ORIGINAL ARTICLE

# Effects of a physical training program for individuals with hemiplegia after stroke

## *Resultados de um programa de exercícios físicos para indivíduos com hemiplegia pós acidente vascular encefálico*

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## ABSTRACT

Among the several sequelae caused by stroke, motor impairment such as hemiplegia and hemiparesis stands out. Recovery from neurological sequelae may occur spontaneously, but part of the recovery depends on motor stimulation. That said, exercise is an important method for rehabilitation and health promotion in individuals who have suffered stroke. **Objective;** To verify the results obtained in global muscle strength and dynamic balance in individuals with post-stroke hemiplegia who participated in a physical exercise program. **Methods:** Twenty-nine individuals with a mean age of 57 years participated in the study. We retrospectively analyzed data from medical records of patients diagnosed with hemiplegia after stroke at the Institute of Physical Medicine and Rehabilitation at the University of São Paulo School of Medicine Hospital das Clínicas - IMREA HCFMUSP, Lapa unit, who participated in an exercise program in the Physical Fitness service from September 2011 to July 2013. **Results:** A significant increase in muscle strength ($p$ <0.05) was observed in all muscles involved in the 10 RM test. The greatest strength gain was in the hamstrings group (65.85%) and the muscles with the lowest strength gain were triceps brachii, with 31.34%. The total average strength gain was 45.20%. Timed Up and Go (TUG) and Sitting and Stand Up (TSL) tests were shorter at the end of the program, meaning that patients improved their ability to perform the same functions initially evaluated. **Conclusion:** This study showed that resistance training is very important for people with post-stroke hemiplegic sequelae, as it improves functional capacity such as dynamic balance, as well as contributing to their daily activities with increasing overall muscle strength.

**Keywords:** Hemiplegia, Exercise, Muscle Strength, Postural Balance

## RESUMO

Dentre as várias sequelas causadas pelo acidente vascular encefálico (AVE), destaca-se o comprometimento motor como a hemiplegia e a hemiparesia. A recuperação das sequelas neurológicas pode ocorrer de maneira espontânea, porém parte da recuperação depende de estímulo motor. Isto posto, o exercício físico é um método importante para a reabilitação e promoção da saúde em indivíduos que sofreram AVE. **Objetivo:** Verificar os resultados obtidos na força muscular global e em equilíbrio dinâmico, em indivíduos com hemiplegia pós AVE, que participaram de um programa de exercícios físicos. **Métodos:** Participaram do estudo 29 indivíduos, com média de idade de 57 anos. Foram analisados, retrospectivamente, dados dos prontuários de pacientes com diagnóstico de hemiplegia após AVE do Instituto de Medicina Física e Reabilitação do Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo – IMREA HCFMUSP, unidade Lapa, que participaram de programa de exercícios no serviço de Condicionamento Físico da instituição no período de setembro de 2011 a julho de 2013. **Resultados:** Observou-se aumento significativo em força muscular ($p$<0,05) em todas as musculaturas envolvidas no teste de 10 RM. O maior ganho de força foi no grupo dos isquiotibiais (65,85%) e a musculatura com menor ganho de força foi tríceps braquial, com 31,34%. A média total de ganho de força foi de 45,20%. O tempo de realização dos testes Timed Up and Go (TUG) e Teste de Sentar e Levantar (TSL) foi menor ao término do programa, o que significa que os pacientes melhoraram a capacidade de realizar as mesmas funções avaliadas inicialmente. **Conclusão:** Este estudo mostrou que o treinamento resistido é muito importante para as pessoas com sequelas de hemiplegia pós AVE, por melhorar a capacidade funcional como o equilíbrio dinâmico, além de contribuir em suas atividades cotidianas com o aumento da força muscular global.

**Palavras-chave:** Hemiplegia, Exercício, Força Muscular, Equilíbrio Postural

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## INTRODUCTION

Stroke is a pathology consisting of the rapid development of focal clinical disorders of cerebral function of vascular origin, classified into two groups: ischemic and hemorrhagic stroke.[1,2]

There are several sequelae caused by this pathology, such as changes in cognition, swallowing and visual perception. Among them, impairment in physical mobility, such as hemiplegia and hemiparesis, are the main causes of disability in adults.[3,4]

Hemiplegia refers to severe loss of motor function on one side of the body and hemiparesis is understood as a mild or moderate degree of muscle weakness.[3,4]

The recovery of neurological sequelae can occur spontaneously, by functional recovery of cortical areas impacted by the lesion, by resorption of edema and neutralization of local neurotoxic factors and other mechanisms, however, part of the recovery depends on motor stimulation.[4]

In this sense, physical exercise acts as an important instrument in rehabilitation and health promotion in people who have suffered stroke, as it contributes to the recovery of muscle strength and improvement of functional capacity through neuromuscular adaptations.[5]

## OBJECTIVE

To verify the results obtained in muscle strength and dynamic balance in individuals with post- stroke hemiplegia, and who participated in a physical exercise program.

## METHOD

We retrospectively analyzed data from medical records of patients diagnosed with hemiplegia after stroke at the Institute of Physical Medicine and Rehabilitation at the University of São Paulo School of Medicine Hospital das Clínicas - IMREA HCFMUSP, Lapa unit, who participated in an exercise program in the fitness service from September 2011 to July 2013. This program consisted of performing muscle-building exercises twice a week in 60-minute sessions for 13 weeks.

As inclusion criteria, the stroke event should have occurred at least 6 months ago and individuals should be walking. Excluded from this analysis were patients who, during the same period in which they participated in this exercise program, performed other types of therapies, also with exercise, as well as individuals who did not continue until the end of the program.

The results obtained in strength of the muscles were verified: hamstrings, quadriceps, dorsal, triceps brachii, adductors and abductors of the hip and biceps brachii. We also analyzed the results in dynamic balance and in the functional ability to sit and get up from the chair.

These results were obtained by means of the tests, respectively, 10 RM (maximum repetitions), Timed up & Go (TUG) and Seat and Stand Up Test (TSL). The 10 RM test consists of performing 7 to 10 repetitions with the maximum possible load and with satisfactory execution of the movement. The TUG consists of the patient getting up from the chair, walking for 3 meters and returning to the chair at the highest possible speed, in complete safety and in the TSL the patient performs 5 movements of getting up and sitting in the chair in the shortest possible time.

The program *Microsoft® Excel 2007* was used to tabulate the data and the statistical analysis was done of the SPSS® *for Windows®* version 16.0. Data were expressed as mean and standard deviation. Data distribution was verified by the Shapiro-Wilk test. Then the *Student's T-test* for paired samples was used for parametric data. A significance level of 5% was adopted ($p < 0.05$).

## RESULTS

The study included 29 individuals, with a mean age of 57 years. Twenty-three of the patients were male and 5 were female.

A significant increase in muscle strength ($p < 0.05$) was observed in all muscles involved in the 10 RM test (Table 1). The greatest strength gain was in the hamstrings group (65.85%) and the muscles with the lowest strength gain were triceps brachii, with 31.34%. The total average strength gain was 45.20%.

The time to perform the TUG and TSL tests was shorter at the end of the program, meaning that patients improved their ability to perform the same functions initially evaluated (Table 2) .

## DISCUSSION

Gait speed has been related to the strength of different muscle groups and the maximum weight supported in the standing position in the affected leg after stroke.[6] People with stroke sequelae bear less weight on the affected leg during the movement from standing up to a standing position than a normal person does.[7]

In our study, the hamstrings muscles (knee flexors) had a gain of 65.85% in strength, while for quadriceps (knee extensors) this gain was 49.05%. When we analyze the research by Flansbjer et al.[8] we found that the gains obtained in knee flexors and extensors were respectively 54.8% and 48.8%. If we compare the average time to perform the TUG, in our survey we obtained as an improvement, 26.31% of the total time, and in the survey by Flansbjer et al.[8] the results showed 23.81%, showing the largest gains in knee extensors in both studies, compared to the hamstrings. The average

**Table 1.** Muscle strength data of participants with hemiplegia after stroke, before and after exercise program

| Muscles | Pre | Post | Δ% | P |
|---|---|---|---|---|
| Quadriceps | 14.33 ± 7.85 | 21.36 ± 8.40 | 49.05 | <0.001 * |
| Hamstrings | 13.50 ± 4.49 | 22.39 ± 10.01 | 65.85 | <0.005 * |
| Dorsal | 26.09 ± 8.81 | 34.93 ± 9.98 | 33.88 | <0.001 * |
| Triceps brachii | 13.72 ± 5.20 | 18.02 ± 6.74 | 31.34 | <0.001 * |
| Hip adductor | 56.91 ± 26.45 | 80.50 ± 26.69 | 41.45 | <0.001 * |
| Hip abductor | 57.35 ± 20.04 | 81.19 ± 27.51 | 41.56 | <0.001 * |
| Biceps brachii | 4.99 ± 1.74 | 7.65 ± 2.40 | 53.3 | <0.005 * |

*Data presented as mean and standard deviaton. * p <0.05*

**Table 2.** Data on postural balance and ability to sit and get up from the chair of participants with hemiplegia after stroke, obtained through the Timed up & Go (TUG) and Sit and Lift (TSL) tests before and after the exercise program

| | Pre | Post | P |
|---|---|---|---|
| Postural balance (time in seconds) | 19.04 ± 12.02 | 14.03 ± 8.79 | <0.001 * |
| Ability to sit and get up from chair ( time in seconds) | 16.28 ± 6.97 | 14.25 ± 15.29 | <0.001 * |

*Data presented as mean and standard deviaton. * p <0.05*

gain in TUG was also similar with a difference of less than 3% in the total test time.

Approximately 15% to 30% of people with stroke suffer permanent sequelae,[9] and ambulation is the activity with the greatest motor loss (about 80% of patients initially affected), causing a great impact on their autonomy.[10]

Our program lasted 13 weeks because, according to the researched literature, most studies take place between 12 and 14 weeks in length.

This activity duration time seems to be an acceptable period in terms of strength gains, as observed by Oullette et al.[11] which was performed at 12 weeks and showed improvement of muscle strength in lower limbs in both affected and unaffected limbs. In our study, patients had strength gain in all evaluated muscles, in upper limbs and lower limbs.

Comparing strength gains in knee extensors (quadriceps), Oullette et al.[11] observed an average increase of 34.5% in muscle strength. Already in our study, the patients obtained on average gain of 49.05% of strength. We believe that this difference in strength found between the two studies may have occurred due to the average age of participants in both surveys, which was 65.8 in Oullete et al.[11] and 57 years in our study.

## CONCLUSION

This study showed that resistance training is very important for people with post-stroke hemiplegic sequelae, as it improves functional capacity such as dynamic balance, as well as contributing to their daily activities with increasing overall muscle strength.

These results contribute to the literature, but studies with more patients are needed to recommend these exercises as a reference for muscle training of people with hemiplegia.

## REFERENCES

1. Rolim CLRC, Martins M. Qualidade do cuidado ao acidente vascular cerebral isquêmico no SUS. Cad Saúde Pública. 2011;27(11):2106-16 DOI: https://doi.org/10.1590/S0102-311X2011001100004
2. Brandstater ME. Reabilitação no derrame. In: Delisa JA. Tratado de Medicina de Reabilitação. 3 ed. São Paulo: Manole; 2002. p.1227-53.
3. Brogårdh C, Lexell J. EfHJUfects of cardiorespiratory fitness and muscle-resistance training after stroke. PM R. 2012;4(11):901-7. DOI: https://doi.org/10.1016/j.pmrj.2012.09.1157
4. Goldstein LB, Bushnell CD, Adams RJ, Appel LJ, Braun LT, Chaturvedi S, et al. Guidelines for the primary prevention of stroke: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. Stroke. 2011;42(2):517-84. DOI: https://doi.org/10.1161/STR.0b013e3181fcb238
5. Thomaz A, Brito CMM. Condicionamento físico pós acidente vascular encefálico. In: Yazbek Junior P, Sabbag LMS, Battistella LR. Tratado de reabilitação: diretrizes nas afecções cardiovasculares, neuromusculares e musculoesqueléticas. São Paulo: Phorte, 2010.
6. Bale M, Strand LI. Does functional strength training of the leg in subacute stroke improve physical performance? A pilot randomized controlled trial. Clin Rehabil. 2008;22(10-11):911-21. DOI: https://doi.org/10.1177/0269215508090092
7. Engardt M, Olsson E. Body weight-bearing while rising and sitting down in patients with stroke. Scand J Rehabil Med. 1992;24(2):67-74.
8. Flansbjer UB, Miller M, Downham D, Lexell J. Progressive resistance training after stroke: effects on muscle strength, muscle tone, gait performance and perceived participation. J Rehabil Med. 2008;40(1):42-8. DOI: https://doi.org/10.2340/16501977-0129
9. American Heart Association. Heart Disease and Stroke Statistics – 2003 Update. Dallas: American Heart Association; 2002.
10. Veerbeek JM, Kwakkel G, van Wegen EE, Ket JC, Heymans MW. Early prediction of outcome of activities of daily living after stroke: a systematic review. Stroke. 2011;42(5):1482-8. DOI: https://doi.org/10.1161/STROKEAHA.110.604090
11. Ouellette MM, LeBrasseur NK, Bean JF, Phillips E, Stein J, Frontera WR, et al. High-intensity resistance training improves muscle strength, self-reported function, and disability in long-term stroke survivors. Stroke. 2004;35(6):1404-9. DOI: https://doi.org/10.1161/01.STR.0000127785.73065.34