

Importance of physical detraining in functional capacity of individuals with chronic peripheral arterial occlusive disease: a cross-sectional pilot study

Importância do destreino físico sobre a capacidade funcional em indivíduos com doença arterial obstrutiva crônica periférica: estudo transversal piloto

Mabel Marciela Ahner^{1,2}, Adamastor Humberto Pereira^{1,2}, Alexandre Araújo Pereira^{1,2}, Gabriel Alves Fonseca^{1,2}, Gabriel Pereira dos Reis Zubarán^{1,2}, Débora dos Santos Macedo^{1,2,3}, Eduardo Lima Garcia^{1,2}, Leandro Tolfo Franzoni^{1,2,3} 

Abstract

Background: Physical training is a well-established strategy for rehabilitation of the functional capacity of individuals with chronic peripheral arterial occlusive disease (PAOD). However, some individuals quit training after participating in a physical training program, undergoing detraining. There is scant literature on the effects of physical detraining in individuals with PAOD and it is therefore important to investigate the effects of this phenomenon. **Objectives:** The objective of this article was to evaluate the effects of physical detraining on functional capacity in individuals with PAOD. **Methods:** Cross-sectional study with 22 individuals. Participants were divided into two groups: a detraining group (DG) and a control group (CG). The distance covered in the 6-minute walk test (6MWTD) and the pain-free walking distance (PFWD) were evaluated. The PFWD is the distance covered until claudication begins, i.e., the distance covered without pain. **Results:** Mean age was 66 ± 8 in the DG and 67 ± 7 in the CG. There were no differences between the groups in either the 6MWTD or the PFWD ($p = 0.428$; $p = 0.537$, respectively). **Conclusions:** The present pilot study allows us to conclude that the functional capacity of individuals with PAOD who participated in a physical training program and subsequently underwent detraining was not superior in relation to individuals who did not participate in a physical training program. The results of the present study serve to encourage maintenance of physical exercise, since physical training is no longer effective if detraining occurs.

Keywords: exercise; peripheral arterial disease; intermittent claudication.

Resumo

Contexto: O treinamento físico é uma estratégia bem estabelecida para a reabilitação da capacidade funcional de indivíduos com doença arterial obstrutiva crônica periférica (DAOP). No entanto, após um programa de treinamento físico, alguns indivíduos podem descontinuar-lo, causando destreino. A literatura é escassa sobre os efeitos do destreino físico em indivíduos com DAOP; portanto, torna-se importante investigar os efeitos nessa temática.

Objetivos: Avaliar os efeitos do destreino físico sobre a capacidade funcional em indivíduos com DAOP.

Métodos: Estudo transversal com 22 indivíduos. Os participantes foram divididos em dois grupos: grupo destreino (GD), grupo controle (GC). Foram avaliadas a distância percorrida no teste de caminhada de 6 minutos (DTC6M) e a distância livre de dor claudicante (DLDC), a qual é referida pela distância percorrida até o início da claudicação, ou seja, sem dor. **Resultados:** A média da idade foi de 66 ± 8 para o GD e de 67 ± 7 para o GC. Tanto a DTC6M como a DLDC não apresentaram diferenças entre os grupos ($p = 0,428$ e $p = 0,537$, respectivamente). **Conclusões:** O presente estudo piloto permite concluir que indivíduos com DAOP que participaram de um programa de treinamento físico e posterior destreino não tiveram efeitos superiores na sua capacidade funcional em relação a indivíduos que não participaram de programa de treinamento físico. O resultado do presente estudo serve para incentivar a manutenção da prática de exercício físico, visto que o treinamento físico deixa de ser efetivo se ocorrer destreino.

Palavras-chave: exercício; doença arterial periférica; claudicação intermitente.

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¹ Universidade Federal do Rio Grande do Sul – UFRGS, Hospital de Clínicas de Porto Alegre – HCPA, Porto Alegre, RS, Brasil.

² Universidade Federal do Rio Grande do Sul – UFRGS, Hospital de Clínicas de Porto Alegre – HCPA, Ambulatório de Cirurgia Vascular, Porto Alegre, RS, Brasil.

³ Universidade Federal do Rio Grande do Sul – UFRGS, Programa de Pós-graduação em Ciências da Saúde: Cardiologia e Ciências Cardiovasculares, Porto Alegre, RS, Brasil. Financial support: None.

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■ INTRODUCTION

Functional capacity is reduced in chronic peripheral arterial occlusive disease (PAOD) because of the atherosclerotic process involving the peripheral arteries,¹ with consequent obstruction of the blood flow to the lower limbs, provoking the classic symptom known as intermittent claudication.² The shorter the distance an individual can walk before claudication sets in, i.e. free from pain, the worse the disease prognosis.³

Physical training is one of the most important tools for increasing the functional capacity of people with PAOD.⁴ The distance covered in a 6-minute walk test (6MWT) and the claudicant pain-free walking distance (PFWD) are important outcomes related to functional capacity.^{3,5} Several different studies have compared the effects of physical training on the 6MWT and PFWD, whether aerobic exercises, strength training, or a combination of the two, and with durations ranging from 8 to 16 weeks.⁶⁻¹⁰ However, after the intervention period, patients tend to give up on physical training.

Physical detraining raises questions about maintenance of the effects yielded by physical training, in terms of the 6MWT and PFWD achieved by patients with PAOD. However, there is a gap in the literature, which lacks studies investigating the effects of physical detraining in PAOD.¹¹⁻¹³ In view of this, the objective of the present study was to compare the effects of physical detraining on 6MWT and PFWD in patients with PAOD. The hypothesis raised is that individuals who participated in a physical training program but then underwent detraining would exhibit greater benefit than individuals who had not participated in the physical training program.

■ METHODS

Study design

This is a cross-sectional, case-control study. The participants were divided into two groups: a detraining group (DG), comprising individuals who had participated in a 12-week physical training program and then undergone detraining for at least 3 months up to a maximum of 36 months; and a control group (CG), comprising patients with PAOD who had not participated in a physical training program in the preceding 36 months.

Study setting and participants

The study was conducted at the Vascular Surgery Outpatient Clinic of a university hospital in southern Brazil, in 2018 and 2019. Patients over the age of 40 years with a diagnosis of intermittent claudication

were recruited. All participants should also have an ankle-brachial index (ABI) below 0.9. The exclusion criteria were: cardiovascular events that occurred less than 3 months before enrollment; uncontrolled severe hypertension (systolic blood pressure ≥ 180 mmHg or diastolic blood pressure ≥ 110 mmHg) and/or uncontrolled diabetes (glycemic index ≥ 290); critical lower limb ischemia; limiting lung disease; or any type of contraindication to the exercise test.

The study was approved by the local Research Ethics Committee (decision number 3.240.172) and conducted entirely in accordance with the ethical standards set out in the Helsinki Declaration. All patients provided written consent to participation before enrollment. One of the study groups (DG) comprised patients who had taken part in a randomized clinical trial that investigated the effects of 12 weeks of physical training on the functional capacity of individuals with PAOD.

Experimental procedures

Functional capacity – 6MWT and PFWD

Walking capacity was measured using the 6-minute walk test (6MWT) by a group of specialists, following American Thoracic Society guidelines.¹⁴ During the 6MWT, we used a visual analog scale (VAS)^{15,16} to measure pain in the lower limbs, and also administered the Borg subjective exertion scale.¹⁷ The test was conducted in a 30m corridor and patients were instructed to walk as far as possible in 6 minutes. Blood pressure and heart rate were measured before and after the test. Patients were asked about onset of pain and instructed to walk as rapidly as possible. The distance walked before onset of pain and the total distance walked were noted and expressed in meters.

Physical activity level

For the purposes of the present study, a simple questionnaire was administered covering physical activity levels. This instrument was based on the short form of the International Physical Activity Questionnaire (IPAQ).¹⁸ Patients were questioned about the number of days per week and the length of time, in minutes, for which they performed mild, moderate, and vigorous walking.

Possible biases

The sample was rigorously selected to minimize possible biases, with full patient history and clinical examination conducted by the team from the Lymphedema and Angiodysplasia Clinic. Additionally, all individuals who performed the 6MWT were assessed by the same researcher, to eliminate intra-examiner

variability, even though a protocol recommended in the literature was followed.¹⁴

Statistical analysis

Sample size was calculated to detect differences between groups of 60 meters (m) for 6MWT and 30 m for PFWD, with a standard deviation equal to the 6MWT difference to be detected, 80% power, and a 5% significance level, which resulted in 14 participants per group.⁷

The Shapiro Wilk and Levene tests were used to analyze normality and homogeneity of data respectively. Student's *t* test (unpaired) or the Mann-Whitney U test were used to analyze differences between groups for the main outcomes (6MWT and PFWD) and other continuous variables, and the chi-square test was used for categorical variables. Normally distributed data were expressed as means and standard deviations and non-normal data were expressed as medians and interquartile ranges. Data were analyzed using SPSS, version 20.0 (IBM, Corporation, Armonk, NY, United States). Results with $p < 0.05$ were considered statistically significant.

RESULTS

The study assessed 22 patients with PAOD, 11 in the DG and 11 in the CG. Table 1 lists data on the characteristics of the sample. It is important to point out that the groups were similar, with no statistically significant differences for age ($p = 0.719$), ABI ($p = 0.455$), or sex ($p = 0.258$). Figure 1 illustrates the process of patient recruitment, selection, and exclusion.

Figure 2 illustrates the main outcomes. There was no statistically significant difference in 6MWT between the two groups, with mean distances of 388 ± 111 m in the DG and 423 ± 87 m in the CG ($p = 0.428$). There was also no significant difference in PFWD between

the groups, with mean distances of 203 ± 138 m in the DG and 236 ± 104 m in the CG ($p = 0.537$). The 6MWT in the DG had been 445 ± 88 meters after the training period; i.e., after detraining there was a mean reduction of 57 ± 119 m ($p = 0.145$). In turn, the PFWD in the DG had been 214 ± 137 m after the training period; i.e., after detraining there was a mean reduction of 11 ± 37 m ($p = 0.341$). The mean duration of detraining was 19 ± 10 months.

Physical activity level

The DG had similar results to the CG for the number of days per week on which the patients engaged in mild walking (DG: 4.55 ± 2.50 ; CG: 4.36 ± 3.10 ; $p = 0.187$). While there was a 68 ± 149 min difference between the DG and CG in the time spent engaged in mild walking, the difference between the groups was not significant (DG: 128 ± 209 min; CG 60 ± 62 min, $p = 0.182$).

There was no significant difference between the DG and the CG in the number of days per week on which the patients engaged in moderate walking (DG: 4 ± 2.68 ; CG: 2 ± 1.44 ; $p = 0.055$). There was no significant difference between the groups in time engaged in moderate walking, (DG: 76 ± 79 min; CG: 62 ± 72 min, $p = 0.669$).

The groups had similar results for the number of days per week on which the patients engaged in vigorous walking (DG: 0.82 ± 1 ; CG: 0.73 ± 1.27 ; $p = 0.858$) and in the time in minutes engaged in vigorous walking (DG: 46 ± 76 min; CG: 24 ± 40 min; $p = 0.392$).

DISCUSSION

The initial hypothesis that individuals in the DG would exhibit benefits in relation to the CG was based on evidence on the positive effects of detraining on different parameters in other populations.¹¹⁻¹³ Additionally, physical training programs promote underlying motor

Table 1. Characteristics of the samples in both groups.

	DG (n = 11)	CG (n = 11)	p
Body mass (kg)	74±11	75±11	0.839
Height (cm)	167±7	170±9	0.385
BMI	27±4	26±3	0.389
Age (years)	66±8	67±7	0.719
ABI	0.66±0.20	0.73±0.22	0.455
Female sex (%)	5 (45)	2 (18)	0.170
Resting HR (bpm)	76±11	68±12	0.133
Systolic BP (mmHg)	142±25	143±11	0.874
Diastolic BP (mmHg)	76±12	76±6	0.982
Borg	3.27±2	3.64±2	0.676

DG = detraining group; CG = control group; BMI = body mass index; ABI = ankle-brachial index; HR = heart rate; BP = blood pressure; Borg = subjective perceived exertion scale. $p < 0.05$ indicates statistically significant difference.

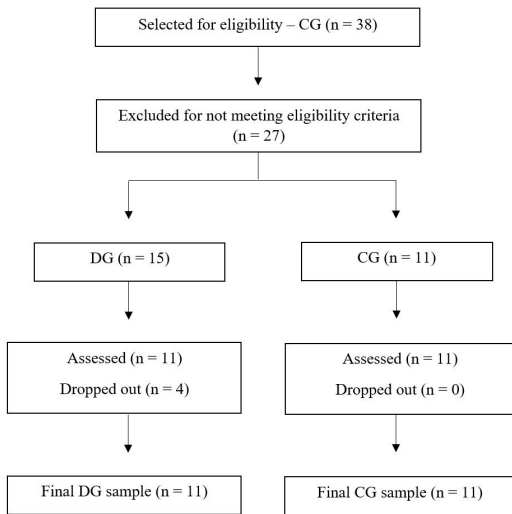


Figure 1. Study flow diagram. CG = control group; DG = detraining group.

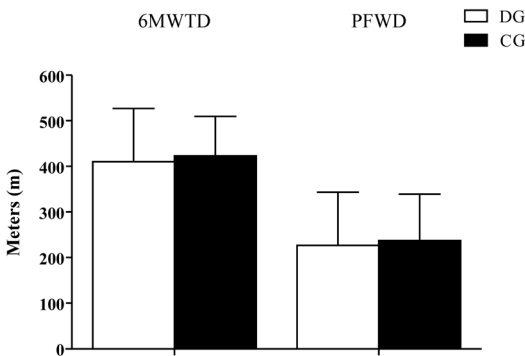


Figure 2. Distance covered in the 6-minute walk test and distance walked free from claudicant pain. 6MWT = 6-minute walk test distance; PFWD = pain free walk distance; DG = detraining group; CG = control group.

function and neuromuscular repertoire, which is why it was considered that individuals who had undergone detraining could have exhibited superior performance to those who had never engaged in physical training.^{4,6-8,10} Only McDermott et al.⁷ (in 2019) have investigated the durability of the effects of a supervised physical training program, but this cannot be considered detraining because the participants were monitored remotely by means of phone calls after the in-person physical training program and were encouraged to maintain their exercise routines. Even so, 6 months after the physical training program, these individuals' 6MWT and PFWD distances had fallen back to their baseline values.

Even though the present study did not detect any significant differences between the groups, it is important to emphasize that physical training is

widely recommended for patients with PAOD, with the objective of promoting increases in functional capacity and, consequently, improving walking performance.¹⁹ Implementation of remote follow-up strategies appears to be an option for maintenance of the benefits achieved during in-person physical training.²⁰ The data observed in the present study underscore the importance of ongoing participation in physical training programs or of planning for after the end of studies with exercise in order to maintain or further improve the outcomes assessed.^{21,22}

The mean difference of 57 m in the DG during the training period compared with after detraining is extremely relevant, since, even after a mean detraining period of 19 months, these individuals did not exhibit significant loss ($p = 0.145$). Compared with the CG, the DG had a mean difference of 35 m, which was not a significant difference, thereby confirming that the groups were similar. Gardner et al.²³ demonstrated that a mean difference of 60 m in the 6MWT is clinically relevant, i.e., trained individuals who undergo detraining have clinically relevant loss. Additionally, individuals who do not participate in training also have impaired functional capacity.

There was also no significant difference in PFWD between the DG and the CG ($p = 0.458$). From a functional point of view, this is the more important variable for PAOD patients, since reduced PFWD is reflected in reduction in daily activities of living, causing depression and worsening quality of life. A reduction of 30 m is considered clinically relevant in the literature.²³ Additionally, McDermott⁸ have shown that physical exercise is capable of improving PFWD to a similar extent to revascularization surgery.

The present study has limitations. The first is the small sample size, which is because this is a pilot study. The second is the mean duration of detraining, which was relatively long (19 ± 10 months) and had a large range. This could have the result that the expected effects were not manifest, because of the small sample with considerable heterogeneity. Moreover, the DG, which comprised individuals who had previously participated in a physical training program in a different study, only contained 11 people because four of the 15 people contacted dropped out before undergoing assessments. This is a significant limitation, since the sample size calculation defined the minimum number necessary as 14 individuals in each group; but there was no way of recruiting additional participants to the DG, because there were only 15 in total. One possible strategy for a future study could be to enroll more participants in the CG, with the objective of increasing the sample's power for statistical inference.

While the study has limitations, it also has strong points. To our knowledge, it is the first study to evaluate the effects of physical detraining on the functional capacity of individuals with PAOD. This is very important to guide clinical practice and find solutions to help patients remain physically active or participating in physical training programs.

This study is very important for the clinical practice of specialists, since it demonstrates that physical detraining provokes significant losses of the adaptations achieved by physical training. It is therefore important that specialists create strategies for patients with PAOD to encourage engagement and continuity in physical training programs.

CONCLUSIONS

This study assessed physical detraining in individuals with PAOD, comparing two groups. One group participated in a physical training program and then underwent detraining and the other did not take part in a physical training program and did not therefore undergo detraining. No significant differences were detected between these groups in 6MWT or PFW. However, it is important to point out that this study's findings confirm the idea that individuals with PAOD require ongoing attention after participating in a physical training program, including planning for continuation of physical training and engagement in a daily physical activity routine.

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Correspondence

Leandro Tolfo Franzoni
 Universidade Federal do Rio Grande do Sul – UFRGS
 Av. Lajeado, 33, apartamento 302 - Petrópolis
 CEP 90640-110 - Porto Alegre (RS), Brasil
 Tel.: +55 (51) 99911-5674
 E-mail: lfranzoni@hcpa.edu.br

Author information

MMA - Physical therapist, Research group Vascular e Exercício (VascuEx).
 AHP - Head, Ambulatório de Cirurgia Vascular, Hospital de Clínicas de Porto Alegre (HCPA), Universidade Federal do Rio Grande do Sul (UFRGS); Full professor, Faculdade de Medicina, UFRGS.
 AAP - Vascular MD, Ambulatório de Cirurgia Vascular (HCPA/UFRGS).
 GAF - Professor of Educação Física, Research group Vascular e Exercício (VascuEx).
 GPRZ - Scientific initiation fellow, Research group Vascular e Exercício (VascuEx).
 DSM - Physical therapist, Research group Vascular e Exercício (VascuEx).
 ELG - PhD in Medicina and Ciências Cirúrgicas; Coordinator, Research group Vascular e Exercício (VascuEx).
 LTF - PhD in progress in Cardiologia e Ciências Cardiovasculares, Universidade Federal do Rio Grande do Sul (UFRGS); Member, Research group Vascular e Exercício (VascuEx), Ambulatório de Cirurgia Vascular (HCPA/UFRGS).

Author contributions

Conception and design: MMA, LTF, ELG
 Analysis and interpretation: LTF, ELG
 Data collection: GPRZ, MMA, GAF
 Writing the article: LTF, ELG
 Critical revision of the article: AHP, AAP
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Resumo

Contexto: O treinamento físico é uma estratégia bem estabelecida para a reabilitação da capacidade funcional de indivíduos com doença arterial obstrutiva crônica periférica (DAOP). No entanto, após um programa de treinamento físico, alguns indivíduos podem descontinuá-lo, causando destreino. A literatura é escassa sobre os efeitos do destreino físico em indivíduos com DAOP; portanto, torna-se importante investigar os efeitos nessa temática.

Objetivos: Avaliar os efeitos do destreino físico sobre a capacidade funcional em indivíduos com DAOP.

Métodos: Estudo transversal com 22 indivíduos. Os participantes foram divididos em dois grupos: grupo destreino (GD), grupo controle (GC). Foram avaliadas a distância percorrida no teste de caminhada de 6 minutos (DTC6M) e a distância livre de dor claudicante (DLDC), a qual é referida pela distância percorrida até o início da claudicação, ou seja, sem dor. **Resultados:** A média da idade foi de 66±8 para o GD e de 67±7 para o GC. Tanto a DTC6M como a DLDC não apresentaram diferenças entre os grupos ($p = 0,428$ e $p = 0,537$, respectivamente). **Conclusões:** O presente estudo piloto permite concluir que indivíduos com DAOP que participaram de um programa de treinamento físico e posterior destreino não tiveram efeitos superiores na sua capacidade funcional em relação a indivíduos que não participaram de programa de treinamento físico. O resultado do presente estudo serve para incentivar a manutenção da prática de exercício físico, visto que o treinamento físico deixa de ser efetivo se ocorrer destreino.

Palavras-chave: exercício; doença arterial periférica; claudicação intermitente.

Abstract

Background: Physical training is a well-established strategy for rehabilitation of the functional capacity of individuals with chronic peripheral arterial occlusive disease (PAOD). However, some individuals quit training after participating in a physical training program, undergoing detraining. There is scant literature on the effects of physical detraining in individuals with PAOD and it is therefore important to investigate the effects of this phenomenon. **Objectives:** The objective of this article was to evaluate the effects of physical detraining on functional capacity in individuals with PAOD. **Methods:** Cross-sectional study with 22 individuals. Participants were divided into two groups: a detraining group (DG) and a control group (CG). The distance covered in the 6-minute walk test (6MWTD) and the pain-free walking distance (PFWD) were evaluated. The PFWD is the distance covered until claudication begins, i.e., the distance covered without pain. **Results:** Mean age was 66 ± 8 in the DG and 67 ± 7 in the CG. There were no differences between the groups in either the 6MWTD or the PFWD ($p = 0.428$; $p = 0.537$, respectively). **Conclusions:** The present pilot study allows us to conclude that the functional capacity of individuals with PAOD who participated in a physical training program and subsequently underwent detraining was not superior in relation to individuals who did not participate in a physical training program. The results of the present study serve to encourage maintenance of physical exercise, since physical training is no longer effective if detraining occurs.

Keywords: exercise; peripheral arterial disease; intermittent claudication.

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¹ Universidade Federal do Rio Grande do Sul – UFRGS, Hospital de Clínicas de Porto Alegre – HCPA, Porto Alegre, RS, Brasil.

² Universidade Federal do Rio Grande do Sul – UFRGS, Hospital de Clínicas de Porto Alegre – HCPA, Ambulatório de Cirurgia Vascular, Porto Alegre, RS, Brasil.

³ Universidade Federal do Rio Grande do Sul – UFRGS, Programa de Pós-graduação em Ciências da Saúde: Cardiologia e Ciências Cardiovasculares, Porto Alegre, RS, Brasil. Fonte de financiamento: Nenhuma.

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■ INTRODUÇÃO

A doença arterial obstrutiva crônica periférica (DAOP) reduz a capacidade funcional, em função do processo aterosclerótico das artérias periféricas¹, com consequente obstrução do fluxo sanguíneo para os membros inferiores, a qual promove um sintoma clássico conhecido como claudicação intermitente². Quanto menor a distância percorrida até apresentar claudicação, ou seja, livre de dor, pior o prognóstico da doença³.

O treinamento físico é um dos principais instrumentos para aumentar a capacidade funcional de pessoas com DAOP⁴. A distância percorrida no teste de caminhada de 6 minutos (DTC6M), bem como a distância livre de dor claudicante (DLDC), são importantes desfechos relacionados à capacidade funcional^{3,5}. Diferentes estudos compararam os efeitos do treinamento físico, seja aeróbico, de força, ou combinado, com duração entre 8 e 16 semanas sobre a DTC6M e a DLDC⁶⁻¹⁰. No entanto, após o tempo de intervenção, geralmente os pacientes descontinuam o programa de treinamento físico.

O destreinamento físico acaba gerando um questionamento sobre a manutenção dos efeitos gerados pelo treinamento físico em relação a DTC6M e DLDC nos pacientes com DAOP. No entanto, há uma lacuna na literatura em termos de estudos que investigam os efeitos do destreinamento físico em DAOP¹¹⁻¹³. Diante disso, o objetivo do presente estudo foi comparar os efeitos do destreinamento físico sobre a DTC6M e a DLDC em pacientes com DAOP. A hipótese do presente estudo é que indivíduos que participaram de um programa de treinamento físico e experimentaram destreinamento teriam maiores benefícios quando comparados a indivíduos que não realizaram um programa de treinamento físico.

■ MÉTODOS

Desenho do estudo

Trata-se de um estudo transversal caso-controle. Os participantes foram divididos em dois grupos: grupo destreinamento (GD), no qual foram incluídos indivíduos que participaram de 12 semanas de treinamento físico e tiveram destreinamento de pelo menos 3 meses e máximo de 36 meses; grupo controle (GC), composto por pacientes com DAOP que não participaram de programa de treinamento físico nos últimos 36 meses.

Local do estudo e participantes

O presente estudo foi realizado no Ambulatório de Cirurgia Vascular de um hospital universitário do sul do

Brasil, entre 2018 e 2019. Foram recrutados pacientes acima dos 40 anos com diagnóstico de claudicação intermitente. Além disso, todos os participantes deveriam apresentar índice tornozelo-braço (ITB) abaixo de 0,9. Os critérios de exclusão foram: eventos cardiovasculares que ocorreram menos de 3 meses antes da inclusão; hipertensão grave não controlada (pressão arterial sistólica ≥ 180 mmHg ou pressão arterial diastólica ≥ 110 mmHg) e/ou diabetes não controlada (índice glicêmico ≥ 290); isquemia crítica de membros inferiores; doença pulmonar limitante; e qualquer contraindicação para a realização do teste com exercício.

O estudo foi aprovado pelo comitê de ética em pesquisa local (parecer nº 3.240.172) e conduzido inteiramente de acordo com os padrões éticos estabelecidos na Declaração de Helsinque. Todos os pacientes forneceram consentimento por escrito para participação antes da inscrição. Parte dos pacientes do estudo (GD) fizeram parte de um ensaio clínico randomizado que investigou o efeito de 12 semanas de treinamento físico sobre a capacidade funcional de indivíduos com DAOP.

Procedimento experimental

Capacidade funcional – DTC6M e DLDC

A capacidade de caminhada foi medida pelo teste de caminhada de 6 minutos (TC6M) por um grupo de especialistas, de acordo com as diretrizes do *American Thoracic Society*¹⁴. Durante o TC6M, usamos uma escala visual analógica (EVA)^{15,16} para medir a dor nos membros inferiores, bem como a escala de sensação subjetiva ao esforço de Borg¹⁷. O teste foi realizado em um corredor de 30 metros, onde cada paciente foi orientado a caminhar a maior distância possível durante 6 minutos. A pressão arterial e a frequência cardíaca foram medidas antes e depois do teste. Os pacientes foram questionados sobre o início da dor e orientados a caminhar o mais rapidamente possível. A distância percorrida até o início da dor e a distância total foram registradas e expressas em metros.

Nível de atividade física

No presente estudo, foi utilizado um questionário simples sobre nível de atividade física, baseado no *International Physical Activity Questionnaire* (IPAQ) versão curta¹⁸. Os pacientes foram arguidos sobre o número de dias da semana, bem como o tempo, em minutos, em que realizaram caminhada leve, moderada e vigorosa.

Possíveis vieses

Para minimizar possíveis vieses, a amostra foi rigorosamente selecionada, com uma anamnese

completa, e com exame clínico realizado pela equipe do Ambulatório de Cirurgia Vascular. Complementarmente, todos indivíduos submetidos ao TC6M foram avaliados pelo mesmo pesquisador, para evitar variabilidade entre avaliadores, mesmo que fosse seguido o protocolo preconizado pela literatura¹⁴.

Análise estatística

Para detectar uma diferença de 60 metros (m) para a DTC6 entre os grupos, e 30 m para a DLDC, com desvio padrão igual à diferença a ser detectada para a DTC6, com poder de 80% e nível de significância de 5%, o tamanho da amostra calculado foi de 14 para cada grupo⁷.

Os testes de Shapiro Wilk e Levene foram utilizados para analisar a normalidade e a homogeneidade dos dados, respectivamente. Para analisar as diferenças entre os grupos, foram utilizados o teste *t* de Student (não pareado) ou o teste de Mann-Whitney U para os desfechos principais (DTC6M e DLDC) e demais variáveis contínuas, e o teste de qui-quadrado para as variáveis categóricas. Os dados foram apresentados por meio de médias e desvio padrão caso apresentassem distribuição normal, ou mediana e intervalo interquartil, caso contrário. Os dados foram analisados por meio do *software* SPSS versão 20.0 (IBM, Corporation, Armonk, NY, EUA). Os valores de $p < 0,05$ foram considerados estatisticamente significativos.

RESULTADOS

O presente estudo avaliou 22 pacientes com DAOP, sendo que 11 faziam parte do GD e 11 do GC. Os dados de caracterização da amostra estão expostos na Tabela 1. Importante destacar que os grupos foram semelhantes, sem apresentar diferenças estatisticamente significativas para idade ($p = 0,719$), ITB ($p = 0,455$) e gênero ($p = 0,258$). A Figura 1 expressa o processo

de recrutamento e seleção dos participantes, bem como de exclusão.

Os desfechos principais estão expressos na Figura 2. A DTC6M não apresentou diferença estatisticamente significativa entre os dois grupos, com valor médio de 388 ± 111 m para o GD e de 423 ± 87 m para o GC ($p = 0,428$). A DLDC também não apresentou diferença significativa entre os grupos, com um valor médio de 203 ± 138 m para o GD e de 236 ± 104 m para o GC ($p = 0,537$). O valor da DTC6M para o GD após o período de treinamento foi de 445 ± 88 metros, ou seja, após destreino houve uma redução média de 57 ± 119 m ($p = 0,145$). O valor de DLDC para o GD após o período de treinamento foi de 214 ± 137 m, ou seja, após destreino houve redução média de 11 ± 37 m ($p = 0,341$). O tempo médio de destreino foi de 19 ± 10 meses.

Nível de atividade física

O GD apresentou resultados semelhantes, comparado ao GC, quanto ao número de dias da semana em que os pacientes praticavam caminhada leve (GD: $4,55 \pm 2,50$; GC: $4,36 \pm 3,10$; $p = 0,187$). Apesar da diferença de 68 ± 149 min entre o GD e o GC em relação ao tempo praticado de caminhada leve, os grupos não apresentaram diferença significativa (GD: 128 ± 209 min; GC 60 ± 62 min, $p = 0,182$).

O GD não apresentou diferença significativa, comparado ao GC, quanto ao número de dias da semana em que os pacientes praticavam caminhada moderada (GD: $4 \pm 2,68$; GC: $2 \pm 1,44$; $p = 0,055$). Em relação ao tempo praticado de caminhada moderada, os grupos não apresentaram diferença significativa (GD: 76 ± 79 min; GC: 62 ± 72 min, $p = 0,669$).

Ambos os grupos apresentaram resultados semelhantes quanto ao número de dias da semana em que os pacientes praticavam caminhada vigorosa

Tabela 1. Características da amostra para ambos os grupos.

	GD (n = 11)	GC (n = 11)	p
Massa corporal (kg)	74±11	75±11	0,839
Altura (cm)	167±7	170±9	0,385
IMC	27±4	26±3	0,389
Idade (anos)	66±8	67±7	0,719
ITB	0,66±0,20	0,73±0,22	0,455
Gênero feminino (%)	5 (45)	2 (18)	0,170
FC repouso (bpm)	76±11	68±12	0,133
PA sistólica (mmHg)	142±25	143±11	0,874
PA diastólica (mmHg)	76±12	76±6	0,982
Borg	3,27±2	3,64±2	0,676

GD = grupo destreino; GC = grupo controle; IMC = índice de massa corporal; ITB = índice tornozelo-braço; FC = frequência cardíaca; PA = pressão arterial; Borg = escala de sensação subjetiva ao esforço. $p < 0,05$ indica diferença estatisticamente significativa.

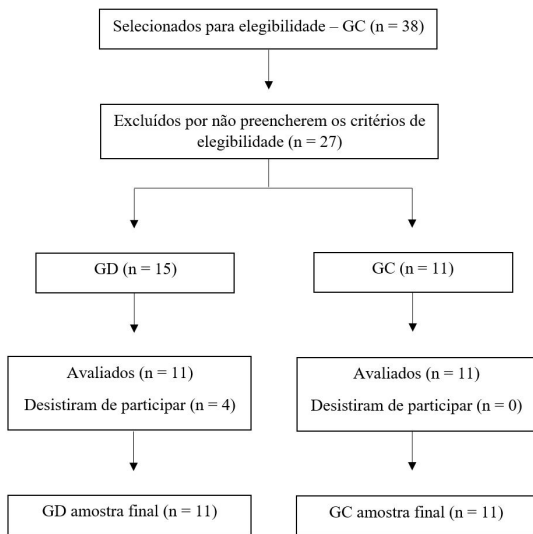


Figura 1. Fluxograma do estudo. GC = grupo controle; GD = grupo destreino.

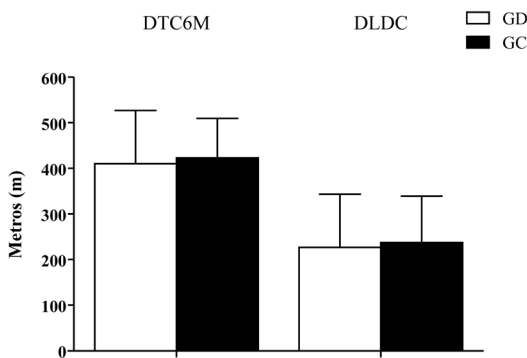


Figura 2. Distância percorrida no teste de caminhada de 6 minutos e distância livre de dor claudicante. DTC6M = distância percorrida no teste de caminhada de 6 minutos; DLDC = distância livre de dor claudicante; GD = grupo destreino; GC = grupo controle.

(GD: $0,82 \pm 1$; GC: $0,73 \pm 1,27$; $p = 0,858$), e também quanto ao tempo de caminhada vigorosa em minutos (GD: 46 ± 76 min; GC: 24 ± 40 min; $p = 0,392$).

DISCUSSÃO

A hipótese inicial de que os indivíduos do GD apresentariam benefícios em relação ao GC se dá em função de algumas evidências a respeito dos efeitos positivos do destreino sobre diferentes parâmetros em outras populações¹¹⁻¹³. Além disso, um programa de treinamento físico proporciona base motora e repertório neuromuscular, razão pela qual os indivíduos submetidos a destreino podem apresentar desempenho superior comparados àqueles que nunca realizaram treinamento físico^{4,6-8,10}. Apenas McDermott et al.⁷, em 2019, investigaram a durabilidade

dos efeitos de um programa de treinamento físico supervisionado, mas aqui não se pode considerar destreino, pois os indivíduos eram monitorados à distância ao final do programa presencial de treinamento físico, por meio de ligações, e encorajados a manter a rotina de exercícios. Mesmo assim, 6 meses após o treinamento físico, os indivíduos reduziram valores de DTC6M e DLDC, retomando os valores basais.

Mesmo que o presente estudo não tenha apresentado diferenças significativas entre os grupos, é importante destacar que o treinamento físico é amplamente recomendado para pacientes com DAOP, com a finalidade de promover aumento da capacidade funcional e, conseqüentemente, melhorar a performance da marcha¹⁹. A implementação de estratégias de seguimento à distância parece ser uma alternativa para a manutenção dos benefícios adquiridos durante o treinamento físico presencial²⁰. Os dados encontrados no presente estudo reforçam que a permanência em programas de treinamento físico ou o planejamento após o término de estudos com exercício são importantes para se manter, ou melhorar ainda mais, os desfechos avaliados^{21,22}.

A diferença média de 57 m para o GD em relação ao período de treinamento comparado ao destreino é extremamente relevante, pois, mesmo após um período médio de destreino de 19 meses, os indivíduos não apresentaram perda significativa ($p = 0,145$). Em comparação ao GC, o GD possui uma diferença média de 35 m, sem diferença significativa, comprovando assim que os grupos eram semelhantes. Gardner et al.²³ demonstraram que uma diferença média de 60 m para a DTC6M é clinicamente relevante, ou seja, indivíduos treinados que sofrem destreino têm uma perda clinicamente relevante. Além disso, indivíduos que não realizam treinamento também apresentam prejuízo na capacidade funcional.

A DLDC também não apresentou diferenças significativas entre o GD e o GC ($p = 0,458$). Essa é a variável mais importante para a DAOP, do ponto de vista funcional, pois reduzir a DLDC gera redução nas atividades de vida diária, causando depressão e piorando a qualidade de vida. Uma redução clinicamente relevante de 30 m é considerada pela literatura²³. Além disso, McDermott⁸ demonstraram que o exercício físico é capaz de melhorar a DLDC, assim como a cirurgia de revascularização.

O presente estudo possui limitações: a primeira é o pequeno tamanho da amostra, por se tratar de um estudo piloto; a segunda é o tempo médio de destreino, o qual foi relativamente grande (19 ± 10 meses), com uma variabilidade alta. Isso pode fazer com que os efeitos esperados não se expressem, por tratar-se de uma pequena amostra com grande heterogeneidade.

Além disso, o GD, o qual participou previamente de um programa de treinamento físico em outro estudo, foi composto por 11 indivíduos, visto que, dos 15 contatados, quatro desistiram de fazer as avaliações. Isso é uma grande limitação, pois o cálculo amostral previu um número necessário de 14 indivíduos para cada grupo; no entanto, não tivemos como incluir mais participantes no GD, visto que tínhamos apenas 15 no total. Uma possível estratégia para um estudo futuro será incluir mais participantes no GC, com a finalidade de aumentar o poder da amostra de inferência estatística.

Apesar de o estudo possuir limitações, também possui méritos. Segundo nosso conhecimento, este é o primeiro estudo que avaliou os efeitos do destreino físico sobre a capacidade funcional de indivíduos com DAOP. Isso é muito importante para guiar a prática clínica e encontrar alternativas para que os pacientes se mantenham fisicamente ativos ou inseridos em programas de treinamento físico.

O presente estudo é fundamental para a prática clínica do especialista, ao demonstrar que o destreino físico promove perdas significativas nas adaptações geradas pelo treinamento físico. Portanto, é importante que o especialista crie estratégias de engajamento e continuidade em programas de treinamento físico para os pacientes com DAOP.

■ CONCLUSÃO

O presente estudo avaliou o destreino físico em indivíduos com DAOP comparando dois grupos, um que participou de um programa de treinamento físico e realizou destreino e outro que não participou de um programa de treinamento físico e, consequentemente, não realizou destreino. Não foram encontradas diferenças significativas entre os grupos para a DTC6M e a DLDC. Apesar disso, é importante ressaltar que os achados do presente estudo reforçam a ideia de que, após a participação em um programa de treinamento físico, os indivíduos com DAOP merecem atenção, desde o planejamento para a continuação do treinamento físico até o engajamento em uma rotina de atividade física diária.

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Correspondência

Leandro Tolfo Franzoni
 Universidade Federal do Rio Grande do Sul – UFRGS
 Av. Lajeado, 33, apartamento 302 - Petrópolis
 CEP 90640-110 - Porto Alegre (RS), Brasil
 Tel.: (51) 99911-5674
 E-mail: lfranzoni@hcpa.edu.br

Informações sobre os autores

MMA - Fisioterapeuta, Grupo de Pesquisa de Vascular e Exercício (VascuEx).
 AHP - Chefe, Ambulatório de Cirurgia Vascular (HCPA/UFRGS); Professor titular, Faculdade de Medicina, UFRGS.
 AAP - Médico vascular, Ambulatório de Cirurgia Vascular (HCPA/UFRGS).
 GAF - Professor de Educação Física, Grupo de pesquisa Vascular e Exercício (VascuEx).
 GPRZ - Bolsista de iniciação científica, Grupo de pesquisa Vascular e Exercício (VascuEx).
 DSM - Fisioterapeuta, Grupo de pesquisa Vascular e Exercício (VascuEx).
 ELG - Doutor em Medicina e Ciências Cirúrgicas; Coordenador, Grupo de pesquisa Vascular e Exercício (VascuEx).
 LTF - Aluno de doutorado em Cardiologia e Ciências Cardiovasculares, Universidade Federal do Rio Grande do Sul (UFRGS); Membro, Grupo de pesquisa Vascular e Exercício (VascuEx), Ambulatório de Cirurgia Vascular (HCPA/UFRGS).

Contribuições dos autores

Concepção e desenho do estudo: MMA, LTF, ELG
 Análise e interpretação dos dados: LTF, ELG
 Coleta de dados: GPRZ, MMA, GAF
 Redação do artigo: LTF, ELG
 Revisão crítica do texto: AHP, AAP
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 Análise estatística: LTF
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Importance of physical detraining in functional capacity of individuals with chronic peripheral arterial occlusive disease: a cross-sectional pilot study

Importância do destreino físico sobre a capacidade funcional em indivíduos com doença arterial obstrutiva crônica periférica: estudo transversal piloto

Mabel Marciela Ahner^{1,2}, Adamastor Humberto Pereira^{1,2}, Alexandre Araújo Pereira^{1,2}, Gabriel Alves Fonseca^{1,2}, Gabriel Pereira dos Reis Zubarán^{1,2}, Débora dos Santos Macedo^{1,2,3}, Eduardo Lima Garcia^{1,2}, Leandro Tolfo Franzoni^{1,2,3} 

Abstract

Background: Physical training is a well-established strategy for rehabilitation of the functional capacity of individuals with chronic peripheral arterial occlusive disease (PAOD). However, some individuals quit training after participating in a physical training program, undergoing detraining. There is scant literature on the effects of physical detraining in individuals with PAOD and it is therefore important to investigate the effects of this phenomenon. **Objectives:** The objective of this article was to evaluate the effects of physical detraining on functional capacity in individuals with PAOD. **Methods:** Cross-sectional study with 22 individuals. Participants were divided into two groups: a detraining group (DG) and a control group (CG). The distance covered in the 6-minute walk test (6MWTD) and the pain-free walking distance (PFWD) were evaluated. The PFWD is the distance covered until claudication begins, i.e., the distance covered without pain. **Results:** Mean age was 66 ± 8 in the DG and 67 ± 7 in the CG. There were no differences between the groups in either the 6MWTD or the PFWD ($p = 0.428$; $p = 0.537$, respectively). **Conclusions:** The present pilot study allows us to conclude that the functional capacity of individuals with PAOD who participated in a physical training program and subsequently underwent detraining was not superior in relation to individuals who did not participate in a physical training program. The results of the present study serve to encourage maintenance of physical exercise, since physical training is no longer effective if detraining occurs.

Keywords: exercise; peripheral arterial disease; intermittent claudication.

Resumo

Contexto: O treinamento físico é uma estratégia bem estabelecida para a reabilitação da capacidade funcional de indivíduos com doença arterial obstrutiva crônica periférica (DAOP). No entanto, após um programa de treinamento físico, alguns indivíduos podem descontinuar-lo, causando destreino. A literatura é escassa sobre os efeitos do destreino físico em indivíduos com DAOP; portanto, torna-se importante investigar os efeitos nessa temática.

Objetivos: Avaliar os efeitos do destreino físico sobre a capacidade funcional em indivíduos com DAOP.

Métodos: Estudo transversal com 22 indivíduos. Os participantes foram divididos em dois grupos: grupo destreino (GD), grupo controle (GC). Foram avaliadas a distância percorrida no teste de caminhada de 6 minutos (DTC6M) e a distância livre de dor claudicante (DLDC), a qual é referida pela distância percorrida até o início da claudicação, ou seja, sem dor. **Resultados:** A média da idade foi de 66 ± 8 para o GD e de 67 ± 7 para o GC. Tanto a DTC6M como a DLDC não apresentaram diferenças entre os grupos ($p = 0,428$ e $p = 0,537$, respectivamente). **Conclusões:** O presente estudo piloto permite concluir que indivíduos com DAOP que participaram de um programa de treinamento físico e posterior destreino não tiveram efeitos superiores na sua capacidade funcional em relação a indivíduos que não participaram de programa de treinamento físico. O resultado do presente estudo serve para incentivar a manutenção da prática de exercício físico, visto que o treinamento físico deixa de ser efetivo se ocorrer destreino.

Palavras-chave: exercício; doença arterial periférica; claudicação intermitente.

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¹ Universidade Federal do Rio Grande do Sul – UFRGS, Hospital de Clínicas de Porto Alegre – HCPA, Porto Alegre, RS, Brasil.

² Universidade Federal do Rio Grande do Sul – UFRGS, Hospital de Clínicas de Porto Alegre – HCPA, Ambulatório de Cirurgia Vascular, Porto Alegre, RS, Brasil.

³ Universidade Federal do Rio Grande do Sul – UFRGS, Programa de Pós-graduação em Ciências da Saúde: Cardiologia e Ciências Cardiovasculares, Porto Alegre, RS, Brasil. Financial support: None.

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■ INTRODUCTION

Functional capacity is reduced in chronic peripheral arterial occlusive disease (PAOD) because of the atherosclerotic process involving the peripheral arteries,¹ with consequent obstruction of the blood flow to the lower limbs, provoking the classic symptom known as intermittent claudication.² The shorter the distance an individual can walk before claudication sets in, i.e. free from pain, the worse the disease prognosis.³

Physical training is one of the most important tools for increasing the functional capacity of people with PAOD.⁴ The distance covered in a 6-minute walk test (6MWT) and the claudicant pain-free walking distance (PFWD) are important outcomes related to functional capacity.^{3,5} Several different studies have compared the effects of physical training on the 6MWT and PFWD, whether aerobic exercises, strength training, or a combination of the two, and with durations ranging from 8 to 16 weeks.⁶⁻¹⁰ However, after the intervention period, patients tend to give up on physical training.

Physical detraining raises questions about maintenance of the effects yielded by physical training, in terms of the 6MWT and PFWD achieved by patients with PAOD. However, there is a gap in the literature, which lacks studies investigating the effects of physical detraining in PAOD.¹¹⁻¹³ In view of this, the objective of the present study was to compare the effects of physical detraining on 6MWT and PFWD in patients with PAOD. The hypothesis raised is that individuals who participated in a physical training program but then underwent detraining would exhibit greater benefit than individuals who had not participated in the physical training program.

■ METHODS

Study design

This is a cross-sectional, case-control study. The participants were divided into two groups: a detraining group (DG), comprising individuals who had participated in a 12-week physical training program and then undergone detraining for at least 3 months up to a maximum of 36 months; and a control group (CG), comprising patients with PAOD who had not participated in a physical training program in the preceding 36 months.

Study setting and participants

The study was conducted at the Vascular Surgery Outpatient Clinic of a university hospital in southern Brazil, in 2018 and 2019. Patients over the age of 40 years with a diagnosis of intermittent claudication

were recruited. All participants should also have an ankle-brachial index (ABI) below 0.9. The exclusion criteria were: cardiovascular events that occurred less than 3 months before enrollment; uncontrolled severe hypertension (systolic blood pressure \geq 180 mmHg or diastolic blood pressure \geq 110 mmHg) and/or uncontrolled diabetes (glycemic index \geq 290); critical lower limb ischemia; limiting lung disease; or any type of contraindication to the exercise test.

The study was approved by the local Research Ethics Committee (decision number 3.240.172) and conducted entirely in accordance with the ethical standards set out in the Helsinki Declaration. All patients provided written consent to participation before enrollment. One of the study groups (DG) comprised patients who had taken part in a randomized clinical trial that investigated the effects of 12 weeks of physical training on the functional capacity of individuals with PAOD.

Experimental procedures

Functional capacity – 6MWT and PFWD

Walking capacity was measured using the 6-minute walk test (6MWT) by a group of specialists, following American Thoracic Society guidelines.¹⁴ During the 6MWT, we used a visual analog scale (VAS)^{15,16} to measure pain in the lower limbs, and also administered the Borg subjective exertion scale.¹⁷ The test was conducted in a 30m corridor and patients were instructed to walk as far as possible in 6 minutes. Blood pressure and heart rate were measured before and after the test. Patients were asked about onset of pain and instructed to walk as rapidly as possible. The distance walked before onset of pain and the total distance walked were noted and expressed in meters.

Physical activity level

For the purposes of the present study, a simple questionnaire was administered covering physical activity levels. This instrument was based on the short form of the International Physical Activity Questionnaire (IPAQ).¹⁸ Patients were questioned about the number of days per week and the length of time, in minutes, for which they performed mild, moderate, and vigorous walking.

Possible biases

The sample was rigorously selected to minimize possible biases, with full patient history and clinical examination conducted by the team from the Lymphedema and Angiodysplasia Clinic. Additionally, all individuals who performed the 6MWT were assessed by the same researcher, to eliminate intra-examiner

variability, even though a protocol recommended in the literature was followed.¹⁴

Statistical analysis

Sample size was calculated to detect differences between groups of 60 meters (m) for 6MWT and 30 m for PFWD, with a standard deviation equal to the 6MWT difference to be detected, 80% power, and a 5% significance level, which resulted in 14 participants per group.⁷

The Shapiro Wilk and Levene tests were used to analyze normality and homogeneity of data respectively. Student's *t* test (unpaired) or the Mann-Whitney U test were used to analyze differences between groups for the main outcomes (6MWT and PFWD) and other continuous variables, and the chi-square test was used for categorical variables. Normally distributed data were expressed as means and standard deviations and non-normal data were expressed as medians and interquartile ranges. Data were analyzed using SPSS, version 20.0 (IBM, Corporation, Armonk, NY, United States). Results with $p < 0.05$ were considered statistically significant.

RESULTS

The study assessed 22 patients with PAOD, 11 in the DG and 11 in the CG. Table 1 lists data on the characteristics of the sample. It is important to point out that the groups were similar, with no statistically significant differences for age ($p = 0.719$), ABI ($p = 0.455$), or sex ($p = 0.258$). Figure 1 illustrates the process of patient recruitment, selection, and exclusion.

Figure 2 illustrates the main outcomes. There was no statistically significant difference in 6MWT between the two groups, with mean distances of 388 ± 111 m in the DG and 423 ± 87 m in the CG ($p = 0.428$). There was also no significant difference in PFWD between

the groups, with mean distances of 203 ± 138 m in the DG and 236 ± 104 m in the CG ($p = 0.537$). The 6MWT in the DG had been 445 ± 88 meters after the training period; i.e., after detraining there was a mean reduction of 57 ± 119 m ($p = 0.145$). In turn, the PFWD in the DG had been 214 ± 137 m after the training period; i.e., after detraining there was a mean reduction of 11 ± 37 m ($p = 0.341$). The mean duration of detraining was 19 ± 10 months.

Physical activity level

The DG had similar results to the CG for the number of days per week on which the patients engaged in mild walking (DG: 4.55 ± 2.50 ; CG: 4.36 ± 3.10 ; $p = 0.187$). While there was a 68 ± 149 min difference between the DG and CG in the time spent engaged in mild walking, the difference between the groups was not significant (DG: 128 ± 209 min; CG 60 ± 62 min, $p = 0.182$).

There was no significant difference between the DG and the CG in the number of days per week on which the patients engaged in moderate walking (DG: 4 ± 2.68 ; CG: 2 ± 1.44 ; $p = 0.055$). There was no significant difference between the groups in time engaged in moderate walking, (DG: 76 ± 79 min; CG: 62 ± 72 min, $p = 0.669$).

The groups had similar results for the number of days per week on which the patients engaged in vigorous walking (DG: 0.82 ± 1 ; CG: 0.73 ± 1.27 ; $p = 0.858$) and in the time in minutes engaged in vigorous walking (DG: 46 ± 76 min; CG: 24 ± 40 min; $p = 0.392$).

DISCUSSION

The initial hypothesis that individuals in the DG would exhibit benefits in relation to the CG was based on evidence on the positive effects of detraining on different parameters in other populations.¹¹⁻¹³ Additionally, physical training programs promote underlying motor

Table 1. Characteristics of the samples in both groups.

	DG (n = 11)	CG (n = 11)	p
Body mass (kg)	74±11	75±11	0.839
Height (cm)	167±7	170±9	0.385
BMI	27±4	26±3	0.389
Age (years)	66±8	67±7	0.719
ABI	0.66±0.20	0.73±0.22	0.455
Female sex (%)	5 (45)	2 (18)	0.170
Resting HR (bpm)	76±11	68±12	0.133
Systolic BP (mmHg)	142±25	143±11	0.874
Diastolic BP (mmHg)	76±12	76±6	0.982
Borg	3.27±2	3.64±2	0.676

DG = detraining group; CG = control group; BMI = body mass index; ABI = ankle-brachial index; HR = heart rate; BP = blood pressure; Borg = subjective perceived exertion scale. $p < 0.05$ indicates statistically significant difference.

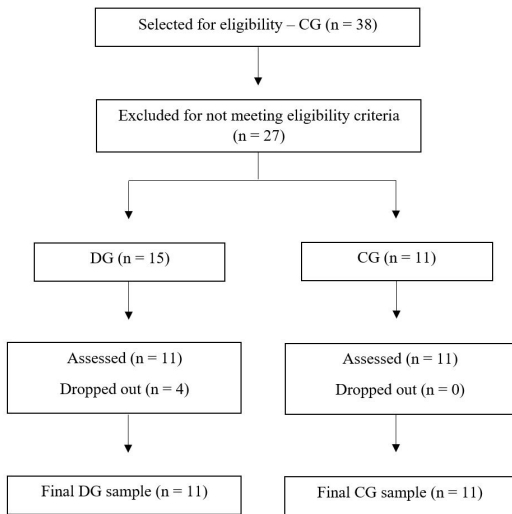


Figure 1. Study flow diagram. CG = control group; DG = detraining group.

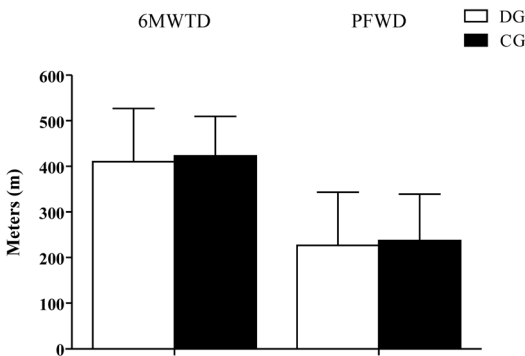


Figure 2. Distance covered in the 6-minute walk test and distance walked free from claudicant pain. 6MWT = 6-minute walk test distance; PFWD = pain free walk distance; DG = detraining group; CG = control group.

function and neuromuscular repertoire, which is why it was considered that individuals who had undergone detraining could have exhibited superior performance to those who had never engaged in physical training.^{4,6-8,10} Only McDermott et al.⁷ (in 2019) have investigated the durability of the effects of a supervised physical training program, but this cannot be considered detraining because the participants were monitored remotely by means of phone calls after the in-person physical training program and were encouraged to maintain their exercise routines. Even so, 6 months after the physical training program, these individuals' 6MWT and PFWD distances had fallen back to their baseline values.

Even though the present study did not detect any significant differences between the groups, it is important to emphasize that physical training is

widely recommended for patients with PAOD, with the objective of promoting increases in functional capacity and, consequently, improving walking performance.¹⁹ Implementation of remote follow-up strategies appears to be an option for maintenance of the benefits achieved during in-person physical training.²⁰ The data observed in the present study underscore the importance of ongoing participation in physical training programs or of planning for after the end of studies with exercise in order to maintain or further improve the outcomes assessed.^{21,22}

The mean difference of 57 m in the DG during the training period compared with after detraining is extremely relevant, since, even after a mean detraining period of 19 months, these individuals did not exhibit significant loss ($p = 0.145$). Compared with the CG, the DG had a mean difference of 35 m, which was not a significant difference, thereby confirming that the groups were similar. Gardner et al.²³ demonstrated that a mean difference of 60 m in the 6MWT is clinically relevant, i.e., trained individuals who undergo detraining have clinically relevant loss. Additionally, individuals who do not participate in training also have impaired functional capacity.

There was also no significant difference in PFWD between the DG and the CG ($p = 0.458$). From a functional point of view, this is the more important variable for PAOD patients, since reduced PFWD is reflected in reduction in daily activities of living, causing depression and worsening quality of life. A reduction of 30 m is considered clinically relevant in the literature.²³ Additionally, McDermott⁸ have shown that physical exercise is capable of improving PFWD to a similar extent to revascularization surgery.

The present study has limitations. The first is the small sample size, which is because this is a pilot study. The second is the mean duration of detraining, which was relatively long (19 ± 10 months) and had a large range. This could have the result that the expected effects were not manifest, because of the small sample with considerable heterogeneity. Moreover, the DG, which comprised individuals who had previously participated in a physical training program in a different study, only contained 11 people because four of the 15 people contacted dropped out before undergoing assessments. This is a significant limitation, since the sample size calculation defined the minimum number necessary as 14 individuals in each group; but there was no way of recruiting additional participants to the DG, because there were only 15 in total. One possible strategy for a future study could be to enroll more participants in the CG, with the objective of increasing the sample's power for statistical inference.

While the study has limitations, it also has strong points. To our knowledge, it is the first study to evaluate the effects of physical detraining on the functional capacity of individuals with PAOD. This is very important to guide clinical practice and find solutions to help patients remain physically active or participating in physical training programs.

This study is very important for the clinical practice of specialists, since it demonstrates that physical detraining provokes significant losses of the adaptations achieved by physical training. It is therefore important that specialists create strategies for patients with PAOD to encourage engagement and continuity in physical training programs.

CONCLUSIONS

This study assessed physical detraining in individuals with PAOD, comparing two groups. One group participated in a physical training program and then underwent detraining and the other did not take part in a physical training program and did not therefore undergo detraining. No significant differences were detected between these groups in 6MWT or PFW. However, it is important to point out that this study's findings confirm the idea that individuals with PAOD require ongoing attention after participating in a physical training program, including planning for continuation of physical training and engagement in a daily physical activity routine.

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Correspondence

Leandro Tolfo Franzoni
 Universidade Federal do Rio Grande do Sul – UFRGS
 Av. Lajeado, 33, apartamento 302 - Petrópolis
 CEP 90640-110 - Porto Alegre (RS), Brasil
 Tel.: +55 (51) 99911-5674
 E-mail: lfranzoni@hcpa.edu.br

Author information

MMA - Physical therapist, Research group Vascular e Exercício (VascuEx).
 AHP - Head, Ambulatório de Cirurgia Vascular, Hospital de Clínicas de Porto Alegre (HCPA), Universidade Federal do Rio Grande do Sul (UFRGS); Full professor, Faculdade de Medicina, UFRGS.
 AAP - Vascular MD, Ambulatório de Cirurgia Vascular (HCPA/UFRGS).
 GAF - Professor of Educação Física, Research group Vascular e Exercício (VascuEx).
 GPRZ - Scientific initiation fellow, Research group Vascular e Exercício (VascuEx).
 DSM - Physical therapist, Research group Vascular e Exercício (VascuEx).
 ELG - PhD in Medicina and Ciências Cirúrgicas; Coordinator, Research group Vascular e Exercício (VascuEx).
 LTF - PhD in progress in Cardiologia e Ciências Cardiovasculares, Universidade Federal do Rio Grande do Sul (UFRGS); Member, Research group Vascular e Exercício (VascuEx), Ambulatório de Cirurgia Vascular (HCPA/UFRGS).

Author contributions

Conception and design: MMA, LTF, ELG
 Analysis and interpretation: LTF, ELG
 Data collection: GPRZ, MMA, GAF
 Writing the article: LTF, ELG
 Critical revision of the article: AHP, AAP
 Final approval of the article*: AHP, AAP, ELG
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