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Contribution of adapted physical activity on body composition and fitness related to the health of vascular hemiplegic patients

Vasküler hemiplejik hastaların sağlığı ile ilgili uyarlanmış fiziksel aktivitenin vücut kompozisyonu ve fitnesine katkısı

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Abstract

Aim: Stroke is a neurological deficit of vascular origin lasting more than 24 hours. We aimed to examine the impact of the functional rehabilitation associated with the practice of adapted physical activities on body composition and fitness related to the health of vascular hemiplegic patients.

Methods: We chose the case-control study method which is consisted to evaluate the body composition and health-related fitness of 90 male hemiplegic patients, after randomization, 40 of whom were in the experimental group undergoing a functional rehabilitation program associated with the practice of adapted physical activities and 50 of the control group submitted to a functional rehabilitation program.

Results: After the two intervention programs we found that subjects in the experimental group significantly changed total fat, visceral fat and muscle compared to the control group ($P<0.001$, $P=0.004$ and $P=0.029$, respectively). Their resting heart rate, respiratory rate, muscle strength, walking speed and rate were significantly reduced compared to the control group ($P<0.001$ for all mentioned comparisons). In addition, their resting systolic blood pressure, resting diastolic blood pressure, forced expiratory volume, muscle strength and Motor skills were significantly improved compared to the control group ($P=0.048$, $P=0.027$, $P=0.003$, $P=0.015$ and $P=0.003$, respectively).

Conclusion: This study shows that the functional rehabilitation program associated with the regular practice of adapted physical activities is more beneficial in improving the morphological state and fitness of hemiplegic patients than the isolated use of functional rehabilitation.

Keywords: Adapted physical activity, Fitness, Hemiplegia

Öz

Amaç: İnme, 24 saatten fazla süren, vasküler orijinli bir nörolojik eksikliktir. Uyarlanmış fiziksel aktivitelerle ilişkili fonksiyonel rehabilitasyonun, vücut kompozisyonu ve vasküler hemiplejik hastaların sağlığı ile ilgili uygunluk üzerindeki etkisini incelemeyi amaçladık.

Yöntemler: 90 erkek hemiplejik hastanın vücut kompozisyonu ve sağlıkla ilgili uygunluğunu değerlendirmek için oluşturulan olgu-kontrol çalışma yöntemini seçtik, randomizasyondan sonra 40'ının uygulamalı fonksiyonel rehabilitasyon programına aldık. Fonksiyonel rehabilitasyon programına sunulan fiziksel aktiviteler ve kontrol grubunun 50'sine uyarlandı.

Bulgular: İki müdahale programından sonra, deney grubundaki deneklerin toplam yağ, visseral yağ ve kası kontrol grubuna anlamlı olarak değiştirdiğini bulduk (Sırasıyla $P<0.001$, $P=0.004$ ve $P=0.029$). Dinlenme kalp hızı, solunum hızı, kas kuvveti, yürüme hızı ve hızı kontrol grubuna göre anlamlı olarak azaldı (belirtilen tüm karşılaştırmalar için $P<0.001$). Ayrıca istirahat sistolik kan basıncı, istirahat diyastolik kan basıncı, zorlu ekspiratuvar volümü, kas kuvveti ve Motor becerileri kontrol grubuna göre anlamlı olarak düzeldi (Sırasıyla, $P=0.048$, $P=0.027$, $P=0.003$, $P=0.015$ ve $P=0.003$).

Sonuç: Bu çalışma, uyarlanmış fiziksel aktivitelerin düzenli olarak uygulanmasıyla ilişkili fonksiyonel rehabilitasyon programının, hemiplejik hastaların morfolojik durumlarını ve fiziksel durumlarını iyileştirmede, fonksiyonel rehabilitasyonun izole kullanımına göre daha faydalı olduğunu göstermektedir.

Anahtar kelimeler: Uyarlanmış fiziksel aktivite, Fitness, Hemipleji

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Introduction

Stroke is the second leading cause of death in the world and in developing countries (developing countries), behind cardiovascular diseases, infectious diseases, especially pulmonary or diarrheal infections, tuberculosis, aids or malaria [1]. The risk of stroke doubles for each successive decade after the age of 55 and between 55 and 75 years. The incidence is 50% higher in men than in women, and the risk of recurrent vascular events is high and may vary according to stroke pathophysiology, comorbidities, and lifestyle risk factors [2-6]. Although most of the stroke is not life-threatening in the first case, the majority of people who have died from a disability accident or new vascular events [7].

There are several risk factors for stroke: high blood pressure, tobacco overuse of salt and alcohol, overweight, diabetes mellitus, bleeding disorders, hypercholesterolemia and physical inactivity [8].Recent studies have shown that individuals after stroke have not only a residual motor and cognitive impairment but also a low ability to withstand physical exertion, where about 70% of them show a coexisting type of heart. In addition to this, the energy that these individuals spend to perform their activities of daily living is significantly higher than in people without functional impairment [9,10]. Although this poor ability to perform physical exertion can be attributed to the regular aging process, studies have shown that aerobic fitness in these individuals is about 40% lower than in sedentary individuals of the same sex and age; which may contribute to increased risk of future stroke or acute myocardial disease [11].

The benefits of regular physical activity provide better control of high blood pressure and hyperlipidemia. Blood viscosity and platelet aggregation are reduced, decreasing the risk of thrombosis [12]. The blood vasodilatation produced during an effort causes the patients a decrease in blood pressure and promotes a good heart condition [13]. Following an effective solicitation of different metabolic systems (respiratory, muscular ...), cardiac adaptation at rest and exercise is better and blood pressure is reduced for the same activity [14].

For muscular and ventilatory functions, bed rest and activity restriction after stroke lead to muscle wasting and exercise deconditioning [15]. Thanks to the mechanical constraints, the physical activity increases the mass and the muscular force without modifying the spasticity [16]. Functional abilities such as stamina and walking speed are improved, as is exercise tolerance. The effects of regular physical activity on the ventilatory function stimulate the alveolar exchanges allowing a better oxygenation of the muscles [17].

However, in the Democratic Republic of Congo (DRC), the re-educational care begins to associate more and more the practice of physical activity but we found that no study was conducted to evaluate the effects of this activity on fitness parameters including muscle strength, stamina and walking speed etc. That's what motivated us to conduct this study.

Materials and methods

Nature, period and framework of study

We opted for the case-control study method that assessed the health status of hemiplegic patients over a 4 month period from September 2018 to January 2019.

The present study was conducted at University Clinics of Kinshasa and the Kinshasa Reference General Hospital. The choice of these institutions is justified by the fact that they are institutions of reference in the Democratic Republic of Congo and that they receive many hemiplegic patients.

Population, sampling and sample

This study consisted of 120 male hemiplegic patients attending the two hospitals mentioned above. In this study we used the random sampling. Of 120 hemiplegic patients approached, 15 were excluded for various reasons.

Of the total reduced to 105 hemiplegic patients, there were 15 additional exclusions during study for voluntary discontinuation (n=6), health problem (n=4), lack of time (n=3); 2 hemiplegic patients were lost sight of. The final experiment thus covered 90 subjects.

Our sample consisted of 90 male hemiplegic patients, 40 of whom were subjected to a rehabilitation program associated with the practice of adapted physical activities (experimental group) and 50 hemiplegic patients subjected only to a rehabilitation program (control group).

The local ethics committee of Physical Medicine and Rehabilitation Department, University Clinics of Kinshasa approved the study that was prepared according to ethical standards of 1975 Helsinki Declaration's Human Experiment Committee which was revised in 2000.

The following inclusion criteria were applied (Figure 1):

- To be a hemiplegic patient;
- To follow the sessions in two institutions selected for our study;
- Do not present a contraindication to the practice of physical activity;
- Have participated in at least 95% of sessions;
- Be present on the first and last day of assessment;
- To freely accept to participate in this study.
- All hemiplegic subjects who did not meet the exclusion criteria mentioned above were excluded.

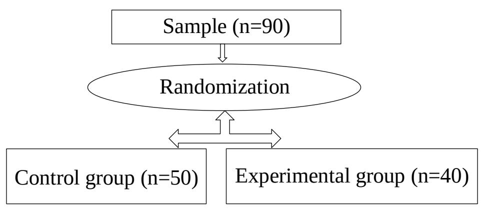

Figure 1: Group repartition

Data gathering

Anthropometric measurements

To keep as much discretion as possible, the anthropometric measurements were taken away from the rest of the group.

These measures include body weight, height, body mass index (BMI) and body fat percentage of participants. In order to determine the percentage of body fat of the participants, the skin folds (triceps, biceps, subscapularis and supra ailiac) will be measured using a vernier caliper [18] located on the right side of the body. The percentage of body fat was calculated according to Oja and Tuxworth (1995).

- Body weight (kg): The weight of the barefoot participant was measured with bioimpedance weighing (Tanita TBF-300A) calibrated to only take body weight, with an accuracy of 0.1 kg.
- Body size (m): The size was measured with inspiration stuck with a barefoot participant. The device used is a Seca 214 portable stadiometer with a 1 mm scale attached to a wall. The subject is positioned on the stadiometer with contact at the heels, buttocks, shoulder blades and (if possible) the skull. The subject's head is positioned according to the Frankfurt plane (i.e. the path from the highest point of the external auditory canal to the lowest point of the lower orbital rim is parallel to the ground) [19].
- Waist circumference (cm): Waist circumference will be measured using a single anatomical landmark, the upper lateral ridge of the iliac crest at the midaxillary line. The lower edge of the tape measure will be placed on the superior lateral ridge of the iliac crest at the midaxillary line [20].
- The body mass index (kg/m^2): The BMI was calculated directly by applying the formula in the database during interpretation. Subsequently, by applying the "WHO Reference 2007 SPSS macro package" [21] to the database, it was possible for us to obtain an estimate of the z-score of the referenced participant's BMI to the database. 2007 WHO BMI-for-age, by sex and age [21].
- Body composition (%): The body composition was evaluated using an Omeron BF-511 scale impedance meter; it was used to evaluate the percentage of total fat (TF), percentage of visceral fat (VF) and percentage of muscle.

Measurement of physiological parameters

- The resting heart rate is measured using a stethoscope and blood pressure using a mechanical sphygmomanometer;
- Respiratory frequency (RF) (cycle/min): it was taken using a stopwatch;
- Forced expiratory volume (FEV) per second (%): It was evaluated using a Piko-6 brand spirometer

Motor evaluation

The Cardiorespiratory endurance, perception of the effort and walking performance parameters were assessed before and after the program. Functional capacity was measured by the six-minute walk test, which allowed us to calculate the maximum oxygen consumption using the formula: VO_2 max (ml/kg/min): 26.9 + 0.014 x dist TDM6 (m) -0.38x BMI (kg/m^2 ; the walking speed was measured with a stopwatch, the hemiplegic patients are timed while walking a distance of 6 m at their preferred speed or spontaneous speed, the normal walking speed in the hemiplegic varies between 1.1 and 1.5 m/sec; the rate was measured as the number of steps per minute, the baseline was based on the size of the hemiplegic and ranged from about 90 steps / minute for tall subjects (1.83 m) to about 125 steps/minute for small subjects (1.5 m); Timed get up and go Test was evaluated thanks to the time taken by the subject to get up from a chair, walk 3 meters, turn around, go back to the seat and sit down; Strength and muscle power of the lower limbs was measured using the number of sit-stand achieved by the subject in 30 seconds, An impossibility or low score below five sit stand passages sign a level of dependence high.

Exercise protocol

For the control group

To best guide the work of the therapists and help them in setting up the collective, 90 cards have been developed. They are intended for patients and follow three exercise models: stretching and functional movement. Each card illustrates an exercise concerning the upper limb, the lower limb or the trunk and is accompanied by an explanatory text. They want to be clear and understandable for the patients, bringing to the therapists situations of exercises that are easy to put in place.

For the experimental group

In addition to the rehabilitation program offered to the control group, a program of physical exercises consisting of treadmill exercise, exercises on ergo manual cycle, balance (static and dynamic), flexibility exercises and muscle strengthening of abdominals, members Upper and lower was added for the experimental group. These exercises were performed twice a week with duration of 45 minutes at a moderate intensity. The cardio frequency meter allowed us to monitor the intensity of the exercise.

Statistical analysis

Quantitative variables are presented as mean (standard deviation). Comparisons between control and experimental groups are made by a student t test (SPSS software). A threshold of significance at $P<0.05$ is retained.

Results

Table 1 shows that before the intervention program, no significant difference was observed between the experimental group and the control group. After the program we found that the experimental group had significantly reduced their percentage of total and visceral fat, but their percentage of muscle increased.

Table 2 shows that before the program, the experimental and control groups showed no statistically significant difference. After the intervention program, we observed that subjects in the experimental group compared to the control group significantly improved their physiological and physical fitness parameters.

Table 1: Comparison of mean values of sociodemographic parameters and body composition before and after the intervention program

	Before the program			After the program		
	EG	Control		EG	Control	
Parameters	Mean (SD)	Mean (SD)	*P*-value	Mean (SD)	Mean (SD)	*P*-value
Age (years)	53(6.2)	51(5.7)	0.061	53(6.2)	51(5.7)	0.061
Heigh(cm)	173.1 (10.5)	171.4 (8.1)	0.272	173.1 (10.5)	171.4 (8.1)	0.272
Weight (kg)	82.6 (4.7)	83.1 (9.03)	0.078	80.1 (6.03)	82.2 (12.86)	0.084
BMI (kg/m²)	28.28 (1.3)	28.46 (0.5)	0.092	26.78 (0.61)	28.15 (6.22)	0.061
TF (%)	32.1 (1.6)	33.7 (1.9)	0.073	27.03 (1.4)	32.7 (5.12)	<0.001*
VF (%)	24.3 (0.71)	22.01 (1.1)	0.064	20.1 (1.08)	23.39 (8.1)	0.004*
Muscle (%)	11.2 (3.6)	12.01 (2.2)	0.089	18.52 (1.33)	11.4 (5.2)	0.029*

EG: Experimental group, TF: Total fat, VF: Visceral fat, * Student's t-test: significant, BMI: Body mass index

Table 2: Comparison of mean values of physiological parameters and physical condition before and after the intervention program

	Before the program			After the program		
	EG	Control		EG	Control	
Parameters	Mean (SD)	Mean (SD)	*P*-value	Mean (SD)	Mean (SD)	*P*-value
Heart rate (beat/min)	80.5 (5.2)	82.7 (10.06)	0.061	78.9 (3.22)	81.7 (9.73)	<0.001*
resting systolic blood pressure (mmHg)	135.1 (9.03)	134.3 (8.17)	0.073	129.3 (6.03)	134.3 (8.17)	0.048*
resting diastolic blood pressure (mmHg)	86.6 (7.16)	87.41 (6.92)	0.081	82.3 (5.21)	86.33 (4.02)	0.027*
Respiratory frequency (cycle/min)	25.35 (1.91)	26.5 (2.62)	0.062	20.12 (1.76)	25.4 (1.81)	<0.001*
Forced expiratory volume (%)	62.71 (10.3)	61.51 (7.12)	0.083	68.95 (6.04)	61.51 (7.12)	0.003*
muscle strength (new)	20.6 (1.82)	22.03 (1.54)	0.099	24.2 (1.31)	22.03 (1.54)	0.015*
Walking speed (m/sec)	0.62 (0.03)	0.64 (0.02)	0.078	0.42 (0.01)	0.62 (0.08)	<0.001*
Risk of falling	17.04 (1.8)	17.51 (1.06)	0.287	26.09 (1.5)	16.34 (1.92)	<0.001*
Motor skills(sec)	31.3 (5.06)	32.43 (7.41)	0.091	25.01 (1.44)	31.71 (2.71)	0.003*
Rate (pas/min)	30.28 (7.08)	31.05 (9.18)	0.793	37.63 (1.56)	29.22 (3.94)	<0.001*
Endurance cardiorespiratory (ml/kg/min)	19.41 (1.99)	17.49 (1.52)	0.062	25.55 (1.08)	18.41 (1.03)	<0.001*

EG: experimental group, * Student's t-test: significant

Discussion

The objective of this study was to evaluate the influence of the practice of adapted physical activities associated with reeducation sessions. This study showed that patients in the experimental group significantly changed their body composition compared to the control group.

Our results corroborate those of Bofosa et al [22] who demonstrated that regular exercise can change the body composition of practitioners.

Training aerobic capacity after stroke improves walking and physical stamina, decreases lower heart rate, improves self-perception and general well-being [23]. When strength and aerobic workouts are combined, there is a significant improvement in maximum oxygen uptake, increased muscle strength and weight loss [23]. Stretching and flexibility exercises can help maintain joint mobility, while balance and proprioception exercises can help prevent falls [24]. In our study, we observed the same thing as the previous findings. Subjects in the experimental group after the practice of adapted physical activities significantly improved their cardiorespiratory endurance, heart rate, and grip strength compared to the control group. Adapted physical activity prevents falls, maintains bone density and makes it easier for stroke patients to carry out activities of daily living [25]. This literature corroborates the results of our study, which show that patients in the experimental group compared to the control group significantly reduced their risk of falling.

The benefits of regular physical activity provide better control of arterial hypertension and hyperlipidemia [26]. Blood viscosity and platelet aggregation are reduced, decreasing the risk of thrombosis. The blood vasodilatation produced during an effort causes the patients a decrease in blood pressure and promotes a good heart condition [27]. Following an effective solicitation of different metabolic systems (respiratory, muscular ...), cardiac adaptation to rest and exercise is better and blood pressure is reduced for the same activity [28]. In our study, blood pressure was also evaluated. We observed that patients in the experimental group significantly reduced their blood pressure compared to the control group. This could be justified by the fact that the low level of adapted physical activities is corroborated with the risk of presenting arterial hypertension.

For muscular and bladder functions, bed rest and restriction of activity after AVC lead to muscle wasting and deconditioning on exercise [29]. Due to mechanical constraints, physical activity increases muscle mass and strength without altering spasticity [30]. Functional abilities such as endurance and walking speed are improved, as is exercise tolerance [31]. The effects of regular physical activity on the ventilatory function stimulate the alveolar exchanges allowing a better oxygenation of the muscles [32]. These findings from the literature corroborate those of our study, which shows that experimental group subjects increased their walking speed, a number of steps, and this in a statistically significant way.

This study is limited to the use of a small sample of a metropolitan city of the Democratic Republic of Congo, which will probably reduce the possibility of generalization of the results. Therefore, a future study of a more representative sample of hemiplegic patients is needed to potentially increase the generalizability in the country.

Conclusion

This study has shown that regular practice of adapted physical activities allows hemiplegic patients to improve their physiological parameters and physical condition. We suggest that this practice be internal in the hospital environment of Kinshasa.

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