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# ORIGINAL

# ANTHROPOMETRY AND STRENGTH, ITS INFLUENCE ON THE SIT AND REACH TEST

# ANTROPOMETRÍA Y FUERZA, SU INFLUENCIA SOBRE EL TEST SIT AND REACH

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## ABSTRACT

Analyzes the influence of kinanthropometric and dynamometric variables on the Sit and Reach test in amateur athletes. We used twenty anthropometric variables, four dynamometry tests, the Sit and Reach test and the amount of physical activity practiced. Significant differences were found between men and women in terms of flexibility levels. The prediction equations were differed according to gender (30.6% men and 32.5% women), height being an influential factor in women. The general prediction equation calculated, the level is 39.1% (moderate). Men and women show significant differences in all anthropometric variables except subscapular and suprailiac skinfolds. What other factors influence the kind of results that can be expected? The results of the flexibility test are not influenced by the anthropometric and dynamometric variables, or by the type of physical activity performed. The strength index does not correlate with the Sit and Reach test value.

**KEYWORDS:** Physical fitness related health, Anthropometry, flexibility testing, dynamometer, strength testing.

## RESUMEN

Se analiza la influencia que tienen las variables cineantropométricas y dinamométricas sobre el test Sit and Reach en deportistas amateur. Se tomaron veinte variables antropométricas, cuatro pruebas de dinamometría, el test Sit and Reach y la actividad física realizada. Encontramos diferencias significativas en los valores de flexibilidad entre hombres y mujeres. Las ecuaciones de predicción fueron diferentes en hombres y en mujeres (30.6% y 32.5%), en las mujeres apareció la talla como factor influyente. La ecuación general de predicción calculada se obtiene un 39,1% (moderada). Hombres y mujeres se diferencian significativamente en todas las variables antropométricas excepto en pliegue subescapular y suprailiaco. ¿Qué otros factores influirían sobre una posible predicción del resultado? Los valores de flexibilidad no se consideran influenciados por las variables antropométricas, dinamométricas y la tipología de actividad física realizada. El índice de fuerza no correlaciona con el valor del test Sit and Reach.

**PALABRAS CLAVE:** condición física relacionada con la salud, antropometría, pruebas de flexibilidad, dinamómetro, pruebas de fuerza.

## INTRODUCTION

Since the second half of the twentieth century, particular interest has been shown in the relationship between physical activity and physical condition as it affects overall state of health and functional capacity (1). Flexibility, strength and body composition have been established as three components of physical condition that are related to health in that they can be improved by appropriate physical activity and are associated with a low risk of developing diseases caused by a sedentary lifestyle (2).

The standard Sit and Reach Test (SRT), as originally designed by Wells & Dillon (3), is included among the battery of tests used by qualified bodies such as the American Alliance for Health, Physical Education, Recreation and Dance (4); the Council of Europe (5); the Australian Council for Health, Physical Education and Recreation (6); and the Canadian Physical Activity, Fitness and Lifestyle Appraisal (7). It is interpreted as showing that the distance reached depends principally on lumbar, pelvic and hamstring muscle flexibility (3).

Although this test is well established and has been widely used, many studies raise the question of whether its results are altered by anatomical factors such as the position of the head (8); antepulsion and scapulohumeral abduction, flexibility in the spine and intervertebral joints (9); length of upper and lower limbs (10); position of the ankles and toes (11); pelvic and hip intervention (12); and compensation of the muscle groups involved (13).

Other studies have: concluded that the validity, reliability and criteria of the SRT are moderate in relation to hamstring flexibility and low in relation to lumbar flexibility (12, 14-16); established differences according to gender and/or age groups (17,18); and have identified a need for the population samples studied to include athletes and physically active people (19).

Kinanthropometry is one of the most widely used techniques for calculating body composition. It measures body dimensions such as: weight, height, waist, hip, diameters, perimeters and skin folds. According to the World Health Organization (WHO): "anthropometric indices are combinations of measurements that are essential for the interpretation of those measurements: it is evident that one value alone has no meaning unless it is related to a variable or indicator" (20, p.8).

The American College of Sports Medicine (ACSM, 21) recognises that muscular strength is a physical quality essential to good health. Therefore, its development and maintenance is needed for preserving functional abilities and facilitating daily activities, besides providing for the prevention of and rehabilitation from musculoskeletal conditions.

In the relationships between dynamometry, flexibility and anthropometry we find that: Chandrasekaran et al., (22) established that height, age and weight are important predictors of strength; Silva et al., (23) indicated the relationship between anthropometric variables and the age with dynamometry, and that being overweight can limit flexibility; Sharma & Kailashiya (24) showed a significant correlation of height and body composition with dynamometry and flexibility.

The objective of our research is to analyse the relationship between the kinanthropometric and dynamometric variables using the SRT on a sample of people who practise physical activity and sports at a recreational level.

## MATERIAL AND METHODS

The sample was made up of 491 people of both sexes (289 men and 202 women) who practised physical activity and sport at the recreational level and had done so for at least a year, following the patterns established by the ACSM (31); their ages ranged between 18 and 68, the average age being 36 (36.2±12.8) for men and 33 (33.6±12.7) for women. Their initial screening took the form of medical and sports assessment at the School of Medicine of Physical Education and Sports of the Complutense University of Madrid (UCM). The participants had to confirm that they had no recent medical conditions, were taking no medication, and did not take part in sport at a competitive level. They were briefed on the measurements that would be taken during the study and gave their written consent. The data collected were codified to observe confidentiality. This research project was approved by the Ethics Committee for research with human beings of the Autónoma University of Madrid (UAM), CEI-90-1674.

The following indicators were selected as criteria for inclusion in the sample: sex; age; weight; height; waist and hip measurements; ICC; bistyloid, biepicondylar and bicondylar diameters; contracted arm and maximum leg perimeters; triceps, subscapular, suprailiac, abdominal anterior thigh and medial leg skinfolds; right hand, left hand, back and legs dynamometry; flexibility; and physical activity performed.

The statistical design was non-experimental and was based on a descriptive, retrospective, observational and prevalence methodology.

All measurements were taken in the laboratory of the UCM's School of Sports Medicine, without the participants engaging in any type of physical activity beforehand. A medical and sports anamnesis was obtained from each participant, with other related variables - such as practice, type, duration and frequency of physical activities - being registered in own questionnaire.

The kinanthropometric assessment was carried out by sports doctors from the School accredited by the International Society for the Advancement of Kinanthropometry (ISAK), using standardised techniques in compliance with their ISAK certification (26).

The instruments used for the measurements were: for height a Holtain® Stadiometer; for weight a Lafayette® Detecto scale; for skinfolds a Holtain® plicometer; for diameters a Holtain® pachymeter or anthropometer; for perimeters. The dynamometry was measured using a TKK-5401 Tecsymp® digital hand dynamometer and a TKK-5002 Tecsymp® back and leg dynamometer.

The flexibility protocol (SRT) and dynamometry were carried out according to the recommendations in the AAHPERD (4), using a standard Lafayette® drawer and placing as a mark value zero to 23 cm before foot support.

The Statistical Package for the Social Sciences ® (SPSS 23) was the software used for the statistical analysis. Data to statistically describe the sample were obtained, as well as centralization, dispersion and shape data (arithmetic mean, standard deviation, variance, asymmetry and kurtosis). The level of significance chosen was <.05. The values established by Hopkins (27) were used for the interpretation of the results obtained: small ($r \leq .3$), moderate ($r \geq .3 < .5$), large ($r \geq .5 < .7$), very large ($r < .9$), almost perfect ($r > .9$). A t-test of independent samples was used following a normality test. To evaluate the association between the different variables, they were calculated by means of a Pearson correlation and their statistical significance determined. With the purpose of identifying the independent associations between the different variables, a linear regression analysis was carried out step by step. The analysis made it possible to calculate the significance of the variables and determine which of them influence flexibility.

## RESULTS

The descriptive results in table I show arithmetic means and standard deviations of flexibility (cm) classified by age and gender, and measured by the SRT.

**Table I:** *Descriptive statistics flexibility values.*

| | Men (mean±SD) | | Women (mean±SD) | |
|---|---|---|---|---|
| **18/19** | N=28 | 30.48±8.10 | N=24 | 30.19±13.72 |
| **20/29** | N=76 | 28.63±10.16 | N=84 | 30.87±7.92 |
| **30/39** | N=63 | 29.40±8.72 | N=37 | 35.27±8.19 |
| **40/49** | N=78 | 25.63±7.57 | N=23 | 32.57±10.55 |
| **50/59** | N=34 | 23.60±6.54 | N=30 | 33.03±6.35 |
| **60/68** | N=9 | 28.90±11.84 | N=4 | |

Means ± Standard deviations.

Table II presents arithmetic means and standard deviations classified by age and gender, and measured by the dynamometry test.

**Table II:** *Descriptive statistics dynamometry values.*

| | | **Total M (n=289) W (n=202)** | **18/19 M (n=28) W (n=24)** | **20/29 M (n=76) W (n=84)** | **30/39 M (n=63) W (n=37)** | **40/49 M (n=78) W (n=23)** | **50/59 M (n=34) W (n=30)** | **60/68 M (n=9) W (n=4)** |
|---|---|---|---|---|---|---|---|---|
| | | **mean±SD** | **mean±SD** | **mean±SD** | **mean±SD** | **mean±SD** | **mean±SD** | **mean±SD** |
| **RHD** | M | **42.05±7.00** | **40.77±5.70** | **41.52±7.11** | **42.78±7.93** | **44.10±7.03** | **41.41±6.92** | **36.10±8.53** |
| | W | **26.96±4.63** | **28.17±5.08** | **27.70±4.37** | **26.10±4.56** | **25.87±5.62** | **25.94±2.60** | |
| | T | **36.36±9.60** | **35.37±8.29** | **34.90±9.12** | **37.50±10.49** | **38.60±10.70** | **36.25±9.40** | **34.30±8.81** |
| **LHD** | **M** | 40.29±7.08 | 38.01±6.68 | 40.53±7.10 | 40.89±7.84 | 42.20±7.52 | 38.49±6.34 | 37.02±10.02 |
| | **W** | 26.07±4.39 | 27.18±3.77 | 26.01±4.15 | 26.06±4.49 | 25.93±5.68 | 25.03±4.38 | |
| | **T** | 34.93±9.27 | 33.36±7.77 | 33.57±9.35 | 36.20±9.81 | 37.29±10.25 | 34.00±8.59 | 34.86±10.40 |
| **BackD** | **M** | 108.23±25.95 | 96.78±22.68 | 106.44±32.74 | 112.77±20.47 | 114.5±26.18 | 97.43±20.25 | 111.3±18.63 |
| | **W** | 64.53±17.29 | 70.73±19.00 | 66.98±16.30 | 61.34±12.87 | 61.11±23.02 | 57.47±12.13 | |
| | **T** | 91.72±31.31 | 85.62±24.64 | 87.53±32.73 | 96.48±30.28 | 98.40±35.20 | 84.11±26.09 | 104.5±23.56 |
| **LegD** | **M** | 132.40±31.83 | 122.9±38.95 | 130.51±37.18 | 139.94±27.76 | 134.0±31.86 | 129.8±21.76 | 135.5±19.43 |
| | **W** | 83.76±27.95 | 84.30±25.24 | 86.11±25.78 | 80.71±24.95 | 82.44±37.38 | 74.68±28.26 | |
| | **T** | 114.31±9.21 | 106.3±38.54 | 109.2±39.05 | 121.1±38.53 | 118.4±40.97 | 111.4±35.47 | 127.7±31.55 |

Means ± Standard deviations. **Abbreviations:** RHD (right hand dynamometry), LHD (left hand dynamometry), BackD (back dynamometry), LegD (leg dynamometry).

Table III displays the age and gender values in relation to anthropometric variables.

**Table III**: *Data from the studied sample categorised by decades and sex declared in relation to anthropometric variables.*

| | | Total (491) M (n=289) W (n=202) | 18/19 M (n=28) W (n=24) | 20/29 M (n=76) W (n=84) | 30/39 M (n=63) W (n=37) | 40/49 M (n=78) W (n=23) | 50/59 M (n=34) W (n=30) | 60/68 M (n=9) W (n=4) |
|---|---|---|---|---|---|---|---|---|
| | | **mean±SD** | **mean±SD** | **mean±SD** | **mean±SD** | **mean±SD** | **mean±SD** | **mean±SD** |
| **Wei** | **M** | 76.63±10.88 | 73.03±10.61 | 73.12±9.46 | 75.50±10.68 | 80.88±10.93 | 79.57±10.5 | 81.80±20.3 |
| | **W** | 61.10±9.75 | 65.52±11.46 | 58.84±8.35 | 59.23±5.30 | 62.31±13.68 | 60.14±9.61 | |
| | **T** | 70.32±12.92 | 69.81±11.46 | 66.27±11.43 | 70.35±12.00 | 75.28±14.53 | 73.10±13.7 | 77.10±21.5 |
| **Heig** | **M** | 175.59±6.87 | 177.85±6.40 | 176.25±6.51 | 176.32±7.51 | 175.97±6.46 | 172.13±6.9 | 169.80±3.9 |
| | **W** | 163.65±7.18 | 171.74±8.82 | 163.84±6.57 | 163.03±4.91 | 161.29±7.15 | 158.90±4.7 | |
| | **T** | 170.72±9.10 | 175.23±8.02 | 170.31±9.01 | 172.12±9.19 | 171.54±9.48 | 167.72±8.8 | 167.33±7.0 |
| **Wai** | **M** | 79.78±12.14 | 82.24±9.16 | 77.03±9.10 | 80.22±11.13 | 78.46±10.50 | 78.76±12.3 | 84.40±4.39 |
| | **W** | 80.71±10.67 | 80.86±12.01 | 81.02±10.95 | 84.38±10.70 | 82.03±10.78 | 80.31±9.42 | |
| | **T** | 80.19±11.57 | 81.65±10.33 | 78.94±10.18 | 81.54±11.08 | 79.54±10.63 | 79.28±11.3 | 85.75±5.13 |
| **Hip** | **M** | 97.01±7.27 | 98.21±4.54 | 95.53±5.90 | 96.68±7.35 | 96.46±7.81 | 97.00±6.76 | 103.24±5.3 |
| | **W** | 98.04±7.25 | 96.69±11.09 | 98.21±6.58 | 101.40±7.44 | 99.17±7.26 | 94.77±9.91 | |
| | **T** | 97.47±7.31 | 97.56±7.92 | 96.85±6.35 | 98.17±7.65 | 97.28±7.69 | 96.25±7.86 | 103.36±4.7 |
| **HWI** | **M** | .82±.11 | .83±.07 | .80±.07 | .82±.08 | .81±.12 | .81±.14 | .81±.06 |
| | **W** | .82±.10 | .84±.14 | .82±.08 | .83±.09 | .83±.13 | .86±.18 | |
| | **T** | .82±.10 | .83±.10 | .81±.07 | .83±.09 | .82±.12 | .83±.15 | .83±.06 |
| **DBi** | **M** | 5.65±0.48 | 5.51±.29 | 5.48±.33 | 5.56±.43 | 5.79±.42 | 5.90±.37 | 5.92±.54 |
| | **W** | 5.02±0.53 | 5.08±.67 | 4.92±.32 | 4.96±.28 | 5.27±1.25 | 5.05±.48 | |
| | **T** | 5.39±0.59 | 5.32±.53 | 5.21±.43 | 5.37±.48 | 5.64±.80 | 5.61±.57 | 5.80±.56 |
| **DBi** | **M** | 6.78±.57 | 6.71±.65 | 6.70±.43 | 6.68±.48 | 6.93±.58 | 6.80±.59 | 7.12±.39 |
| | **W** | 5.98±.55 | 6.06±.61 | 5.89±.52 | 5.91±.39 | 5.81±.46 | 6.07±.71 | |
| | **T** | 6.45±.69 | 6.43±.70 | 6.31±.62 | 6.44±.58 | 6.59±.75 | 6.56±.71 | 6.96±.51 |
| **DBi** | **M** | 9.74±.67 | 9.74±.72 | 9.58±.58 | 9.61±.80 | 9.92±.53 | 10.01±.60 | 10.06±.68 |
| | **W** | 9.00±.75 | 9.12±.84 | 8.80±.59 | 8.91±.49 | 8.85±1.06 | 9.10±.77 | |
| | **T** | 9.44±.79 | 9.47±.82 | 9.21±.70 | 9.39±.78 | 9.60±.88 | 9.71±.78 | 9.83±.82 |
| **CAP** | **M** | 32.89±2.86 | 32.30±2.96 | 32.96±3.00 | 32.62±2.66 | 33.55±3.45 | 33.10±1.99 | 34.58±5.71 |
| | **W** | 27.93±2.97 | 28.28±2.87 | 27.00±2.45 | 27.58±2.39 | 28.30±3.65 | 28.54±3.31 | |
| | **T** | 30.85±3.79 | 30.58±3.51 | 30.10±4.05 | 31.03±3.48 | 31.97±4.24 | 31.58±3.28 | 33.15±6.19 |
| **ELP** | **M** | 37.70±2.63 | 37.36±2.62 | 37.12±1.66 | 37.00±3.12 | 38.85±2.93 | 38.08±2.45 | 38.46±4.73 |
| | **W** | 36.08±5.53 | 40.67±17.56 | 35.31±2.41 | 35.24±1.66 | 35.76±2.96 | 36.40±4.27 | |
| | **T** | 37.03±4.15 | 38.78±11.56 | 36.25±2.24 | 36.44±2.85 | 37.92±3.24 | 37.52±3.20 | 37.38±4.98 |
| **STri** | **M** | 13.01±5.52 | 11.88±5.50 | 12.34±5.96 | 12.42±5.11 | 13.54±5.45 | 14.80±6.65 | 17.84±6.70 |
| | **W** | 19.68±6.54 | 16.58±5.61 | 17.35±5.42 | 20.28±7.19 | 20.50±6.17 | 22.67±7.06 | |
| | **T** | 15.75±6.80 | 13.89±5.95 | 14.74±6.21 | 14.91±6.86 | 15.64±6.48 | 17.43±7.67 | 16.90±6.42 |
| **SSu** | **M** | 15.25±7.11 | 12.08±8.02 | 12.91±6.56 | 13.69±6.15 | 18.15±7.83 | 20.43±6.82 | 19.14±10.0 |
| | **W** | 14.18±6.64 | 12.10±4.16 | 11.98±4.28 | 15.40±7.52 | 15.30±6.30 | 16.13±8.30 | |
| | **T** | 14.81±6.93 | 12.08±6.56 | 12.46±5.78 | 14.23±6.59 | 17.29±7.47 | 19.00±7.50 | 17.81±9.58 |
| **SSu** | **M** | 13.27±6.99 | 11.14±8.51 | 11.82±8.07 | 11.86±5.16 | 15.02±7.39 | 14.73±5.80 | 16.74±9.11 |
| | **W** | 13.61±6.44 | 12.22±4.75 | 12.04±4.78 | 13.37±7.12 | 13.93±5.99 | 13.89±5.92 | |
| | **T** | 13.41±6.77 | 11.60±7.08 | 11.92±6.66 | 12.34±5.83 | 14.69±6.97 | 14.45±5.76 | 15.51±8.68 |
| **SAb** | **M** | 23.01±9.52 | 16.72±9.73 | 19.86±10.46 | 20.15±7.39 | 26.27±8.08 | 29.65±8.87 | 29.78±5.41 |
| | **W** | 20.64±7.41 | 18.81±7.60 | 18.53±6.81 | 20.45±7.01 | 21.33±7.00 | 22.20±8.26 | |
| | **T** | 22.04±8.79 | 17.61±8.82 | 19.22±8.88 | 20.24±7.21 | 24.78±8.05 | 27.17±9.26 | 27.78±6.88 |
| **ATS** | **M** | 15.91±7.24 | 16.96±8.84 | 15.38±6.97 | 15.28±6.89 | 17.12±7.55 | 15.38±7.22 | 20.96±5.49 |
| | **W** | 26.68±8.04 | 25.12±9.50 | 24.93±7.28 | 26.84±7.27 | 25.73±7.71 | 30.92±9.15 | |
| | **T** | 20.34±9.24 | 20.46±9.88 | 19.96±8.55 | 18.94±8.82 | 19.71±8.52 | 20.56±10.75 | 20.96±4.91 |
| **MLS** | **M** | 9.64±4.87 | 9.37±5.18 | 8.96±4.56 | 9.31±4.94 | 10.63±5.98 | 10.78±6.49 | 12.46±4.17 |
| | **W** | 16.68±6.32 | 15.35±6.61 | 15.31±6.08 | 16.57±6.51 | 15.93±5.18 | 17.22±5.93 | |
| | **T** | 12.53±6.51 | 11.93±6.48 | 12.00±6.20 | 11.61±6.41 | 12.23±6.21 | 12.93±6.94 | 12.81±3.83 |

Means ± Standard deviations. **Abbreviations:** weight, height, waist, CAD (hip), HWI (hip-waist index), DBist (bistyloid diameter), DBiep (biepicondylar diameter) and DBic (bicondylar diameter), CAP (contracted arm perimeter), ELP (extended leg perimeter) and STri (triceps skinfold), SSub (subscapular skinfold), SSup (suprailiac skinfold), SAbd (abdominal skinfold), ATS (anterior thigh skinfold), MLS (medial leg skinfold).

The analysed variables that show a greater correlation with flexibility are: the abdominal skinfold (r = -.313) and the weight (r = -.297).

An independent samples t-test is carried out on the different variables. Its results show significant differences in all variables in terms of gender, except in the following: the subscapular skinfold and the suprailiac skinfold.

The prediction equation of the SRT in the general sample, calculated in a stepwise linear regression, indicates that the determinant variables are: the abdominal skinfold, the biepicondylar diameter and the triceps skinfold. Suggests a moderate prediction of 39.1% ($R^2$=0.391) in relation to the value of flexibility using the following formula:

Flexibility = 48.301 - .361 × abdominal skinfold - 2.262 × biepicondylar diameter + .179 × triceps skinfold.

In the case of males who practise physical activity and sport, correlation was calculated to determine the relationship between the different variables and flexibility. The variables with the greater correlation were: subscapular skinfold (r = -.262), suprailiac skinfold (r = -.287) and abdominal skinfold (r = -.306). Once the prediction equation of the SRT had been established, the abdominal skinfold showed a significant relation. Suggests a moderate prediction of 30.6% ($R^2$=0.306) in relation to the value of flexibility using the following formula:

Flexibility = 32.838 - .284 × abdominal skinfold.

In the case of females who practise physical activity and sport, correlation was calculated to determine the relationship between the different variables and flexibility. The variables with the greater correlation were: weight (r = -.236), subscapular skinfold (r = -.255), suprailiac skinfold (r = -.238), abdominal skinfold (r = -.282) and medial leg skinfold (r = -.259). Once the prediction equation of the SRT had been established, abdominal skinfold and height showed a significant relation. Suggests a moderate prediction of 32.5% (R2= 0.325) in relation to the value of flexibility using the following formula:

Flexibility = 71.200 - .335 × abdominal skinfold - .199 × height.

## DISCUSSION

The interest of this article lies in determining which factors are more significant for measurements in the SRT; that is, whether test results are influenced by a person’s proportions, body composition or strength. However, no reference studies have been found analysing the relationship between flexibility, graded by means of the SRT, dynamometry, anthropometric variables, and physical activity carried out according to the parameters judged healthy by the ACSM (25).

The subscapular and suprailiac skinfolds are significant statistically in both sexes. It could also be influenced by which is the subject's dominant side, since a greater skill with that extremity could result in asymmetric musculoskeletal adaptations (28). This would affect the biomechanics of human movement while engaging in physical activity and sport, this movement being located in anatomical areas next to the skinfolds. Arellano & Kram (29) stress that in order to minimise the expenditure of energy and improve lateral balance, biomechanics are adapted by taking shorter steps and swinging the arms when walking.

As established by the general formula of the sample, the triceps skinfold, the biepicondylar diameter and the abdominal skinfold appear to be predictors. A study by Bale et al., (30) concluded that the difference in body fat percentage was reflected mainly in the triceps skinfold. Vila et al., (31) distinguish the triceps skinfold in its predictive model related to body composition.

Carrasco et al., (32) show a difference in athletes who take part in sports where an object is involved, as compared with others, in the arm's biepicondylar, bistyloid, and bicondylar diameters. Iermakov et al., (33) stress the fact that diameters of the arm and forearm are greater in contact sports in relation to the strength exerted or dynamometry. Norton & Olds (34) highlight the increased diameters found in athletes who engage in adversarial sports, in relation to nutrition, ergogenicity or training. This goes against the study by Vila et al., (31) which defines such diameters as anthropometric variables not modifiable by training.

The linear regression analysis established the abdominal skinfold as part of the predictive formula for men, and the abdominal skinfold and height for women.

The value of the abdominal skinfold increases significantly in men aged between 40 and 49. Analysing this variable as one of the predictor variables of flexibility in both men and women, there is a higher prediction for women ($p = -.335$) than for men ($p = -.284$). According to Kerr & Stewart (35), some of the factors that affect body composition in people who practise physical activity and sport are: genetics, growth, ageing and nutrition. Growth and ageing are accompanied by changes in adipose tissue, muscle tissue, and bone mass. Hrazdira et al., (36) discovered that the accumulation of abdominal fat is a limiting factor in the SRT, being higher in men than in women.

The influence of height in the SRT, in inverse relationship in women but not in men, confirms the findings of studies on the influence of body proportions on the test itself. Significant differences are found between men and women $p=.001$. Women with a smaller size obtain better results in the SRT, which indicates that neither the longitudinal variables nor the longitudinal proportions influence the numerical result of the SRT. Similar results were obtained by Shephard et al., (37), who point out that size does not affect men's results in the SRT, but it does influence women's.

In terms of flexibility, there is lower data dispersion in the age range 50 to 59 and higher flexibility values in females. According to Smith & Miller (8) significance is high between gender and the SRT; Mier (17) showed moderate validity of the ischiotibial flexibility for women and low validity for men. However, Mayorga et al., (18) showed that the SRT results have a moderate-high mean criterion-related validity for estimating flexibility of the hamstring muscles, which is higher for men than for women.

Therefore, according to Kim et al., (38), participation in physical activity and sports results in beneficial changes in skeletal muscle fitness, in flexibility and in body composition; Hrazdira et al., (36) point out that physically active people are more flexible than those who are inactive in all age groups; Mathunjwa et al., (39) study with athletes differentiated by gender showed that the results improved as ages increased; this could be due to adaptations brought about by training or the technical demands of particular sports. Matos-Duarte et al., (40) noted that flexibility was improved by practising physical activity and sport in accordance with ACSM recommendations.

## CONCLUSIONS

In the total sample of athletes we found a moderate correlation between several variables and flexibility values measured by the SRT, such as abdominal skinfold and weight.

In the case of men, the variables that correlate with flexibility measured by the SRT are subscapular, suprailiac and abdominal skinfolds. In the case of women, weight is added.

In all the samples, the level of prediction of the SRT values is considered moderate. We would stress:

- The abdominal skinfold predicts flexibility in the general formula and in both sexes.
- The influence on the flexibility, but only in the general formula of the biepicondyal diameter and the triceps skinfold.
- Height is inversely influential in the value of flexibility in the case of females.
- The strength index does not correlate with the value of the Sit and Reach test.

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