

Matos-Duarte, M. y Berlanga, L.A. (201x) Efectos del ejercicio sobre la flexibilidad en personas mayores de 65 años / Effects of Exercise on Flexibility in Adults over 65 Years and Older. Revista Internacional de Medicina y Ciencias de la Actividad Física y el Deporte vol. 20 (80) pp. 611-622  
[Http://cdeporte.rediris.es/revista/revista80/artefectos1197.htm](http://cdeporte.rediris.es/revista/revista80/artefectos1197.htm)  
DOI: <https://doi.org/10.15366/rimcafd2020.80.010>

## ORIGINAL

### EFFECTS OF EXERCISE ON FLEXIBILITY IN ADULTS OVER 65 YEARS OLD

### EFFECTOS DEL EJERCICIO SOBRE LA FLEXIBILIDAD EN PERSONAS MAYORES DE 65 AÑOS

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**Código UNESCO / UNESCO code:** 3212 Salud Pública / Public Health

**Clasificación Consejo de Europa / Council of Europe classification:** 17 Otros (Actividad Física y Salud) / Others (Physical Activity and Health)

**Recibido** 28 de noviembre de 2018 **Received** November, 28, 2018

**Aceptado** 25 de junio de 2019 **Accepted** June 25, 2019

#### ABSTRACT

Aging involves physiological alterations such as detriments in physical fitness and its components. Lower levels of flexibility are associated to a loss of functional capacity, and participation in supervised physical exercise programs could maintain or improve levels of that physical ability. In our study, we analysed flexibility in 53 adults over 65 years old ( $M=73,74\pm 4,54$ ) who participated in an exercise program for at least 6 months; using Back Scratch Test (TBS), and Chair Sit and Reach Test (TCSAR). At the end of the program, the results of flexibility were found to be within the normative values of reference; being, on many occasions exceeded them. In conclusion, staying physically active minimises the loss of flexibility inherent to the aging process, which could have an important impact on the functional capacity and quality of life of older adults.

**KEY WORDS:** Flexibility, Back Scratch Test, Chair Sit and Reach Test, Physical Activity, Exercise, Older Adults.

## RESUMEN

Es sabido que el envejecimiento provoca el deterioro de la condición física y sus componentes. Menores niveles de flexibilidad se asocian a una pérdida de la capacidad funcional, y la participación en programas de ejercicio físico supervisado podría mantener o mejorar los niveles de dicha cualidad física. En nuestro estudio, evaluamos la flexibilidad de 53 adultos mayores de 65 años ( $M=73,74\pm 4,54$  años) que participaban en un programa de ejercicio durante, al menos, 6 meses; utilizando los tests back scratch (TBS) y chair sit and reach (TCSAR). Al finalizar el programa, los resultados de flexibilidad resultaron estar dentro de los valores normativos de referencia; estando, en muchas ocasiones, por encima. En conclusión, mantenerse físicamente activo minimiza la pérdida de flexibilidad inherente al proceso de envejecimiento, incluso cuando la actividad física no está directamente dirigida a mejorar esa capacidad. Este hecho podría tener importantes repercusiones sobre la capacidad funcional y la calidad de vida de los adultos mayores.

**PALABRAS CLAVE:** Flexibilidad, Test Back Scratch, Test Chair Sit and Reach, Actividad Física, Ejercicio, Personas Mayores

## INTRODUCTION

Aging is a process inherent in human beings that involves physiological, psychological and social changes in life. Among the physiological alterations, it is worth mentioning the deterioration of numerous components of the physical condition, including flexibility. This physical skill tends to decrease over the years (Marques et al., 2014; Stathokostas, McDonald, Little & Paterson, 2013; Vagetti et al., 2015; Vaquero-Cristóbal, González-Moro, Ros & Alacid, 2012) which can lead to a loss of motion of up to 40% in some joints (American College of Sports Medicine - ACSM, 2009).

The significant loss of flexibility is considered an aggravating factor in the health and quality of life of older people (Fabre et al., 2007), its maintenance being essential to perform daily activities autonomously and effectively, (Goncalves, Barata, Varejão & Dantas, 2011). Its conservation is associated with fall prevention, (Guimarães & Farinatti, 2005), adequate performance of activities of daily living (Brach & VanSwearingen, 2002; Geraldes, Albuquerque, Soares, Carvalho & Farinatti, 2008; Stanziano, Roos, Perry, Lai & Signorile, 2009) maintenance of locomotion (Cristopoliski, Sarraf, Dezan, Provensi & Rodacki, 2008; Schenatto, Milano, Berlezi & Bonamigo, 2009), prevention of postural alterations (ACSM, 2005; Da Silva Dias & Gómez-Conesa, 2008) and decrease in muscle pain (King et al., 2000; Ponce, Sempere & Cortés, 2014).

Flexibility is an essential physical capacity for the proper functioning of the organism and the preservation of health, however, the scientific research on this physical capacity is still insufficient and certainly contradictory, due to the methodological heterogeneity and the samples analyzed (Fiatarone Singh, 2002; Rikli & Jones, 2013).

Although, there seems to be a generalized consensus on the importance of maintaining the extensibility of muscles and joints that are agile and have acceptable mobility to maintain a correct functional capacity. In older people, this is an important issue, as the aging process interferes with levels of flexibility due to the biological alterations typical of advanced age, as well as sedentary lifestyle and physical inactivity that are more pronounced in this phase of life (Guthold, Ono, Strong, Chatterji & Morabia, 2008), worsening the range of motion because of the lack of use of joints (Heyward, 2008).

The current recommendations of physical activity suggest that the increase of the physical condition with the practice of flexibility exercises combats the tendency to the loss of amplitude of movement (Correa-Bautista, Sandoval-Cuellar, Alfonso-Mora & Rodríguez-Daza, 2012; Hulya, Sevi, Serap & Ayse, 2015; Toto et al., 2012; Vieira et al., 2015). Consequently, coherent for the elderly is the adoption of an active lifestyle to benefit from sufficiently flexible joints to continue carrying out the basic actions of daily life with autonomy and independence. In this way, older people that include in their daily routine reproduction of habitual movements performed at its maximum amplitude could ensure a certain degree of stretching (Andújar, 2010). Likewise, it would be advisable to participate in structured physical exercise programs that develop the overall physical condition, including the specific work of flexibility.

Therefore, the active lifestyle adopted by each person will be determinant not only to preserve the range of motion, but also to delay the loss of functionality over the years (Coelho de Farias, Borba-Pinheiro, Oliveira & Gomes de Souza 2014; Vaquero-Cristóbal, López-Miñarro, Alacid-Cárceles & Esparza-Ros, 2015). As a result, it will favor the functioning of the body, allowing the person to experience aging more positively, since flexibility is associated with the quality of life of the elderly individual (Gonçalves et al., 2011; Sławińska, Połuszny & Rożek, 2013).

To determine the levels of flexibility there are several methods, being the linear tests the easiest to apply, to be reproduced by the subjects, and the simple use of economic materials in their measurement (Geraldes, Cavalcante, Albuquerque, Carvalho & Farinatti, 2007). In elderly people, the flexibility tests Senior Fitness Test (SFT) developed by Rikli and Jones (2001) are highly recommended, due to their safety, ease of execution regarding movements, their reliability and proven validity (Rikli & Jones, 1999a). These tests include the Back Scratch Test (TBS), which measures the range of motion of the upper body, especially the shoulders; and the Chair Sit and Reach Test (TCSAR), which evaluates that of the lower body.

By measuring flexibility with the TBS and TCSAR tests, results can be compared with the standard reference values, compiled by the SFT authors (Rikli & Jones, 2001). This evaluation tool is important so that older people can identify their results and compare them with the values obtained by populations of the same gender and age range. In addition, it is a valid instrument for professionals in the field of health and physical activity to easily and accurately assess the state in which the joint mobility of the elderly population is found. Knowledge of the state of joint health will facilitate the structuring of strategies and physical exercise programs specifically focused on the development and improvement of the functional capacity of these people.

In this context, the aim of this study is to analyze the range of motion of the upper and lower body in a group of physically active elderly people and compare it with the international reference values.

## **MATERIAL AND METHODS**

### **Subjects**

The present study included 53 Brazilian volunteers (14 men and 39 women) older than 65 years ( $M = 73.74 \pm 4.54$  years), all of them participants of the Physical Activity and Health Program in the Elderly (Physical Activity Program and Health of Older People, PAFSI) of the Federal University of Minas Gerais (UFMG), located in the city of Belo Horizonte, Brazil. For the selection of the sample, it was established as a requirement that the volunteers were at least 65 years of age and that they participated in the PAFSI program for at least six months prior to the start of the study. Also, taking as reference the definition of

autonomy and independence suggested by Moraes (2012), as an inclusion criterion, it was considered that the subjects of the sample were functionally independent; and that they had a medical certificate in accordance with the performance of physical activity and that there were no signs of musculoskeletal and cognitive limitations that could compromise the execution of the movements to be evaluated.

### **Physical Exercised Program**

The PAFSI was administered by professional graduates in Physical Activity and Sports Sciences. In addition to having a structured program of physical exercise, the project had social and leisure activities outside the space of the university and the usual schedules. Likewise, the program included seminars and informative talks in order to guide and raise awareness among participants about issues of great importance for health and quality of life in aging, such as nutrition or falls prevention.

The program consisted of three weekly sessions of 60 minutes. In general, the structure of the classes was divided into an initial warm-up of about 15 minutes, which included walking, joint mobility exercises and static stretching. Next, the main part of the session was about 35 minutes, in which the various aspects of global physical condition were worked through varied global activities (games, dances, adapted sports and cardiovascular, strength, balance, coordination and flexibility). Finally, the sessions ended with relaxation, breathing and stretching exercises in order to cool down for about 10 minutes.

### **Instruments**

For the evaluation of flexibility, the TBS and TCSAR tests proposed by Rikli and Jones (2001) were used, which are tests with high reliability ( $r = 0.96$  and  $r = 0.95$ , respectively) and proven validity (Rikli & Jones, 1999a), being also safe and easy to carry out. These authors conducted a study in the United States with a sample of 7183 subjects between 60 and 94 years of age, establishing reference values for both flexibility and other physical abilities (Rikli & Jones, 1999b), differentiating between genders and age bands of five years.

In order to carry out these tests, all the protocols established by Rikli and Jones (2001) were respected, with regard to pre-warm up, providing the pertinent information to the participants about the execution of the movements, and the reproduction of the same by the evaluators to exemplify; as well as a short period of time for the participants to become familiar with the movements and choose the preferred side of their body to be measured. The specific standard procedures were also followed in the application of each test, its scoring, registration, analysis of the data and security standards for execution.

The tests were administered by a single evaluator with knowledge about the protocols of each test and with experience in the application of the same. The

data collection was extended for two days, with the collection of the measurements being done always in the morning, at the university and using a previously conditioned room for the optimal development of the assessments.

To compare the sample data with the international reference values, the SFT flexibility tables were used with their normative values transformed into centimeters, as shown in tables 1 and 2:

**Table 1.** Reference normative values for men

Age	60-64	65-69	70-74	75-79	80-84	85-89	90-94
<b>Test chair sit and reach</b>	-6.4 a	-7.6 a	-7.6 a	-10.2 a	-14.0 a	-14.0 a	-16.5 a
	+10.2	+7.6	+7.6	+5.1	+3.8	+1.3	-1.3
<b>Test back scratch</b>	-16.5 a	-19.1 a	-20.3 a	-22.9 a	-24.1 a	-24.1 a	-26.7 a
	+0.0	-2.5	-2.5	-5.1	-5.1	-7.6	-10.2

*Note:* Values converted into centimeters.

*Reference:* Adapted from Rikli, R. E. & Jones, C. J. (2001). *Senior Fitness Test Manual*. Champaign, IL: Human Kinetics. pp.143.

**Table 2.** Reference of normative values for women

Age	60-64	65-69	70-74	75-79	80-84	85-89	90-94
<b>Test chair sit and reach</b>	-1.3 a	-1.3 a	-2.5 a	-3.8 a	-5.1 a	-6.4 a	-11.4 a
	+12.8	+11.4	+10.2	+8.9	+7.6	+6.4	+2.5
<b>Test back scratch</b>	-7.6 a	-8.9 a	-10.2 a	-12.8 a	-14.0 a	-17.8 a	-20.3 a
	+3.8	+3.8	+2.5	+1.3	+0.0	-2.5	-2.5

*Note:* Values converted into centimeters.

*Reference:* Adapted from Rikli, R. E. & Jones, C. J. (2001). *Senior Fitness Test Manual*. Champaign, IL: Human Kinetics. pp.143.

To carry out the statistical analysis, the Statistical Package for the Social Sciences - SPSS for Windows in version 22.0 was used. A descriptive analysis of the variables of the age of the sample was carried out, in addition to the investigated variables containing the mean, maximum, minimum and standard deviations values. The normality test (Kolmogorov-Smirnov) was applied for the variables and the Levene test to verify the homogeneity of the variances. The level of significance adopted was  $p < 0.05$ .

All information relevant to the study was provided to the participants, who signed the corresponding informed consent. The identity of the sample was preserved in anonymity, the collected data having the sole purpose of the investigation. The considerations established by the Research Ethics Committee of

the Autonomous University of Madrid, in association with the Department of Physical Education, Sport and Human Motility and the Postgraduate Department of Sports Sciences of the UFMG, were met. As in all studies involving human beings, the ethical standards promulgated by the World Medical Association in the Declaration of Helsinki were respected.

## RESULTS

The results are presented in descriptive tables, with sample flexibility values separated by age and gender groups. The statistical tests showed significant differences between men and women in the group of 70 to 74 years for the TBS test, not observing significant differences in the other groups or in the results of the TCSAR.

**Table 3.** Descriptive analysis of the flexibility of the upper body through the TBS and the lower body through TCSAR in men and women divided by age groups.

Age	N	Men		N	Women	
		TBS Average (±SD)	TCSAR Average(±SD)		TBS Average (±SD)	TCSAR Average (±SD)
65-69	1	1.5±0	0.7±0	7	2.29±3.48	0.09±11.51
70-74	6	-10.50±2.57*	-5.35±5.6	20	-3.44±8.98*	-2.08±7.74
75-79	4	-12.15±10.41	-11.02±13.68	9	-3.08±13.73	-2.52±12.15
80-84	3	-5.93±2.80	-12.37±10.95	3	-14.6±5.6	4.3±5.86

SD – standard deviation; \* p<0.05 in relation to the test (difference between men and women)

Table 4 presents the percentages of the sample that were found within, above and below the normative reference values according to the classification proposed by Rikli and Jones (2001). The men presented in their majority values equal to or higher than those of international reference in all age groups for both the TBS and the TCSAR, except in the group 75 to 79 years, in which 50% was below the value of reference and 50% above or within these normative values. Most of the women had flexibility values within or above the normative reference values in TBS and TCSAR, except in the group 80 to 84 years in TBS (66.7% below) and 70 to 74 years in TCSAR (50% below).

**Table 4.** Percentages of the sample in relation to the reference values for men and women in both tests.

Age	Ref.	Men			Women							
		TBS ↓	TBS ↑	TCSAR Ref.	TCSAR ↓	TCSAR ↑	TBS Ref.	TBS ↓	TBS ↑	TCSAR Ref.	TCSAR ↓	TCSAR ↑
65-69	0	0	100%	100%	0	0	57.1%	14.3%	28.6%	42.9%	42.9%	14.2%
70-74	100%	0	0%	83.3%	16.7%	0	60%	15%	25%	45%	50%	5%
75-79	50%	25%	25%	25%	50%	25%	33.3%	22.2%	44.5%	33.3%	44.5%	22.2%
80-84	66.7%	33.3%	0%	66.7%	0	33.3%	33.3%	66.7%	0%	66.7%	33.3%	0

Ref. – within the reference values; “↓” – below the reference values; “↑” – above the reference values

## DISCUSSION

Knowing that aging is an inherent process in all people and that it supposes the diminution of the physiological, psychological and social capacities of the individual; the first finding to highlight from our study is that supervised physical exercise manages, at least, to maintain the levels of flexibility in a population over 65 years of age within the normative values of reference; resulting, in many cases, values that are above the normative ones. Only subjects between 75 to 79 years for the TCSAR, and women between 80 to 84 years for the TBS, were mostly below the reference values.

These results are in accordance with the findings of other researchers. Gonçalves et al. (2011) recorded an improvement in flexibility measured with a goniometer in a sample of 120 subjects aged 60 years or older, who performed two yoga sessions a week of 60 minutes for 14 weeks. In addition, these authors evaluated functional tests related to the activities of daily life, where flexibility and range of motion are essential for its execution, finding that yoga improved all tests except that of putting on and taking off a shirt; concluding that the regular practice of this exercise modality improves the amplitude of movement and the performance of daily tasks, also demonstrating important improvements in the quality of life of the subjects.

In the same line, Matos-Duarte, Martínez-de-Haro, Sanz-Arribas, Andrade and Chagas (2017) found that in a sample of subjects older than 65 years, evaluated using the same instruments that in this study (TBS and TCSAR), the flexibility of both the upper and lower body, continues to improve over time as long as the subjects remain active in programs of global physical exercise that enhances the development of this physical quality.

In an observational study involving 74 elderly people, Fabre et al. (2007) concluded that the loss of flexibility associated with aging continues even after reaching 90 years of age and is a significant decline in the quality of life of these people. In fact, the loss of flexibility associated with aging and its relationship with functional capacity and quality of life was clearly defined by Sayer et al. (2008), in whose review spoke of a disability threshold related to the loss of muscle mass and strength and the ability to move. Marmolejo, Medhanie and Tarleton (2018) state that people with higher levels of flexibility have better muscle balance and body posture, which could translate into greater productivity and muscle efficiency that would decrease the risk of injury.

Regarding the gender difference observed in the TBS in the age range of 70 to 74 years, Santos et al. (2012) also observed significant differences between genders in favor of women, having evaluated the flexibility of 312 subjects from 65 to 103 years with the use of both TBS and TCSAR. However, these authors did not present a detailed analysis by age group, as the reference normative values are classified, so we cannot know where this significant difference was presented or whether the response to the physical exercise program was different depending on the age of the participants.



Gouveia et al. (2013), in their sample of 802 Portuguese men and women between 60 and 79 years old, found that women obtained significantly better scores than men in TSCAR and TBS, although men were in better physical condition in general. These authors also found greater improvements in the variables evaluated in those subjects with greater participation in programs of activity and physical exercise, as well as the important benefits regarding functional capacity and quality of life of the subjects.

Therefore, analyzing the evolution of levels of flexibility in older people is of vital importance because of its involvement in the development of daily activities and to help them preserve their autonomy, preventing the functional disability that affects a large part of the elderly population and its quality of life. However, a limitation of this study was that it did not include the registry of this variable. In addition, the normative reference values of Rikli and Jones (1999b) were validated for a US sample; therefore, it would be advisable to validate specific reference values for different countries.

## CONCLUSION

We conclude with our study that, according to internationally established parameters, our sample of people over 65 years of age who participate in a supervised physical exercise program, can maintain levels of joint mobility and adequate range of motion. However, it is recommended to increase the workload specifically oriented to the development of these physical skills in the elderly, in order to improve the autonomy and functional capacity of this population.

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