ROBSON BONOTO TEIXEIRA

AVALIAÇÃO DO ESTADO MENTAL DE PACIENTES COM HIPERTENSÃO E DIABETES ATENDIDOS PELO CENTRO HIPERDIA DE VIÇOSA APÓS PROGRAMA DE EXERCÍCIOS FÍSICOS SUPERVISIONADOS

Dissertação apresentada à Universidade Federal de Viçosa, como parte das exigências do Programa de Pós-Graduação em Educação Física, para obtenção do título de *Magister Scientiae.*

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Aos meus pais, irmãs, namorada e amigos que estavão sempre presentes durante todo esse período do mestrado. Especialmente aos meus professores Luciana Moreira Lima e João Carlos Bouzas Marins

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SUMÁRIO

LISTA DE ABREVIATURAS

ADA = AMERICAN DIABETES ASSOCIATION

AT = AEROBIC TRAINING

BAI = BECK ANXIETY INVENTORY

BDI = BECK DEPRESSION INVENTORY

BMI = BODY MASS INDEX

DM = DIABETES MELLITUS

DM2 = DIABETES MELLITUS TYPE 2

EPI = EFFORT PERCEPTION INDEX

ET = EXERCISE TESTING

HAS = HIPERTENSÃO ARTERIAL SISTÊMICA

HR = HEART RATE

MEEM = MINI EXAME DO ESTADO MENTAL

MHR = MAXIMUM HEART RATE

MMSE = MINI MENTAL STATE EXAMINATION

MTTS = MENTAL TEST AND TRAINING SYSTEM

PA = PRESSÃO ARTERIAL

PAD = PRESSÃO ARTERIAL DIASTÓLICA

SAH = SYSTEMIC ARTERIAL HYPERTENSION

PAS = PRESSÃO ARTERIAL SISTÓLICA

SD = STANDARD DEVIATION

SH = SYSTEMIC HYPERTENSION

SRQ-20 = SELF REPORTING QUESTIONNAIRE

SUS = UNIFIELD HEALTH SYSTEM

WHO = WORLD HEALTH ORGANIZATION

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RESUMO

TEIXEIRA, Robson Bonoto, M. Sc., Universidade Federal de Viçosa, Maio de 2016. **Avaliação do estado mental de pacientes com hipertensão e diabetes atendidos pelo Centro Hiperdia de Viçosa após programa de exercícios físicos supervisionados.** Orientador: Luciana Moreira Lima.

A hipertensão arterial sistêmica (HAS) e o diabetes *mellitus* (DM) são desordens muito comuns na atualidade, ocasionando disfunções físicas e também neuropsicológicas, como os transtornos depressivos, de ansiedade e o déficit cognitivo. Estudos relatam que a prevalência desses transtornos psicológicos são maiores em hipertensos e diabéticos do que na população em geral, e que hipertensos possuem risco de desenvolver demência vascular três vezes maior que indivíduos normotensos, aumentando para seis vezes quando a HAS está associada com o DM. Neste contexto, a prática de exercícios físicos vem sendo utilizada como instrumento fundamental para a atenuação de possíveis sintomas depressivos, ansiosos e déficit cognitivo que esses pacientes possam apresentar. O objetivo geral dessa dissertação foi verificar e analisar possíveis melhoras na saúde mental em pacientes atendidos no Centro Hiperdia de Viçosa, Minas Gerais, submetidos a um programa de exercícios físicos supervisionados composto por exercícios de características aeróbica e anaeróbica. A presente dissertação contempla três artigos distintos, sendo que os objetivos específicos foram: descrever o estado mental, quadros de declínio cognitivo, bem como quadros de depressão e ansiedade em pacientes hipertensos e diabéticos atendidos num centro de atenção secundária de uma cidade do interior de Minas Gerais, candidatos à participação em programa de treinamento físico; Analisar possíveis benefícios da prática regular de exercícios nos níveis de ansiedade, depressão e déficit cognitivo de diabéticos e hipertensos pertencentes a um programa de exercícios físicos supervisionados, além de avaliar e comparar os resultados entre programas de exercícios aeróbicos e resistidos; E verificar se a prática de exercício físico supervisionado, com duração de 12 semanas, é suficiente para impor modificações no estado cognitivo de pacientes diabéticos e hipertensos, através da utilização do *Mental Test and Training System* (MTTS). No primeiro estudo, avaliou-se 34 pacientes (23 mulheres e 11 homens), sendo 17 hipertensos (59 ±10

anos) e 17 diabéticos (54 ± 10 anos), onde foram aplicados os seguintes questionários: Mini Exame do Estado Mental (MEEM), Inventário de Beck para Depressão (BDI) e Ansiedade (BAI) e o Self Reporting Questionnaire (SRQ-20). Detectou-se que 82% dos hipertensos e 65% dos diabéticos apresentaram suspeição de transtorno mental, não havendo diferença entre os dois grupos (p=0,246). Já, 76% dos diabéticos e 65% dos hipertensos foram classificados com depressão de moderada a grave, enquanto que 64% dos hipertensos e 48% dos diabéticos demonstraram ansiedade de moderada a grave. Não foram encontrados quadros de déficit cognitivo. Foi evidenciada, assim, elevada porcentagem de quadros depressivos e de ansiedade na amostra estudada, reforçando a importância do diagnóstico pelo médico que o acompanha. No segundo estudo avaliou-se 17 pacientes, (55 ± 9 anos) sendo 9 hipertensos (de 57 ± 8 anos) e 8 diabéticos (53 ± 8 anos) que foram submetidos a um programa de exercícios físicos resistidos supervisionados, utizando o método circuito alternado por segmento e aeróbicos em esteira e bicicleta ergométrica, por 12 semanas, com frequência semanal de 3 dias e de intensidade moderada. Os mesmos questionários do trabalho anterior foram aplicados antes e após o período de intervenção. Observou-se queda de 61% (p=0,001) na pontuação alcançada pelo BDI, assim como queda de 53% (p=0,02) na pontuação do BAI após o período de 12 semanas de exercícios. Também registrou-se diminuição de 73% dos pacientes classificados com suspeição de transtorno mental. Não foram observadas melhoras nos níveis cognitivos através do MEEM após o período de intervenção, e não houve diferença entre os grupos de exercícios aeróbico e resistido. Foram demonstrados assim efeitos positivos nos quadros depressivos, ansiosos e de transtornos mentais não psicóticos em hipertensos e diabéticos, após um período de 12 semanas de realização de exercícios físicos supervisionados, independente da característica do exercício. O terceiro estudo foi realizado com 13 pacientes, (55 ± 12 anos) sendo 6 diabéticos (49 ± 13 anos) e 7 hipertensos, (60 ± 9 anos) onde aplicou-se testes que avaliam atenção e concentração, atenção seletiva e tempo de reação no equipamento MTTS antes e após o período de 12 semanas de realização de exercícios, por um grupo aeróbico e por outro resistido supervisionado. Os resultados demonstraram que houve melhoras significativas no teste de Atenção e Concentração, na variável “não reações incorretas” para hipertensos (p = 0,031) e diabéticos (p = 0,013), além da variável “reações corretas” (p = 0,013) e “reações

incorretas” (p = 0,028) para diabéticos. Não houve diferença entre os grupos que realizaram exercícios aeróbico e resistido. O desenvolvimento do estudo permitiu concluir que apesar da alta prevalência de quadros depressivos e ansiosos nos hipertensos e diabéticos que participaram desta pesquisa, o exercício físico foi capaz de minimizar esses transtornos psiquiátricos consideravelmente após um período 12 semanas de treinamento com modalidades de exercício de característica aeróbica e resistida. Neste contexto, o protocolo de exercício sugerido foi também eficaz na melhora dos níveis de atenção e concentração dos pacientes. Conclui-se que o exercício físico supervisionado pode ser utilizado como instrumento eficaz não apenas no tratamento das comorbidades cardiometabólicas presentes em hipertensos e diabéticos, mas também nas suas prevalentes comorbidades neuropsiquiátricas.

ABSTRACT

TEIXEIRA, Robson Bonoto, M. Sc., Universidade Federal de Viçosa, May, 2016. **Mental status evaluation of patients with hypertension and diabetes attended by Viçosa's Hiperdia center after program of supervised physical exercise.** Adviser: Luciana Moreira Lima.

Systemic arterial hypertension (SAH) and diabetes mellitus (DM) are very common disorders today, causing physical and psychological disorders such as depressive disorders, anxiety disorders and cognitive deficit. Studies have reported that the prevalence of these psychological disorders are higher in hypertensives and diabetics than in the general population, and hypertensive have at risk of developing vascular dementia three times higher than normotensive individuals, increasing to six times when SAH is associated with DM. In this context, the practice of physical exercise has been used as a fundamental tool for the mitigation of possible depressive and, anxiety symptoms and cognitive deficit that patients may present. The overall objective of this thesis was to investigate and to analyze possible improvements in mental health of patients seen in Viçosa Hiperdia Center, Minas Gerais, undergoing to a supervised physical exercise program that consists in aerobic and anaerobic characteristics exercises of aerobic and anaerobic exercise features. This thesis has three separate articles, and the aims were to describe the mental state, cadres of cognitive decline as well as cases of depression and anxiety in hypertensive and diabetic patients treated at a center of secondary attention of Minas Gerais' city, candidates to the participation in a physical training program; Examine possible benefits of practice regular exercise in the levels of anxiety, depression and cognitive impairment in diabetic and hypertensive patients belonging to a program of supervised physical exercise, beyond to evaluate and to compare the results between aerobic and resistance exercise programs; And check whether the practical of supervised physical exercise with duration 12 weeks it is sufficient to impose changes in cognitive status of diabetic and hypertensive patients through the use of the Mental Test and Training System (MTTS). In the first one study, we evaluated 34 patients, (23 women and 11 men) which 17 are hypertensive (59 ± 10 years) and 17 are and diabetic patients (54 ± 10 years), and the following questionnaires were applied: Mini Exam Mental State Examination (MMSE), Beck Depression Inventory

(BDI) and Anxiety (BAI) and the Self Reporting Questionnaire (SRQ-20). It was found that 82% of hypertensives and 65% of diabetics showed mental disorder suspicion, with no difference between the two groups (p = 0.246). Already, 76% of diabetics and 65% of hypertensive patients were classified with moderate to severe depression, while 64% of hypertensive and 48% of diabetic patient showed moderate to severe anxiety. Not being found cognitive deficit frames. Showing thus high percentage of depressive disorders and anxiety in the sample studied, reinforcing the importance of psychiatric care. In the second study we evaluated 17 patients (55 ± 9 years), which 9 hypertensives (57 ± 8 years) and 8 diabetics (53 ± 8 years) who underwent a program of resisrence physical exercise using the alternate circuit method by segment and aerobic exercise supervised on the treadmill and ergometer for 12 weeks, with weekly frequency of 3 days and moderate intensity. The same questionnaires from the previous work were applied before and after the intervention period. There was a reduction of 61% (p = 0.001) scores achieved by the BDI, as well as decrease of 53% (p = 0.02) in the BAI score after 12 weeks of exercise. Also it was recorded a decrease of 73% of patients classified with a mental disorder suspicion. There were no improvements in cognitive levels through the MMSE after the intervention period, and there was no difference between groups of aerobic and resistance exercises. Demonstrating positive effects on depressive disorders, anxiety and nonpsychotic mental disorders in hypertensive and diabetic, after a 12-week period conducting supervised exercise, regardless of the exercises characteristics. The third study was conducted with 13 patients, (55 ± 12years) 6 diabetics (49 ± 13 years) and 7 hypertensive (60 ± 9 years) applying tests that assess attention and concentration, selective attention and reaction time in MTTS equipment before and after 12 weeks conducting exercises for an aerobic group and a supervised resistance group. The results showed that there were significant improvements in attention and concentration tests in the variable "no reation incorrect" to hypertensive subjects (p = 0.031) and diabetic patients (p = 0.013), and the variable "correct" reactions (p = 0.013) and " incorrect reactions "(p = 0.028) for diabetics. There was no difference between the groups who performed aerobic and resistance exercises. The development of the study concluded that despite the high prevalence of depressive and anxiety tables in hypertensives and diabetics who participated in this study, physical exercise was able to minimize these psychiatric disorders considerably after

a period of 12 weeks training with modalities of aerobic and resistance exercises. In this context the suggested exercises protocol was also effective in improving the levels of attention and concentration of the patients, even if not diagnosed by MMSE questionnaire or a type of cognitive impairment. Thereby demonstrating that supervised exercise can be used as an effective tool not only in the treatment of cardiometabolic comorbidities in hypertensives and diabetics but also on their mental health.

1- INTRODUÇÃO GERAL

A hipertensão arterial sistêmica (HAS) e o diabetes *mellitus* (DM) desordens clínicas mais comuns da atualidade. A HAS é constituída como uma condição multifatorial caracterizada por níveis elevados (≥140/90 mmHg) e sustentados de pressão arterial (PA) (SBC, 2010). Apesar de significativos avanços tecnológicos e farmacológicos estejam ocorrendo, principalmente nos últimos 50 anos, a HAS continua sendo a principal causa de morte no Brasil e um dos principais problemas de saúde pública no mundo. No Brasil, estudos populacionais elaborados nos últimos 15 anos demonstraram baixos níveis de controle da PA na faixa de 19,6% (ACSM 2004; SBC, 2010). É encontrada também no DM uma grande epidemia de caráter global ameaçando a população no século XXI, apresentando-se como problema de saúde pública tanto em países desenvolvidos como nos países em desenvolvimento. (CHENG et al., 2013). Estima-se que mais de 382 milhões de pessoas são afetadas pelo DM em todo o mundo, com previsão de aumento para 592 milhões de pessoas no ano de 2035, onde dois terços destas pessoas estão nos países em desenvolvimento (IDF, 2013; LORBER, 2014, SBD, 2014). Estima-se que 5,2% das mortes em todo o mundo estão relacionadas ao DM, o que faz com que essa doença seja a quinta principal causa de morte no mundo (SBD, 2014).

Além de todos os problemas de ordem física já conhecidos que acometem os portadores de HAS e DM, existem evidências que níveis elevados de pressão arterial sistólica (PAS) e diastólica (PAD) estão relacionados com o declínio da capacidade cognitiva, tanto em jovens quanto em idosos, sendo que adultos jovens com níveis pressóricos muito elevados possuem maiores riscos de desenvolvimento de demência na terceira idade (NINOMIYA et al., 2011). Corroborando a isto, a perda de memória é um dos déficits cognitivos mais relatados entre os diabéticos, causando comportamentos que afetam o controle da doença, interferindo no auto-cuidado durante o tratamento e favorecendo a permanência do estado de hiperglicemia (PALTA et al., 2014). Além disso, a prevalência de transtornos neuropsicológicos como a ansiedade, depressão e déficit cognitivo são maiores nos portadores de HAS e DM do que na população em geral (KOMSUOGLU CELIKYURT et al., 2014).

O DM pode levar a transtornos mentais relacionados a várias alterações no sistema nervoso central, como: a doença microvascular cerebral, efeitos da

hiperglicemia nos circuitos e redes neurais, o hiperrinsulinismo, o déficit funcional da insulina no cérebro, o maior stress oxidativo e a dislipidemia característica do DM. Além disso, doenças cardiovasculares, insuficiência renal, obesidade, síndrome metabólica e sedentarismo, podem contribuir para transtornos mentais nesses pacientes (STRACHAN, 2011).

Já a associação entre a HAS e ansiedade e depressão, apesar de não estar clara na literatura, é corroborada pelo encontro de emaranhados neurofibrilares e atrofia cerebral em autópsias de portadores desta condição clínica, a qual também pode ser responsável por uma maior produção de radicais livres ligados aos mecanismos de dano cerebrovascular (REITZ et al., 2007). Com isso, a prática regular de atividades físicas vem sendo apontada, como um instrumento fundamental para o tratamento da HAS e DM (NAITO; KASAI, 2015; RIBEIRO; COSTA; MESQUITA-BASTOS, 2015).

Benefícios como melhor controle glicêmico e cardiorrespiratório e diminuição da pressão arterial de forma aguda e crônica (EICHER et al., 2010; HORDERN et al., 2011; JIA et al., 2014), vem sendo relacionado a pessoas com um estilo de vida ativo, melhorando os índices de saúde desses pacientes. Entretanto, além dos benefícios físicos e cardiometabólicos, a prática de exercícios físicos pode resultar na diminuição de sintomas depressivos e ansiosos (LEBLANC; DESJARDINS; DESGAGNÉ, 2015), e ainda influenciar nas funções cognitivas, pelo aumento da oxigenação cerebral por um maior fluxo e perfusão sanguínea, o que interfere na cognição, independente da idade (DUPUY et al., 2015). Ou, além disso, pela liberação de neurotransmissores que ativam áreas específicas do cérebro atuando no estado de humor (MATTA et al., 2013). O exercício físico pode trazer benefícios comparáveis a medicamentos anti-depressivos ou potencializar sua ação (HOFFMAN et al., 2011), além de ser um tratamento eficaz na redução da ansiedade (HERRING; O'CONNOR; DISHMAN, 2010), apesar de alguns estudos terem encontrado resultados contraditórios aos efeitos ansiolíticos do exercício em modelo animal (FUSS; GASS, 2010). Também não está claro na literatura qual tipo de exercício promove melhores benefícios para diabéticos, havendo ainda controvérsias sobre esses temas.

Em relação à cognição desses pacientes, fortes evidências demonstram que níveis elevados de pressão arterial se relacionam ao declínio cognitivo tanto em indivíduos mais jovens quanto em idosos, assim como o estado hiperglicêmico

acarretado pelo DM pode conduzir a déficits cognitivos induzindo a doenças macro e microvasculares no cérebro (NINOMIYA et al., 2011; QIU et al., 2014). Estudos relatam que hipertensos apresentam risco de desenvolver demência vascular três vezes maiores que indivíduos normotensos. Sendo que essa proporção aumenta para seis vezes quando a presença de HAS está associada ao DM (POSNER et al., 2002).

Reconhecida a importância dos aspectos mentais para o tratamento da HAS e DM, o Mental Test and Training System (MTTS) surge como uma ferramenta de avaliação mental, muito utilizado no esporte de alto rendimento, mas pouco utilizado em patologias clínicas associadas ao risco de aumento do declínio cognitivo. Assim, a prática regular de exercícios físicos também pode influenciar positivamente nas funções cognitivas de hipertensos e diabéticos, pelo aumento da oxigenação cerebral de um maior fluxo e perfusão sanguínea, o que influencia na cognição, independente da idade (DUPUY et al., 2015). Apesar destas evidências, poucos trabalhos e ainda discordantes quanto à intensidade, duração e tipo de exercício avaliam o emprego da atividade física como estratégia minimizadora do declínio cognitivo em pacientes diabéticos e hipertensos (HOFFMAN et al., 2011), gerando assim um importante campo de estudo.

Com isso, o oferecimento de programas de exercícios físicos supervisionados a pacientes hipertensos e diabéticos pode ser de fundamental importância para o estabelecimento da saúde física e neuropsicológica dessas pessoas.

1.1 Referências

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1.2. Objetivos

1.2.1 Geral

Essa dissertação foi proposta com o objetivo principal de verificar e analisar possíveis melhoras na saúde mental em pacientes do Centro Hiperdia de Viçosa, Minas Gerais, submetidos a um programa de exercícios físicos supervisionados composto por exercícios físicos de características aeróbica e anaeróbica.

1.2.2. Específicos

Descrever o estado mental, quadros de declínio cognitivo, bem como quadros de depressão e ansiedade em pacientes hipertensos e diabéticos atendidos num centro de atenção secundária de uma cidade do interior de Minas Gerais, candidatos à participação em programa de treinamento físico.

Analisar possíveis benefícios da prática regular de exercícios físicos nos níveis de ansiedade, depressão e déficit cognitivo de diabéticos e hipertensos pertencentes a um programa de exercícios físicos supervisionados, além de avaliar e comparar os resultados entre programas de exercícios aeróbicos e resistidos.

Verificar se a prática de exercício físico supervisionado com duração de 12 semanas é suficiente para impor modificações no estado cognitivo de pacientes diabéticos e hipertensos, através da utilização do *Mental Test and Training System* (MTTS).

ORIGINAL ARTICLE

Psychological and Cognitive Profile of Hypertensive and Diabetic Patients

Abstract

Chronic disorders such as hypertension and diabetes mellitus are often associated with depressive and anxiety symptoms, as well as cognitive de- cline. Once developed, psychological support is essential for improving the qual- ity of life. This study is aimed at identifying impaired mental health in connection with these systemic metabolic disorders. A total of 34 patients were included in this cross-sectional study: 17 hypertensive individuals with a mean age of 59 ± 10 years, and 17 diabetic patients aged 54 ± 10 years. The following psychomet- ric tests were used: Mini-Mental State Examination (MMSE), Beck Depression

Inventory, Beck Anxiety Inventory, and self-reporting questionnaire (SRQ-20). A large number of patients with high blood pressure or diabetes was associated with mental health problems (82% or 65%, respectively; $p = 0.246$). Affective disorder, especially moderate to severe depression, was seen mainly in diabetic patients (76%), whereas hypertensive individuals had higher prevalence of anxi- ety (64%). There was no cognitive impairment in this middle-aged population. This study shows a high proportion of depression and anxiety symptoms in pa- tients with hypertension or diabetes mellitus, reinforcing the importance of psy- chiatric support for appropriate control of these metabolic disorders.

Key Words: Anxiety, cognitive function, depression, diabetes, hypertension, mental health.

Introduction

There is evidence that high levels of systolic blood pressure and di- astolic blood pressure are significantly related to cognitive decline, both in younger people as well as the elderly, and young adults with very high blood pressure have increased risks of dementia in old age (Ninomiya et al., 2011).

The association between systemic hypertension (SH), anxiety, and depression is not yet fully established in literature. However, neuro- fibrillary tangles and brain atrophy have been evidenced in autopsy of patients with this clinical condition, which can also be responsible for increased production of free radicals linked to the mechanisms of cere- brovascular damage (Reitz et al., 2007).

Hypertensive individuals are at risk of developing vascular de- mentia 3 times higher than the normotensive ones, and this proportion increases to 6 times with the presence of SH associated with diabetes mellitus (DM) (Posner et al., 2002). In diabetic patients, prevalence of anxiety and depression is greater than in the general population (Komsuoglu Celikyurt et al., 2014). Innumerable changes related to DM can lead to mental disorders, including cerebral microvascular dis- ease, the effects of hyperglycemia on the circuits and neural networks, hyperinsulinism, functional deficit of insulin in the brain, increased ox- idative stress, and the characteristic DM dyslipidemia. The presence of cardiovascular disease, kidney failure, obesity, metabolic syndrome, and sedentary lifestyle can also contribute to mental disorders in dia- betic patients (Strachan, 2011).

Memory loss is one of the most frequently reported cognitive deficits in diabetic patients, causing inappropriate behavior (Palta et al., 2014), which can interfere with self-care during treatment and promote the permanence of hyperglycemia. The hyperglycemic state can cause cognitive deficits leading to macrovascular and microvascu- lar diseases in the brain, such as stroke and white matter lesions, asso- ciated with neurodegeneration markers, leading to atrophy of the medial lobe. Additionally, follow-up studies have shown that DM is as- sociated with accelerated development of cerebral atrophy (Qiu et al., 2014). On the other

hand, anxiety and depression may also contribute to weight gain (De Wit et al., 2010) and SH and/or DM development, which is one more reason for the counseling of hypertensive and diabetic patients.

This study aimed to describe the mental, cognitive decline as well as depression and anxiety states in hypertensive and diabetic pa- tients treated at a center of secondary care of a city in Minas Gerais, candidates for participation in physical training program.

METHODS

Study Design

This is a descriptive, cross-sectional study developed as part of the "Global assessment of cardiovascular risk and mental status of patients assisted by Viçosa Hiperdia Center after exercise program," a partnership between the Federal University of Viçosa with the Hiperdia Minas Program. The study was fully performed on the pre- mises of Hiperdia Center in Viçosa, MG. The study was approved by the Ethics in Research Committee of the Federal University of Viçosa and registered in Brazil Platform with number 33979214.3.0000.5153 protocol number 832.149/2014.

Sample

The study included a total of 34 patients, 17 patients with type 2 DM and 17 patients with resistant SH, characterized by high blood pressure that remains above the levels considered ideal, despite the concomitant use of 3 different classes of antihypertensive drugs, one needing to be diuretic in their correct dosages (Daugherty et al., 2012).

All volunteers were eligible to participate in the supervised exer- cise program Hiperdia Center in Viçosa, MG, for the registration and monitoring of hypertensive and/or diabetic patients assisted by the Unified Health System that meet the SES Resolution no. 2606 of December 7, 2010, which set out the guiding criteria for

Integrated Ref- erence Centers Viva Vida and Hiperdia Minas. The following exclusion criteria were considered: nonparticipation in the supervised exercise program Hiperdia Center in Viçosa, MG; type 1 diabetic patients, peripheral arterial disease patients, illicit drug users, congestive heart failure, and pulmonary disease decompensated and symptomatic cardiac arrhythmia.

Data Collection

The evaluation of the mental state of the participants was performed by a psychiatrist with the following instruments: Mini-Mental State Examination (MMSE) (Folstein et al., 1975), the Beck Depression Inventory (BDI) (Aksoy et al., 2015), the Beck Anxiety Inventory (BAI) (Ay et al., 2014), and a self-reporting questionnaire (SRQ-20) (Giang et al., 2006). The researcher guided the patient to take into account the last week and the day that the psychiatric evaluation was performed.

The MMSE is composed of questions measuring functions such as temporal and spatial orientation, attention and calculation, recall or memory, and language. A minimum score of 20 points was considered for illiterate patients, 25 points for patients with 1 to 4 years of school- ing; 26.5 points for 5 to 8 years, 28 points for 9 to 11 years, and 29 points for more than 11 years of schooling (Bertolucci et al., 1994; Brucki et al., 2003).

The BDI is a psychometric questionnaire of self-evaluation. The scale consists of 21 items including attitudes and symptoms with inten- sity ranging from zero to 3 and are intended to identify the presence of depressive indicators, considering various categories of symptoms such as: mood (sadness, loss of interest, crying, and mood fluctuation), vegetative or somatic (loss of weight, loss of appetite, sleep, and fa- tigue), cognitive (guilt, hopelessness, and suicidal thoughts), social (so- cial withdrawal and inhibition), and physical symptoms (inhibition and agitation) (Beck et al., 1988). The participants who scored zero to 9 points were considered minimal depression; 10 to 16, mild depres- sion; 17 to 29, moderate; and 30 to 63, severe (Aksoy et al., 2015).

The Beck Anxiety Inventory was used to assess the severity of symptoms of

anxiety using a symptom scale organized in 21 items, ranging from nothing, slightly, moderately, and severely, shown in anx- iety symptoms such as nervousness and tremors; and questions about palpitations, fear, feeling of suffocation and fainting, heat, numbness, and others. We considered zero to 7 points minimal anxiety; 8 to 15, mild anxiety; 16 to 25, moderate; and 26 to 63, severe (Ay et al., 2014).

The SRQ-20 was used for tracking nonpsychotic mental disorders in the evaluation of mental suffering. The instrument consists of 20 questions, and the answers are binary (yes/no); the final score was obtained by adding the positive responses made in the test. Obtaining up to 6 positive responses led to no suspicion of mental disorder, and above 7 positive responses led to a mental disorder suspicion in relation to the last 30 days lived by the patient (Tajfard et al., 2014).

Table 1 - Characteristics of the sample of hypertensive diabetics assisted by Hiperdia in Viçosa, MG.

	Total (n=34)	**Hypertensive (n=17)**	**Diabetics (n=17)**	***P***
Age (years)	56 ± 10	59 ± 10	54 ± 10	0.434[ǂ]
Men/Women	11/23	4/13	7/10	---
BMI				
Underweight	0	0	0	---
Ideal weight	4 (12%)	1 (6%)	3 (18%)	0.601[ǂǂ]
Overweight	11 (33%)	7 (41%)	4 (24%)	0.464[ǂǂ]
Obesity	19 (56%)	9 (53%)	10 (59%)	0.999[ǂǂǂ]
Education (years)				
Illiterate	12 (35%)	6 (35%)	6 (35%)	0.999[ǂǂǂ]
0 - 3	9 (26%)	5 (29%)	4 (24%)	0.998[ǂǂ]
4 - 8	10 (29%)	5 (29%)	5 (29%)	0.999[ǂǂǂ]
8 or more	3 (9%)	1 (6%)	2 (12%)	0.999[ǂǂ]

n = sample size, BMI = body mass index, p = probability for the hypothesis tests. ([ǂ]) Student t test, data presented as mean ± standard deviation. ([ǂǂ])Fisher Exact Test, data presented as number of participants and percentage. ([ǂǂǂ])Chi-square test, data presented as number of participants and percentage.

Table 2: Mini Mental State Examination, Beck Depression Inventory and Beck Anxiety Inventory in the hypertensive and diabetic groups.

	Total n=34	**Hypertensive n=17**	**Diabetics n=17**	***p***
MMSE (points)	24 ± 6	24 ± 3	25 ± 3	0.506
Beck Depression Inventory (points)	24 ± 12	24 ± 13	23 ± 12	0.770
Beck Anxiety Inventory (points)	21 ± 14	21 ± 13	19 ± 13	0.627

n= sample size, MMSE = Mini Mental State Examination, p = probability for the hypothesis tests. (†) Student t test, data presented as mean ± standard deviation.

StatisticalAnalysis

The minimum size of the sample was defined using the coeffi- cient of variation obtained in this study (25%), considering 15% of var- iation around the average, with a minimum number of 11 individuals each group. It was possible to verify statistical differences with a 5% level of significance. Initially, we used the descriptive statistics of the sample, obtaining the means and SDs. The Shapiro-Wilk normality test was used. Given that the data showed a normal behavior, a descriptive statistic was used to characterize the sample besides the independent *t* test for observing significance between the groups of hypertensive and diabetic patients, in addition to using the *t* test of a sample to measure the probability of the average score on the MMSE concerning the stipulated amount for that population. In addition, we used the χ^2 and the Fisher exact tests to test possible differences in anxiety and depres- sion between the 2 groups. Pearson and Spearman correlation tests were used to verify the correlations between variables. We also promoted the percentage distribution between the response rates of depression and anxiety prevalence among hypertensive and diabetic patients. The significance level for the tests was 5%. The data were analyzed using the SPSS statistics 20 software.

RESULTS

Characteristics of the studied sample is delineated in Table 1. Of the 34 patients evaluated, there was a higher prevalence of women (68%) compared to male members. There were no significant diff- erences between the groups for age, education, or for body mass index (BMI).

The values obtained with the MMSE showed that hypertensive and diabetic patients had a score consistent with the average education of the 2 groups (3 years), which is 25 points, so the population studied showed no cognitive decline considering the data obtained with the MMSE. There was also no difference in the scores achieved by the participants older than 60 years old (n = 13), where an average of 24 points has been reached.

Table 2 presents the mean and SD values obtained for each group according to the score of each questionnaire used. Significant differences in the scores of questionnaires were not observed.

Table 3: Degrees of depression and anxiety in hypertensive and diabetic groups.

Classification	Total (n=34)	Hypertensive (n=17)	Diabetics (n=17)	*p*
Minimum Depression	4 (12%)	2 (12%)	2 (12%)	0.999[ǂ]
Mild Depression	6 (18%)	4 (24%)	2 (12%)	0.656[ǂ]
Moderate Depression	12 (35%)	5 (29%)	7 (41%)	0.720[#]
SevereDepression	12 (35%)	6 (35%)	6 (35%)	0.999[#]
Minimum Anxiety	4 (11%)	2 (12%)	2 (12%)	0.999[ǂ]
Mild Anxiety	11 (32%)	4 (24%)	7 (41%)	0.464[ǂ]
ModerateAnxiety	10 (29%)	6 (35%)	4 (24%)	0.707[ǂ]
SevereAnxiety	9 (26%)	5 (29%)	4 (24%)	0.893[ǂ]

n= sample size, ([ǂ]) Chi-square, data presented as number of participants and percentage; ([#])Fisher Exact Test, data presented as number of participants and percentage.

The values observed in the BDI showed a prevalence of moderate depression for both the hypertensive group and for the diabetic group, with no significant differences between them. The scores ranged from 1 to 47 points, with 35% of the

sample having severe depression according to the questionnaire and the modal value of 20 points. The most frequently reported data were complete loss of interest in sex and the report of waking up several hours earlier than accustomed and not going back to sleep. The same applies to the BAI, where the 2 groups were classified with a predominance of mild anxiety, which is the interval from 16 to 25 points, also with no significant difference. The scores ranged from 1 to 55 points, where 26% had severe anxiety; the modal value was 13 points. The most frequently reported scores were high degree of nervousness and fear of losing control. Table 3 shows the number of participants and their respective percentages ac- cording to the classification of depression and anxiety degrees, in total values and for each group.

According to the SRQ-20 questionnaire, approximately 74% of the participants were classified as having a mental illness suspicion. Of the hypertensive group, 82.3% had a mental disorder suspicion, whereas 64.7% of diabetic patients also had this suspicion, with no sig- nificant difference between the groups ($p = 0.246$).

Positive and significant correlations were observed between the scores obtained with the BDI and BAI ($r = 0.86$; $p < 0.001$), between BDI and SRQ-20 ($r = 0.65$; $p < 0.001$) and between SRQ-20 and BAI ($r = 0.61$; $p < 0.001$). There were no significant correlations be- tween these parameters and age or BMI.

DISCUSSION

The main finding of this study was the moderate level of depression and anxiety in patients with SH and/or type 2 DM, besides a high number of patients, particularly hypertensive, with likely positive screening for a nonpsychotic mental disorder.

With regard to depression and anxiety found in the participants, it becomes difficult to infer if the presence of SH and/or diabetes may lead to this mental illness, or if the development of this condition during the life has worsened the development of these clinical conditions, that is, because individuals with anxiogenic and depressive feelings are more likely to have a less healthy lifestyle (Tajfard et al., 2014). This fact can lead to carelessness with food and physical activity, being more likely to develop cardiovascular disease and diabetes. Kretchy et al. (2014) noted

that 57% of hypertensive patients had some degree of anxiety when 400 hypertensive patients were studied, aged 18 to 70 years, 149 men and 251 women, 41.5% being elderly. In this study, when hypertensive patients classified with moderate to severe anxiety were grouped, this number corresponded to 55% of the participants. With regard to depression, in the study of Kretchy et al. (2014), only 4% had the disorder, in contrast to the study presented here that adding patients classified with moderate and severe depression was observed, totaling to 70% of the sample.

One of the main harmful effects of depressive events is the intervention on medical treatment for control of the presented clinical conditions, thereby decreasing the effectiveness of the treatment, the monitoring of these patients in a mental health service (KrouselWood and Frohlich, 2010) being extremely important. Serafini et al (2010), studying 240 patients with congestive heart failure and hyper- tension, with a mean age of 60 years, found that only 0.01% of the participants had psychiatric treatment. For that reason, physicians often do not detect mental disorders that may be influencing the disease.

Psychiatric evaluation is extremely important for these patients, and all the attention should be given to target the improvement of quality of life and control of the psychiatric disorder, for potential improvement and compliance to the treatment. Psychiatrists and physicians from other specialties should be encouraged to work together to approach and manage complex and chronic diseases such as hypertension (Serafini et al., 2010).

We noted that 76% of the diabetic participants were classified with moderate to severe depression. It is worth considering that the diabetic patient who has depression may have great difficulty performing glycemic control. Improper DM treatment can intensify the symptoms of depression. Nouwen et al (2010), in their meta-analysis of 11 studies, found that type 2 diabetes patients are 24% more likely to develop depression than those who do not have the disease. Another meta-analysis performed by Knol et al (2006), which included 9 studies, showed that individuals with depressive symptoms were 37% more likely to develop DM than individuals without these symptoms.

Regarding anxiety in diabetics, there was a high rate of moderate and severe anxiety in this study. Adding these 2 categories, we have 55% of the studied population with anxiety levels that require care. There is a lot of controversy among studies. Gois et al (2012) found no relationship between anxiety symptoms

and glycemic control in a sample of 273 patients with type 2 diabetes. Hall et al (2009) observed that the anxious behavior was associated with a diagnosis of prediabetes in a sample of 204 patients with type 2 DM. During anxiety events, the body experiences a state of stress with increased cortisol levels, resulting in hyperglycemic effects, thus inducing a lower glycemic control by the diabetic patient.

Considering evidences that show a high level of anxiety among diabetic patients, it becomes possible to recommend daily physical activities that provide relaxation, as well as options such as yoga or meditation. Recreational activities can also be very interesting such as dance. Some studies showed that regular physical activity can be extremely beneficial in controlling anxiety (Hur et al., 2014; Kim et al., 2013; Yoshihara et al., 2014).

In relation to the obtained data found using the MMSE, cognitive impairment was not observed in the studied participants. This instrument was chosen for its high validity, reliability, and easy application and is recommended for use in the elderly despite being increasingly used in adults. Jabourian et al. (2014) used the MMSE in a population of 266 healthy adults ranging from 18 to 65 years, where he observed lower cognitive scores in individuals older than 50 years, unlike the study of Singh-Manoux et al (2014), which used the same questionnaire in individuals aged 35 to 55 years, where no association between age and cognitive deficit was observed but other factors were observed, such as high levels of IL-6 cytokine. In the present study, there was no difference in the scores achieved on the MMSE between the elderly and adults. The same level of education presented between them could, in part, explain these findings. When hypertension and diabetes are associated in the same person, it increases the risk of cognitive loss by 6 times (Posner et al., 2002). Although 70.5% of the diabetics have hypertension in the studied sample, a lower MMSE score was not found when compared with those who had only hypertension or diabetes.

Considering the nonpsychotic mental disorder evaluated by the SRQ-20, a high rate of patients at risk for mental distress, especially with hypertension, was observed. One explanation for this may be the association of noncommunicable diseases with mental suffering, such as the findings in patients with pulmonary arterial hypertension and thromboembolic pulmonary hypertension in the study of Harzheim et al (2013), where mental disorders were observed in 22.8% of their 172

patients with a mean age of 56 years.

Furthermore, these disorders are also associated with polypharmacy (Coelho et al., 2009). After some years of intensive treatment with various medicines, changes in mood may occur. It is necessary to emphasize that all participants in the hypertensive group were taking 3 or more antihypertensive drugs per day. Unlike the BDI and the BAI, the SRQ-20 seeks to identify, more broadly, mental suffering that can be related to other mental disorders, not only depression and anxiety.

Because it is a questionnaire with ample capacity for screening of mental disorders, the SRQ-20 proposes compliance with a screening of depressive and anxiety symptoms, as well as the BAI and BDI, and other mental disorders, as this may be the explanation for the positive correlation between these 3 instruments shown in this study.

Another fact that deserves attention in this study is the high rates of obesity presented by volunteers (Table 1), which may have contributed to the findings related to depression and anxiety. Obesity associated with SH and DM can further maximize the depression and anxiety symptoms, which are already often present in these diseases. Several studies have indicated an association between obesity and depressive/anxiety symptoms (Guedes et al., 2013), and even a reduction of these disorders after surgery for weight reduction (Zwaan et al., 2011). However, further studies are needed for the actual verification of the importance of obesity in mental status of this population, since this study was unable to identify a significant correlation between BMI and the scores observed for anxiety and depression.

The high prevalence of obesity in this evaluated group reinforces the importance of educational activities, such as providing places for supervised safe exercises for this group. Exercise can promote significant changes in already debilitated health along with a balanced diet, helping to reduce the consumption of medications and improve quality of life (American College of Sports Medicine, 2013).

Study Limitations

Since it is a transversal study, there was no follow-up appointment with the patients. Therefore, it was unclear whether the displayed mental state was only transitory or actually part of the sample. There was also the use of tracking instruments only, which cannot serve as a definitive diagnosis. In addition, as one of

the inclusion criteria for this study was the following participation in the exercise program of the Hiperdia Center, this fact led to a limited sample size, since not all diabetic and hypertensive patients assisted at the Center can perform the exercises, only those that are recommended by the physician after a rigorous evaluation.

CONCLUSION

This study showed a high percentage of depression and anxiety state in patients with resistant SH or type 2 DM, with higher rates in hypertensive patients. The prevalence of depression and anxiety observed is considered high and may lead to a compromise in compliance and maintaining good control of the underlying disease, an assumption also reinforced by mental suffering suspicion observed in most participants. However, cognitive impairment among participants was not found, taking into account the presented education. These symptoms should be carefully studied and evaluated, to show evidence to the importance of psychiatric and psychological treatments in patients with SH and type 2 DM for an effective treatment of these diseases, consequently improving the quality of life of hypertensive and diabetic patients.

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DISCLOSURE

The authors declare no conflict of interest.

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Original Article

Improved cognitive, affective and anxiety measures in patients with chronic systemic disorders following structured physical activity

Abstract

Mental illnesses are frequent co-morbid conditions in chronic systemic diseases. High incidences of depression, anxiety and cognitive impairment complicate cardiovascular and metabolic disorders such as hypertension and diabetes mellitus. Lifestyle changes including regular exercise have been advocated to reduce blood pressure and improve glycaemic control. The purpose of this project was to evaluate the effect of physical training on the most prevalent corollary psychiatric problems in patients with chronic organic ailments. This longitudinal study assessed the mental health of hypertensive (age: 57 ± 8 years) and/or diabetic (age: 53 ± 8 years) patients using mini- mental state examination, Beck's depression inventory, Beck's anxiety inventory and self-reporting questionnaire-20 before and after a 3-month supervised resistance and aerobic exercise programme comprising structured physical activity three times a week. Clinically relevant improvement was observed in the Beck's depression inventory and Beck's anxiety inventory scores following the 12-week training (61%, $p = 0.001$, and 53%, $p = 0.02$, respectively). Even though statistically not significant ($p = 0.398$), the cognitive performance of this relatively young patient population also benefited from the programme. These results demonstrate positive effects of active lifestyle on non-psychotic mental disorders in patients with chronic systemic diseases, recommending exercise as an alternative treatment option.

Keywords

Anxiety, chronic disease, cognitive dysfunction, depression, diabetes mellitus, hypertension, mental health, physical exercise

Introduction

Regular physical activity has been considered as one of the mainstream in treating systemic arterial hypertension (SAH) and diabetes mellitus (DM).[1,2] Benefits such as better glycaemic and cardiorespiratory control,[3] increased insulin sensitivity,[4] improved lipid profile[5] and weight loss are well characterized.[6] Acute[7] and chronic[8] blood pressure lowering has also been linked to an active lifestyle.

In addition to physical and cardio-metabolic benefits, regular physical exercise can result in decreased depression and anxiety symptoms,[9] which may influence cognitive functions, probably by increased brain oxygenation due to a greater blood flow and perfusion, which directly influences cognition, regardless of age.[10]

The prevalence of mental disorders such as anxiety and depression is greater in patients with DM compared with the general population.[11] Regular exercise plays an important role in controlling these disorders, and it can reduce levels of depression and anxiety by releasing neurotransmitters that activate specific cortical areas of the brain, acting in the mood.[12] However, it remains unclear in the literature which exercise type promotes a greater benefit to diabetics. Regarding patients with SAH, exercises can bring comparable benefits to anti-depressants, or even enhance their action,[13] as well as being an effective and practical treatment in reducing anxiety,[14] although some studies have found the results contradictory to the anxiolytic effects of exercise in animal models.[15] Thus, there is still controversy on the subject.

Hypertensive individuals are at risk of developing vascular dementia three times greater than normotensive individuals. This proportion increases to six times when the presence of SAH is associated with DM.[16] There are different models of exercise prescription. The most common ones are activities with aerobic characteristics, such as walking or running,[17] with interesting results about the effect on mental health in the diabetic population. However, the prescription of anaerobic activities is possible, such as resistance training (RT), which implies a completely different metabolic action than aerobic exercise. The results showing

an association between an active lifestyle and mental disorder control are still scarce, as well as the effects of aerobic and resistance exercises in this population.

It is important to check the extent of the impact of the physical activity inclusion and compare if the exercise type prescribed in a systematic manner (aerobic or RT) has different impact amplitudes on mental health. This may guide the best way to prescribe exercises for this population. Thus, the objective of this study was to assess possible benefits of regular physical exercise on levels of anxiety, depression and cognitive impairment in diabetic and hypertensive patients belonging to a programme of supervised physical exercise, besides evaluating and com- paring the results between programmes of aerobic and resistance exercises.

Material and methods

Study design

A descriptive, longitudinal type study, developed as part of the project 'Global assessment of cardiovascular risk and mental state of patients assisted by the Viçosa Hiperdia Center after physical exercise program', a partnership of the Federal University of Viçosa with Hiperdia Minas Program.

The study was conducted entirely at the premises of Hiperdia Center of the city of Viçosa, MG, consisting of a secondary health centre which has as a function the treatment of diabetics with glycosylated haemoglobin greater than or equal to 9% and patients with resistant hypertension. The study was approved by the Ethics in Research Committee of the Federal University of Viçosa, registered in Brazil Platform no. 33979214.3.0000.5153 protocol no. 832.149/2014.

Sample

Patient recruitment was done through analysis of medical records, where type 2 diabetic patients and resistant hypertension were selected. A phone call was made to these selected patients, where all the research procedures were clarified. If the subject agreed to participate, a first meeting in Hiperdia Center was scheduled for further information on the study procedures. The study began with a total of 21 patients, but 4 volunteers abandoned the research during the exercise routine for various reasons: financial difficulties to travel to Hiperdia, surgeries (umbilical hernia and cataract) and a cardiac ischaemia event. So the research ended with a sample of 17 patients, 8 patients with diabetes type 2 (DM2) and 9 resistant

hypertensives (SAH), characterized by blood pressure that remains above the levels considered ideal, despite the concomitant use of three different classes of antihypertensive medications, one being necessarily diuretic.[18] All volunteers were participants in the supervised physical exercise programme of the Hiperdia Center in Viçosa, MG, for the registration and monitoring of resistant hypertensive and/or diabetic patients assisted by the Unified Health System (SUS) that meet Resolution SES no. 2.606 of 7 December 2010 which establishes the referral criteria for the Integrated Reference Centers Viva Vida and Hiperdia Minas.

As inclusion criteria, patients with DM2 and SAH, of both genders, over 18 years old, who do not practice routine and/or systematized exercise, were considered. The adopted exclusion criteria were as follows: type 1 diabetics, patients with peripheral artery disease, illicit drug users, congestive heart failure, decompensated pulmonary disease, symptomatic cardiac arrhythmia, orthopaedic or rheumatologic diseases that prevented the realization of the proposed exercises, symptomatic peripheral artery dis- ease to exercise, acute cardiac ischaemia signs during exercise testing (ET) and symptomatic cardiac arrhythmia caused by ET. Also, individuals in use of anti-depressants or antianxiety medications were excluded.

At baseline, all participants were asked not to change their eating habits, not being prescribed any meal plan with calorie restriction. In addition, physicians were asked not to change the drug plan for any patient during the 12 weeks of training. All patients were informed about the methodology and the study's objectives and they signed the Free and Informed Consent Term.

Data collection

Aiming for a possible diagnosis of cardiovascular disease, and further evaluation of symptoms consistent with arrhythmias and ischaemia induced by exercise, which are considered exclusion criteria, all patients were assessed by ET on ramp protocol, performed by a cardiologist in the centre itself, following the rules of the Brazilian Society of Cardiology guidelines[19] with the subsequent issue of medical opinion. Seeking the safety of volunteers, measurements of blood pressure were performed in all participants before the beginning of each exercise session, after 30 min of physical activity and 20 min after the end of each session.

In these same periods, measurements of blood glucose in diabetic patients were conducted. Glucometer Roche Accu Chek Performa® (Mannheim, Germany, 2009) was used to measure the glucose, while for the blood pressure measurements we used the stethoscope and sphygmomanometer aneroid Premium (Wenzhou Instrument Co., China, 2014). Anthropometric procedures, used to collect data, were through body weight, using the Mercy® scale (LC 200 model, Brazil, 2010) ranging from 1 to 200 kg with 50 g of precision. Height was measured by stadiometer Welmy® (R110 model, Brazil, 2009) ranging from 0.8 to 2.00 m with 1 mm precision. Circumferences of waist, abdomen and hip were measured using retractable and flexible measuring tape Proximus® (Rio de Janeiro, Brazil, 2013) ranging from 0 to 200 cm with 1 mm precision. For measurements of skinfolds, the caliper Cescorf® Mitutoyo (Brazil) was used, with a reading amplitude of 88 mm and precision of 0.1 mm. The skinfolds were obtained using the equation suggested by Jackson and Pollock,[20] for men, and Jackson et al.,[21] which used the sum of the following three skinfolds: chest, abdominal and medium femoral for men, and triceps, abdominal and medium femoral for women. For the conversion of body density (BD) in body fat percentage (BF %), the equation proposed by Siri[22] was used, using the sum of the skin- folds. The methodological procedures for the anthropometric records had the International Society for the Advancement of Kinanthropometry (ISAK)[23] recommendations as guidelines, being performed by two physical education professionals trained in this technique.

The evaluation of the mental state of the participants was performed by an experienced psychiatrist on the premises of the Hiperdia Center itself, with the following instruments: mini-mental state examination (MMSE),[24] Beck's depression inventory (BDI),[25] Beck's anxiety inventory (BAI)[26] and self-reporting questionnaire (SRQ- 20).[27] The researcher instructed the patient to take into account the last week and the day the psychiatric evaluation was performed.

The MMSE is composed of questions that measure functions such as temporal and spatial orientation, attention and calculation, memory or recall and language. In our modified MMSE reflecting scholastic attainment, a minimum score of 20 points was considered for illiterate patients, 25 points for patients with 1–4 years of education, 26.5 points for 4–8 years, 28 points for 9–11 years and 29

points for more than 11 years.[28,29]

The BDI is a psychometric questionnaire of self-evaluation. The scale consists of 21 items that include attitudes and symptoms with intensity ranging from 0 to 3 and are intended to identify the presence of depressive indicators, considering various categories of symptoms, such as mood (sadness, loss of interest, crying and mood fluctuation), vegetative or somatic (weight loss, loss of appetite, sleep and fatigue), cognitive (guilt, hopelessness and suicidal thoughts), social (social withdrawal and inhibition) and motor (inhibition and agitation).[30] Participants who scored 0–9 points were considered with minimal depression, 10– 16 mild, 17–29 moderate and 30–63 severe depression.[25]

The BAI was used to assess the severity of anxiety symptoms using a scale of symptoms organized in 21 items, ranging from *nothing*, *slightly*, *moderately* and *severely*, expressed in anxiety symptoms, such as nervousness and tremors, and questions about palpitations, fear, feeling of suffocation and fainting, heat, numbness and others. A score between 0–7, 8–15, 16–25 and 26–63 represented minimal, mild, moderate and severe anxiety, respectively.[26]

The SRQ-20 was used for tracking non-psychotic mental disorders in the evaluation of mental suffering. The instrument consists of 20 questions, and the answers are binary (yes/no). The final score was obtained by adding together the positive responses found in the test. Obtaining up to six positive responses led to no suspicion of mental disorder, and above seven positive responses mental disorder suspicion in relation to the last 30 days lived by the patient.[27]

After this assessment step, the assessed patients initiated the supervised exercise routine. The exercises were prescribed individually respecting the limitations and potential of each patient identified in the initial assessments, and they followed the international guidelines pro- posed by the American College of Sport Medicine[31] and the American Diabetes Association (ADA)[32] for the diabetic population and the American College of Sports Medicine[33] for the hypertensive population.

Study participants underwent an intervention with physical exercise three times a week for 12 weeks. All training sessions were supervised by physical education professionals, assistants, physicians and nurses of the Hiperdia Center in Viçosa, MG. The training sessions took place in the morning period (7:00–11:00

a.m.) or afternoon (14:00– 17:00 p.m.), according to the availability of study participants. In total, 36 sessions of physical exercises were held during 3 months of intervention, distributed in three sessions per week, where participants were free to choose the most appropriate days during the week to perform the routine proposed exercises. A 90% adherence to the programme was determined so that the results were valid.

Participants were randomly divided into two groups, corresponding to aerobic and resistance exercises. The group that corresponded to aerobic training (AT) consisted of nine patients (four hypertensives and five diabetics) and the RT group had eight patients (five hypertensives and three diabetics). Initially, seeking an appropriate physiological and motor adaptation, the duration of the main part of the sessions was 20 min, progressing to 30 min in the second week and to 40 min in the following week for the two intervention groups.

Training sessions for both groups started with a warm- up in a cycle ergometer for 10 min at an intensity of 50% of the maximum heart rate (MHR), estimated by the Tanaka et al.[34] equation MHR = 208 − (0.7 × age). The return to calm comprised exercises of active and passive stretching, lasting around 10 min, of the major muscle groups (quadriceps, hamstrings, large dorsal, chest, back). The average time to complete each exercise session was between 50 and 60 min after the third week.

The effort perception index (EPI) by the Borg scale[35] was used for both groups during exercise, because due to the patients' low physical fitness and motor skills, the initial loads of each exercise were stipulated according to their effort perception, using the scale from 6 to 20 pro- posed by Borg[35] and, as improvements occur on the movement pattern and physical condition, the loads were adjusted. The scale values that were used were from 11 to 13, representing a moderate effort. Even with the load adjustments, the participants' effort perception has always remained in the range from 11 to 13. We opted for the prescription and training load control in strength exercises from the perceived exertion due to low levels of physical fitness and motor coordination and to treat patients with high cardiovascular risk. Load testing or maximum repetitions would entail a non-consistent effort with health conditions of the participants, which would increase the risk of adverse events. Therefore, the training loads were adjusted to the extent

that physical fitness and motor skills of the participants improved, but always taking into account the perceived exertion as moderate.

Participants of the resistance group followed a sequence of 10 exercises: neutral rowing, squats, lying dumbbell bench press, knee extension with shin pads, dumbbell shoulder press, dumbbell curls, bending knees with dumb- bells, standing calf raises, cable rope overhead triceps extension and abdominal crunch. The circuit method with an interval of 15 s between exercises was used in the first 2 weeks in order to adapt the neural, joint and muscle systems, and the volunteers performed two sets of 15 repetitions. After this period, the training consisted of three sets of 12 repetitions. The loads were adjusted as improvements occurred in the motor and physical behaviours. The execution of the exercise repetitions was held continuously, controlled, with moderate speed and similar duration between the concentric and eccentric phases.

Aiming for an appropriate physiological and motor adaptation for the AT group, the duration of the main part of the sessions was initially 20 min the first week, 30 min the second week and 40 min from the subsequent week. The training was performed on a treadmill, exercise bikes, elliptical and upper body cycle ergometer. Initially, there was the intensity control proposal of training through the percentage of MHR estimated by Tanaka equation[33] with the establishment of 60% for the main part of the training. However, because some patients use adrenergic beta- blockers to control blood pressure, the scale of subjective effort perception, proposed by Borg,[35] was used for the control of training loads of these patients. For diabetic patients who did not have high blood pressure or did not use beta-blockers, the initial plan was maintained. Monitoring the heart rate (HR) was conducted through frequency meters of ergometers and controlled by the researchers responsible for the supervision of exercise sessions, controlled from the individual calculation of HR previously held. Regarding the use of EPI, the same RT group procedures were kept. After 12 weeks of inclusion in the proposed exercise programme, volunteers were reassessed using the same initial protocol.

Statistical analysis

Initially, the descriptive statistics of the sample was to obtain the means and standard deviations. The Shapiro Wilk normality test was used. Then the paired T

test and Wilcoxon test were used to compare pre- and post-training for parametric and non-parametric parameters, respec- tively. The χ^2 and Fisher's exact tests were used for dichotomous parameters when appropriate. The significance level was 5%. The data were analysed using SPSS statistics software.[20]

Results

Table 1 presents characteristics of the sample. A higher prevalence of women (76%) was observed among the 17 patients compared to male members. Significant differences between the groups for age and education were not observed, and a high number of patients classified with obesity was noted, totalling almost half the sample (47%). The average adherence of 36 total sessions supervised proposal exercise was 95.1% and 91.9% for RT and AT groups, respectively.

Table 2 shows the mean and standard deviation of anthropometric parameters of diabetic and hypertensive patients, before and after intervention with exercises, and significant difference in both groups was not observed. The values considered high for abdominal circumference in patients of both diseases were observed, as well as waist–hip ratio and BF %. All study participants had waist circumference above the cutoff set by the World Health Organization (WHO),[36] which is above or equal to 94 cm for men and 80 cm for women, increasing cardiovascular risks. Regarding the waist–hip ratio, 75% of men showed values above 0.90, also established by WHO[36] as a limit value, since 54% of women had values above the cutoff value, which is 0.85. WHO[37] also states that fat percent- ages above 25% and 35% for men and women, respec- tively, indicate obesity status. Following this principle, the women in this study showed a high level of obesity, sug- gesting a further complicating factor in glycaemic and mental health control, as opposed to the sample of men.

Table 1 – Sample characterization of hypertensive and diabetic patients.

	Total (n=17)	Hipertensives (n=9)	Diabetics (n=8)	*p*
Age (years)	55 ± 9	57 ± 8	53 ± 8	0.385[ǂ]
Men/Women	4/13	1/8	3/5	---
BMI				
Underweight	0	0	0	---
Ideal weight	1 (6%)	0	1 (13%)	---
Overweight	8 (47%)	5 (56%)	3 (38%)	0.637[ǂǂ]
Obesity	8 (47%)	4 (44%)	4 (50%)	0.999[ǂǂ]
Education				
Illiterate	5 (29%)	3 (33%)	2 (25%)	0.999[ǂǂ]
0 to 3	5 (29%)	3 (33%)	2 (25%)	0.999[ǂǂ]
4 to 8	6 (35%)	3 (33%)	3 (38%)	0.999[ǂǂ]
8 or more	1 (6%)	0	1 (13%)	---

n = sample size, BMI = body mass index, p = probability for the hypothesis tests. (ǂ) Student T test, data presented as mean ± standard deviation. (ǂǂ) Fischer's Exact Test, data presented as number of participants and percentage.

Table 2 - Anthropometric parameters of men and women before and at the end of a 12 week training.

	Men (n=4)			Women (n=13)		
	Pre-Workout	Post-Workou	p	Pre-Workout	Post-Workout	p
Abdominal circumference (cm)	110 ± 25	109 ± 24	0.109[ǂǂ]	95 ± 12	94 ± 12	0.754[ǂǂ]
Waist-hip ratio	0.99 ± 0.2	1.00 ± 0.11	0.923[ǂǂ]	0.85 ± 0.0	0.83 ± 0.07	0.567[ǂǂ]
Body fat (%)	27 ± 9	25 ± 10	0.725[ǂǂ]	40 ± 6	40 ± 6	0.961[ǂǂ]

n = sample size, cm= centimeters, %= percentage, p = probability for the hypothesis tests. (ǂǂ) Nonparametric test, (ǂǂ) Student T test, data presented as mean ± standard deviation.

Adding all the volunteers' score, the values obtained with the MMSE totalled a score of 416 points before the intervention with exercises, averaging 24 points, with an increase to 430 points after the intervention, averaging 25 points (p = 0.398), totalling an increase of 3.3%. Thus, a slight improvement among patients was noted. Regarding the diseases studied, there was a slight increase achieved by the hypertensives (2.2%), the same to the diabetics (4.3%) according to the MMSE. Two patients achieved progress in classification, moving from classification 'with' cognitive impairment to 'without' cognitive impairment, both diabetics.

With regard to depressive parameters, we observed in the pre-tests the sum of 439 points, averaging 26 among the participants, causing a drop of 61% after physical exercise, totalling 170 points and averaging 10 (p = 0.001). Both diseases decreased in scores on the BDI questionnaire after supervised training, a total decrease of 64% in hypertensive patients and 59% in diabetics.

Significant results were also observed with regard to the improvement of anxiety symptoms. The average achieved by the participants after training with exercises was 10 points in the BAI, unlike the 21 observed before the intervention (p = 0.02). There was a decrease of 53% in the average score achieved after training with exercises, and the hypertensive reached a decrease of 55% and the diabetics 52%.

People with both diseases were classified on their average with moderate anxiety before starting the exercise routine. After 12 weeks of intervention with the pro- posed exercises, a score corresponding to a mild anxiety level was reached, according to the BAI questionnaire. The values observed in the BDI showed that before the studied population performed the proposed intervention, there was a predominance of moderate depression among the hypertensives and severe depression among the diabetics. Minimum depression levels were observed among the hypertensives and mild levels among the diabetics in the post-tests

Table 3 – Parameters of cognitive state and degrees of depression and anxiety in hypertensive and diabetic groups before and at the end of 12 weeks of physical exercises

	Total (n=17)			Hipertensives (n=9)			Diabetics (n=8)		
	Pre-Workout	**Post-Workout**	**P**	**Pre-Workout**	**Post-Workout**	**P**	**Pre-Workout**	**Post-Workout**	**P**
With cognitive impairment (MMSE)	7 (41%)	6 (35%)	0.99‡‡	3 (33%)	4 (44%)	0.49‡‡	4 (50%)	2 (25%)	0.65‡‡
Without cognitive impairment (MMSE)	10 (59%)	11 (65%)	0.99‡‡	6 (67%)	5 (56%)	0.99‡‡	4 (50%)	6 (75%)	0.70‡‡
Minimum anxiety	0	11 (65%)	---	0	7 (78%)	---	0 (0%)	4 (50%)	0.10‡‡
Mild anxiety	6 (35%)	3 (18%)	0.43‡‡	3 (33%)	1 (11%)	0.66‡‡	3 (38%)	2 (25%)	0.99‡‡
Moderate anxiety	6 (35%)	2 (12%)	0.22‡‡	4 (44%)	0 (0%)	0.10‡‡	2 (25%)	2 (25%)	0.99‡‡
Severe anxiety	5 (30%)	1 (5%)	0.17 ‡	2 (22%)	1 (11%)	0.99‡‡	0	0	---
Minimum depression	1 (5%)	10 (59%)	0.01‡‡	1 (11%)	7 (78%)	0.03‡‡	0	3 (38%)	---
Mild depression	2 (12%)	4 (23%)	0.65‡‡	2 (22%)	1 (11%)	0.99‡‡	0	3 (38%)	---
Moderate depression	7 (41%)	3 (18%)	0.25‡‡	4 (44%)	1 (11%)	0.33‡‡	3 (38%)	2 (25%)	0.99‡‡
Severe depression	7 (41%)	0	---	2 (22%)	0	---	5 (63%)	0	---

n= sample size, p = probability for the hypothesis tests. (‡‡)Chi-square, data presented with a number of participants and percentage.

Table 3 shows in detail the cognitive status of patients before and after training with exercises, as well as their levels of anxiety and depression through the mean and standard deviation obtained for each group according to the score of each questionnaire used. A few changes were observed in what concerns the cognitive state after 12 weeks of physical exercises, with no significant differences in both groups.

Referring to the number of patients achieving minimal anxiety levels after the end of the 12-week intervention with exercises, an increase of 65% was observed, with a migration of patients with moderate and severe anxiety to the minimum anxiety, reaching a clinically satisfactory result. As in anxiety, a sharp decline was observed in depressive symptoms. This is because 82% of the total sample had levels of depression, from moderate to severe, in the pre-tests. After the exercise inclusion in the sample routine, this percentage was limited to 18%, with an attenuation of depression levels to minimum depression state, reaching 59% of the studied population, and these beneficial effects of physical exercise were evident in both diseases.

According to the SRQ-20 questionnaire, 88% of participants were classified 'with suspicion of common mental disorder' before the intervention with exercise. After intervention, this quota was reduced to 12% ($p = 0.001$). In the hypertensive group, seven patients (78%) were suspected of common mental disorders before the exercise programme, dropping to two patients (22%) after the intervention ($p = 0.05$), while six diabetics (75%) were classified as 'no suspicion of common mental disorder' after 12 weeks of performing the proposed exercises, an opposite scenario to what was found before the intervention, when eight patients (100%) were suspected of common mental disorder ($p = 0.006$).

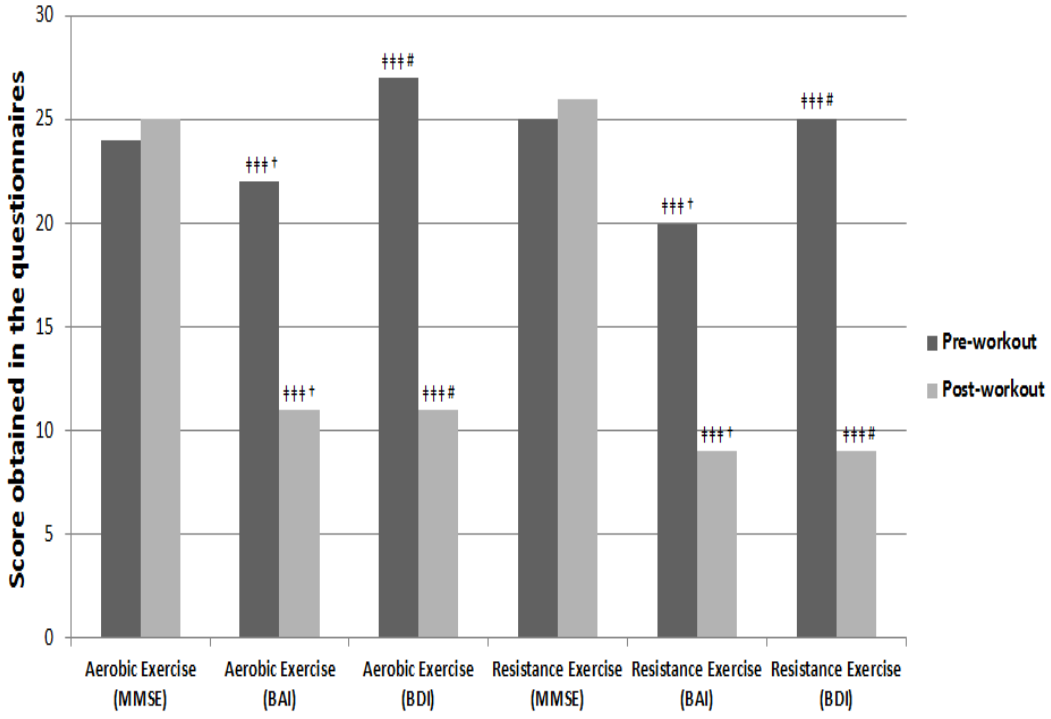
Regardless of the exercise mode, a significant decrease was observed in the levels of anxiety and depression in hypertensives and diabetics, as it can be seen in Figure 1 through the mean and standard deviation achieved in the instruments used, revealing that both aerobic and resistance exercises were beneficial for mental health patients. Significant improvements in cognition were not found in both groups.

Discussion

The main findings of this study were the reduction in depression and anxiety symptoms of both hypertensive and diabetic patients after a 12-week intervention of super- vised exercises. A decrease in the number of patients with probably positive screening of non-psychotic mental dis- order was also noted, where anxiety and depressive symptoms are also investigated in the SRQ-20 scale. In addition, both the aerobic and resistance exercise groups had results with similar improvements. There is evidence that this study was the first to evaluate cognitive impairment, depression, anxiety and non-psychotic mental disorders in hypertensive and diabetic patients after intervention of an exercise programme consisting of aerobic or resistance activities. As there is no difference between the exercise types in improving mental disorder levels in the population studied, alternative forms of regular physical activity insertion can be used in training methodologies.

Resistant hypertensive and type 2 diabetic patients belonging to the sample studied had high body mass index (BMI) index and fat percentage as well as waist circumference and waist–hip ratio above what is recommended by the WHO[36] (Tables 1 and 2). The incidence of DM is associated with increased waist–hip ratio and peripheral lipoatrophy. Thus, abnormal distribution of adipose tissue, particularly visceral, is closely related to the incidence of DM.[38] Depression and anxiety are the most common mental disorders associated with over- weight.[39] This association between depression and obesity can also be explained by the attitude of society towards obese individuals, leading some people to lose confidence and self-esteem.[40] Matini et al.[39] observed in their study that the higher the BMI, the greater the levels of psychiatric disorders in a population of 67 morbidly obese patients, with a mean age of 36 years and BMI of 48.8 kg/m^2. Weight gain may also be accelerated by the use of antipsychotic medication, leading to DM, or patients with this syndrome who use this class of medication to lose control over this disease.[41] As food intake was not controlled in this study, it may explain, in part, the lack of improvement in anthropometric levels of the

sample. Nevertheless, exercise has been consolidated as an extremely important instrument in combating obesity, along with oriented nutritional education. Resistance exercise of low to moderate intensity showed no benefits on the anthropometric parameters, yet was effective on mental disorders. Thus, it can be used in these individuals, as they are easy for people who find it difficult to join in more intense activities.[42]



MMSE (Mini Mental State Examination; BDI (Beck Depression Inventory); BAI (Beck Anxiety Inventory); ǂǂ (p<0.05); † (Student T test); * (nonparametric test).

Figure 1- Evolution of depression, anxiety and cognitive levels of aerobic and resistance training groups before and at the end of 12 weeks of supervised training.

SAH may favour anxiety and depression states in their patients, as noted in the study of Mushtaq and Najam,[43] which detected a combination of these psychiatric symptoms in 137 hypertensive patients, 77 men and 60 women with a mean age of 43 years, compared to a control group. As noted in this study, exercise can have a positive effect on depression (Table 3). Data corroborate the findings of Zarshenas et al.'[44] where 41 women with a mean age of 26 years

showed a significant reduction in the levels of depression after intervention of 4 weeks of aerobic exercise compared to the control group matched for age, education and marital status. The duration of the exercises was 30–35 min in the main part of the sessions, with a 60%– 80% of MHR. It is noteworthy that considerable uncertainty about the optimal workout duration and frequency to obtain satisfactory results still occurs.[45]

In addition to depression, there are evidences that suggest positive effects of physical exercise also on anxiety parameters, corroborating the findings of this study (Table 3). Aidar et al.[46] concluded that after a 12-week intervention of RT with 48 h of rest between sessions and durations of 45–60 min in 13 individuals with a mean age of 52 years affected by stroke, large reductions in anxiety levels occurred compared to the control group of a similar age.

In diabetic patients, the depression symptoms are strongly associated with the disease, but little is known about anxiety.[47] In this study, both psychiatric disorders showed high prevalence in diabetics before supervised exercise intervention. After the set period of intervention, clinically favourable results were observed in this study (Table 3). Broadly in line with our findings, Gallagher et al.[48] observed that depressive symptoms were halved in patients with diabetes and cardiovascular disease who made life-style changes including both exercise and healthier diet. In a cross-sectional study, Saleh et al.[49] observed in 500 patients with DM type 2, aged more than 25 years, that 80% of patients who performed less than 45 min of exercise per week, in other words, who did not adhere to a regular exercise routine, had depressive and anxiety symptoms. The regular exercise programme can increase self-esteem, mood, well-being feeling and positive effects on body image, reducing the physiological effects of stress.[5]

Table 4 – Parameters of the psychological state of hypertensive and diabetic patients before and at the end of 12 weeks of supervised training

	Hypertensives (n= 9)			Diabetics (n=8)		
	Pre-Workout	**Post-Workout**	***p***	**Pre-Workout**	**Post-Workout**	***p***
MMSE	24 ± 3	25± 3	0.683[‡]	25 ± 3	26 ± 3	0.458[ǂ]
BDI	22 ± 11	8 ± 5	0.05[‡]	31 ± 10	13 ± 5	0.001[‡]
BAI	19 ± 9	8 ± 8	0.018[ǂ]	24 ± 15	12 ± 8	0.061[‡]

n= sample size, p = probability for the hypothesis tests. ([‡]) Student T test, data presented as mean ± standard deviation. ([ǂ]) Nonparametric test. MMSE= Mini-Mental State Examination, BAI = Beck Anxiety Inventory, BDI= Beck Depression Inventory.

Data observed using the MMSE showed no beneficial effects on cognitive aspects evaluated by this questionnaire (Table 4). The MMSE was chosen by itshigh validity, reliability and easy application. Despite its recommendation for the elderly, it has been increasingly used in adults.[51] Research has shown that cognitive function can be benefited by physical exercise. Furthermore, studies have been proving that physically active people have a delay in cognitive decline,[52] as noted in the study of Dupuy et al.,[10] when 22 women with a mean age of 24 years and 36 women with a mean age of 62 years were submitted to a maximal progressive test and performed the Stroop cognitive test in the meantime. The results showed that the higher the cardiorespiratory fitness of these women, the higher their performance on cognitive tests. The lack of improvement in cognitive status may be partly due to the characteristics of the prescribed activities, which are repetitive. It is possible that activities such dance and mini games require more from the cognitive process, resulting in greater benefits.

Regarding the SRQ-20 questionnaire, this instrument was used for its wide tracking capability of common mental disorders symptoms, such as depressive–anxious mood, somatic symptoms, vital energy decrease and depressive thoughts, being necessary to emphasize that this instrument seeks a screening of non-psychotic psychiatric disorders, such as anxiety, depression and other mental disorders, and is widely used to diagnose suspicion of common mental disorders.

Before the intervention with exercise, mental health levels tracked by the three instruments were worrying, and these mental disorders were alleviated after the intervention period, with both resistance and aerobic exercises. Thus, the improvements observed by the SRQ-20 corroborate the findings on BDI and BAI questionnaires (Table 4).

Study limitations

Only screening instruments were used in this study, which do not replace the medical interview for an accurate diagnosis. In addition, one of the inclusion criteria in the study was the condition of participation in the physical exercise programme at the Hiperdia Center. This led to a limited sample size, since not all the diabetic and hypertensive patients assisted at the Center can perform the training, but only those that are recommended by the physician after a rigorous evaluation. The non-inclusion of a control group may also be considered as a limitation of the study. This was the great difficulty encountered in recruiting patients for participation in the study.

Conclusion

This study showed positive interference of exercise on the mental health of patients with hypertension and diabetes type 2. Significant improvements on depression and anxiety status in both disorders were found after 12 weeks of supervised exercise intervention as well as great improvements in states of possible suspicion of non-psychotic mental disorder. On the other hand, improvements on cognitive status of hypertensive and diabetic patients after the intervention with physical exercise were not found. Benefits to mental health were found in the groups who performed aerobic and resistance exercises, leading us to believe that regardless of the performed mode, exercise is beneficial to the mental health of hypertensives and diabetics and clearly shows the importance of supervised physical exercise in the full health treatment of hypertensives and diabetics, which can benefit in the treatment adherence and maintenance of a good underlying disease control, even in a short training period of 12 weeks of activities.

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Artigo Original

Effects of exercise on cognitive function of hypertensive and diabetic valued at Mental test and training system (MTTS)

Abstract

Introduction: There is strong evidence that systemic arterial hypertension (SAH) and Diabetes Mellitus (DM) are important risk factors for cognitive impairment, mainly through brain microvasculature injury. The Mental Test and Training System (MTTS) is a device that assesses cognition through several tests, and has been widely used for athletes testing. However it has been hardly used for the cognitive assessment of diabetic and hypertensive patients. **Objectives:** To verify whether a 12-week program of supervised physical exercise is enough to promote changes in cognitive status, assessed by MTTS, of diabetic and hypertensive patients. **Methods:** The study was conducted with 13 patients (9 women and 4 men) of 55 ± 12 years, 7 of them with SAH, and 6 of them with SAH plus type 2 diabetes (SAH+DM2); all sedentary and belonging to HiperDia Center Viçosa-MG. They performed the same MTTS tests as baseline as well as after the intervention. These tests assessed the cognitive state evaluating attention and concentration, reaction time and selective attention. Participants were divided into two exercise groups, 7 patients underwent aerobic training and 6 resistance training through 12 weeks, three times a week, exercising during 60 minutes with an intensity of 11-13 by the Borg scale. All exercise sessions were supervised by graduates in physical education. Statistical analysis was performed using paired t tests and the level of significance was set at 0.05. **Results:** Attention and Concentration test showed significant improvements in the "omitted reactions" variable for both SAH ($p = 0.031$) and SAH+DM2 ($p = 0.013$), and in the "correct reactions" and “incorrect reactions” variables for SAH+DM2 ($p = 0.013$ and $p = 0.028$, respectively). The other tests showed no significant differences. No significant differences were found between aerobic training and resistance training results. **Conclusion:** A 12-week intervention of

supervised physical training with aerobic or resistance exercise was sufficient to improve attention and concentration in patients with DM2 and SAH, despite the lack of significant differences in the reaction time and selective attention tests.

Keywords: Physical Activity, Cognition, MTTS

INTRODUCTION

Evidence shows that elevated blood pressure levels are related to cognitive decline in both young and elderly subjects (Ninomiya et al., 2011). Moreover, the hyperglycemic state caused by *Diabetes Mellitus* (DM) can lead to cognitive impairments producing macro and microvascular diseases in the brain (Qiu et al., 2014). In a study performed during 9 years on 824 subjects aged 75 on average, who underwent detailed annual clinical evaluations, those with DM (15.4% of the sample) had a 65% increase in the risk of developing AD compared with those without DM and had a 44% greater rate of decline in perceptual speed (Arvanitakis, Wilson, Bienias, Evans, & Bennett, 2004).

Known the relevance of mental aspects to achieve excellence in the treatment of DM and systemic arterial hypertension (SAH), the Mental Test and Training System (MTTS) appears as a mental evaluation tool based on action theory, widely used within the sports psychology (Hackfort, Kilgallen, & HAO, 2009), as shown by the works of Gierczuk & Ljach (2012) and Poliszczuk, Dąbrowska-Perzyna, Johne (2013). However, little is known about its applicability in clinical conditions associated with an increased risk of cognitive decline, such as DM and SAH, despite the large amount of tests within MTTS that evaluate specific cognitive skills (Rawlings et al., 2014; Liu, 2012).

Some studies have reported DM as a risk factor for mild cognitive decline, Alzheimer's disease, vascular dementia and other types of dementia (Cheng & Huang, 2012), as well as associations between cognitive decline and SAH. Nevertheless the pathophysiological parameters and methodologies used in these studies are controversial (Duron & Hanon, 2008). In addition, subjects with high blood pressure had a threefold increased risk of develop vascular dementia than normotensive people, and the risk increases to six-fold if the subject presents SAH

and DM (Posner et al., 2002). All this may significantly compromise the quality of life and independence in elderly people with these conditions. Moreover, these diseases are also associated with high levels of depression and anxiety and they may cause impairment in treatment compliance and in maintaining good control of the underlying disease (Teixeira et al., 2015).

Regular physical exercise can influence cognitive function by increasing brain oxygenation due to a greater blood flow and perfusion, which directly influences cognition regardless of age (Dupuy et al., 2015). However few studies investigate the use of physical activity as a strategy for reduce cognitive decline in diabetic and SAH patients, and they differ in intensity, duration and type of exercise used (Devore, Kang, Okereke, & Grodstein, 2009). These differences in methodologies may be the reason for the discordant results seen in the bibliography, where some studies find small association between physical activity and cognition was found by an observational study in older women with DM2 (Devore et al., 2009; Swoap, Norvell, Graves, & Pollock, 1994), whereas others reported improvements in cognitive performance after an exercise intervention. For instance, Baker et al (2010). found an executive function enhancement in glucose intolerant elderly after six-month aerobic training, and Liu-Ambrose et al. described a positive impact of resistance training in seniors over the functional plasticity of response inhibition processes in cortex, as increased regional cerebral perfusion has been reported in another study (Liu-Ambrose, Nagamatsu, Voss, Khan, & Handy, 2012) (Xu et al., 2014)

International guidelines state the need for including regular physical activity on DM (Association, 2014) and SAH (Pescatello et al., 2004) treatments; especially highlighting the physiological responses, but they may also have a positive impact on cognition. Therefore is important to know how supervised exercise training may influence on cognitive aspects of DM and hypertension. This could increase the quality of life of DM and SAH patients through better concentration, attention, memory and other cognitive abilities that help in their daily lives. The aim of this study was to determine whether a 12-week program of supervised physical exercise is enough to induce changes in the cognitive status, assessed by the MTTS, of

diabetic and hypertensive patients.

MATERIAL AND METHODS

Study design

A descriptive, longitudinal type study developed as part of the project 'Global assessment of cardiovascular risk and mental state of patients assisted by the Viçosa Hiperdia Center after physical exercise program', a partnership of the Federal University of Viçosa with Hiperdia Minas Program. The study was conducted entirely at the premises of Hiperdia Center of the city of Viçosa, MG, consisting of a secondary health centre, which has the aim of treat of patients with resistant hypertension, characterized by blood pressure that remains above the levels considered ideal, despite the concomitant use of three different classes of antihypertensive medications, one being necessarily diuretic (Daugherty et al., 2012); and/or diabetics with glycosylated haemoglobin greater than or equal to 9%.

The exercise intervention program lasted 12 weeks and assessments were performed before (i.e. maximal graded exercise test, anthropometric measurements and MTTS tests) and after (i.e. MTTS tests) the intervention. The study was approved by the Ethics in Research Committee of the Federal University of Viçosa, registered in Brazil Platform no. 33979214.3.0000.5153 protocol no. 832.149/2014.

Sample

All volunteers were engaged in the supervised physical exercise programme of the Hiperdia Center in Viçosa, MG, for the registration and monitoring of resistant hypertensive and/or diabetic patients assisted by the Unified Health System (SUS) that meet Resolution SES no. 2.606 of 7 December 2010 which establishes the referral criteria for the Integrated Reference Centers Viva Vida and Hiperdia Minas. Patient recruitment was done through analysis of medical records, where patients with resistant hypertension, or patients with resistance hypertension plus type 2 diabetes, were selected. A phone call was made to these selected patients, where all the research procedures were clarified. If the subject agreed to participate, a first

meeting in Hiperdia Center was scheduled for further information on the study procedures. Figure 1 shows the initial sample and the completers, as well as the reason for withdrawal and the exercise groups assignment. As inclusion criteria, patients with DM2 and/or SAH of both genders, over 18 years old, who do not practice routine and/or systematized exercise, were considered. The adopted exclusion criteria were as follows: type 1 diabetics, patients with peripheral artery disease, illicit drug users, congestive heart failure, decompensated pulmonary disease, symptomatic cardiac arrhythmia, orthopaedic or rheumatologic diseases that prevented the realization of the proposed exercises, symptomatic peripheral artery disease to exercise, acute cardiac ischemia signs during the maximal graded test and symptomatic cardiac arrhythmia caused by the graded exercise test. Also, individuals in use of anti-depressants or antianxiety medications were excluded. At baseline, all participants were asked not to change their eating habits, not being prescribed any meal plan with calorie restriction. In addition, physicians were asked not to change the drug plan for any patient during the 12weeks of training. All patients were informed about the methodology and the study's objectives and they signed the Free and Informed Consent Term.

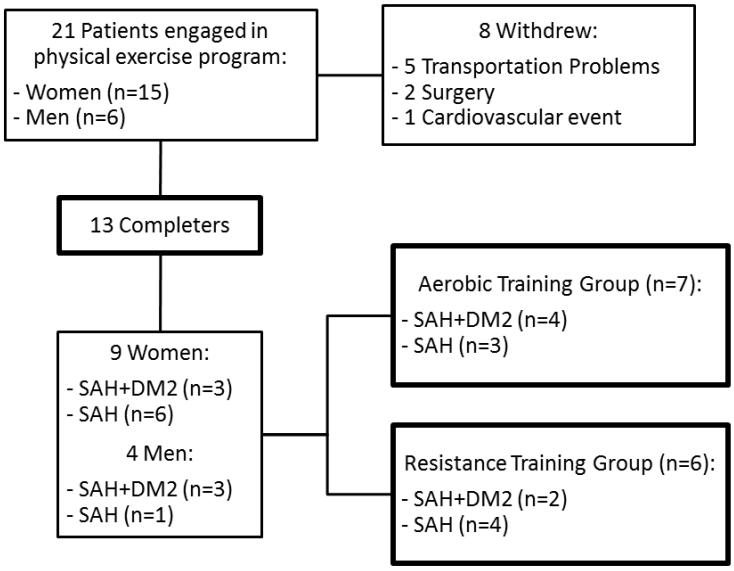

Figure 1. Initial sample size and completers, as well as the reason for withdrawal and the exercise groups assignment

Baseline measurements

Aiming for a possible diagnosis of cardiovascular disease, and further evaluation of symptoms consistent with arrhythmias and ischemia induced by exercise, which are considered exclusion criteria, all patients were assessed by an a graded exercise test to maximal voluntary exertion using a ramp protocol, performed by a cardiologist in the centre itself, following the rules of the Brazilian Society of Cardiology guidelines (Ghorayeb et al., 2013) with the subsequent issue of medical opinion.

The anthropometric parameters were also measured at baseline. Body weight was assessed using a Mercy® scale (LC 200 model, Brazil, 2010) ranging from 1 to 200 kg with 50 g of precision; and height was measured with a stadiometer Welmy® (R110 model, Brazil, 2009) ranging from 0.8 to 2.00 m with 1 mm of precision.

MTTS tests

The participants performed three tests on the MTTS with an established time of 45 min. All tests had an adaptation period, which included a moment before performing the test itself, allowing the evaluated had a familiarization process prior to the test. The MTTS is a device consisting of an evaluation system of cognitive processes, which is the relationship between subject-environment-task. It is based on the idea that specific situations can provide important information regarding cognitive processes. The evaluation system consists of a battery of 26 tests that assess specific cognitive skills such as attention, memory, perception, knowledge and decision making. The system includes a monitor and a central processing unit, as well as one action unit, one control unit, and peripheral equipment, such as foot pedals and a peripheral perception display (Hackfort et al., 2009). This system has already been used by previous studies for assessing cognitive processes (Krzepota et al., 2015; Mańkowska & Poliszczuk, 2015).

The tests performed on the equipment were: Cognitrone (COG, version S4) that measures attention and concentration; the Determination Test (DT, version S1), which assess the participant's reaction time; and the Visual Pursuit Test (LVT,

version S3) to evaluate selective attention. The three tests were performed within the same assessment session, in the cited order, at the Centre of Research and Studies in Soccer located in the Department of Physical Education of the Federal University of Viçosa. The tests were applied by a Physical Education professional with high experience in handling the equipment.

Cognitrone Test (form now on Attention and Concentration test) assesses attention and concentration, by recognising a figure given among a set of figures presented, as quickly as possible. The test required a reaction only if the figure given is within the set presented. The variables recorded in this test were a) number of “correct reactions”; b) number of “incorrect reactions” (i.e. the figure selected was not correct); and c) number of “omitted reactions” (i.e. the evaluated did not select any figure within the given time) (Schuhfried, 2011).

The Determination Test (test that evaluates reaction time) assesses the participants' reaction time, testing their reactive stress tolerance and the reaction time associated. During the test, the participant has to react to visual and acoustic stimuli pressing specific buttons for each stimulus. The variables analysed were: a) number of "correct reactions", that is the main variable of this test, and represents the total number of appropriate reactions to the stimuli; b) number of “incorrect reactions", which is the total number of inadequate reactions to the stimuli; and c) the “median reaction time”, defining reaction time as the interval that runs between the presentation of the stimulus and the pressing of the appropriate button (Schuhfried, 2011).

For the evaluation of selective attention we used the Visual Pursuit Test. The subject had to identify as quickly as possible, the end of a given line that is part of a maze composed of more lines. The difficulty increases as the test draws. The variables recorded were: a) the number of "correct reactions"; b) the time spent for complete the test, achieving higher punctuations as the time was lesser; and c) the "median time of correct reactions" (Biehl, 2011), that is the median of the time intervals spent in each correct reaction. The initial screens of the tests used are shown in Figure 2.

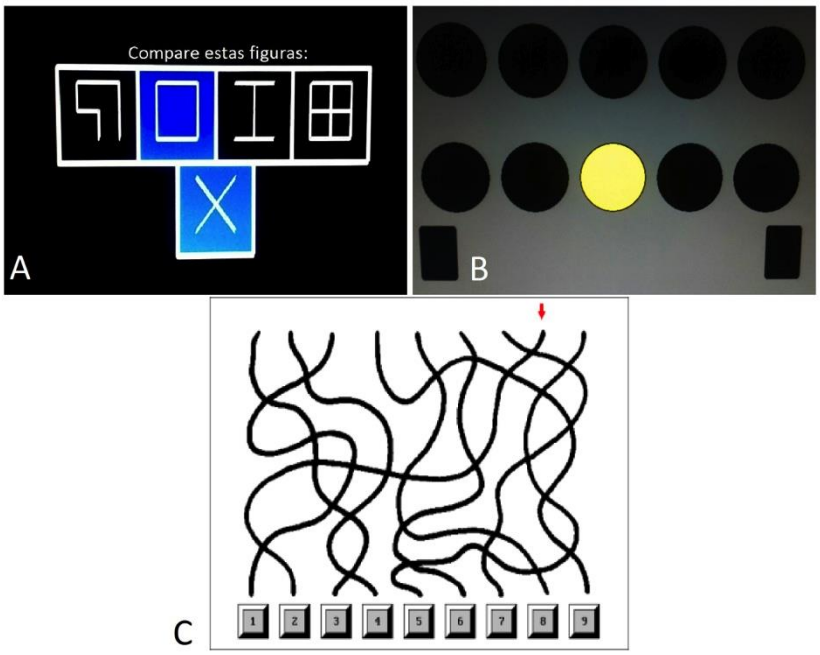

Figure 2: A: Initial screen for the Cognitive Test or Attention and Concentration test; B: Initial screen for the Determination test or Reaction Time test; C: Visual Pursuit Test or the Selective Attention test.

The MTTS tests do not have a scale for assess the results; consequently the evaluation was made through the comparison of the results obtained at baseline and after the intervention.

Exercise program

The volunteers who fulfilled the inclusion criteria were randomly allocated in one of the two exercise groups: aerobic or resistance training (Figure 1), both of them lasting 12 weeks and with a training frequency of 3 times per week. All training sessions were supervised by graduates in physical education. A minimum of 90% of adherence to the programme was required for assuring de validity of results.

The exercise program followed the recommendations for exercising in diabetic population of the American College of Sport Medicine (Colberg et al., 2010) and the American Diabetes Association ADA (2014), and the recommendations for hypertensive population of the American College of Sports Medicine (Pescatello et al., 2004).

Seeking an appropriate physiological and motor adaptation, the volume of both exercise programs (i.e. aerobic or resistance training) increased progressively during the first weeks, so that the main part of the session lasted 20 min within the first week, 30 min in the second week, and 40 minutes in the following weeks.

All training sessions started with a warm-up in a cycle ergometer for 10 min at 50% of the maximum heart rate, estimated by the Tanaka et al. equation MHR=208−(0.7×age) Tanaka, Monahan, & Seals (2001), and ended with a 10 min cool down of active and passive stretching exercises of the major muscle groups (quadriceps, hamstrings, large dorsal, chest, back). Therefore, from the third week onward, the average time to complete each exercise session was around 50-60. Participants of the resistance group followed a sequence of 10 exercises with 15 s of recovery among them: seated cable row, squats, dumbbells bench press, knee extension with ankle weights, dumbbell shoulder press, dumbbell biceps curl, standing knee flexion with ankle weights, standing calf raises, cable rope overhead triceps extension and abdominal crunch. The circuit method with an interval of 15 s between exercises was used in the first 2weeks in order to adapt the neural, joint and muscle systems, and the volunteers performed two sets of 15 repetitions. After this period, the training consisted of three sets of 12 repetitions. The exercises were performed in a control fashion, with moderate speed and similar duration between the concentric and eccentric phases. Regarding the aerobic group, participants performed 20, 30 or 40 min of aerobic exercise (depending on the progression phase), in bouts of 10-20 min without rest among them, using one of the following devices (self-selected by the participant): treadmill, bike, elliptical or upper-body cycle ergometer.

The intensity for both programs was prescribed individually, respecting the limitations and potential of each patient. The intensity of the resistance exercise program was controlled using the perceived effort by means of the 6-20 Borg scale (Borg, 1982). The participants had to exercise at an intensity of 11-12, representing a moderate effort[32]. Even with the load adjustments, the participants' effort perception has always remained in the range from 11 to 12. We opted for the prescription and

training load control in strength exercises from the perceived exertion due to low levels of physical fitness and motor coordination and to treat patients with high cardiovascular risk.

For the aerobic program, the intensity was set at 60% of the maximal heart frequency estimated by Tanaka, Monahan, & Seals (2001) equation, except for those under adrenergic betablockers treatment. If the volunteer was taking these medications, exercise intensity was controlled using the Borg Scale, using the values 11 - 12 which represent a moderate effort, besides having a strong association with the average percentage of cardiac frequency (David & Julen, 2015). Heart rate was controlled using the heart rate monitors integrated in the ergometers.

In order to avoid any health event, measurements of blood pressure were performed in all participants before each exercise session, as well as 30 min after its beginning and 20 min after the end of each session. At the same time points, measurements of blood glucose were conducted in diabetic participants. The glucometer Roche Accu Chek Performa® (Mannheim, Germany, 2009) was used to measure the glucose, while the stethoscope and sphygmomanometer aneroid Premium (Wenzhou Instrument Co., China, 2014) were used for the blood pressure measurements.

Statistical analysis

Standard statistical methods were used for the calculation of means and standard deviation (±SD). The Saphiro-Wilk test was used to analyze the normality of the variables. Afterwards, pre-post comparisons were made by means of paired t-test for variables with normal distribution, and by means of Wilcoxon test for those that were not normally distributed. Fisher's exact test was used for frequency comparisons. On the other hand, regarding the MTTS tests, Pearson correlation was used to established associations between variables: between “correct reactions” and “incorrect reactions” within the Attention and Concentration test; between “correct reactions” and “median reaction time” within the Reaction Time test; and “correct reactions” and "median time of correct reactions" in the Selective Attention test. Significance was set at $\alpha=0.05$. All analyses were performed using SPSS v.20.0 software (SPSS Inc., Chicago, IL, USA).

RESULTS

Table 1 shows the characteristics of the sample. Most of the sample were women (69%) and had high body mass index (BMI) (92%), whereas no significant differences were observed between the groups for age and education level.

Table 1. Sample characterization.

	Total (n=13)	**SAH (n=7)**	**SAH+DM2 (n=6)**	**p**
Age (years)	55 ± 12	60 ± 9	49 ± 13	0,218ǂ
Men/Women	4/9	1/6	3/3	---
BMI				
Underweight	0	0	0	---
Normal weight	1 (8%)	0	1 (17%)	---
Overweight	6 (46%)	4 (57%)	2 (33%)	0.592ǂǂ
Obesity	6 (46%)	3 (43%)	3 (50%)	0.616ǂǂ
Education (years)				
Illiterate	5 (38%)	3 (42%)	2 (33%)	0.587ǂǂ
0 to 3	4 (31%)	3 (43%)	1 (17%)	0.559ǂǂ
4 to 8	3 (23%)	1 (14%)	2 (33%)	0.559ǂǂ
8or more	1 (8%)	0	1 (17%)	---

SAH= Systemic Arterial Hypertension patients; SAH+DM2= Systemic Arterial Hypertension plus Diabetes Mellitus 2 patients; BMI = body mass index, (ǂ) Student T test, data presented as mean ± standard deviation. (ǂǂ) Fischer's Exact Test, data presented as number of participants and percentage.

Table 2 shows the results for the MTTS tests for hypertensive and for diabetics plus hypertensive participants at baseline and after the exercise intervention. There was no change on reaction time levels and selective attention after the program. However in the Attention and Concentration test, the group of diabetics plus hypertensive patients showed a significant increase on “correct reactions", as well as on "incorrect reactions", reflecting an augmented response to the stimuli presented after the intervention. For this group the variable "omitted reactions" also improved, demonstrating a decrease in the cases of non-identification of two similar figures. In contrast, in the hypertensive group this variable significantly decreased, exhibiting a higher number of times the participants did not identify the correct figure.

Table 2: Results for the Mental Test and Training System tests at baseline and after the 12-weeks exercise intervention, for the diabetics and hypertensive groups

	SAH (n=7)			SAH+DM2 (n=6)		
	Cognitrone test (Attention and Concentration test)					
	Baseline	**Post-Intervention**	**P**	**Baseline**	**Post-Intervention**	**p**
Correct reactions	34 ± 15	29 ± 15	0.621‡	22 ± 11	51 ± 15	0.013‡
Incorrect reactions	38 ± 22	32 ± 18	0,609‡	22 ± 9	50 ± 28	0.028‡
Omitted reactions	37 ± 11	51 ± 15	0.031‡	59 ± 11	29 ± 15	0.013‡
	Determination Test (Reaction Time test)					
	Baseline	**Post-Intervention**	**P**	**Baseline**	**Post-Intervention**	**p**
Correct reactions	107 ± 45	90 ± 60	0.595‡	104 ± 58	150 ± 54	0.153‡
Incorrect reactions	18 ± 14	17 ± 11	0.871‡	9 ± 6	24 ± 15	0.096‡
Median reaction time (s)	1,3 ± 0,2	1,4 ± 0,3	0.367‡	1,5 ± 0,6	1,2 ± 0,2	0.258‡
	Visual Pursuit Test (Selective Attention test)					
	Baseline	**Post-Intervention**	**P**	**Baseline**	**Post-Intervention**	**p**
Correct reactions	15 ± 2	11 ± 5	0.176‡	10 ± 7	16 ± 1	0.116‡
Median time of correct reactions (s)	6 ± 2	9 ± 7	0.413‡	6 ± 2	6 ± 2	0.959‡
Time for complete the test (s)	126 ± 47	198 ± 150	0.331‡	102 ± 21	111 ± 48	0.635‡

Analysing by exercise group, we did not observed differences comparing baseline and post-intervention values in any of the tests performed, for any of the two groups (Figure 3).

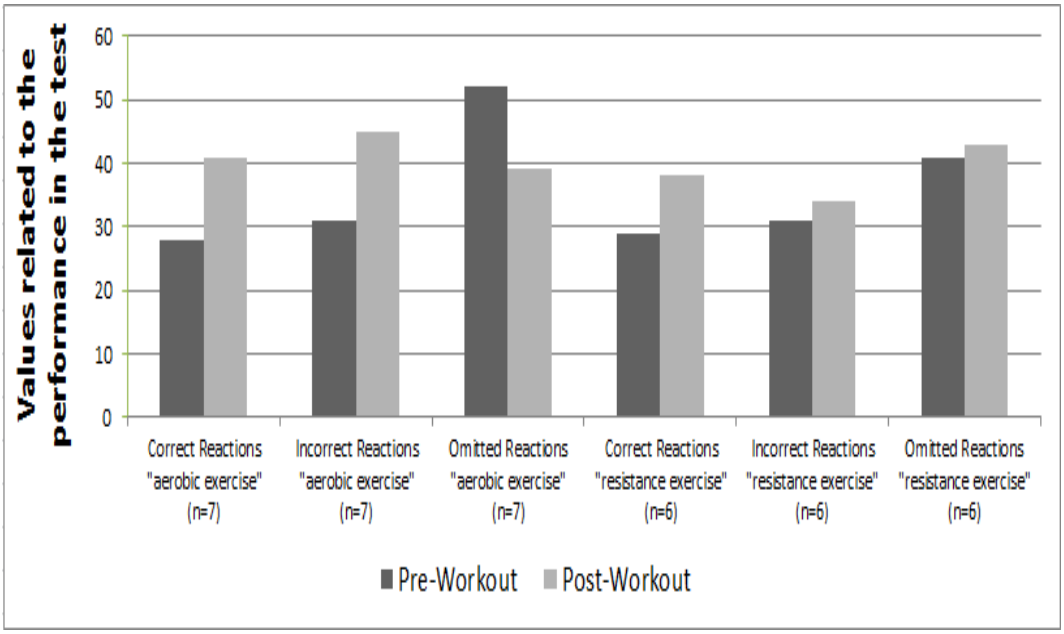

Figure 3: Comparison of variables in attention and concentration test of aerobic and resistance training groups before and at the end of the 12-week supervised training.

Taking in account the complete sample, a negative correlation was observed between "correct reactions" and "omitted reactions" (r= - 0.999; p=0.001) in the Cognitrone Test. This correlation means that as higher the number of "correct reactions" appears, a lower number of "omitted reactions" was registered. Another strong negative correlation was observer within the Determination Test between "correct reactions" and "median reaction time" (r= - 0.904; p=0.001), which shows that as the number of correct reactions was greater, the time interval between stimulus presentation and correct reaction was lower.

Finally, within the Visual Pursuit test, we found a slighter negative correlation between "correct reactions" and "median time of correct reactions" (r= - 0.689; p=0.009). That is, the greater the number of "correct reactions" the lower the time needed for this correct reactions.

DISCUSSION

As far as we know, this is the first study to assess cognitive parameters in diabetic and hypertensive patients using the MTTS equipment. The main finding was the increase in the number of "correct reactions" and "incorrect reactions", as

well as the decrease in the number of "omitted reactions", of a test assessing attention and concentration, after a 12-week resistance or aerobic exercise intervention in patients with SAH plus DM2. These results demonstrate improvements in attention and concentration, both of them key aspects for DM people, who usually take several medications at different hours and have to be careful with their food intake. Moreover, attention and concentration can also improve their socialization with relatives and friends, improving their quality of life. The lack of differences found between aerobic or resistance exercise implies that both trainings can be introduced as good strategies for the non-pharmacological treatment of DM.

The BMI of the sample was above the recommended values (Evans, McIntyre, Fluck, McIntyre, & Taal, 2012), being 92% of the participants overweight or obese. A growing body of research indicates that obesity in middle age is an important predictor of cognitive decline in old age (Odegaard & Chawla, 2013). Obesity is a white adipose tissue accumulation, promoting the process of systemic inflammation (Odegaard & Chawla, 2013) . This may contribute to cognitive decline and dementia due to several pro-inflammatory cytokines release, such as IL-1β and IL-6, which are known to disrupt neural circuits involved in cognition and memory (Nguyen, Killcross, & Jenkins, 2014). Prickett, Brennan & Stolwyk (2015) and Bischof & Park (2015) showed in their respective reviews that there is strong evidence for obesity leading to cognitive deficit, especially in the elderly. Nevertheless the authors point out that there are many methodological problems with the reviewed studies. Therefore, more studies are needed for evidencing obesity as a risk factor for cognitive impairment.

The fact that most of the sample were illiterate and had no access to electronic devices could have influence the performance during the MTTS tests, since they are done using modern and technic equipment. However, we believe that the familiarization phase made prior to the testing helped to minimize such influence, since we found differences in profile of satisfactory results in the Attention and Concentration test. Most tests for cognitive analysis require the skills of reading and writing, such as the Alzheimer's Disease Assessment Scale-Cognitive subscale (ADAS-Cog) or the Consortium to Establish a Registry for Alzheimer's Disease (CERAD)[39], and this could be a limitation for analyse the illiterate population. Therefore, is essential the development of evaluation tools for

assess cognition regardless the educational level, such as the Literacy Independent Cognitive Assessment (LICA), which is based on oral and visual responses. This reduces the number of false cognitive impairment diagnoses (Shim et al., 2015). It is important to highlight that the tests chosen for our study were carefully selected so that the patient did not necessarily need to be literate. Thus the education level of our sample probably was not a confounding factor during the assessment.

We found significant improvements in the "omitted reactions" variable score, within the Attention and Concentration test, after the exercise intervention. This implies that after the exercise program, the participants did not press any key when they did not identify any figure as the correct, because they were more focused and had higher attention. Several studies show that physical exercise improves cognitive ability. Smith et al. (2010) reviewed 29 works, with a total of 2,049 participants, and found that subjects who received aerobic training obtained slight improvement in attention levels and processing speed. Furthermore, it has been reported that cognitive attention and memory improvements are maintained 9 months after a cardiac rehabilitation program, raising the possibility that supervised exercise reduces the risk of dementia in patients with cardiovascular disease or attenuate cognitive decline (Alosco et al., 2014). A study conducted by Strassnig et al. (2015) with 12 psychiatric patients (schizophrenic and bipolar) who were overweight, showed a significant improvement in musculoskeletal and cognitive capacities, as well as in psychiatric symptoms. In agreement with these findings, Vidoni et al. (2015), comparing different training volumes (i.e. 75, 150 or 225 min of walking) in older adults, observed improved cognitive function in all the exercise groups compared to the control group without training, and that the greater the volume training the better the physical benefits achieved. However, it is necessary to highlight that none of these studies used the MTTS as an evaluation tool. In addition, it seems that it is still unclear what kind of exercise, aerobic or resistance, presents the greatest benefits for mental status.

Our results indicate that the selected exercise programs enhance the reaction of the diabetic plus hypertensive participants, since they reacted more times during the Attention and Concentration Test because "correct reactions" and "incorrect reaction" both increased. The negative correlation found between "correct reactions" and "omitted reactions" in the hypertensive plus diabetic patients, showing that exercise program makes the participants perceived more

stimulus and consequently better results. The negative correlations observed between “correct reactions” and “median reaction time”, within the Reaction Time test, and between “correct reactions” and “median time of correct reactions” indicate a shorter interval of time needed to obtain correct responses after the exercise intervention. Despite the lack of differences between baseline and post-intervention measurements in the Selective Attention and Reaction Time tests, we observed a higher participants’ reaction, that is, they spent less time for delivering the right response after the 12 weeks of exercise training. Moreover, we recorded increases of 31% and 38% in the “correct reactions” variables of these tests (Reaction Time and Selective Attention, respectively), displaying what appears to be the beginning of a positive evolution, and representing a considerable clinical improvement. Maybe the time intervention (12 weeks) partially determined this lack of significant differences that have been reported by previous works. For instance Liu-Ambrose et al. (2012) observed improvements in the levels of selective attention and conflict resolution, using the Stroop test, in 65-75 years women performing resistance training during 12 months. In the same line, Baker et al. (2010) demonstrated that six months of aerobic training were enough to improve selective attention tasks in old men, whereas their control group without exercise training did not improved. Perhaps, the inclusion of activities such as dance and simple games would require more complex cognitive process, and would provide more benefits to the participants (Teixeira et al., 2015b).

To the best of our knowledge, this is the first study using the MTTS tests to evaluate the benefits of supervised exercise on cognitive function of patients with DM2 and SAH. The non-existence of a standard of normality makes difficult to compare our results with others of healthy populations. This reinforces the importance of the results obtained in this study, since they can be used to create normative standards, facilitating the comparison between different studies and populations. However, further studies are needed to confirm the MTTS as an assessment tool for therapeutic interventions in patients with DM2 and SAH.

Study limitations

The main limitation of the study was the sample size. However, the special characteristics of the sample and the scarcity of works on this focus, makes our research helpful for future studies investigating with larger samples for confirming

the importance of exercise prescription also on the cognitive aspect for DM and SAH. Another limitation may have been the duration of the exercise program. It is possible that a six months or longer intervention would have produced greater improvements. Therefore we propose longer exercise intervention for future works.

CONCLUSION

Our results suggest a positive influence of supervised exercise over cognitive processes in patients with DM plus SAH. Significant improvements were found in levels of attention and concentration, after 12 weeks of supervised resistance or aerobic exercise. On the contrary, there were no significant differences in Reaction Time test and Selective Attention test responses, although we observed improvements in some variables, pointing out a clinical advance. As MTTS is not used routinely to evaluate the cognitive state of patients with DM and SAH, prospective studies with follow-up involving a larger number of individuals are essential to clarify, with reliability, the utility MTTS for the assessment of cognitive state in patients with these diseases.

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Conflict of interest

The authors declare no conflict of interests.

Academic Affiliation

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CONCLUSÕES

Os resultados apresentados pelo primeiro estudo evidenciaram que os pacientes portadores de HAS e DM apresentaram elevados quadros depressivos e ansiosos, sendo mais elevados nos pacientes hipertensos. Esse dado é preocupante, pois pode acarretar em comprometimento e dificuldade da manutenção de um bom controle da doença crônica. Em contrapartida, não foi evidenciado comprometimento cognitivo em relação à escolaridade dos mesmos.

Já o segundo estudo demonstrou que, após um período de 12 semanas de intervenção com exercícios físicos supervisionados, ocorreram melhoras significativas nos quadros depressivos e ansiosos, além de melhora acentuada nos quadros de possível suspeição de transtorno mental não psicótico. Não houve diferença nos níveis cognitivos nos hipertensos e diabéticos após o período de intervenção proposto. Os benefícios à saúde mental foram encontrados em ambos os grupos que praticaram exercícios aeróbicos e resistidos, levando a crer que independente do exercício realizado ocorreu benefícios à saúde mental dos pacientes.

Evidenciou-se também no terceiro estudo interferência positiva nos níveis de atenção e concentração nos pacientes diabéticos/hipertensos, apesar de não terem sido encontradas diferenças significativas nos testes de Tempo de Reação e Atenção Seletiva, após o período de 12 semanas de intervenção com exercícios físicos supervisionados. Tendo em vista que o equipamento MTTS não é utilizado de forma rotineira na avaliação do estado cognitivo de pacientes com DM e HAS, novos estudos devem ser elaborados, envolvendo um número maior de indivíduos, para analisarmos a verdadeira utilidade do MTTS para a avaliação do estado cognitivo desses pacientes.

CONSIDERAÇÕES FINAIS

Os resultados encontrados nesta dissertação deixam clara a importância do exercício físico supervisionado no tratamento integral da saúde de hipertensos e diabéticos, o que contribui para a manutenção de um bom controle da doença crônica, beneficiando a adesão ao tratamento mesmo em um período curto de 12 semanas de treinamento com exercícios físicos supervisionados. Sendo assim, é importante ressaltar a primordial realização de novos estudos com maior tamanho amostral e com período de intervenção maior, para fortalecimento dos resultados encontrados no presente estudo. Por fim, sugerimos a necessidade de inserção de programas de exercícios físicos supervisionados nos sistemas públicos e privados de saúde, como forma de auxiliar e maximizar o tratamento nutricional e medicamentoso. Contribuindo dessa forma, para a melhora da saúde mental de seus participantes. Sem dúvida, são necessários mais incentivos do poder público para a prevenção da saúde com exercícios físicos.

Anexo A

Termo de consentimento livre e esclarecido

UNIVERSIDADE FEDERAL DE VIÇOSA
CENTRO DE CIÊNCIAS BIOLÓGICAS E DA SAÚDE
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TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

TCLE confeccionado em observância à Resolução nº 466, de 12 de dezembro de 2012 do Conselho Nacional de Saúde.

TÍTULO DO PROJETO: A*valiação global do risco cardiovascular e do estado mental de pacientes atendidos pelo Centro Hiperdia de Viçosa após programa de exercícios físicos* – parte integrante do projeto "AVALIAÇÃO E TRATAMENTO DE DIABÉTICOS E HIPERTENSOS ATENDIDOS NO CENTRO HIPERDIA EM VIÇOSA"
COORDENADORA DA PESQUISA (Pesquisadora responsável): Profa. Dra. Luciana Moreira Lima, Departamento de Medicina e Enfermagem/UFV, (31) 3899-3905, (31) 9996-3384, luciana.lima@ufv.br

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Você está sendo convidado(a) a participar da pesquisa: "Avaliação e tratamento de diabéticos e hipertensos atendidos pelo Centro Hiperdia de Viçosa". O objetivo é verificar Investigar as adaptações cardiológicas e metabólicas agudas e crônicas além da composição corporal em diabéticos e/ou hipertensos frequentadores do Centro Hiperdia de Viçosa submetidos a um programa de intervenção com exercícios supervisionados.

Sua colaboração neste estudo é MUITO IMPORTANTE, mas a decisão de participar é VOLUNTÁRIA, o que significa que o(a) senhor(a) terá o direito de decidir se quer ou não participar, ou mesmo recusar de participar de alguma parte do estudo em especial. Também poderá desistir de participar do estudo em qualquer momento.

CONFIDENCIALIDADE DOS DADOS E ANONIMATO

Garantimos que será mantida a CONFIDENCIALIDADE das informações e o ANONIMATO. Ou seja, o seu nome não será mencionado em qualquer hipótese ou circunstância, mesmo em publicações científicas. Informamos que os resultados obtidos irão compor uma base de dados que poderão ser utilizados em outros estudos desenvolvidos pelo grupo responsável pelas investigações desenvolvidas no Centro Hiperdia de Viçosa em parceria com a Universidade Federal de Viçosa.

PROCEDIMENTOS DA DINÂMICA DO ESTUDO QUE ESTARÁ SENDO REALIZADO

A dinâmica do estudo corresponderá a aproximadamente 22 semanas. Na primeira semana, você será avaliado por dois médicos com um exame clínico e um exame psiquiátrico, responderá a uma anamnese e a questionários sobre problemas físicos, psiquiátricos e história da atividade física, além de um exame de sangue, levantamento antropométrico e teste de esforço com um cardiologista. Também será feito um monitoramento da pressão arterial durante 24 horas, além da medição da temperatura da pele por termografia, e orientação nutricional. Você também será encaminhado para o Departamento de Educação Física (DES) da UFV para realizar um teste psicotécnico. Todos esses testes serão totalmente gratuitos, realizados por profissionais vinculados ao Hiperdia ou dos pesquisadores desse estudo. Ao longo desse estudo, caso seja necessário serão realizados no máximo mais duas vezes essa rotina. Finalizada a primeira semana, haverá um período de até 21 semanas em que será feito uma prescrição de exercício supervisionada por profissionais de Educação Física, contando como colaboradores, enfermeiros, médicos, assistentes sociais que irão atuar auxiliando no tratamento da doença. A frequência semanal dos exercícios deverá ser no mínimo de duas e máximo de três vezes por semana, ao longo do estudo. Cada dia de exercício terá uma duração máxima de 60 minutos com atividades de baixa e média intensidade, sempre realizadas respeitando seu limite individual. Em cada dia de exercício para os pacientes que tenham quadro de diabetes, será feita

uma leitura de sangue capilar para leitura da glicemia, e durante todo o período de exercício haverá um monitoramento da frequência cardíaca e pressão arterial. Ao final das 21 semanas de exercício, será coletada nova amostra de sangue para os exames laboratoriais.

Toda dinâmica do estudo será realizada no Hiperdia ou no DES em que todos os testes serão realizados em sala reservada, estando somente o avaliado, o avaliador e se caso necessário mais um auxiliar. As imagens termográficas serão utilizadas única e exclusivamente para fins acadêmicos, sendo totalmente assegurada a privacidade de sua identidade. A etapa de exercício físico será feita em uma sala contando com a participação de outros pacientes.

INFORMAÇÕES FINANCEIRAS

Os pesquisadores deixam claro que não haverá nenhuma compensação financeira por participar do estudo, ou custos de transporte e de alimentação. Também não será exigido por parte do avaliado nenhuma cobrança financeira por estar participando do estudo.

São considerados como benefícios de sua participação:

Você irá receber um relatório com os resultados dos seus testes e os resultados finais do estudo. Caso seja encontrada alguma anormalidade, quanto ao exame de sangue, teste cardiológico, composição corporal, na frequência cardíaca, pressão arterial em repouso ou exercício, assim como o comportamento térmico, você será encaminhado para um profissional específico para o tratamento. Os resultados do presente estudo também poderão auxiliar a compreender de que forma ocorrem os ajustes do exercício auxiliando o tratamento de sua doença. Espera-se com a etapa do exercício promover algum emagrecimento, redução do consumo de medicamentos, normalização de alguns parâmetros sanguíneos, aumento da capacidade física e de bem estar, aprimorando assim sua autonomia.

Quanto aos riscos de participação do Estudo:

O presente estudo prevê mínimas ações invasivas, como a retirada de sangue. Serão tomadas todas as medidas sanitárias para que não ocorra risco de contaminação biológica e desconforto excessivo ao avaliado. Os procedimentos antropométricos de mensuração das dobras cutâneas, assim como a aferição da pressão arterial poderão gerar mínimo desconforto de compressão do aparelho, contudo serão realizados por um profissional treinado para minimizar o desconforto. As medidas antropométricas, aferição da pressão arterial e a aplicação dos questionários serão realizadas em local apropriado, sem a presença de estranhos, havendo somente a presença do avaliado, avaliador e no máximo um auxiliar, diminuindo assim o risco de inibição. A pesquisa pode também provocar um desconforto pelo tempo exigido ou até um constrangimento pelo teor dos questionamentos. No entanto, a equipe envolvida no estudo tentará minimizar os riscos com atendimento individual e humanizado pautado no respeito e atenção com os pacientes. Você poderá, caso queira, simplesmente não responder determinada pergunta. Durante a etapa de exercício é provável que surja a produção de suor, e a sensação da elevação da frequência cardíaca que em alguns casos geram um desconforto. Contudo a intensidade das seções de exercício será em nível submáximo. Em alguns casos poderá haver sensação de enjôo e náuseas, sendo o exercício interrompido imediatamente. Lembrando que o Centro Hiperdia é equipado com todos os equipamentos de segurança nos casos de emergências clínicas (ambu, desfibriladores, carrinhos de emergência, laringoscópio e tubos orotraqueais) e possui carro à disposição para possíveis encaminhamentos hospitalares.

DÚVIDAS SOBRE O ESTUDO

Em caso de dúvida o senhor poderá entrar em contato com a Profa. Dra. Luciana Moreira Lima, coordenadora da pesquisa, no Departamento de Medicina e Enfermagem – Universidade Federal de Viçosa – DEM/UFV, na Av. P.H.Holfs, ns/n – sala 207 – , ou pelo telefone
(31) 3899-3905, ou no e-mail: luciana.lima@ufv.br

Para que possamos manter contato posteriormente, mandando informações sobre seus resultados, gostaríamos caso tenha interesse em preencher os seguintes dados:

[ ] Não tenho interesse de receber os resultados. [ ] Tenho interesse de ter minhas informações.

Nome:_____Data de nascimento: / /

Sexo: Nacionalidade:_____Telefone: _____e-mail:_____Endereço:_____Bairro: _____Cidade:_____Estado:_____CEP: _____

Eu,_____, declaro estar esclarecido(a) sobre os termos apresentados quanto aos objetivos, dinâmica do estudo, confidencialidade de meus dados, benefícios e riscos, além da possibilidade de recusar minha participação parcial do estudo, ou mesmo solicitar minha exclusão posteriormente. Também fui esclarecido de todas as dúvidas. Fui informado e autorizo que meus dados registrados em meu prontuário, ou decorrente de amostras coletadas/armazenadas sejam usados para compor futuros estudos de levantamento estatístico de prevalência de certas doenças. Fui orientado também pelos pesquisadores que poderei compor um grupo especial do estudo denominado "controle", em que não terei que realizar nenhum exercício físico, somente realizando as avaliações indicadas pelos pesquisadores. Desta forma, consinto por minha livre e espontânea vontade, em participar desta pesquisa e assino o presente documento em duas vias de igual teor e forma, ficando uma em minha posse. Para qualquer dúvida ou queixa geral sobre esse estudo poderei entrar em contato com o seguinte setor: Comitê de ética em Pesquisa com Seres Humanos da Universidade Federal de Viçosa, CEP/UFV, localizada no Prédio Arthur Bernardes, ou pelo e-mail cep@ufv.br , pelo site www.cep.ufv.br ou ainda pelo telefone: (31) 3899-2492.

Viçosa,_/ /__

_____ _____

Profa. Dra. Luciana Moreira Lima (Assinatura do participante)

(Assinatura do pesquisador responsável)

Anexo B

Aprovação do projeto pelo comitê de ética em seres humanos da UFV

PARECER CONSUBSTANCIADO DO CEP

DADOS DO PROJETO DE PESQUISA

Título da Pesquisa: Avaliação global do risco cardiovascular e do estado mental dos pacientes atendidos pelo Centro Hiperdia de Viçosa após programa de exercícios físicos

Pesquisador: Luciana Moreira Lima

Área Temática:

Versão: 2

CAAE: 33979214.3.0000.5153

Instituição Proponente: Departamento de Medicina e Enfermagem

Patrocinador Principal: FUNDACAO DE AMPARO A PESQUISA DO ESTADO DE MINAS GERAIS

DADOS DO PARECER

Número do Parecer: 832.149

Data da Relatoria: 13/10/2014

Apresentação do Projeto:

O presente protocolo foi enquadrado como pertencente à(s) seguinte(s) Área(s) Temática(s): "Ciências da Saúde".

"PB_INFORMAÇÕES_BÁSICAS_DO_PROJETO_364732.pdf",item introdução, lê- se: "O presente estudo é parte integrante de um projeto maior intitulado "Avaliação e tratamento de diabéticos e hipertensos atendidos pelo Centro Hiperdia de Viçosa", que já foi aprovado sob o ponto de vista ético e formal pelo Comitê de Ética em Pesquisa com Seres Humanos (CEP) da Universidade Federal de Viçosa (Anexo I). No entanto, o projeto maior não contemplava a avaliação cardiovascular global e e do estado mental dos participantes. Os pacientes serão selecionados por sorteio, sendo esclarecidos sobre a dinâmica de trabalho e do período que serão submetidos de exercício supervisionado, assim como as avaliações clínicas e os exames complementares. Está bem consolidado que a prática de exercício físico regular é um instrumento poderoso para melhorar a qualidade de vida de pessoas com comprometimentos cardiometabólicos e psicológicos (ACSM, 2010; ACSM, 2004). Assim que se

pretende avaliar o risco global de DCV e possível envolvimento de queda cognitiva e quadros depressivos e ansiosos nos pacientes hipertensos e diabéticos num serviço único na região de Viçosa, durante uma intervenção multiprofissional para prescrição de exercícios supervisionados visando reduzir a morbidade e mortalidade desses pacientes. Essa abordagem também traz benefícios econômicos importantes, ao reduzir o consumo de medicamentos e problemas mais graves como AVC, glaucoma, infartos ou insuficiência renal, situações de elevado custo econômico e social. A população atendida no centro HIPERDIA pertence a um grupo de alto risco de eventos cardiovasculares, provenientes, na maioria das vezes, da Estratégia de Saúde da Família e que são encaminhados devido à proposta do centro de referência HIPERDIA de redução de mortalidade, redução de complicações preveníveis, melhora da qualidade de vida e assistência especializada (Resolução 2.606 de 7 de dezembro de 2010). Esse projeto também visa maximizar uma infraestrutura física e de equipamentos já pré-existentes do Centro Hiperdia de Viçosa, bem como de outros equipamentos adquiridos em projetos anteriores financiados pela FAPEMIG na UFV, dando assim um retorno social a população. Aos bolsistas, estudantes e estagiários que estarão envolvidos no projeto, que terão um processo de formação de recursos humanos, que poderão atuar como multiplicadores em outros municípios do Estado. Trata de um projeto pioneiro em âmbito municipal de Viçosa e demais cidades (Araponga, Cajuri, Canaã, Paula Cândido, Pedra do Anta, Porto Firme, São Miguel do Anta e Teixeiras) que fazem parte do consórcio intermunicipal, para aportar um serviço de atendimento multiprofissional, tendo como foco central a prescrição de exercício físico supervisionado, visando melhorar a qualidade de vida dos sujeitos comprometidos por HAS e DM. Tendo em vista que haverá a integração de estudantes de quatro cursos de graduação da UFV, Educação Física, Nutrição, Medicina e Enfermagem, haverá um efeito multiplicador na formação de recursos humanos para que possam levar a experiência desse projeto a outros municípios de MG, difundindo assim esse conhecimento e prática profissional. Para os pacientes, será um local de excelência com total infraestrutura de atendimento, com recursos humanos e materiais, com total segurança, único na região. Isso oportunizará um serviço de atendimento que provavelmente irá impactar em um menor consumo medicamentoso, aumento da autonomia e qualidade de vida, colaborando assim para reduzir a morbidade e mortalidade em pacientes portadores

de HAS e DM. Em 2012, no que tange à assistência do Centro Hiperdia Minas de Viçosa, dentro dos critérios de referência, foram atendidos 237 diabéticos, sendo 99 portadores somente de diabetes e 185 portadores de diabetes e HAS. Foram atendidos, também, 289 hipertensos de acordo com os critérios de referência, sendo 103 portadores de HAS e 185 portadores de HAS e diabetes. Esses dados demostram como o Centro se encontra em pleno funcionamento com sua equipe de trabalho totalmente integrada na parte de tratamento. O presente projeto será um processo de amadurecimento ao propor uma nova alternativa de avaliação do tratamento não farmacológico de pacientes hipertensos e diabéticos".

Objetivo da Pesquisa:

De acordo com o documento intitulado "PB_INFORMAÇÕES_BÁSICAS_DO_PROJETO_364732.pdf": Objetivo primário: Verificar e analisar possíveis melhoras nos quadros de HAS e DM, sobretudo nos aspectos bioquímicos, cardiovasculares e neuropsicológicos em pacientes do Centro Hiperdia de Viçosa, Minas Gerais, submetidos a um programa de treinamento composto por atividades físicas aeróbicas e resistidas.

Objetivo Secundário: a)Verificar o impacto das atividades físicas supervisionadas sobre respostas agudas e crônicas cardiovasculares, como a frequência cardíaca, pressão arterial e VO2máx.;b)Investigar e comparar o impacto dos programas de exercícios supervisionados sobre os perfis lipídico e glicêmico dos pacientes hipertensos e diabéticos;c)Avaliar o risco cardiovascular global dos pacientes hipertensos e diabéticos antes e depois dos programas de exercícios supervisionados;d)Relacionar os benefícios dos exercícios físicos no tratamento da HAS e DM;e)Comparar os aspectos neuropsicológicos dos pacientes hipertensos e diabéticos do centro Hiperdia de Viçosa antes e após a realização de exercícios físicos;f) Verificar se a capacidade cognitiva influencia o entendimento de questionamentos básicos no que se refere à memória imediata, orientação tempo-espaço;g)Analisar qual modalidade de exercício (aeróbico ou resistido) resulta em melhoras de fatores cognitivos (atenção, concentração, percepção, coordenação motora, tempo de reação) e maior aprimoramento no tratamento de Hipertensos e Diabéticos;h)Estudar a relação entre fatores de risco cardiovascular e déficit cognitivo.

Avaliação dos Riscos e Benefícios:

Os pesquisadores indicam no documento intitulado "PB_INFORMAÇÕES_BÁSICAS_DO_PROJETO_364732.pdf", os seguintes Riscos: "O presente estudo prevê mínimas ações invasivas, como a retirada de sangue. Serão tomadas todas as medidas sanitárias para que não ocorra risco de contaminação biológica e desconforto excessivo ao avaliado. Os procedimentos antropométricos de mensuração das dobras cutâneas, assim como a aferição da pressão arterial poderão gerar mínimo desconforto de compressão do aparelho, contudo serão realizados por um profissional treinado para minimizar o desconforto. As medidas antropométricas, aferição da pressão arterial e a aplicação dos questionários serão realizadas em local apropriado, sem a presença de estranhos, havendo somente a presença do avaliado, avaliador e no máximo um auxiliar, diminuindo assim o risco de inibição. A pesquisa pode também provocar um desconforto pelo tempo exigido ou até um constrangimento pelo teor dos questionamentos. No entanto, a equipe envolvida no estudo tentará minimizar os riscos com atendimento individual e humanizado pautado no respeito e atenção com os pacientes. O participante poderá, caso queira, simplesmente não responder determinada pergunta. Durante a etapa de exercício é provável que surja a produção de suor, e a sensação da elevação da frequência cardíaca que em alguns casos geram um desconforto. Contudo a intensidade das seções de exercício será em nível submáximo. Em alguns casos poderá haver sensação de enjôo e náuseas, sendo o exercício interrompido imediatamente. Lembrando que o Centro Hiperdia é equipado com todos os equipamentos de segurança nos casos de emergências clínicas (ambu, desfibriladores, carrinhos de emergência, laringoscópio e tubos orotraqueais) e possui carro à disposição para possíveis encaminhamentos hospitalares" e os seguintes benefícios: "O participante irá receber um relatório com os resultados dos seus testes e os resultados finais do estudo. Caso seja encontrada alguma anormalidade, quanto ao exame de sangue, teste cardiológico, composição corporal, na frequência cardíaca, pressão arterial em repouso ou exercício, assim como o comportamento térmico, o mesmo será encaminhado para um profissional específico para o tratamento. Os resultados do presente estudo também poderão auxiliar a compreender de que forma ocorrem os ajustes do exercício auxiliando o tratamento da HAS e do DM. Espera-se com a etapa do exercício promover algum emagrecimento, redução do consumo de medicamentos, normalização de alguns

parâmetros sanguíneos, aumento da capacidade física e de bem estar, aprimorando assim a autonomia do participante".

Comentários e Considerações sobre a Pesquisa:

O presente estudo pretende Verificar e analisar possíveis melhoras nos quadros de HAS e DM, sobretudo nos aspectos bioquímicos, cardiovasculares e neuropsicológicos em pacientes do Centro Hiperdia de Viçosa, Minas Gerais, submetidos a um programa de treinamento composto por atividades físicas aeróbicas e resistidas.Para tanto, propõe-se caso os pacientes que concordarem em participar do estudo e que assinarem o TCLE iniciarão a rotina de trabalho da seguinte forma: 1ª visita: nessa primeira etapa realizarse

-á a primeira avaliação por médico especialista em clínica médica e outro especialista em psiquiatria, também maiores esclarecimentos sobre os objetivos da pesquisa e sobre a metodologia da mesma. A avaliação constará de anamnese e exames clínico e psiquiátrico completos, além de avaliação antropométrica. Os voluntários serão pesados e medidos, com o mínimo de roupa, em balança mecânica antropométrica para cálculo de índice de massa corpórea (IMC) peso (Kg) / altura(m2) e medida da circunferência da cintura (CC). Esta avaliação terá os seguintes objetivos: -avaliação clínica, psiquiátrica e antropométrica - identificação da presença de algum fator que possa excluir o paciente da pesquisa - identificação de comorbidades associadas e detecção de fatores de risco, sinais e sintomas sugestivos de doenças cardiovasculares, pulmonares, metabólicas ou do aparelho locomotor. - identificação dos medicamentos de uso rotineiro - confirmação do sedentarismo do paciente - confirmação da não alteração do esquema farmacológico nas últimas 4 semanas - verificação da disponibilidade de horários para a realização dos protocolos de pesquisa - assinatura de termo de autorização para uso do prontuário agendamento de avaliação por cardiologista 2ª visita: esta segunda etapa é composta por avaliação por cardiologista clínico (Anexo IV), o qual irá indicar ou não a inclusão do paciente no protocolo de pesquisa. Aqueles que forem indicados realizarão a marcação do Teste de Esforço em esteira ergométrica (TE), conforme recomendado pela diretriz da Sociedade Brasileira de Cardiologia e de Medicina do Esporte, o qual possibilita detectar alterações que contra indiquem a participação do paciente no protocolo de pesquisa, como isquemia miocárdica, arritmias cardíacas e outros distúrbios hemodinâmicos e DCV, além de avaliar a capacidade funcional e a condição

aeróbica e consequentemente auxiliar na prescrição dos exercícios (CUNHA, 2013). Este TE será realizado por cardiologista especializado. 3ª visita: realização da primeira coleta dos exames de sangue em jejum, colocação do equipamento de MAPA para a primeira medida de 24h da PA, antes do início do protocolo de exercícios, um médico psiquiatra irá aplicar questionários neuropsicológicos com a finalidade de analisar o quadro cognitivo dos pacientes. Posteriormente os pacientes participantes, serão encaminhados para o laboratório Núcleo de Pesquisa e Estudos em Futebol (NUPEF), situado no departamento de Educação Física da UFV, para a realização do Mental Test and Training

System (MTTS). 4ª visita: prescrição do treinamento individualizado para os grupos de intervenção. Esta etapa será realizada pelo profissional de Educação Física. Superada as etapas anteriores, os pacientes iniciarão a rotina de exercícios supervisionados. Durante a realização dos exercícios haverá a presença do profissional em educação física, além de estagiários estudantes de graduação do curso de educação física da UFV. Ao longo de toda a sessão de exercícios haverá a presença de médicos e enfermeiros treinados no Centro Hiperdia para atuarem na segurança e no atendimento dos pacientes. Lembrando que o Centro é equipado com todos os equipamentos de segurança nos casos de emergências clínicas (ambulâncias, desfibriladores, carrinhos de emergência, laringoscópio e tubos orotraqueais) e possui carro à disposição para possíveis encaminhamentos hospitalares. 5ª visita: realização da segunda coleta dos exames de sangue em jejum, reaplicação dos testes cognitivos e do MTTS para a comparação dos resultados e colocação do equipamento de MAPA para a segunda medida de 24h da PA, após a realização do protocolo de exercícios.

Considerações sobre os Termos de apresentação obrigatória:

Os pesquisadores apresentaram os seguintes documentos: 1. Autorização do Departamento, 2. Questionários a serem aplicados, 3. Folha de Rosto, 4. Autorização do Centro Integrado Viva Vida e Hiperia Minas, 5. TCLE Modificado.

Todos os documentos estão de acordo com os procedimentos éticos para pesquisa com seres humanos prevista na Resolução 466/12.

Recomendações:

Abordagem, com relação à coleta de dados deve ser realizada de sorte a não gerar nenhum constrangimento, em face das perguntas e deve observar a dignidade humana e sexual das participantes da pesquisa. Deve ser enfática, a possibilidade, de se recusar a pesquisa a qualquer momento.

Conclusões ou Pendências e Lista de Inadequações:

Aprovado

Situação do Parecer:

Aprovado

Necessita Apreciação da CONEP:

Não

Considerações Finais a critério do CEP:

Ao término da pesquisa é necessária a apresentação do Relatório Final e após a aprovação desse, deve ser encaminhado o Comunicado de Término dos Estudos.

Projeto analisado durante a 7ª reunião de 2014, realizada nos dias 25 e 29 de agosto de 2014.

VICOSA, 15 de Outubro de 2014

Assinado por:

Patrícia Aurélia Del Nero (Coordenador)

Anexo C

Folha de produtividade

MESTRADO EM EDUCAÇÃO FÍSICA

Universidade Federal de Viçosa **Departamento de Educação Física**	**Universidade Federal de Juiz de Fora** **Faculdade de Educação Física e Desportos**

FOLHA DE ATIVIDADES DESENVOLVIDAS NO CURSO

1. PARTICIPAÇÃO EM ARTIGOS COMPLETOS PUBLICADOS EM PERIÓDICOS

TEIXEIRA, ROBSON BONOTO; MARINS, JOÃO CARLOS BOUZAS ; DE SÁ-JUNIOR, ANTÔNIO REIS ; DE CARVALHO, CRISTIANE JUNQUEIRA ; LADE, CARLOS GABRIEL ; RIZVANOV, ALBERT A. ; KIYASOV, ANDREY P. ; MUKHAMEDYAROV, MARAT A. ; PALOTÁS, ANDRÁS ; LIMA, LUCIANA MOREIRA . Psychological and Cognitive Profile of Hypertensive and Diabetic Patients. The Journal of Nervous and Mental Disease (Print) JCR, v. 203, p. 781-785, 2015.

Origem:
[ ] Trabalho originário de disciplina do mestrado: EFI 792
[x] Trabalho originário do texto da dissertação.
[ ] Trabalho originário de outras parcerias

TEIXEIRA, R. B.; MARINS, J. C. B. ; DE SA JUNIOR, A. R. ; DE CARVALHO, C. J. ; DA SILVA MOURA, T. A. ; LADE, C. G. ; RIZVANOV, A. A. ; KIYASOV, A. P. ; MUKHAMEDYAROV, M. A. ; ZEFIROV, A. L. ; PALOTAS, A. ; LIMA, L. M. . Improved cognitive, affective and anxiety measures in patients with chronic systemic disorders following structured physical activity. Diabetes & Vascular Disease Research JCR, v. 12, p. 445, 2015.

Origem:
[ ] Trabalho originário de disciplina do mestrado: EFI 792
[x] Trabalho originário do texto da dissertação.
[ ] Trabalho originário de outras parcerias

GUIMARÃES, FABIANA COSTA ; AMORIM, PAULO ROBERTO DOS SANTOS ; DOS REIS, FERNANDO FONSECA ; **BONOTO, ROBSON TEIXEIRA** ; DE OLIVEIRA, WEDERSON CANDIDO ; MOURA, TIAGO AUGUSTO DA SILVA ; DE ASSIS, CLÁUDIA LOURES ; PALOTÁS, ANDRÁS ; LIMA, LUCIANA MOREIRA . Physical Activity and Better Medication Compliance Improve Mini-Mental State Examination Scores in the Elderly. Dementia and Geriatric Cognitive Disorders (Online) JCR, v. 39, p. 25-31, 2015.

Origem:
[ ] Trabalho originário de disciplina do mestrado: EFI 792
[ ] Trabalho originário do texto da dissertação.
[x] Trabalho originário de outras parcerias

2. PARTICIPAÇÃO EM ARTIGOS ACEITOS EM PERIÓDICOS

Não há

3. PARTICIPAÇÃO EM ARTIGOS SUBMETIDOS EM PERIÓDICOS

AUTORES: Robson Bonoto Teixeira, João Carlos Bouzas Marins, Israel Teoldo Costa, Rocío Cupeiro, Marcelo Odilon Cabral de Andrade, Yuri de Lucas Xavier Martins, Pollyana de Rezende Castilho, Daniel Demétrio Magalhães, Luciana Moreira Lima
TÍTULO: Effects of exercise on cognitive function of hypertensive and diabetic valued at Mental test and training system (MTTS)
REVISTA: Human Moviment Science

Origem:
[ ] Trabalho originário de disciplina do mestrado: EFI 792
[x] Trabalho originário do texto da dissertação.
[ ] Trabalho originário de outras parcerias

AUTORES: Robson Bonoto Teixeira, Luciana Moreira Lima, Yuri de Lucas Xavier Martins, Carlos Gabriel de Lade, Gabriela Fernandes Lopes, Hamilton Henrique Teixeira Reis, João Carlos Bouzas Marins
TÍTULO: Efeito do exercício físico em variáveis antropométricas e na capacidade funcional de pacientes com diabetes tipo 2

REVISTA: Terapia Manual

Origem:
[x] Trabalho originário de disciplina do mestrado: EFI 616
[ ] Trabalho originário do texto da dissertação.
[ ] Trabalho originário de outras parcerias

4. LIVROS PUBLICADOS EM PERIÓDICOS

Não há

5. PARTICIPAÇÃO EM CAPÍTULO DE LIVROS PUBLICADOS

Não há

6. PARTICIPAÇÃO EM JORNAIS DE NOTÍCIAS OU REVISTAS

Não há

7. PARTICIPAÇÃO EM CONGRESSOS, SEMINÁRIOS, CURSOS, SIMPÓSIOS COMO PALESTRANTE

Evento: Aula prática de fisiologia 2 Faculdade de Viçosa (FDV)

Título: A avaliação do esforço em cicloergômetro
Data: 15 de maio de 2015
Local: Academia Via Campus
Órgão promotor: Faculdade de Viçosa (FDV)
Público estimado: 15 pessoas

Evento: Ciclo de palestras sobre saúde no Hiperdia
Título: Atividade física e diabetes
Data: 15 de dezembro de 2014
Local: Hiperdia Viçosa/MG
Órgão promotor: Hiperdia
Público estimado: 25 pessoas

8. RESUMOS PUBLICADOS EM ANAIS DE CONGRESSOS

TEIXEIRA, R. B.; Marins, B, C, J ; Oliveira, R, A, R ; Junior, M, J, R ; Lima, M, L . PRONTIDÃO PARA A PRÁTICA DE ATIVIDADE FÍSICA EM SERVIDORES PÚBLICOS. In: Simposio Internacional de ciência dos Esportes, 2014, São Paulo. Celafiscs, 2014.

Junior, M, J, R ; Oliveira, R, A, R ; **BONOTO,R.T** ; Tavares. D, D, F ; Marins, B, C, J . Prevalência de Fatores de Risco e Risco Cardiovascular em Professores da Educação Básica. In: 12 Congresso Sabincor de Cardiologia, 2014, Juiz de Fora. 12 Congresso Sabincor de Cardiologia, 2014.

BONOTO,R.T; Carvalho, J, C ; REIS, Hamilton Henrique Teixeira Reis ; Marins, B, C, J ; Lima, M, L . Perfil dos hipertensos no centro Hiperdia de Viçosa. In: 12 Congresso Sabincor, 2014, Juiz de Fora. 12 Congresso Sabincor de Cardiologia, 2014.

BONOTO,R.T; Junior, S, R, A ; Lade, G, C ; Carvalho, J, C ; LIMA, M. F. C. ; Lima, M, L . Correlação entre níveis depressivos e glicemia de jejum em pacientes diabéticos atendidos no hiperdia de Viçosa-MG participantes de um programa de atividade física. In: 12 Congresso Sabincor, 2014, Juiz de Fora. 12 Congresso Sabincor de cardiologia, 2014.

Lopes GF ; **BONOTO,R.T** ; Matias GG ; Coelho FM ; Lima JRP ; PEREIRA, E. T. . Sobrepeso e qualidade de vida em pacientes submetidos a hemodiálise. In: 13 Congresso Sabincor, 2015, Juiz de Fora. 13 Congresso Sabincor, 2015.

BONOTO,R.T; Marins, B, C, J ; Costa IT ; Andrade, C, O, M ; Yuri de Lucas Xavier Martins ; Lima, M, L . Mental Test and Training System. In: 13 Congresso Sabincor, 2015, Juiz de Fora. 13 Congresso Sabincor, 2015.

Vieira, BR ; Yuri de Lucas Xavier Martins ; Moreira SPL ; Lade, G,

C ; **BONOTO,R.T** ; Marins, B, C, J . Perfil antropométrico de pacientes hipertensos e diabéticos participantes do programa de exercícios supervisionados do Centro Hiperdia de Viçosa/MG. In: 13 Congresso Sabincor, 2015, Juiz de Fora. 13 Congresso Sabincor, 2015.

Yuri de Lucas Xavier Martins ; Lade, G, C ; **BONOTO,R.T** ; Vieira, BR ; Nascimento FR ; Amorim, S, R, P . Prevalência de dislipidemia em pacientes diabéticos participantes do programa de exercício do centro Hiperdia de Viçosa/MG. In: 13 Congresso Sabincor, 2015, Juiz de Fora. 13 congresso Sabincor, 2015.

9. VISITAS TÉCNICAS, INTERCÂMBIOS OU ESTÁGIOS

Instituição: Programa de pós-graduação Educação Física UFV
Data: 06 de março de 2015
Local: Hospital universitário
Órgão promotor: Programa de pós-graduação Educação Física UFV

10. ORIENTAÇÕES

Não há

11. PARTICIPAÇÃO EM BANCAS

Não há

12. AULAS MINISTRADAS DE GRADUAÇÃO NA UFV ou UFJF

Não há