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ORIGINAL

BIOHEALTHY CIRCUIT AND COMPLY WITH THE RECOMMENDATIONS IN PHYSICAL ACTIVITY FOR OLDER PEOPLE

CIRCUITOS BIOSALUDABLES Y CUMPLIMIENTO DE LAS RECOMENDACIONES SOBRE ACTIVIDAD FÍSICA PARA MAYORES

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ABSTRACT

The aim of this study was to verify the contribution of biohealthy circuits for older people to achieve the recommended levels of physical activity. This study examined catalogues from 23 companies who build and distribute exercise equipment for biohealthy circuits. In addition, we analyzed the physical qualities and muscle groups that each equipment exercises, and the extent to which the equipment follows the physical activity guidelines.

This study concluded that biohealthy circuits have the potential to help older adults to achieve the physical activity guidelines. However, they present limitations regarding resistance training, since weight cannot be modified, and most machines use only the upper body. This study recommends designing equipment that also exercises balance and flexibility.

KEY WORDS: biohealthy circuit, guidelines, public park, physical activity, elderly.

RESUMEN

El objetivo de este estudio fue comprobar la validez de los circuitos biosaludables para el cumplimiento de las recomendaciones sobre actividad física para mayores. Se utilizaron los catálogos de 23 empresas, que construyen y/o distribuyen estos elementos, se analizaron las cualidades físicas y grupos musculares en los que intervenía cada una de las máquinas, y su relación con las guías sobre actividad física.

Los circuitos biosaludables son equipamientos que ayudan a cumplir las recomendaciones de actividad física para mayores, pero presentan dificultades para el entrenamiento de la fuerza debido a que no se puede modificar la carga y predominan los aparatos que entrenan las extremidades superiores. Se recomienda el diseño de aparatos que trabajen el equilibrio y la flexibilidad.

PALABRAS CLAVE: circuito biosaludable, líneas guía, parque público, actividad física, personas mayores.

INTRODUCTION

Spain is one of the countries that show more life expectancy, and the forecast predicts an increase in longevity rates. By 2050 it will be 85.4 years for men and 92 years for women¹. As a consequence, there will be a rapid increase in the elderly population. In regions such as Galicia², older people will surpass the 20% of the total population. In Spain, during the last five years (2004-2009) the age group of 80-84 years has increased by 19.3% and the age group of 84 years or more has augmented by 24.7%³.

At this time, governments have difficulties to meet the needs of dependent people, due to high economic costs. Nevertheless, physical activity programs that maintain or improve quality of life related to the health of the population have a low cost. Therefore, these programs decrease health costs^{1,4,5}. In addition, physical activity has positive effects on functional and psychological aspects⁶, protects the brain structures against the aging effects⁷, reduces the risk of diseases, as well as cardiovascular dysfunctions^{5,8}, diabetes⁹, cancer¹⁰, hypertension¹¹, depression¹² and osteoporosis¹³. Even people who are overweight or obese and perform physical activity show less mortality and morbidity compared to sedentary subjects with normal weight^{9,14-16}. Aside from the previously mentioned aspects, physical activity in the elderly is associated to better levels of functionality, lower risk of falls¹⁷ and better cognitive function¹⁶.

As age advances it increases the dependence and health costs. This increase in older people, both in absolute and relative terms, conditions health and care policies insomuch that these people cannot be served under the same standards of quality of life compared to other developed countries. This is due to the association of obesity with a higher prevalence of disablement in elderly individuals^{18,19}, as well as chronic diseases⁸. Being as physically active elderly people show a lower health spending compared to those not active, savings in health costs could be given to programs that promote physical activity^{19,20}.

This reality makes necessary to enhance all strategies aimed to the decrease of the period of morbidity in the last years of life^{21,22}, as the tendency suggests that the elderly population with disabilities and physical handicaps is going to increase²³. It is not necessary to perform complex activities or to have expensive equipments, as exercise has repercussions in the improvement of health and it reduces the effects of chronic diseases²⁴. Therefore, many countries and various organizations develop guidelines or recommendations about the duration and characteristics of physical activity that the elderly people must do.

There is not a clear position in Spain about the guidelines related to physical activity for the elderly, though there are some references with generic recommendations. Most of these initiatives are attached to the regions. The guidelines published by the government have a very disparate nature, though they also share some points in common. These initiatives depend on the Ministry of Health and in the case of the regions, they are related to the transferred competences of the corresponding autonomic ministry. However, it has been noted by regional authorities dedicated to physical activity and sport that there is a complete neglect to the recommendations of the guidelines²⁵.

Therefore, it is possible to assure that in Spain, the guidelines are reduced to isolated programs in which a series of basic recommendations for maintaining health are shown, as well as general programs of good habits where appear some references related to physical activity. Due to the situation depicted in Spain, we have resorted to the guidelines of the American College of Sport Medicine (ACSM) and the American Heart Association (AHA)^{33,34}, as well as the World Health Organization (WHO)³⁵.

In Spain, municipalities and regional governments are constructing bio-healthy circuits (BHC) in public spaces^{26,27} and in recent years there has been a massive increase in the implementation of this equipment²⁸. There are few studies about these circuits and the ones found are related to general facts²⁹⁻³¹; a census of these parks in Galicia²⁷; a pilot experiment in Andalusia³² and some features of these equipment^{26,28}. Nevertheless, we have not found any study that links physical activity guidelines with this type of equipment. In the study of Hernández Aparicio²⁸ it is concluded that the usage of these equipment improves the quality

of life and physical condition of the elderly population. However, it is not clear whether this equipment is suited enough or not in order to meet with the recommendations of the guidelines about physical activity of the WHO³⁵ and the ACSM/AHA^{33,34}. Therefore, with this study, we have attempted to prove to what extent are the BHC effective considering the established requirements of the recommendations about physical activity for the elderly people.

First of all, the guidelines established by the ACSM/AHA^{33,34} and the WHO³⁵ were identified for each physical quality of older people.

Secondly, we located companies that distribute these circuits and have their headquarters in Spain. Lastly, we grouped the equipment by features according to the muscle groups in which they exercise. Once classified depending on the body zone and the physical quality in which intervene, the recommendations of the guidelines were linked.

The aim of this study was to ascertain whether the BHC favor the fulfillment of the last recommendations about physical activity for the elderly people.

MATERIAL AND METHOD

For this study, the last versions of the recommendations and the guidelines of the ACSM/AHA^{33,34} and the WHO were analyzed³⁵.

The machines and equipment manufactured and distributed by companies with headquarters in Spain were also analyzed. This study took into consideration the information available for each one of the equipment that appeared in the catalogues of these companies. Moreover, in order to know if there was any association or society that agglutinated all the manufacturers of bio-healthy circuits, a telephone survey was performed. The results shown that there is neither any association or society that list or represent these circuits, nor any special epigraph to locate them in the Ministry of Industry or the Department of Treasury. Some companies use the European standards UNE EN 957-1: 2005 (for stationary) and the UNE EN 957-7:1998 (for other machines).

In order to locate the manufacturing and distributing companies of the BHC, an online search was done, by using the keywords: bio-healthy park, bio-healthy circuit, Geriatric Park, park for the elderly, circuit for the elderly, circuit for older people, park for the elderly people. This procedure was done in this way until saturating the information about companies. The inclusion criteria used were:

a) The company must be manufacturer or distributor of equipment or bio-healthy circuits.

- b) The company must have a catalogue of equipment and machines in its website, or at least provide us with one via e-mail or mail.
- c) The company must have its headquarters in Spain.

With all the information obtained, we performed an analysis of the main muscle groups that are exercised on each piece of equipment, as well as the physical qualities in which they intervene. Due to the disparity of criteria to name each term, we used the classification of Hernández Aparicio (2009)²⁸.

A descriptive study with an analysis of the catalogues' content of each company was done, in order to assess each piece of equipment and to identify the muscle groups that are exercised on each one of them. Altogether, 23 catalogues were assessed.

RESULTS

Guidelines

The recommendations of the WHO (2010)³⁵ and the ACSM/AHA^{33,34} show that the elderly people must dedicate 150 minutes per week in moderate intensity physical activity in order to obtain health benefits. This time should be increased if additional benefits want to be obtained. To do this, the intensity, frequency and duration of this activity need to be increased. We have grouped these recommendations in the following paragraphs.

Endurance exercises

- *Frequency*: Accumulate 30³³⁻³⁵ or at most 60^{33, 34} minutes of moderate physical activity in a daily basis. Each bout must not be less than 10 minutes. A total of 150³³⁻³⁵ to 300^{33,34} minutes per week or more must be accumulated, or 20-30 minutes per day or more of vigorous physical activity to a total of 75³³⁻³⁵ to 150^{33,34} minutes per week. It is possible to choose one of the possibilities previously mentioned or a mixture of both.
- *Intensity*: On a scale of 0 to 10 (Borg Scale)³⁶, the moderate intensity activity would be in a range of 5-6 and in the case of the vigorous intensity would be 7-8.
- *Duration*: For moderate intensity, 30 minutes per day are recommended with a minimum intensity of 10 minutes for each bout, or 20 minutes of continuous vigorous activity.
- *Type of activity*: Any type of activity can be performed, as long as it has not an excessive overload, such as hiking, water activities or cycling.

Resistance exercises^{33, 34}

- *Frequency*. At least two days per week.
- *Intensity*: Between moderate (5-6) and vigorous (7-8) on a scale of 0-10.
- *Type*: A program of overload exercises (weights). Between 8 and 10 exercises that involve major muscle groups. 8 to 10 repetitions must be performed. It is recommended to climb stairs and other strengthening activities that involve major muscle groups.

Flexibility^{33, 34}

- *Frequency*. At least two days per week.
- *Intensity*. Moderate, between 5 and 6 on a scale of 0 to 10.
- *Type*. Any activity that maintains or increases flexibility with sustained and static stretches. Ballistic movements must not be performed

Balance^{33, 34}

Balance exercises for people who suffer falls or have mobility problems. Currently there is not sufficient evidence about recommendations regarding frequency or the type of balance exercise. Anyway, the ACSM/AHA^{33,34} recommends the following: a) exercise, reducing the exteroception (i.e., it can be performed with the eyes closed), b) influence on posture muscles, c) include displacements of centre of gravity and d) avoid reductions in the support base.

Bio-healthy circuits

Currently, many public resources are being devoted to the construction of BHC in Spain. The cost of these parks varies depending on the amount of elements. Its average cost is estimated in 12,000€, though the type of pavement, the locking and the auxiliary facilities may also influence the cost as well. The cost of each piece of equipment ranges from 700€ to 1,500€³¹.

The low cost of this equipment may be one of the reasons of its expansion. Afterwards the first initiative, which was developed by the Leganes City Council, the model has been implemented in other cities. Currently, there is any census of BHC in Spain, though there is census in some regions, such as Galicia. This region has a population of 2,800,000 and yet is provided with 110 BHC and 10 more under construction²⁶.

These circuits are a public service for the elderly people and their construction is managed by the municipalities, in some cases on their own and in other cases with the collaboration of the autonomous governments. An area of a hundred square meters of public space is enough to build a park of these features, which allows locating them in city centers, inside city parks or gardens.

There are not many companies in Spain that build the equipment for BHC and therefore, in this study we have also included the distributing companies that have their headquarters in Spain, even though the equipment that they commercialize may have been built in other countries. Altogether, we have accounted 23 companies (Table 1)

Table 1. Manufacturing and distributing companies of BHC in Spain

Company	Location	Website
Ciudad Parque S.L	Vitoria-Gasteiz	http://www.ciudadparque.es/
Dr. Play	Valencia	http://www.parquesinfantiles.info/
Exdega	A Coruña	http://www.exdega.com/
Dador	Almería	http://www.geess.es/
Galvan sport	Valladolid	http://www.galvansport.com/
Gestibeca Sport	Lugo	http://www.gestibeca.com/
Grupo Ramos	Ciudad Real	http://www.fdramos.com/
Grupo Vimalto	Murcia	http://www.lineagarden.info/catalogo2.php#
Iberca	Valencia	http://www.iberca.es/
Ibercolmex	Madrid	http://www.ibercolmex.net/
Iplay	Barcelona	http://iplaybcn.com/
Isaba	Valencia	http://www.isaba.com/
Kitres	Guipúzcoa	http://www.kitres.com/
Martín del Cid Sport	Seville	http://www.martindelcid.com/
Metalsur 2006	Granada	http://www.metalsur2006.com/
Miracle Play	Madrid	http://www.miracleplay.com/
Mon-Jocs	Alicante	http://www.mon-jocs.com/
Moycosa	Madrid	http://www.moycosa.com/
Mundopark	Valencia	http://www.mundopark.com/
Norten	Valencia	http://www.norten.es/
Parkesa	Madrid	http://www.parkesa.com/indexES.html
Tecnicasarik	Zaragoza	http://www.tecnicasarik.es/parquesmayores.html
Yor	Vitoria-Gasteiz	http://www.yor.es/

Each BHC consists on various machines and an information sign with instructions. In general, the signs are anchored in the soil, with vandal resistant features. These signs are constructed with steel pipe and corrosion protection. The machines employ the weight of the user as an overload. The elements have familiar names for the older people, such as: wheel, bus or lift.

Once all the machines designed by the different companies for the BHC were analyzed, we grouped them according to their features. We took into consideration the major muscle groups in which each machine intervenes and the physical activity performed, after an analysis of the photographs, drawings and information in the catalogues (Table 2).

Tabla 2. BHC units and muscle groups involved

Body zone	Unit / machine name	Muscle groups involved
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		Pct	Drsl	Dlt	Bcps	Trcp				
Upper part	Bus		✓		✓					
	Wheel	✓	✓	✓	✓	✓				
	Bars	✓		✓						
	Lift		✓		✓					
	Horse	✓		✓						
	Dove		✓		✓					
	Helm	✓	✓	✓	✓	✓				
		Glt	Qdr	Hmt						
Lower part	Jota	✓	✓	✓						
	Swing	✓	✓	✓						
	Pedals	✓	✓	✓						
	Bicycle	✓	✓	✓						
	Skates	✓	✓	✓						
		Abd	Obl	Lmb						
Waist	Trunk	✓		✓						
	Seat	✓		✓						
	Waist		✓							
	Surf		✓							
	Massage	Waist muscle in general								
		Abd	Glt	Qdr	Hmt	Pct	Drsl	Lmb	Bcps	Trcp
Overall body	Pony		✓	✓	✓	✓		✓	✓	
	Skiing	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Rowing	✓	✓	✓	✓		✓		✓	
	Tube		✓	✓	✓					
	Helicopter		✓	✓	✓	✓	✓			
	Rocket	✓				✓	✓			

Pct: Pectoral; Drsl: Dorsal; Dlt: Deltoid; Bcps: Biceps; Trcp: Triceps; Glt: Gluteus; Qdr: Quadriceps; Hmt: Hamstring; Abd: Abdominal; Lmb: Lumbar.

In order to compare the action developed by the elements and/or the machines of the BHC, they were classified according to the function of the physical quality in which they influence (Table 3). The recommendations of the ACSM/AHA^{33, 34} and the WHO³⁵ were taken into consideration.

Table 3. BHC units and physical quality.

Body zone	Machine	Type of exercise		
		Resistance	Endurance	Flexibility/ Mobility
Upper part	Bus			✓
	Wheel			✓
	Bars	✓		
	Lift	✓		
	Horse	✓		
	Dove	✓		
	Helm			✓
Lower part	Jota			✓
	Swing	✓		
	Pedals		✓	
	Bicycle		✓	
	Skates		✓	
Waist	Trunk	✓		
	Seat	✓		
	Waist	✓		
	Surf		✓	
	Massage			✓
Overall body	Pony		✓	
	Skiing		✓	
	Rowing		✓	
	Tube	✓		
	Helicopter	✓		
	Rocket			✓

DISCUSSION

In the review of the catalogues from the 23 companies mentioned, it was observed that the different machines have a similar impact in connection with the body zone in which they influence. Nevertheless, the highest frequency occurs in the machines that influence the upper part of the body.

There are enough machines to influence on the major muscle groups: pectoral, dorsal, deltoid, biceps, triceps, gluteus, abdominal, oblique, lumbar, hamstring and quadriceps. As a consequence, it is possible to develop a complete exercise routine for the elderly people.

Regarding the qualities on which the machines of the BHC can intervene, the machines that influence on resistance and endurance are predominant. There are not many machines capable of exercise flexibility and none of them exercises balance. Solely a machine intervenes in a specific way over the resistance of the lower extremities (the swing). In addition, the swing does not present contraindications for the elderly, as it releases the backbone from any overload³⁷. However, regarding the endurance exercise, the number of machines is lower and they are focused on the lower part (pedals, bicycle and skates). This is logical, as these kinds of muscles present a higher energy expenditure³⁸.

When linking the machines that intervene in each physical quality with the recommendations established in the guidelines of the WHO³⁵ and the ACSM/AHA^{33, 34}, we have found the following information:

Resistance^{33, 34}: In general, it is recommended to exercise major muscle groups^{10, 39-41}. If we analyze the elements offered by the market for the BHC and we relate the type of machine with muscle groups, it follows these relations: a) pectoral-triceps: the horse and the bars; b) for dorsal muscles and biceps: the lift and the dove c) for quadriceps and hamstring: the swing and the tube.

If we take into account that in these exercises it is not possible to calibrate the weight, the recommendations of Pollock and Graves (1994)⁴² cannot be followed. These recommendations establish weights of 30% to 40%, so that the subject performs comfortably 14 to 16 repetitions and if not so, the weight should be reduced.

The main drawback of excessive weights may be an increase in blood pressure⁴³. Peterson (2010)⁴⁴, verified in a recent meta-analysis that high resistance intensities ($70 \pm 12,7\%$ 1MR) were very suitable for maintaining independence in older people. The reality is that the machines are not adjustable, whereby each subject would exercise with an intensity depending on their weight and this would be inadequate in many cases.

Endurance: In connection with the endurance, the recommendations³³⁻³⁵ establish 150 minutes of moderate physical activity or 75 minutes of vigorous activity. The endurance machines suited for use would be: pedals, bicycle, skates, pony, skiing and rowing. The equipment in which higher intensities are obtained are: rowing, pony, skiing and bicycle. In the rest of the machines, intensity is moderate. In the equipment where the pedals are used, older people remain seated whilst performing the exercise and in pieces of equipment such as skates, there is little swing, which implies more moderate physical requirements^{32,45}.

Kallinen (2005)⁴⁶ verified that older people can suffer from health problems while developing an vigorous cardiovascular exercised, although these problems could not be related to physical effort⁴⁷. Therefore, more research is still needed in this area. The use of machines such as the pony, skiing and rowing⁴⁸ display high cardiovascular requirements, so that exercises should be performed with the aid of a professional, as a security measure^{46, 49}.

The performance of physical activity that implies resistance and endurance exercise is crucial in order to have good health and to prevent diseases³⁹, although in the guidelines of the ACSM/AHA is also established that it is important to influence on flexibility and balance. This latter is not obtained adequately with the equipment that is currently in the BHC.

Flexibility: the recommendations³³⁻³⁵ suggest that it is possible to perform any activity that maintains or increases flexibility with sustained stretches for each muscle group. The action must have a static character instead of performing ballistic movements. The machine called *Jota* could pose problems for older people, as they have reduced mobility in the hip joint because of age⁵⁰.

Balance: Within the analyzed catalogues, we have not found any element or specific equipment for exercising balance.

As future research, we aim at the possibility of measuring the metabolic cost made by older people on each machine of the BHC.

In conclusion of this study, it is important to highlight the fact that the equipment of the BHC intervenes in the major muscle groups, predominantly the ones that act upon resistance (especially those in the upper extremities) and endurance. Nevertheless, we have not found any piece of equipment that intervenes in balance. The bio-healthy circuits are helpful equipment in order to meet physical activity recommendations for the elderly, but they present difficulties for resistance training, as weight cannot be changed. The design of equipment that influences on balance and flexibility is recommended.

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