INFLUENCE OF SEX ON THE ACUTE EFFECT OF STRETCHING ON V SIT-AND-REACH SCORES IN UNIVERSITY STUDENTS

Rafael Merino-Marban,[1, A, B, D] Daiana P. Romano,[1, A, B, D] Daniel Mayorga-Vega[2, C, D, E]

[1] Facultad de Ciencias de la Educación, Universidad de Málaga (UMA), Campus de Teatinos, s/n, 29071, Málaga, Spain
[2] Department of Physical Education and Sport, University of Granada, Spain
[A] Study Design; [B] Data Collection; [C] Statistical Analysis; [D] Manuscript Preparation; [E] Funds Collection

Address for correspondence:
Rafael Merino-Marban, PhD
Facultad de Ciencias de la Educación
Departamento de Didáctica de la Expresión Musical, Plástica y Corporal
Universidad de Málaga (UMA), Campus de Teatinos, s/n, 29071, Málaga, Spain
E-mail: rmerino@uma.es

Abstract. The purpose of this study was to examine the influence of sex on the acute effect of static-passive one-session stretching on V sit-and-reach scores in university students. A sample of 76 college students aged 19–30 years were divided into a women group (n = 36) and men group (n = 40). During one session the students performed stretching exercises for the major body muscles using the static-passive technique. Hamstring and lower back muscles extensibility was estimated by the V-sit-and-reach test at the beginning and at the end of the stretching session. The results of the two-way ANOVA with the Bonferroni adjustment showed that females and males did not show a different response to the one-session stretching intervention ($p > 0.05$). However, both the women and men increased statistically their scores after performing the stretching session ($p < 0.001$). In conclusion, no differences have been found in the trainability of flexibility by sex. However, there are differences of flexibility by the sex of students, being the females, who obtained the highest marks in the V-sit-and-reach. All this knowledge could help coaches to design more effectives stretching programs.

Key words: gender differences, flexibility, extensibility, trainability, physical fitness

Introduction

Flexibility is recognized as an important component of physical fitness (Boraczyński et al. 2009; Chilló et al. 2010; Yamamoto et al. 2009) and one of the components of physical fitness related to health (Castro-Piñero et al. 2009; Grabara et al. 2010; Ortega et al. 2008). Recent advances in sports medicine and rehabilitation indicate that flexibility is important for overall health and physical condition (Monteiro et al. 2008; Yuktasir and Kaya 2009). Stretching is widely recommended to increase joint mobility (Daneshmandi et al. 2010), eliminate contractures (Grabara et al. 2010; Harvey et al. 2002), increase athletic performance, prevent or reduce muscle injury (Bonvicine et al. 2005; Casáis Martínez 2008; Grabara et al. 2010; McHugh and Cosgrave 2010; Witvrouw et al. 2004) as well as its treatment (Malliaropoulos et al. 2004; Spernoga 2000).

In respect to evaluation and the tests used for measure flexibility, many protocols were described. Among all of them, the V-sit-and-reach (V-SR) is an easy and practical test used for evaluating hamstring and low back muscle flexibility, since its realization do not require any specialist equipment - only one ruler (López-Miñarro et al. 2008). The assessment of the flexibility is a common practice in physiotherapy and other areas of the Physical Education. In the diseases of the motor system, to examine the joint range of motion is the basis for assessing their functionality in daily use (Rodríguez and Moreno 1997) and as a criterion for effective rehabilitation (Boraczyński et al. 2009).

Currently, there are some studies that state the differences in flexibility between university male and female students, utilizing the Modified Sit-and-Reach Test (Chung and Yuen 1999; Baltaci et al. 2003), the Straight Leg Raise and Popliteal Angle Tests (Youdas et al. 2005), the Deep Trunk Flexion Test (Delgado Valdivia et al. 2009), the Sit-and-Reach, Tot-Flex Tests (Benavent et al. 2008) and different angular tests (González Montesinos et al. 2009). However, few studies compare sex differences in the trainability of flexibility. Hoge et al. (2010) compared the effects of passive stretching of the plantar flexors. Cramer et al. (2007) compared the acute effects of static stretching on isokinetic range of motion over the rectus femoral. No documents have been found comparing sex differences in the trainability of extensibility on the hamstring and low back muscles. Consequently, the purpose of this study was to examine the influence of sex on the acute effect of static-passive one-session stretching on V-SR scores in university students.

Methods

Participants

The Ethical Committee of the University of Malaga approved the study protocol. The exclusion criteria was a history of orthopedic problems such as episodes of hamstrings injuries, fractures, surgery or pain in the spine or hamstring muscles over the past six months (Rodríguez et al. 2008). Participants were fully informed about all the features of the study, and were required to sign an informed-consent document.

Seventy-six apparently healthy university students, 36 women and 40 men (19–30 years old), from two different classes of a Public University participated in this study. None of the participants were competitive athletes, but they were recreationally active college students, which was defined as completing 2 to 5 hours of regular physical activity per week.

Procedure

Familiarization period. Previous to the intervention, all the participants performed a training session in order to obtain a proper familiarization with the V-SR test and the organization of the program. Such familiarization was completed one week before the intervention in a total of two sessions. The V-SR test was explained to students and it was repeated twice.

Intervention session. Students performed an assisted static-passive stretching session of the major body muscles: Soleus, calves, hamstrings, gluteus, quadriceps, tensor fasciae latae, psoas major, adductors, piriformis, spinal erectors, rectus abdominis, pectorals, deltoids, rhomboids, angle of the scapula, upper trapezius, biceps and triceps.

Stretching exercises were performed in partner with a similar complexion, assuming the correct position slowly and gently until the end point. All stretches were performed with the spine aligned, keeping their physiological curves (Rodríguez et al. 2008) and assisted by the partner. Once students achieved the final position, it was held for

15s at a point of mild discomfort but no pain was acknowledged by the participant. So, participants completed one repetition of each exercise with a 10–15 s rest period between exercises.

Measurements

The application of the V-SR test was carried out at the beginning of the session, without performing a warm-up, and at the end of the stretching session. All measured sessions were conducted in the same indoor sports facility at a constant temperature (23ºC) and within the same time interval for all groups involved.

The test "President's Challenge Physical Fitness" provides management protocols, posture and necessary equipment. For the execution of the V-SR, the subject was placed in a sitting position with outstretched legs and feet about 30cm from each other, in the frontal plane. The soles of their feet were placed perpendicular to the floor, toes pointing up, avoiding external rotation. Between the legs of the subject, a ruler without a measuring drawer was placed. The subject with palms down should push sliding across the floor, up to the maximum distance possible (slowly flexing the trunk and keeping arms and legs outstretched). In each measurement, two repetitions with a 1-minute rest were performed, keeping the average for the posterior statistical analysis.

Statistical analyses

Descriptive statistics (means and standard deviations) for age, body mass, height, body mass index, physical activity levels, and V-SR scores were calculated. As the general characteristics variables did not follow the parametric assumptions, the Mann-Whitney U test was used to study the differences between males and females. Afterwards, a two-way ANOVA was applied over the V-SR scores using the sex (females, males) and time factors (pre-intervention, post-intervention). For the post hoc analyses, α values were corrected using the Bonferroni adjustment. Furthermore, the Hedges´ g effect size was used to determine the magnitude of treatment effects (Hedges 2007). The test-retest reliability of the V-SR test was estimated using the intraclass correlation coefficient from two-way ANOVA (Shrout and Fleiss 1979), as well as the 95% interval of confidence. All statistical analyses were performed using the SPSS version 20.0 for Windows (IBM® SPSS® Statistics 20). The statistical significance level was set at $p < 0.05$.

Results

The general characteristics of the participants studied are shown in Table 1. The Mann-Whitney U test showed statistically significant greater values of body mass, height, body mass index and physical activity levels for males than for females ($p < 0.05$). However, in terms of age, statistically significant differences were not found ($p > 0.05$).

Table 1. General characteristics (mean ± standard deviation) of the participants

	Females (n = 36)	Males (n = 40)	p[a]
Age (year)	20.94 ±1.85	21.88 ±3.37	0.234
Body mass (kg)	58.11 ±7.87	73.71 ±8.33	<0.001
Height (cm)	165.46 ±6.68	175.95 ±7.21	<0.001
Body mass index (kg/m^2)	21.19 ±3.10	23.80 ±2.27	<0.001
Physical activity levels (h/ week)	4.06 ±5.59	5.60 ±4.29	0.012

[a] Significance level from the Mann-Whitney U test between males and females.

The results of the two-way ANOVA on the average obtained in the V-SR did not show interaction effects between the sex and time variables [F(1, 74) = 0.957; p = 0.331; η^2_p = 0.013; P = 0.162] (Table 2). However, for the post hoc analysis, the ANOVA with the Bonferroni adjustment showed that both the females and males increased statistically in a significant way from the pre-stretch to the post-stretch (p < 0.001).

Table 2. Influence of sex on acute effect of stretching on V sit-and-reach scores (cm)

Sex	Pre-stretch (M ± SD)	Post-stretch (M ± SD)	p[a]	g[b]
Females (n = 36)	3.8 ±10.1	8.2 ±9.7*	>0.05	0.07
Males (n = 40)	–2.3 ±1 1.1	1.4 ±11.4*		

M = mean; SD = standard deviation; [a] Significance level from two-way analysis of variance; post hoc analysis with Bonferroni adjustment from pre-stretch to post-stretch (*p < 0.001); [b] Hedges´ g effect size.

Discussion

The main objective of the present study was to examine the influence of sex on the acute effect of a passive-static one-session stretching on the scores of V-SR in university students. The results obtained showed that the women and men did not show a different response to the one-session stretching intervention. However, both the women and men increased the V-SR scores from the pre-stretch to the post-stretch after performing a stretching session.

The analysis of the data shows that the development of a stretching routine improves the flexibility in university students, as others have documented performing various training programs. Bandy and Irion (1994) in their study, after a 6-week program of passive stretching, achieved a 27% increase in the range of motion of the hip. Meanwhile, Sainz de Baranda and Ayala (2010) conducted their study with 122 men and 51 young college students, using different stretching techniques (active and passive) during a 12-week period, to measure the extensibility of the hamstring muscle using the Passive Straight Leg Raise test. In the results, regardless of the technique used, all groups improved their flexibility. Moreover, Meroni et al. (2010) investigated the effects after doing a stretching program for 6 weeks with 50 subjects (21 women and 29 men). They compared the effectiveness of two techniques (active and passive) in hamstring flexibility, achieving improvements with both techniques.

Regarding the difference in trainability between sexes after a session of stretching, it is noteworthy that we have not found studies about measuring the flexibility of the hamstrings and low back in university students. Hoge et al. (2010) compared the differences in flexibility of the plantar flexors between men and women in a sample of 13 men and 19 women, after a session of passive stretching. As in our study, all subjects performed a familiarization session days before the measurement, and a session of passive stretching, in which it was concluded that the flexibility increased only for the female sex, unlike our study, where no significant differences in flexibility by sex were found. However, in Cramer´s et al. (2007) study in which 10 women and 8 men took part with the aim of measuring the effects of static stretching of the rectus femoris in men and women using isokinetic tests, they concluded, in agreement with our study, that both groups responded equally to static stretching, so there were no differences in stretching regarding the sex of the person.

With the data obtained, a significant difference between sexes is set (being higher in females), just as Youdas et al. (2005) evidenced in their study, in which 214 subjects aged between 20 and 79 years were assessed, in order to verify the influence of sex and age on hamstring extensibility through the Passive Straight Leg Raise and

Popliteal Angle tests. The results obtained by these authors noted that Passive Straight Leg Raise marks in men (68.5° ±6.8°) were significantly lower than in women (76.3° ±9.8°) ($p < 0.001$). Also, the value of Popliteal Angle in men (141.4° ±8.1°) was significantly lower than in women (152.0° ±10.6°) ($p < 0.001$). In other studies conducted with young adults, women reached greater distance in all linear tests (Hui et al. 1999; Hui and Yuen 2000; Liemohn et al. 1994; Minkler and Patterson 1994). Between all possible justifications for this, Miñarro et al. (2007) argue that the men reached less distance than women, which could be due to the position of the hands on the floor, reducing the angle between the line of the arms to the axis, and increase of the stem and thoracic intervertebral flexion. These circumstances generate a shorter range in hamstring extensibility (Hui et al. 1999; Hui and Yuen 2000).

In conclusion, the results of the present study indicate that after performing a passive-static stretching session both male and female university students improved their extensibility in hamstring and low back muscles in a similar way. Therefore, no differences have been found in the trainability of flexibility by sex. However, there are differences of flexibility by the sex of students, being the females, who posses the highest marks in the V-SR. All this knowledge could help coaches to design more effectives stretching programs. In future studies, it would be interesting to use a long-term stretching program in order to examine the potential influences of sex over chronic responses on flexibility.

Acknowledgments

The last author is supported by a research grant from the Spanish Ministry of Education, Culture and Sport (AP2010-5905).

References

Baltaci G., Un N., Tunay V., Besler A., Gerçeker S. Comparison of three different sit and reach test for measurement of hamstring flexibility in females university students. British Journal of Sports Medicine. 2003; 37: 59–61.

Bandy W.D., Irion J.M. The effect of time on static stretch on the flexibility of the hamstring muscles. Physical Therapy. 1994; 74: 845–852.

Benavent J., Tella V., González-Millan I., Colado J.C. Comparison of different field tests for the evaluation of the general active flexibility. Fitness & Performance Journal. 2008; 7: 26–29.

Bonvicine C., Gonçalves C., Batigália F. Comparison of hamstring flexibility gain with different techniques of static stretching. Acta Fisiatrica. 2005; 12: 43–47.

Boraczyński T., Boraczyńska B.L., Urniaż J. The influence of physical activity on body composition and the level of student's flexibility. Medicine Sportive. 2009; 13: 13–16.

Casáis Martínez L. Revisión de las estrategias para la prevención de lesiones en el deporte desde la actividad física. Apúnts Medicina de L´Esport. 2008; 157: 30–40.

Castro-Piñero J., Chillón P., Ortega F.B., Montesinos J.L., Sjöström M., Ruiz J.R. Criterion-related validity of sit-and-reach and modified sit-and-reach test for estimating hamstring flexibility in children and adolescents aged 6–17 years. International Journal of Sports Medicine. 2009; 30: 658–662.

Chillón P., Castro-Piñero J., Ruiz J.R., Soto V.M., Carbonell-Baeza A., Dafos J., Vicente-Rodríguez G., Castillo M.J., Ortega F.B. Hip flexibility is the main determinant of the back-saver sit-and-reach test in adolescents. Journal of Sports Sciences. 2010; 28: 641–648.

Chung P.K., Yuen C.K. Criterion-related validity of sit and reach test in university men in Hong Kong. Perceptual and Motor Skills. 1999; 88: 304–316.

Cramer J.T., Beck T.W., Housh T.J., Massey L.L., Marek S.M., Danglemeier S., Purkayastha S., Culbertson J.Y., Fitz K.A., Egan A.D. Acute effects of static stretching on characteristics of the isokinetic angle – torque relationship, surface electromyography, and mechanomyography. Journal of Sports Sciences. 2007; 25(6): 687–698.

Daneshmandi H., Rahmaninia F., Shahrokhi H., Rahmani P., Esmaeili S. Shoulder joint flexibility in top athletes. Journal of Biomedical Science and Engineering. 2010; 3: 811–815.

Delgado Valdivia O., Martín Cañada M.A., Zurita Ortega F., Antequera Rodríguez J.J., Fernández Sánchez M. Evolutividad de la capacidad flexora según el sexo y el nivel de enseñanza. Apunts Med Esport. 2009; 161: 10–17.

González Montesinos J.L., López Herrero M.M., Ramos Espada D., Mora Rodríguez H., Mora Vicente J. Battery tests to evaluate the articulation mobility, muscular shorten and imbalance in university students. Revista Española de Educación Física y Deportes. 2009; 10: 63–67.

Grabara M., Kołodziej G., Wójcik M. Spine flexibility and the prevalence of contractures of selected postural muscle groups in junior male football players. Biomedical Human Kinetics. 2010; 2: 15–18.

Harvey L., Herbert M., Crosbie J. Does stretching induce lasting increases in joint ROM? A systematic review. Physiotherapy Research International. 2002; 7: 1–13.

Hedges L.V. Effect sizes in cluster-randomized designs. Journal of Educational and Behavioral Statistics. 2007; 32: 341–370.

Hoge K.M., Ryan E.D., Costa P.B., Herda T.J., Walter A.A., Stout J.R. Sex differences in musculotendinous stiffness and range of motion after an acute bout of stretching. Journal of Strength and Conditioning Research. 2010; 24: 2618–2626.

Hui S.C., Morrow J.R., Jackson A.W. Comparison of the criterion-related validity of sit-and-reach test with and without limb length adjustment in Asian adults. Research Quarterly for Exercise and Sport. 1999; 70: 401–406.

Hui S.C., Yuen P.Y. Validity of the modified back-saver sit-and-reach test: a comparison with other protocols. Medicine and Science in Sports and Exercise. 2000; 32: 1655–1659.

Liemohn W., Sharpe G.L., Wasserman J.F. Criterion related validity of the sit-and-reach test. Journal of Strength and Conditioning Research. 1994; 8: 91–94.

López-Miñarro P.A., Sáinz de Baranda P., Rodríguez-García P.L. A comparison of the sit-and-reach test and the back-saver sit-and-reach test in university students. Journal of Sports Science and Medicine. 2009; 8: 116–122.

López-Miñarro P.A., Sáinz de Baranda P., Rodríguez-García P.L., Yuste J.L. Comparison between sit-and-reach test and V sit-and-reach test in young adults. Gazzetta medica Italiana. 2008; 167: 135–142.

Malliaropoulos N., Papalexandris S., Papalada A., Papacostas E. The role of stretching in rehabilitation of hamstring injuries: 80 athletes follow-up. Medicine and Science in Sports and Exercise. 2004; 36: 756–759.

McHugh M.P., Cosgrave C.H. To stretch or not to stretch: the role of stretching in injury prevention and performance. Scandinavian Journal of Medicine & Science in Sports. 2010; 20: 169–181.

Meroni R., Cerri C.G., Lanzarini C., Barindelli G., Morte G.D., Gessaga V., De Vito G. Comparison of active stretching technique and static stretching technique on hamstring flexibility. Clinical Journal of Sport Medicine. 2010; 20: 8–14.

Minkler S., Patterson P. The validity of the modified sit-and reach test in college age students. Research Quarterly for Exercise and Sport. 1994; 65: 189–192.

Miñarro P.A., Andujar P.S., García P.L., Toro E.O. A comparison of the spine posture among several sit-and-reach test protocols. Journal of Science and Medicine in Sport. 2007; 10: 456–462.

Monteiro W.D., Simão R., Doederlein Polito M., Araújo Santana C., Batista Chaves R., Bezerra E., Fleck S.J. Influence of strength training on adult women's flexibility. Journal of Strength and Conditioning Research. 2008; 22: 672–677.

Ortega F.B., Artero E.G., Ruiz J.R., Vicente-Rodriguez G., Bergman P., Hagströmer M., Ottevaere C., Nagy E., Konsta O., Rey-López J.P., Polito A., Dietrich S., Plada M., Béghin L., Manios Y., Sjöström M., Castillo M.J. Reliability of health-related physical fitness tests in European adolescents. The HELENA Study. International Journal of Obesity. 2008; 32: 49–57.

Rodríguez P.L., Moreno J.A. Justificación de la continuidad en el trabajo de estiramiento muscular para la consecución de mejoras en los índices de amplitud articular. Apuntes Educación Física y Deportes. 1997; 48: 54–61.

Rodríguez P.L., Santonja F.M., López-Miñarro P.A., Sáinz de Baranda P., Yuste J.L. Effect of physical education stretching programme on sit-and-reach score in schoolchildren. Science & Sports. 2008; 23: 170–175.

Sainz de Baranda P., Ayala F. Chronic flexibility improvement after 12 week of stretching program utilizing the ACSM recommendations: Hamstring flexibility. Sports Medicine. 2010; 31: 389–396.

Shrout P.E., Fleiss J.L. Intraclass correlations: Uses in assessing rater reliability. Psychological Bulletin. 1979; 86: 420–428.

Spernoga S.G., Uhl T.L., Arnold B.L., Gansneder B.M. Duration of maintained hamstring flexibility after a one-time, modified hold-relax stretching protocol. Journal of Athletic Training. 2000; 36: 44–48.

Witvrouw E., Mahieu N., Danneels L., McNair P. Stretching and injury prevention. An obscure relationship. Sports Medicine. 2004; 34: 443–449.

Yamamoto K., Kawano H., Gando Y., Iemitsu M., Murakami H., Sanada K., Tanimoto M., Ohmori Y., Higuchi M., Tabata I., Miyachi M. Poor trunk flexibility is associated with arterial stiffening. American Journal of Physiology Heart and Circulatory Physiology. 2009; 297: 1314–1318.

Youdas J., Krause D., Hollman J., Harsen W., Laskowski E. The influence of sex and age on hamstring muscle length in healthy adults. Journal of Orthopedic & Sports Physical Therapy. 2005; 35: 246–252.

Yuktasir B., Kaya F. Investigation into the long-term effects of static and PNF stretching exercises on range of motion and jump performance. Journal of Bodywork and Movement Therapies. 2009; 13: 11–21.

Cite this article as: Merino-Marban R., Romano D.P., Mayorga-Vega D. Influence of sex on the acute effect of stretching on V sit-and-reach scores in university students. Centr Eur J Sport Med. 2014; 6 (2): 13–19.