

# Adapted karate training on functional autonomy, muscle strength and quality of life of elderly man with osteoporosis: a clinical case

## Authors' Contribution:

- ✍ A Study Design
- 📁 B Data Collection
- 📊 C Statistical Analysis
- 📄 D Manuscript Preparation
- 📁 E Funds Collection

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## Abstract

### Background & Study Aim:

With advancing age, the decrease of functional capabilities, increasing the occurrence of diseases, among them, osteoporosis that is characterized by loss of bone mineral density, making bones fragile and susceptible to fractures. Aim of the study was the effect of adapted karate training (AKT) in functional autonomy, muscle strength and quality of life (QoL) of elderly man with osteoporosis.

### Materials & Methods:

An elderly man of ethnic Euro-American South with 75 yrs. of age with osteoporosis participated in the study. The program AKT had a three-month period with frequency 3 x wk. in alternate days and with 60 min/class. The functional autonomy by Latin American Maturity Development Group Protocol: 10-m walk (10MW), rising from sitting position (RSP), rising from ventral decubitus position (RVDP) among other tests; the strength of the lower limbs by 10 repetitions maximum (10RM) test in 45° leg press and leg extension, the short form 36 (SF-36) for assessment of QoL and osteoporosis was determined by Absorptiometry Dual energy X-ray were evaluated.

### Results:

There was an increase for physical health  $\Delta\% = 10\%$ , mental health  $\Delta\% = 4\%$  and total QoL  $\Delta\% = 5.5\%$ . To functional autonomy increases were observed for all tests, including: RVDP  $\Delta\% = -9.18\%$ , RSP  $\Delta\% = -22.92\%$ , C10mw  $\Delta\% = -21.45\%$ . In addition, showed increases in the leg press 45°  $\Delta\% = 16.05\%$  and knee extension  $\Delta\% = 15.15\%$  tests.

### Conclusions:

For case study, assessments performance and health variables showed increases in functional autonomy, strength and QoL of elderly men with osteoporosis after AKT. Therefore, it is an empirical justification for the need to intensify research in order to verify the suitability of martial arts in the treatment of osteoporosis.

### Key words:

bone mineral density • combat sport • martial arts • physical inactivity • resistance training

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**Adapted karate training**

– It is karate training with methodological adaptations practiced by older adults and without previous knowledge of the modality [12].

**Combat sport** – *noun* a sport in which one person fights another, e.g. wrestling, boxing and the martial arts [17].

**Martial arts** – *plural noun* any of various systems of combat and self-defence, e.g. judo or karate, developed especially in Japan and Korea and now usually practised as a sport [17].

**Main relationship between combat sport and martial arts** – every combat sport is martial arts but not vice versa [18].

**3 x wk.** – three times per week.

**Bone mineral density (BMD)**

– is the amount measured in (g/cm<sup>2</sup>) of mineral for bone area [2].

**Functional autonomy (FA)**

– The principle of functional autonomy is particularized enough in its operation to account for the uniqueness of personal conduct [21].

**Quality-of-life (QoL)** – it is a multifactorial variable that measures the physical and mental health.

**Muscular strength** – it is the possibility of a muscle or muscular group overcome a resistance [9].

**Resistance training** – *noun* training that increases muscle strength by working against resistance such as a weighted dumbbell or barbell [17].

**INTRODUCTION**

Aging is a continuous process in which there is a progressive decline in physical abilities, such as: muscle strength, bone mineral density (BMD), functional autonomy, balance and quality of life (QoL) [1]. With advancing age, the decrease of functional capabilities, increasing the occurrence of diseases, among them, osteoporosis that is characterized by loss of bone mineral density (BMD), making bones fragile and susceptible to fractures [2].

Worldwide, 3% to 6% of men over 50 have osteoporosis. Although, predominantly, a female disease, it is estimated that 1/5 of white men over 60 have 25% chance to acquire a fracture caused by osteoporosis. This is due to secondary factors such as smoking, alcohol, reduced testosterone levels and physical inactivity [3].

Among various exercises types, the resistance training is the most recommended because they improve balance, strength, agility and BMD, which prevents falls [4].

However, exercise programs involving combat sport are underexplored and cited in the scientific literature, which can justify the present study, that proposes, an adapted karate training (AKT) method, based in studies of Borba-Pinheiro et al. [5, 6] that used adapted judo methods to older women with low BMD.

Therefore, the objective of this study was the effect of adapted karate training in functional autonomy, muscle strength and quality of life of elderly man with osteoporosis.

**MATERIAL AND METHODS****Clinical Case**

The participant of this case is a male volunteer, 74-year-old, Euro-South American ethnic characteristics with 1.70 cm of height, 70 kg of body mass and body mass index of 24.2 kg/m<sup>2</sup>, with preserved musculoskeletal capacity, well as your blood pressure within the standards of normality, and therefore, did not use pharmacological treatment. In addition, he reported that never practiced karate and no other regular exercise. The volunteer had low bone mineral density (BMD) to lumbar spine L2-L4 (T score = -2.30 SD), femoral neck (T = score -1.18 SD) and osteoporosis in wards triangle (T score = -2.69 SD) measured by Dual Energy X-ray absorptiometry (DXA) of Lunar® model DPX (USA).

The volunteer had pharmacological treatment for osteoporosis with sodium alendronate 70mg/week and vitamin D3 5600IU/week during the study period, according to the prescription provided by your medical doctor. It is noteworthy that the men volunteer became aware of their osteoporosis diagnosis by the DXA provided by the research project, and therefore, did not using previously pharmacological treatment. After anamnesis procedures, the volunteer was evaluated by the following protocols:

- assessment of functional autonomy (FA);
- the protocol of the Latin American Development Group for Maturity (GDLAM) aims to standardize the assessment of FA [7];

GDLAM protocol has the following tests to assess FA:

- (a) 10-m walk (10MW): walk the distance of 10 m;
- (b) rising from sitting position (RSP): the individuals should get up and sit down of an chair five times consecutively;
- (c) rising from ventral decubitus position (RVDP): the individuals must stand up as fast as possible;
- (d) rising from a chair and walking around the house (RCWH): the test assess agility and dynamic balance;
- (e) putting on and taking off a shirt (PRTS): the individuals must put on and take off the shirt (G t-shirt Hering1, Brazil). The GDLAM autonomy index (AI) was calculated using the following formula:

$$AI = \frac{[(10MW + RSP + RVDP + PRTS) \cdot 2] + RCWH}{4}$$

Assessment of QoL. *Medical Outcomes Studies 36 – Short-Form (SF-36)* was used to assessment QoL. Made up of 36 items covering eight scales that culminate in the final three categories, which are physical health, mental health and total score [8].

Assessment of Muscular Strength. To assess muscle strength, the 10 maximum repetitions test (10MR) was used. Each individual had from three to four attempts to perform the test with a 10MR load according to the recommendations of the American College of Sports Medicine [9].

The study met all the requirements of Resolution 466/12 of the National Health Council of Brazil, which regulates research involving human beings [10].

**Intervention Procedure**  
**Adapted karate training (AKT)**

The AKT program was realized in a period of three months and the classes were developed in three alternate weekly-sessions from 7 a.m. to 8 a.m. in a room with wooden floor measuring 80m<sup>2</sup>. To determine the intensity of the training-classes was used a subjective effort scale [11]. The AKT classes follow a method adapted according to the recommendations of Borba-Pinheiro et al. [12] consisting in:

- initial greetings to the teacher and master founder;
- stretches: with exercises for the major muscle groups with a range of 10 seconds for each exercise;
- exercises of motor coordination, agility, static balance (dynamic) recovered and muscle strength;
- basic technical training;
- specific technical training;
- excluded the fighting-training (*kumite*), due to increased risk of injury in this activity;
- final stretches, with exercises for the same muscle groups following the same procedure, now carried out to the relaxing music sound;
- final greetings to the teacher and master founder.

The training periodization is presented in the Table 1.

All ethical procedures for research on human volunteers have been conducted according to international standards mandated by the Declaration of Helsinki [13].

To calculate the percentage delta ( $\Delta\%$ ) was used the formula:

$$\Delta\% = [(post-test - test) \cdot 100/test]$$

**RESULTS**

Figure 1A shows an improvement  $\Delta\%$  in GDLAM protocol autonomy index  $\Delta\%$  IG = -14.41%. Figure 1B shows the results for the functional autonomy of the voluntary after TKA, showing improvements  $\Delta\%$  in run time of the following tests: RVDP = -9.18%; PRTS = -6.25%; RSP = -22.92%; 10MW = -21.45 and RCWH = -16.49%.

Figure 2 shows the results for the QoL of the volunteer after the AKT presenting improvements  $\Delta\%$  for physical health ( $\Delta\%$  = 10%), mental health ( $\Delta\%$  = 4%) and

**Training load** – “A simple mathematical model of training load can be defined as the product of qualitative and quantitative factor. This reasoning may become unclear whenever the quantitative factor is called ‘workload volume’ or ‘training volume’ interchangeably with ‘volume of physical activity’. Various units have been adopted as measures i.e. the number of repetitions, kilometres, tons, kilocalories, etc. as well as various units of time (seconds, minutes, hours) (...) As in the real world nothing happens beyond the time, the basic procedure of improvement of workload measurement should logically start with separation of the time factor from the set of phenomena so far classified together as ‘workload volume’. (...) Due to the fact that the heart rate (HR) is commonly accepted as the universal measure of workload intensity, the product of effort duration and HR seems to be the general indicator of training load defined as the amount of workload. It is useful in analyses with a high level of generality. (...) In current research and training practice the product of effort duration and HR was referred to as conventional units’ or further calculations have been made to convert it into points.” [16, p. 238].

**Table 1.** Periodisation of adapted karate training.

1 - Cycle (second week)	2 - Cycle (fourth week)	3 - Cycle (sixth week)	4 - Cycle (eighth week)	5 - Cycle (tenth week)	6 - Cycle (twelfth week)
stretches 5 min	stretches 5min	stretches 5min	stretches 5min	stretches 5min	stretches 5min
light running 3min	light running 5min	moderate running 7 min	moderate running 7 min	moderate running 7 min	moderate running 7 min
abdominal exercise 3sets 15 repetitions	abdominal exercise 3sets 25 repetitions	abdominal exercise 5 sets 20 repetitions	abdominal exercise 5 sets 25 repetitions	abdominal exercise 5 sets 25 repetitions	abdominal exercise 5 sets 30 repetitions
5 basic karate exercises no displacement, attack and defense 40min	5 basic karate exercises with displacement Base <i>zenkutsu- dachi</i> attack and defense 40 min	5 basic karate exercises with displacement Base <i>zenkutsu- dachi</i> attack and defense 45 min	5 basic karate exercises with displacement Bases <i>zenkutsus- dachi, kiba-dachi</i> and <i>kokutsu-dachi</i> attack and defense and kata 50 min	5 basic karate exercises with displacement Bases <i>zenkutsus- dachi, kiba-dachi</i> and <i>kokutsu-dachi</i> attack and defense and kata 50 min	5 basic karate exercises with displacement Bases <i>zenkutsus- dachi, kiba-dachi</i> and <i>kokutsu-dachi</i> attack and defense and kata 50 min
stretches 15min	stretches 15min	stretches 10min	stretches 5min	stretches 5min	stretches 5min
low intensity Borg scale 12	low intensity Borg scale 12	moderate intensity Borg scale 13-14	moderate intensity Borg scale 13-14	moderate intensity Borg scale 13-14	moderate intensity Borg scale 13-14
total time 63 min	total time 65 min	total time 67 min	total time 67 min	total time 67 min	total time 67 min

**Kata** – noun a sequence of movements in some martial arts such as karate, used either for training or to demonstrate technique [17].

**Kata** – predetermined and choreographed physical exercises, which together with free exercises (*randori*), lectures (*kōgi*) and discussions (*mondō*) form the four critical pillars of *Kōdōkan jūdō* education [19].

**Kata** – prescribed patterns or sequences of techniques [20].

**Kumite** – is a semi-contact karate competitive concurrence, where two athletes perform various kicking, punching and blocking techniques towards each other with maximum control in order to gain points and win the match. Destruction is fictive.

**Figure 1.** Results for functional autonomy protocol (1A presented results for autonomy index and 1B presented results for autonomy tests).

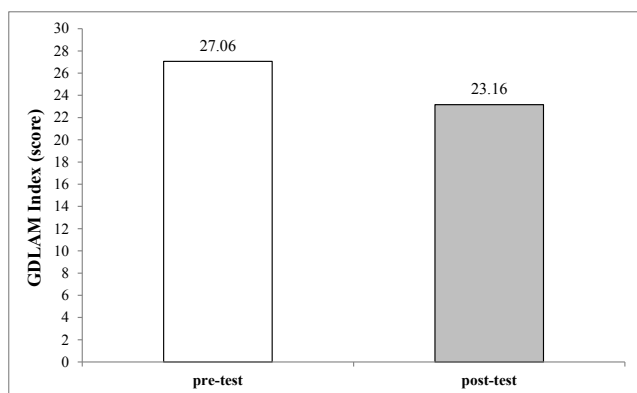


Figure 1A

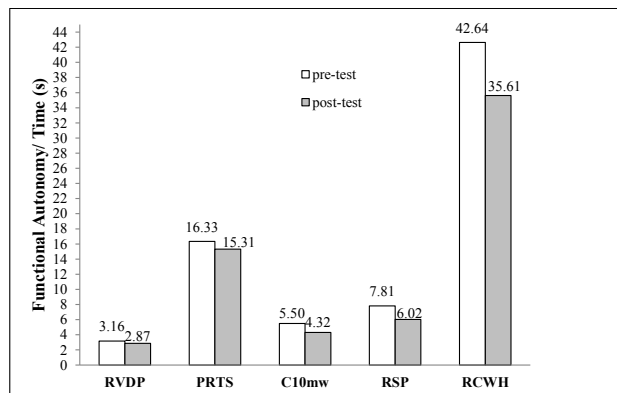
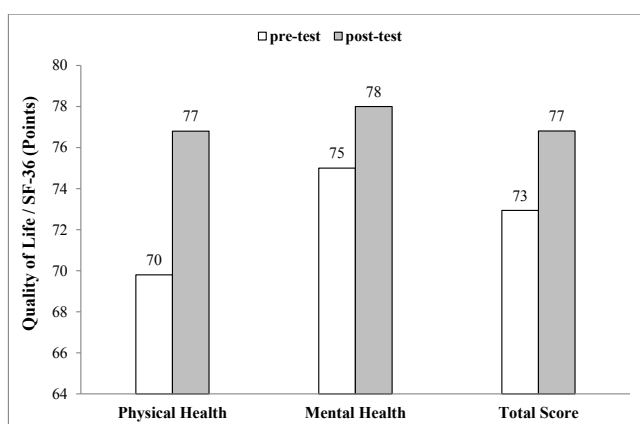
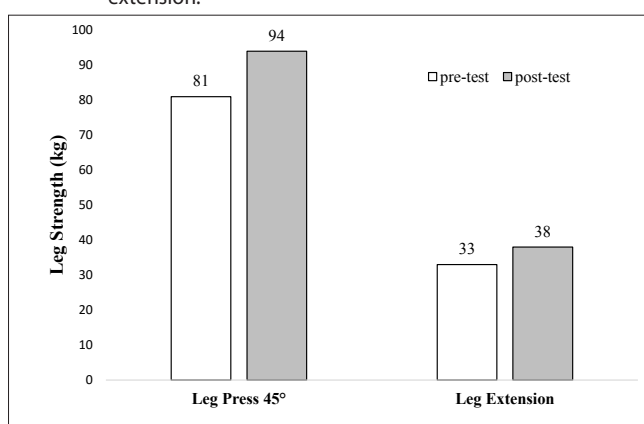


Figure 1B

**Figure 2.** Results for quality of life variables protocol.



**Figure 3.** Results for strength legs in the leg press machine and leg extension.



total QoL score ( $\Delta\% = 5.5\%$ ). Figure 3 shows results for muscular strength of the lower members of the voluntary after AKT, presenting improvements  $\Delta\%$  for the test Leg press machine 45° ( $\Delta\% = 16.05\%$ ), and also to leg extension ( $\Delta\% = 15.15\%$ ).

### DISCUSSION

The results presented in this case study show improvements in functional autonomy variables, strength, and QoL of the studied volunteer. These results can be discussed in the literature, because there are few studies involving elderly men with osteoporosis practicing combat sport as AKT with benefits for the health variables that decline with aging.

According with the results in this study, there was improvement in functional autonomy tests that are related to carrying out the activities of daily living (Figure 1A and 1B). The physical exercise programs using adapted combat sport has shown favourable

results for the functional autonomy and variables of falls risk in elderly [7, 12].

In a research that used AKT were showed favourable results to functional autonomy ( $\Delta\% = -14.6\%$ ,  $p = 0.005$ ) and muscle strength of lower limbs: leg extension ( $\Delta\% = 28.3\%$ ,  $p = 0.002$ ) and leg press machine 45° ( $\Delta\% = 50.5\%$ ,  $p = 0.016$ ) in older women (Borba-Pinheiro et al. [12]. The results presented by AKT in this case study, held during the three months also showed an improvement for the physical health and QoL-total score (Figure 2 and Figure 3).

For Pereira et al. [14] the *tai chi* can also improve functional capacity and QoL of the elderly men with low BMD. Borba-Pinheiro et al. [4] states that the judo with methodological adaptation can bring beneficial effects for variables related with falls risk, because maintained lumbar-BMD, increasing QoL and body balance. Another research Borba-Pinheiro

et al. [5] shows that the adapted judo training can be an alternative exercise for the maintenance of DMD of bone-variables.

This study also showed an increase in muscle strength in the lower limbs (Figure 3) of the elderly man. In a case study of Borba-Pinheiro et al. [6] showed that the adapted judo training was effective for maintenance of BMD, increasing body balance and muscle strength of a man with osteoporosis. According Malinez et al. [15] the techniques of attack and defence with runs of short duration and high intensity, show that karate can be a potential exercise for the development of agility, strength, dynamic balance with positive responses to the cardiorespiratory system. Although, there are few studies on combat sports for health of the elderly, the methodological adaptations can make these activities, an alternative to promote the health of this population. It is necessary to accurately document the training load [16], including the proportions of formal exercises (*kata*) and *kumite*. This is the basic condition for the creation of individual training programs.

Finally, the elderly men with osteoporosis improved the evaluated variables, with better performance in activities of daily life and improving the QoL. It is recommended that further studies using TKA with groups of elderly subjects and the control group in order to consolidate the AKT as an alternative and safe exercise for low BMD elderly.

## CONCLUSIONS

For this case study, the AKT was effective to improve functional autonomy, strength and QoL of the elderly

men with osteoporosis, which indicates better performances to carrying out the activities of daily living. Therefore, it is an empirical justification for the need to intensify research in order to verify the suitability of martial arts in the treatment of osteoporosis.

## HIGHLIGHTS

- Increase of information about adapted combat sports on multiple-variables that decrease falls risk, is of interest to researchers who study aging.
- Adapted karate training can be suggested to increase legs strength, functional autonomy and quality of life of elderly men.
- Effects of adapted karate training on multiple-variables of falls risk increased the functional independence of elderly men.

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## CONFLICT OF INTEREST

All authors declared did not have financial support of any institution, so there are no potential conflicts of interest for this study.

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