise (Fig. 1). No change was observed in pre-exercise levels of SBP (Fig. 2) and DBP across time (Fig. 3). Despite the fact that this study suggested only 90 min of weekly exercise training, instead of the minimum of 150 min of exercise recommended by several sports medicine associations [5], a significant improvement in blood glucose level was observed in the participant. Our findings were in agreement with a recent case study in a woman of similar age and pathologies, where resistance training was beneficial for health and quality of life [10]. The present study could not discriminate which type of exercise, resistance or aerobic exercise, was more effective; however, the data confirmed the largest decrease in glucose level measurements at the end of the exercise. The blood pressure values indicated long-term stability and were very close to the normal values (130–80 mmHg). A specific dietary plan was suggested; nevertheless, the patient did not successfully follow the nutritional restrictions and several glucose measurements were higher than normal. At the end of the fifth month, the patient reported

Table 1. Exercise prescription

Type of exercise	Parameter	Variables
Isometric resistance	Intensity	70% of 1RM
	Volume	3 reps
	Frequency	2 times/week
	Duration	5 months
Isotonic resistance	Intensity	60% of 1RM
	Volume	4 sets of 12 reps
	Frequency	2 times/week
	Duration	5 months
Aerobic cycling	Intensity	60–70% of MHR
	Volume	30 min
	Frequency	2 times/week
	Duration	5 months

1RM: 1 repetition maximum; MHR: maximum heart rate.

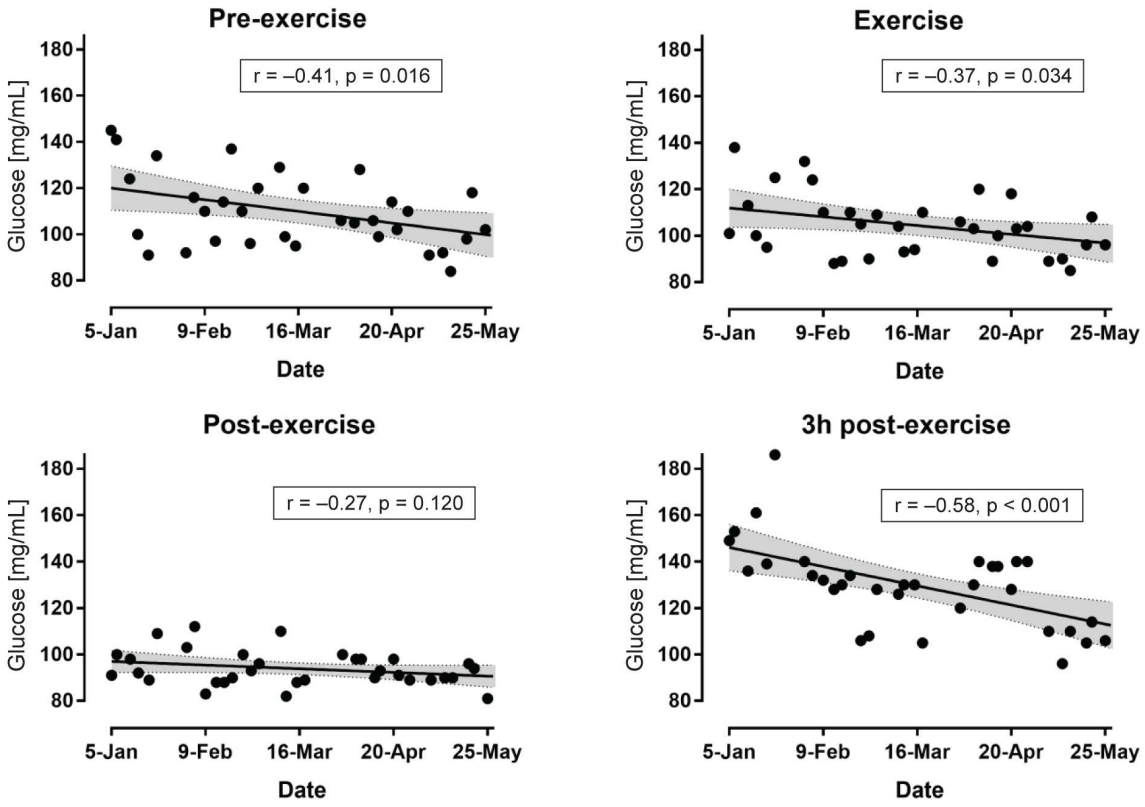

Fig. 1. Variation of glucose level across time. Error bars represent 95% confidence intervals

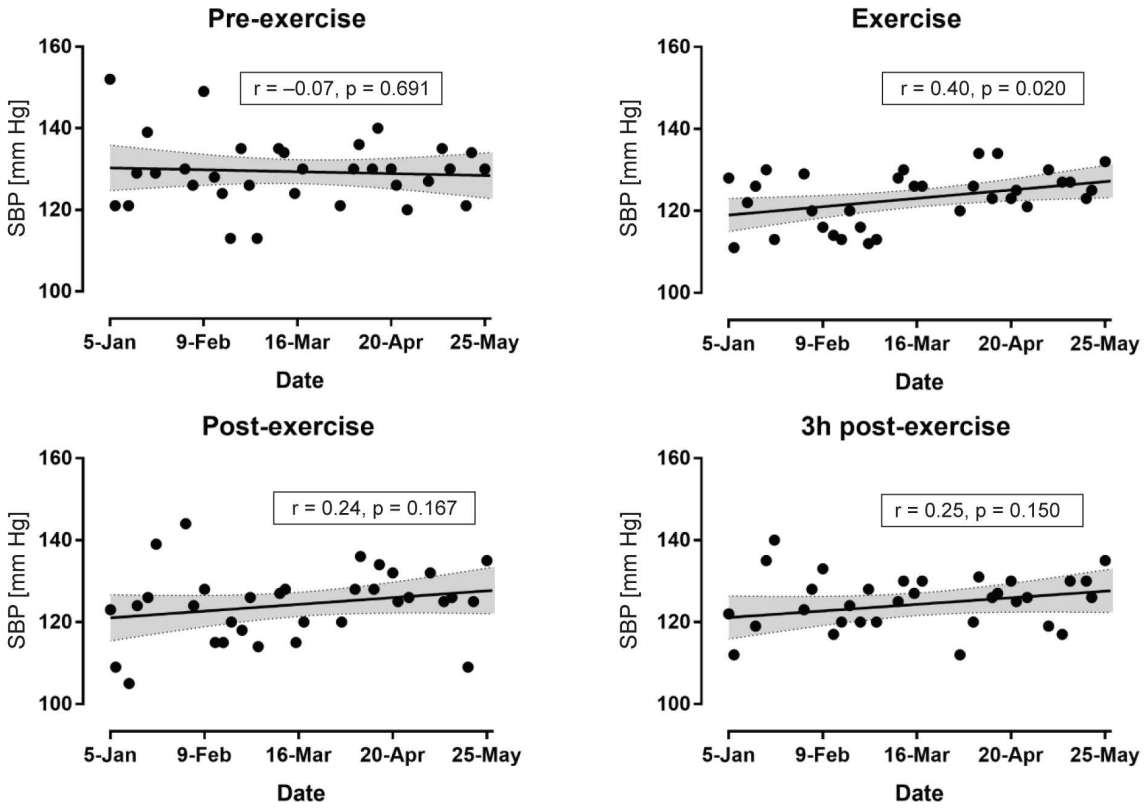

Fig. 2. Variation of systolic blood pressure across time. SBP = systolic blood pressure; error bars represent 95% confidence intervals

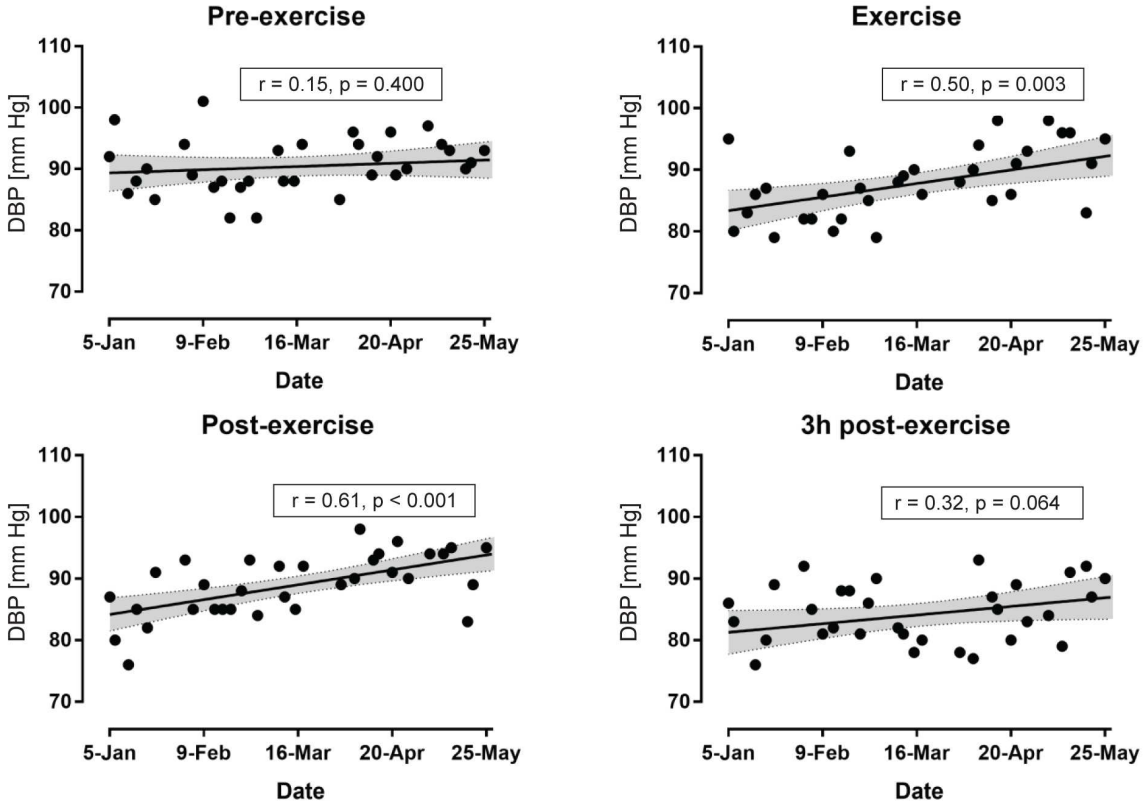

Fig. 3. Variation of diastolic blood pressure across time
DBP = diastolic blood pressure; error bars represent 95% confidence intervals.

improved physical condition: aerobic capacity, improved daily activities, improved quality of life and decreased medication dosage especially for the hypertension medication. Future studies should investigate further the role of exercise mode (e.g., aerobic versus resistance training) in women with similar characteristics as the patient in this case study.

Conclusion

In summary, the present case study showed that an adult woman with diabetes mellitus and hypertension benefited from a 5-month exercise program combining aerobic and resistance training in terms of blood glucose regulation, physical condition and quality of life.

Conflict of interest: Authors state no conflict of interest.

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