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Effects of a rhythmic and choreographic program in obese and overweight participants

Cristina Monleón[1], Ana Pablos[1], Filomena Carnide[2], Marta Martín[1] y Carlos Pablos[1]

[1]Department of Physical Activity and Sport, Catholic University of Valencia, Valencia, Spain. [2]Universidade de Lisboa, Fac de Motricidade Humana, LBMF, CIPER, Lisbon, Portugal.

Abstract

Introduction: **Currently there is a growing trend in the prevalence of overweight and obesity. This increased prevalence trend leads to an increase in the costs of health care.**

Objective: **The aim of the present study was to analyze the effects on physical fitness and bone mineral density through an intervention program of physical activity based on rhythmic and choreographic activities in an overweight and obese population.**

Method: **An 8-month physical activity based on rhythmic and choreographic activities was conducted in overweight and obese people. Thirty-four participants aged 50.43 ± 10.57 with a body mass index (BMI) 38.37 ± 4.82 took part in the physical activity program. This study assesses the effects of fitness, percentage of body fat and bone mineral density (BMD).**

Results: **After an 8-month physical activity intervention program based on rhythmic and choreographic activities, significant differences were found in: percentage of body fat (p = 0.004), aerobic capacity (p = 0.023), flexibility of the lower limbs (flexibility in the right leg p = 0.029 and left leg p = 0.002), balance (p < 0.001), strength in lower limbs (p = 0..003) and strength in upper limbs (p < 0.001). Besides that, significant differences were found in parameters related with BMD such as T-Score (p = 0.025) and Z-Score (p = 0.012), Bone Quality Index (BQI) (p = 0.026) and an increase in Broadband Ultrasound Attenuation (BUA) although not a statistically significant one (p = 0.939).**

Conclusions: **These findings suggest that a physical activity program based on rhythmic and choreographic activities can act as a preventive method of mobility and fragility, as well as preventing bone loss.**

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Key words: *Obesity. Overweight. Exercise. Health.*

Correspondence: Cristina Monleón García.
Department of Physical Activity and Sport.
Catholic University of Valencia.
Ramiro de Maeztu 12, 46900 Torrente (Valencia), Spain.
E-mail: cristina.monleon@ucv.es

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EFECTOS DE UN PROGRAMA RÍTMICO Y COREOGRÁFICO EN PARTICIPANTES OBESOS Y CON SOBREPESO

Resumen

Introducción: **Actualmente hay una tendencia creciente en la prevalencia del sobrepeso y la obesidad. Esta tendencia creciente en la prevalencia de la obesidad conduce a un aumento en los costos de la atención sanitaria.**

Objetivo: **El objetivo del presente estudio fue analizar los efectos sobre la aptitud física y la densidad mineral ósea a través de un programa de intervención de actividad física basado en actividades rítmicas y coreográficas en una población con sobrepeso y obesidad.**

Método: **8 meses de actividad física basada en actividades rítmicas y coreográficas fue llevado a cabo en personas con sobrepeso y obesidad. Treinta y cuatro participantes de 50.43 ± 10.57 años y con un índice de masa corporal (IMC) de 38.37 ± 4.82 participaron en el programa de actividad física. Este estudio evalúa los efectos sobre la aptitud física, el porcentaje de grasa corporal y la densidad mineral ósea (DMO).**

Resultados: **Después de un programa de intervención de actividad física de 8 meses basado en actividades rítmicas y coreográficas, se encontraron diferencias significativas en: el porcentaje de grasa corporal (p = 0.004), la capacidad aeróbica (p = 0.023), la flexibilidad de las extremidades inferiores (flexibilidad en la pierna derecha p = 0.029 y en la pierna izquierda p = 0.002), el equilibrio (p <0.001), la fuerza en los miembros inferiores (p = 0.003) y la fuerza en los miembros superiores (p <0.001). Además, se encontraron diferencias significativas en los parámetros relacionados con la DMO, tales como T-Score (p = 0.025) y Z-Score (p = 0.012), el Índice de Calidad de hueso (BQI) (p = 0.026) y el aumento de la Atenuación de Ultrasonido por Banda Ancha (BUA), aunque no fue estadísticamente significativa (p = 0.939).**

Conclusiones: **Estos hallazgos sugieren que un programa de actividad física basado en actividades rítmicas y coreográficas puede actuar como un método preventivo en la movilidad y fragilidad, así como en la prevención de la pérdida ósea.**

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Palabras clave: *Obesidad. Sobrepeso. Ejercicio físico. Salud.*

Abbreviations

ACSM: American College of Sports Medicine.
BMD: Bone Mineral Density.
BMI: Body Mass Index.
BQI: Bone Quality Index.
BUA: Broadband Ultrasound Attenuation.
CDPD: Cuestionario de Diversión de los sujetos con la Práctica Deportiva (Enjoyment of the Practice of Sports Questionnaire).
QUS: Quantitative Ultrasound measurement.
RPE: Borg Rating of Perceived Exertion.
SOS: speed of sound.

Introduction

Worldwide obesity is increasing and has been recognized as a priority public health issue[1]. Obesity is linked with physical and psychological factors[2]. In the same way, overweight and obesity affects joint wear and tear, decrease exercise capacity, increase rate of chronic diseases such as cardiovascular disease, diabetes and arthritis, resulting in physical disability[3]. Nevertheless, an important factor is that overweight and obesity, is mostly preventable[4], and exercise is a primarily treatment for this[1]. Thus, physical exercise is essential to minimize functional dependency and to promote improvements in body composition, bone mineral density (BMD), reduced pain and vascular resistance, increase aerobic capacity and improve the capacities of strength, flexibility, self-esteem, self-confidence and sense of depression[5]. In addition, in obese populations, regular physical activity, has known benefits and is one key factor for the treatment of obesity[2].

Obesity in middle-age and older individuals, acts as a predictor of mobility limitation[3]. In this sense, physical inactivity affects the ability of people to perform everyday activities and has been recognized as a factor contributing to the decline in physical and psychological functions[6].

Thus, an intensification in the levels of physical activity were associated with increased bone mass with the inclusion of specific training programs acting as a way to improve bone-related variables[7]. Nevertheless, not all types and forms of exercise have an equal influence in bone mass[7]. According to Yung[8], bone status is related with Body Mass Index (BMI), calcium intake, physical exercise, foot dimension, as well as, site specificity. Therefore, physical activity has a preventive value and is recommended as the first step for preventing osteoporosis, as well as, increasing muscle strength and reducing falls and fractures[9].

The improvement of movement efficiency can be achieved by the prescription of aerobic exercise, resistance weight training, as well as intervention in gait, posture and balance[10]. Hence, one way to promote physical exercise, enhanced motivation and social interaction, is through dance programs[11]. In fact, these authors demonstrate that salsa dance can promote the work of balance and force production because of the difficulty of its movements in terms of changes of direction and the use of the toes to perform them[11]. It also requires the performance of movement to the rhythm of music, with a positive impact in other abilities such as coordination, agility and rhythm coordination. Dance is recommended to maintain dexterity, muscle tone, and coordination[12]. In this sense, aerobic dance exercises include various forms and movements coordinated to the rhythm of music, and with different intensities, thus affecting an effective cardio-respiratory training[13]. Furthermore, head and trunk movements, changes of direction and shifts of the center of gravity in different directions are characteristic of dance, and contribute to the maintenance of balance, coordination, and joint mobility[14].

In addition, Garber et al.[15] recommend the use of strategies for behavior change, such as supervision by experienced fitness professionals, smooth and enjoyable exercises to improve adherence[16] and compliance with the prescription of exercise programs.

Thus, the aim of the present study was to analyze the effects on physical fitness and bone mineral density through an intervention program of physical activity based on rhythmic and choreographic activities in an overweight and obese population.

Methods

Participants

The obese and overweight participants were selected through non-probabilistic sampling from the obesity database of the Unit of Endocrinology and Nutrition Specialist Centre, Spain. For this study, 39 participants started the program, of whom 34 completed all the sessions [25 women (73.5%) and 9 men (26.5%)], aged 50.43 ± 10.57 and BMI 38.37 ± 4.82, were enrolled in the 8-month intervention program. The participants who left the program were for working or health reasons. The general inclusion criteria was: having a BMI ≥ 25 Kg/m^2, being sedentary, being submitted to physical training and, after being informed of the purpose of the study, accepting to participate and signing the informed consent form. Participants did not know the type of activity proposed until the moment of giving informed consent. The study protocols and procedures were approved by the Ethics Committee of Catholic University of Valencia.

Exercise program

Participants were engaged in a rhythmic and choreographic activities program. The physical activity program was carried out three times a week for one hour/session over a period of eight months. Profes-

sionals in physical activity and dance supervised the program for two days a week and on the third day participants worked at home with elastic bands and an exercise folder with a music CD to combine physical and rhythmic activities together. In addition, participants had to follow a diet provided by a doctor of the Endocrinology and Nutrition Specialist Centre. Despite giving a diet to participants, feeding was not controlled throughout the program. The activities provided met the American College of Sports Medicine (ACSM) recommendation criteria including cardiorespiratory, flexibility, strength, endurance and neuromotor exercise[15] with the use of dance and music at all times. These activities were a combination of different dances such as salsa, bachata, merengue, chachachá, and quaternaries rhythms. Apart from a combination of dances, different games involving dancing were used (for the dance phase). The training session included a 10 minute warm-up, 40 minutes of dance and rhythmic activities and finally 10 minutes to cool-down.

Through the Borg Rating of Perceived Exertion (RPE)[17] was used to control for the moderate intensity level required in all the sessions.

Materials and testing procedures

For this study, were selected 9 tests and the parameters were measured at the baseline and at the end of the program. And at the end of the 8-month intervention, was measured the enjoyment with physical activity based on rhythmic and choreographic activities. Each examiner received a manual of functional fitness test instructions and was trained to assess according to the author's method.

So, a Sit-and-Reach test was used to assess lower back and hamstring flexibility in both legs and a 6-min Walk test from Senior Fitness Battery was used to assess aerobic capacity[18], with the findings obtained by Beriault et al.[19] as a fitness indicator for obese subjects.

The Tandem Walk Backward test was used to assess the dynamic balance of participants[20]. For the purposes of this study, three items were considered: the time of a successful performance, the number of times participants came out the line and the number of times that participants did not touch the heel of the foot with the tiptoe. To evaluate the test, the following equation was created to penalize mistakes:

$$SB = T + [(NOL \times 2) + NTHT]$$

Where SB is score balance; T is time; NOL is number of outputs of line; NTHT is number of times the heel didn't touch the toe.

The objective of the Flexibility Scapular Waist test is to evaluate the flexibility of the shoulder joint. They were asked to go back without bending the arms, and to try to keep the distance between their hands as minimum as possible.

An isoinertial dynamometer T-Force dynamic measurement system V. 2.35 (Ergotech, Murcia, Spain) was used to assess the strength of the lower limbs and upper limbs. The real effort can be measured by the actual speed taken in each repetition[21]. To assess the strength of the lower limbs, the movement began with a bar of 3 kg behind the neck in an upright position with the knees slightly bent. The participant had to make a leg flexion at maximum power. To assess the upper limbs strength, participants began by standing with the knees slightly bent and the elbows close to the body. They had to take a 3 kg rod in parallel to the ground and had to curl up in full speed to complete the bending movement of the arm.

Body weight and composition were also measured for the BMI and calculated with bioelectrical impedance analysis measurements (Tanita BC 418 MA Segmental; Tanita Corporation, Tokyo, Japan). Height was measured with SECA 220 stadiometer model. Obesity is defined as a BMI ≥ 30 kg/m^2 or greater, and the prevalence of overweight as BMI ≥ 25 kg/m^2[1,2]. Bioelectrical impedance was also used to estimate the percentage of fat mass because[22] have demonstrated the system validity of Tanita BC 418 MA Segmental.

There are different methods to measure bone mineral density[23]. One method to evaluate the status of bone is the Quantitative Ultrasound measurement (QUS)[24]. QUS is a method for osteoporosis screening which is portable, inexpensive, fast and with less radiation with respect to DXA[25] and predict the risk of fractures due to osteoporosis[23]. So, a SONOST-3000 densitometer model (OsteoSys Co., Ltd, Seoul, Korea) was used to assess bone mineral density of the calcaneus by ultrasound. Sites which are exposed to weight load are those where one can appreciate the effect of weight load in physical activity[26]. Thereby, the main stresses applied on the calcaneus are produced by the ground reaction forces[8] and therefore calcaneus seems appropriate to evaluate the effect of high-impact physical activity[24]. This densitometer calculated the calcaneal BMD (in g/cm^2) and measured different bone properties combining the BUA (Broadband Ultrasound Attenuation) in dB/MHz (it is related to bone structure and trabecular connectivity), speed of sound (SOS) in m/s (it is related to bone density and its elasticity)[23] and BQI (Bone Quality Index).

After 8-months of physical activity intervention all participants completed the Enjoyment of the Practice of Sports Questionnaire (Cuestionario de Diversión de los sujetos con la Práctica Deportiva, CDPD) from Duda & Nicholls, adapted to Spanish by Cervelló, Escartí, & Balagué[27]. This questionnaire measured the subjects' enjoyment of the practice of sport and consists of 8 items grouped into 1 factor called "Enjoyment". Responses were recorded on a Likert scale ranging from 1 to 5, where 1 meant "Not identified" and 5 "Strongly identified".

This questionnaire has been used in several studies and it has demonstrated internal consistency and validity[28].

Statistical analysis

The values in the study were obtained using the paired Student's *t*-test, with a 95% confidence interval ($p < 0.05$) and with the Wilcoxon test, when the normality distribution was not verified through the Saphiro-Wilk tests. All data was presented as means standard deviations.

Afterwards, a descriptive analysis of the different items was conducted to determine the degree of satisfaction with the program. Furthermore, to verify its validity and reliability in the context of a physical activity intervention in a sample of obese people, was examined the psychometric characteristics thereof and was performed a factorial analysis of the main components in order to determine its structure. Items 3, 5 and 8 were analyzed inversely.

The SPSS version 20 (IBM, Somers, NY, USA) software package was used.

Results

The data concerning the physical condition and BMD variables of the full sample are detailed in Table I.

A significant decrease in percentage of fat mass was obtained after the exercise program ($p = 0.004$).

In the same way, significant differences were found between baseline and post-intervention in the aerobic capacity ($p = 0.023$) with an increasing distance of about 50 meters. Similarly, significant improvement was noted in the flexibility of the lower limbs: the flexibility of the right leg had a significance of $p = 0.029$ and the flexibility of the left leg $p = 0.002$.

Conversely, no improvements were obtained in the flexibility of the upper limbs ($p = 0,338$), possibly because of the difficulty the obese population has when lifting the arms and the sense of fatigue generated by that movement.

Balance was improved after the exercise program ($p < 0.001$) taking into account the time, the number of times participants comes off the line and the number of times that they did not touch the heel of the foot with the tip of the other foot.

Regarding the data concerning strength (mean velocity) in lower and upper limbs, it show great significance ($p = 0.003$ and $p < 0.001$ respectively) between the baseline and after the intervention (at 8 months).

Significant differences were obtained after analyzing the baseline and post intervention in T-Score and Z-Score ($p = 0.025$ and $p = 0.012$ respectively). Similarly, significant differences were found in the BQI ($p = 0.026$) and an increase in BUA was obtained, although not a statistically significant finding ($p = 0.939$) between baseline and after the intervention (102.4 and 103.48 dB/MHz respectively).

A reliability analysis of the scale CDPD was conducted taking a single major factor which we called "Enjoyment" and which comprised 7 items (item 3 was removed for not having a minimum weight of 0.35). The factor explained 49.377% of the variance.

In this research, the values reflect that the item with more weight is 7 "I usually enjoy taking part in the program's activities" ("Normalmente me da placer hacer las actividades del programa") with a value of 0.912, while item 5 "I get bored easily" ("Normalmente me aburro") is the smallest reproducible value (0.457) (Table II). Cronbach's alpha for all items was 0.806.

Table I
Paired Student's t-*test for physical and BMD*

Variables	*N*	*mean ± SD PRE*	*mean ± SD POST*	*t (p-value)*
Percentage of body fat	34	43,65 ± 5,78	42,38 ± 6,39	3,097**
Aerobic capacity (m)	32	565,94 ± 158,19	614,38 ± 129,48	-2,39*
Right leg flexibility (cm)	34	-2.76 ± 11,43	0,13 ± 10,22	-2,28*
Left leg flexibility (cm)	34	-2.6 ± 10,76	0,84 ± 10,09	-3,334**
Upper limb flexibility (cm)	29	102,34 ± 18,77	100,17 ± 12,56	,976
Score Balance	34	37,05 ± 18,36	26,05 ± 11,35	-4,74***
Mean Velocity lower limb (m/s)	32	0,59 ± 0,19	0,71 ± 0,20	-2,936**
Mean Velocity upper limb (m/s)	31	1,09 ± 0,25	1,37 ± 0,39	-4,369***
BUA (dB/MHz)	34	102,40 ± 15,87	103,48 ± 16,76	-0,077
BQI	34	90,41 ± 13,91	93,61 ± 15,97	-2,338*
T-Score	34	-0,79 ± 0,75	-0,61 ± 0,86	-2,35*
Z-Score	34	-0,41 ± 0,87	-0,20 ± 0,99	-2,65*

* *P*<0.05; ** *P*<0.01; *** *P*<0.001

Table II
Descriptive statistics and components matrix

	mean	*SD*	*Components*
1- I usually have fun doing things	4,58	0,604	0,638
2- I use to find interesting the exercises of the program	4,53	0,654	0,804
4- I am usually able to concentrate on the things I am doing	4,19	0,920	0,510
5- I get bored easily	4,47	1,108	0,457
6- Usually it feels like time passes very quickly	4,28	0,974	0,841
7- I usually enjoy taking part in the program's activities	4,44	1,054	0,912
8- Usually I wish the class finishes sooner	4,47	0,878	0,628
N valid	34		

As we can see in Table II, the participants were very happy with the program which is reflected in the means of each item in the questionnaire. All the items are above 4 out of 5 with question 1 ("I usually have fun doing things", in Spanish "Me suelo divertir haciendo cosas") having the best score (4.58).

Discussion

This study analyzed the effect of an 8-month physical activity program based on rhythmic and choreographic activities in an obese and overweight population. The results obtained demonstrate benefits fundamentally in the lower limbs. This data is highly relevant because locomotion is one of the most important and frequent demands of daily living and with excess weight exerting an excessive force to the joints it would alter body movement and lead to musculoskeletal disorders in the obese population[29,30].

The results found by Houston et al.[3], suggest the prevention of overweight and obesity in middle age to prevent mobility limitation. Thus, an exercise program with the features that has been implemented in the present study could prevent this functional limitation and mobility. It is noteworthy that participants performed a session unsupervised at home and yet it there has been an improvement in the functionality and mobility of these people with overweight and obesity.

Thus, a consequence of the aging is the deterioration of the balance capacity[14]. For this reason, prevention of falls becomes important, as well as identifying of older people at risk of falling[6]. Talbot, Musiol, Witham, & Metter[31] found that the frequency of falls occurred in all age groups and that woman were more falls than men, regardless of age.

Hence, balance is an important ability to remain independence in older people[16]. In accordance with Federici et al.[14], who used Caribbean dance intervention along 3-months, practice during middle age helps improve balance and is important for prevention of falls in the elderly. In this sense, improving the balance after exercise intervention based on rhythmic and choreographic activities, suggest that it may be considered as a useful tool in reducing the risk of falls for middle-aged adults and senior. Hence, prevention work with middle-aged adults has vital importance[31].

Having an efficient musculature in the lower limbs is a key factor for both basic mobility to the variety in job tasks[29]. Thereby, the motor function can be affected by muscular strength and power inadequate of the lower limbs. In this sense, Hills et al.[10] suggest that in obese individuals the loads on joints are greater than normal-weight individuals and the obese have greater difficulty changes in walking speed. Thus, as suggested by different authors mean velocity attained can be used as a good estimate of the relative load of a certain weight[21].

Studies such as the Hulens, Vansant, Claessens, Lysens, & Muls[32] show differences in the ability to walk between obese and lean people, being more difficult or hampered to the obese people. It also suggests that lean people have a higher speed when compared to obese people walking. These authors discussed that these data seem obvious, because obese people should be move with greater body mass than lean people. So, the results obtained of the strength show great improvement in the speed of execution both of lower and upper limbs, improvements that have a major impact on the health and musculoskeletal pain.

Furthermore, the results obtained in the aerobic capacity test also show significant improvement, increasing the distance walked after participating in an intervention program of physical activity during 8 months. These data suggest that there has been an improvement in functional mobility.

Regarding improvement in percentage of body fat in this study found a significant differences between baseline and after intervention ($p = 0.004$). The exercise training, as Miller et al.[33] noted, promote fat mass loss by helping to preserve lean mass. This systematic review emphasize that a smaller reduction in lean mass and a higher fat mass loss exists when physical exercise and energetic restriction are combined. Furthermore, according to Nakamura, Tanaka, Yabushita, Sakai, & Shigematsu[34] the participation in exercise for long periods of time may to improve body composition and overall functional fitness. In this way, they found benefits in the exercise group performed 3 days/week for 90 minutes during three months, compared to the other two groups who practiced less frequently. Donnelly et al.[35], suggests that the physical activity levels between 225 and 420 $min \cdot wek^{-1}$ provide greater weight loss (5 to 7.5 kg) compared to moderate lev-

els of physical activity (> 150 min·wek^{-1}, weight loss of 2-3 kg) or low levels < 150 min·wek^{-1} (minimum weight loss). Consequently, the ACSM recommends a dose of 250-300 min/week of moderate physical activity for overweight or obese[35]. Hergenroeder et al.[1] found that the mobility of older adults was associated with BMI, such that a higher BMI was greater impairment of mobility, even with less obese individual. This could suggest that improving in percentage of body fat has importance in functional fitness.

Seco et al.[36] performed a simple physical activity program 9-month with a period of three months of detraining in 227 adults divided into 2 groups; 65-74 year and > 74 years. Their results showed improvements in balance, flexibility and muscle strength after the training period. After the detraining period, it was observed that balance and flexibility tended to get lost and the strength to continue. In the same direction, was obtained improved lower body flexibility. This would improve, as the authors suggest, may prevent the musculoskeletal resulting from falls. These results obtained both in this study as in the study of these authors in terms of lower body flexibility are highly relevant, since the maintenance of flexibility prevents lower back pain and the risk of falls[36]. These could means that the onset of exercise habits at the beginning of the aging or before and keep it off long term. The results obtained indicate the importance of healthy eating habits and physical activity.

As suggested Ejaz et al.[25] weight can have a preventive or positive effect on BMD but increases the risk of heart diseases among others. In this way, the obese and overweight group, in baseline was in a T-score of -0.79 (normal) and after 8-months of physical activity intervention decreased to -0.61 (also normal). The improvements achieved at the level of bone mineral density, could be due to the calcaneus is a specific weight-bearing which it is exposed to mechanical load[24].

Studies such as the Yanagimoto, Oshida, & Sato[37], shows the impact of walking activity on bone quality. Therefore, these authors suggested BUA parameter relating to the number of steps performed, and hence, a higher level of activity of walking will be obtained a greater benefit in bone quality. In this sense, intervention programs with rhythmic and choreographic activities might favor and hence prevent the loss of bone mass due to continuous mechanical stress offered. However, studies with other devices that analyze other specific body areas are needed to generalize this data to overall body level.

In summary, the significant results found in the present study, bet for the prevention and maintenance of functional abilities to overweight and obese people. Functional mobility should be a priority in this type of obese population. Moreover, physical activity programs based on rhythmic and choreographic activities as presented here show a great acceptance by this obese population, as it was proved in the questionnaire of enjoyment through a high score. The low participation of men cannot be attributable to the type of proposed program because the participants did not know the nature of the activities to be performed until the moment of the first briefing. However, there are some limitations in the study. On the one hand, it was difficult to control participants to undertake the third session unsupervised with elastic bands and on the other hand, it was difficult to control participants determined to take out the diet that was previously agreed. More studies in this direction with more control on the diet and all the sessions supervised as well as a higher number of participants are required to find most important changes in physical performance.

Conclusions

the purpose of this study was demonstrating the importance of a rhythmic and choreographic program in overweight and obese persons. This program reached not only an improvement in their physical capacity but also in their adherence and enjoyment to the program. The results show the importance of preventive work to maintain the functionality and mobility in overweight or obese people with this sort of program. So, eight months of moderate physical activity program was sufficient to decrease the percentage in fat mass and gain in functionality and mobility, which are determinant for daily tasks.

In conclusion, a physical activity program based on rhythmic and choreographic activities must be approached from a behavioral preventive perspective, that is, a combination of physical activity and a thorough survey of diet and eating behavior. This kind of physical activity programs can contribute to reducing health care costs and contribute positively to reduce obesity and osteoporosis.

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