Original Article

Assessment of the sagittal spinal curvatures in dancers of Spanish dance

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ABSTRACT

The goal of this study was to assess whether dancers of Spanish dance had better curvatures of the thoracic and lumbar spine than the rest of the population. The study assessed 34 students of Spanish dance from a professional dance conservatory, with an average age of 17.06 ± 2.86 years, and average practice time of 10.65 ± 3.41 years. The study measured the sagittal spinal curvatures of the dancers in a relaxed standing position. The measurements were performed using a uni-level inclinometer. The main findings revealed that the average thoracic kyphosis was 34.18 ± 5.10, and the average lumbar lordosis was 28.71 ± 4.91. The average values of the sagittal plane alignment of the thoracic and lumbar spine of the dancers in the standing position were normal, according to the scale proposed by Santoja (1993) and Contreras et al. (1981). There were no statistically significant differences; however, it was observed that the more advanced dance courses, the less thoracic and lumbar curvatures. **Key words:** SAGITTAL PLANE, THORACIC KYPHOSIS, LUMBAR KYPHOSIS, DANCE.

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INTRODUCTION

Sports practice requires a large involvement of the spine. Therefore, it is important to conduct studies to assess the influence that every sport has on the health of the spine (Uetake, 1998). Although some studies have assessed spinal morphotypes in different sports, such as gymnasts specialised in trampoline gymnastics (Sainz et al., 2009); footballers (Wodecki et al., 2002), ballet dancers (Nilsson et al., 1993), elite cyclists (Muyor et al., 2011; Rodriguez, López-Miñarro & Cárceles, 2012; Muyor et al., 2016), swimmers (Pastor, 2002), or individuals who exercised in fitness rooms (López et al., 2007), the majority of these works focused on sports that caused kyphosis and are not beneficial for the postural hygiene. Few studies have focused on sports that are beneficial due to the impact that they have on kyphosis (Balius, 1987). For these reasons, we assessed whether the Spanish dance brought benefits for postural hygiene. There are few studies on dance, and they were mainly focused on ballet or contemporary dance professionals (Pozo, 2003). This way, the present study can be considered innovative in this sense.

The Spanish dance could be defined as the synthesis of folk music, bolero and flamenco schools, and stylised dance. The technique of these dances is based on ballet, which is the basis of any type of dance and has some very specific technical fundamentals (Pozo, 2003).

The bolero school includes dances such as fandango, seguidillas, and boleros (Espada, 1997). On the other hand, folk music has very popular dances, such as jota, boleros, and aurresku, among others (Espejo & Espejo, 2001). Also, stylised dance combines folk music, bolero, and flamenco. Finally, flamenco is the best known dance in Spain and combines singing, playing, and dancing (Espada, 1997).

The anatomical structure of the spine comprises four basic curves. The sacral and thoracic regions have a concave shape in the anterior part, and, on the other hand, the lumbar and cervical regions are concave in the posterior part. These curves allow supporting the weight of the human body (Netter, 1999). Sometimes, for various reasons, these curves may suffer misalignments. Often, these misalignments are caused by poor postural habits, which are known as non-structured postural attitudes. There is no bone structural alteration in this type of misalignments; therefore, the individuals can correct or improve the position of the spine (López-Miñarro, 2009).

Postural misalignments are very common in the pre-puberty and puberty phases, and they can develop and intensify more quickly during these phases. These misalignments are: hyperkyphosis, or dorsal kyphosis; lumbar hyperlordosis; kypholordosis; flat back; and inversion of the physiological curves (Rodríguez, 1998, 2000).

The clinical examination is based on assessing the posture and the sagittal plane, taking into consideration aesthetics, flexibility, and dynamics of the spine (Rodríguez, 1998). Different instruments can be used to measure the degrees of the curvatures in the sagittal plane, such as a kyphometer, a spinal pantograph, or an inclinometer. The latter is used to measure the degrees of the sagittal curvatures easily and fast (Santoja, 2010). For this reason we used this instrument in the present study. Our main goal was to determine whether one of the benefits provided by Spanish dance was a good postural hygiene.

METHOD

Design of the study

This is an observational study without a comparison group, because the results were only compared using scales that have been already proposed. It has a descriptive and cross-sectional approach (Ato et al., 2013).

Sample

We performed a non-probability sampling based on convenience. The subjects of the study were students from the Antonio Ruiz Soler Professional Dance Conservatory, Seville, Spain, attending the third to the sixth course of the Spanish Dance Repertoire. The sample was composed of 34 students with an average age of 17.06 years. The average number of students per course was 10.65.

Procedure

We requested the authorisation of the conservatory above mentioned and the parents or legal guardians of the students, so that they could participate in the study. The measurements were performed during a month, contacting the different groups before the beginning of the sessions.

A uni-level inclinometer (ISOMED) was used to measure the curvature angles of the thoracic and lumbar spine. To measure the curves in the standing position, the students remained standing with the arms relaxed at the sides of the trunks, the feet separated by the width of the hips, and their eyes fixed forward. Prior to the procedure, we asked the students to wear a leotard that should not cover the area to be measured.

Subsequently, we performed the measurements in each student as follows: to measure thoracic kyphosis, we placed the inclinometer at the beginning of the thoracic curvature (T1), placing the inclinometer at zero degree. Then, we moved the instrument down until obtaining the higher angular value or the end of the kyphotic curvaturee, which usually coincides with the thoracolumbar junction (T12 - L1). We placed the inclinometer at zero degree on the same site where the measurement had stopped and moved it towards the L-5 vertebra, obtaining the degree of lumbar lordosis (Santoja, 2010).

To classify the angular values, Santoja (1993) and Contreras et al. (1981) provided some references to classify the values obtained. This way, the thoracic kyphosis and lumbar lordosis were classified into the following categories:

Table 1. Reference values.

Thoracic kyphosis	Lumbar lordosis
Thoracic rectification (<20°)	Lumbar rectification (<20°)
Normality (20° - 45°)	Normality (20° - 40°)
Mild thoracic hyperkyphosis (46° - 60°)	Lumbar hyperlordosis (>40°)
Moderate thoracic hyperkyphosis (<61°)	

RESULTS

Frequency of curves

The average degree of thoracic curvature was 34.18 ± 5.10. Table 2 shows that the most frequent thoracic curvature was 35 °, followed by an angle of 30°. The degrees of the thoracic curvatures measured were within normality, according to the scale proposed by Contreras et al. (1981) and Santoja (1993).

Table 2. Frequency of thoracic curvature.

Degrees of thoracic curvatures				
Valid	**Frequency**	**Percentage**	**Valid percentage**	**Accumulated percentage**
22	1	2.9	2.9	2.9
24	1	2.9	2.9	5.9
25	1	2.9	2.9	8.8
27	1	2.9	2.9	11.8
30	5	14.7	14.7	26.5
32	1	2.9	2.9	29.4
33	2	5.9	5.9	35.3
34	2	5.9	5.9	41.2
35	6	17.6	17.6	58.8
36	4	11.8	11.8	70.6
37	4	11.8	11.8	82.4
38	1	2.9	2.9	85.3
39	2	5.9	5.9	91.2
40	1	2.9	2.9	94.1
45	2	5.9	5.9	100
Total	34	100	100	

The average degree of lumbar curvature was 28.71 ± 4.91. Table 3 shows that the most frequent curvature degree was 26°.

Table 3. Frequency of lumbar curvature.

Degrees of lumbar curvatures				
Valid	**Frequency**	**Percentage**	**Valid percentage**	**Accumulated percentage**
20	1	2.9	2.9	2.9
21	1	2.9	2.9	5.9
22	1	2.9	2.9	8.8
23	1	2.9	2.9	11.8
24	2	5.9	5.9	17.6
25	3	8.8	8.8	26.5
26	5	14.7	14.7	41.2
27	3	8.8	8.8	50
28	1	2.9	2.9	52.9
29	1	2.9	2.9	55.9
30	3	8.8	8.8	64.7
31	1	2.9	2.9	67.6
32	4	11.8	11.8	79.4
33	2	5.9	5.9	85.3
34	1	2.9	2.9	88.2
35	2	5.9	5.9	94.1
40	2	5.9	5.9	100
Total	34	100	100	

Years of practice

The average number of years of practice was 10.65 ± 3.4. It can be observed that the interval of years of practice was from three to twenty years. Spanish dance had been practised for 12 years by 23.5% of the participants accessed.

Table 4. Years of practice.

Years of practice				
Valid	**Frequency**	**Percentage**	**Valid percentage**	**Accumulated percentage**
3	1	2.9	2.9	2.9
5	3	8.8	8.8	11.8
6	1	2.9	2.9	14.7
9	6	17.6	17.6	32.4
10	4	11.8	11.8	44.1
11	4	11.8	11.8	55.9
12	8	23.5	23.5	79.4
13	4	11.8	11.8	91.2
14	1	2.9	2.9	94.1
18	1	2.9	2.9	97.1
20	1	2.9	2.9	100
Total	34	100	100	

One-factor ANOVA

There were no significant differences between thoracic and lumbar curvatures. We performed an ANOVA test in which the dependent variable was thoracic and lumbar curvatures, and the independent variables were the dance courses of the conservatory. We did not find statistically significant differences; however, we observed that the more advanced dance courses, the less thoracic and lumbar curvatures (F[3] = .409; p = .748; F[3] = .849; p = .478, respectively). Post-hoc Tukey's test showed that there were no statistically significant differences between the courses.

Correlations

We estimated Pearson's correlation coefficient between age and degrees of thoracic and lumbar curvatures. There were no statistically significant correlations between the items assessed (Table 5).

Table 5. Correlations between age and thoracic and lumbar curvatures.

Correlations		
Age	**Degrees of thoracic curvatures**	**Degrees of lumbar curvatures**
Pearson's correlation coefficient	-.065	.016
Sig. (bilateral)	.715	.927
No.	34	34

We also estimated Pearson's correlation coefficient between years of practice and degrees of thoracic and lumbar curvatures. The results indicated that there were no statistically significant correlations between the items assessed (Table 6).

Table 6. Correlations between years of practice and thoracic and lumbar curvatures.

Correlations		
Years of practice	**Degrees of thoracic curvatures**	**Degrees of lumbar curvatures**
Pearson's correlation coefficient	.047	.120
Sig. (bilateral)	.791	.498
No.	34	34

DISCUSSION

We found that the more advanced the courses, the less thoracic and lumbar curvatures. Considering the standing position as normality range for kyphosis between 20° and 45°, and lordosis between 20° and 40° (Contreras et al., 1981; Santoja, 1993), the results of the present study showed normal values for kyphosis and lordosis. All the participants assessed had normality values of thoracic and lumbar curvatures. In the standing position, dorsal kyphosis was 34.18 ± 5.10, and lumbar lordosis was 28.71 ± 4.91.

There were no cases of hyperkyphosis or hyperlordosis in the sample assessed. Although the type of dance we assessed was not the same, our findings correspond or are similar to those of another study that assessed classical dance. Nilsson (1993) and Gómez et al (2013) found significant differences between flamenco dancers and women who performed maintenance gymnastics. In that study, the dancers exhibited lower values of dorsal kyphosis and hyperlordosis than the control group. The results indicated that the group of dancers exhibited lower values of kyphosis and lordosis in the standing position than the control group. Also, Cristobal et al. (2015) found similar results.

On the other hand, Pozo (2003) conducted a study with dancers measuring the spinal angles. This author found that 37% of the individuals assessed exhibited signs of lumbar hyperlordosis, and 25% of the individuals exhibited signs of dorsal hyperlordosis. It was also observed that none of the individuals exhibited isolated dorsal hyperkyphosis, i.e., the individuals with signs of hyperkyphosis also exhibited signs of hyperlordosis.

Similar studies have been conducted assessing other sports and obtained very different values depending on the context where the measurements were carried out. It is worth noting that, according to Balius et al. (1987), the majority of sports submitted to this type of measurements cause kyphosis and are not beneficial for the postural hygiene. Wodecki et al. (2002) conducted a study assessing the sagittal shape of the spine in footballers and compared them with a sample of a sedentary population. The authors found that the footballers exhibited lower values of thoracic kyphosis than the individuals that did not perform physical activities; however, they found that footballers exhibited greater values of lumbar lordosis.

Sainz, Santoja and Rodríguez-Iniesta (2009) measured the sagittal curvatures of the spine in gymnasts specialised in trampoline gymnastics. The authors found that men exhibited greater values of dorsal kyphosis in the standing position and during trunk flexion, whereas women exhibited greater values of lordosis in the standing position, and lumbar kyphosis in flexion and sitting positions.

López-Miñarro et al. (2007) conducted a study to assess the curvatures of the thoracic and lumbar spine in the standing position in individuals who exercised in fitness rooms. The authors found changed thoracic morphotypes in a large percentage of cases, whereas the lumbar curvatures exhibited normal morphotypes in the majority of the individuals assessed. On the other hand, another similar study that assessed kayakers

found differences between men and women regarding the spinal curvatures, and women exhibited more aligned spinal and pelvic positions (López-Miñarro et al., 2016).

Muyor et al. (2011) stated that elite cyclists were characterised by a specific adaptation of the lumbar spine when cycling, reaching a greater lumbar flexion in different gripping positions than sedentary individuals. Also, these authors concluded that the cyclists in the standing position did not exhibit adaptations associated with their posture in a prolonged sitting position.

Pastor (2000) assessed sagittal spinal curvatures in swimmers and found that breaststroke was the style that caused more kyphosis in men, whereas crawl was the least damaging style with respect to this disorder. On the other hand, breaststroke was the style that caused more kyphosis in women, whereas butterfly and backstroke were the styles that caused less kyphosis.

CONCLUSIONS

The main goal of the present study was to determine whether one of the benefits provided by Spanish dance was a good postural hygiene. We can affirm that the degrees of spinal curvature in the sagittal plane of the entire sample of dancers from Antonio Ruiz Soler Professional Dance Conservatory, Seville, Spain, fell within the normality values established by the scale proposed by Santoja (1993) and Contreras et al. (1981). In addition, we observed that the more advanced dance courses, the less thoracic and lumbar curvatures.

There were no statistically significant differences in the results, probably due to the fact that the sample was not large enough. However, observing the results and having compared them with those of similar studies on other sports, we can infer that Spanish dance might provide a good postural hygiene as expected. The values of the curvatures measured were within the normal range. This result may be due to the fact that postural hygiene is systematically worked in all movements of Spanish dance.

REFERENCES

Ato, M., López, J. J. & Benavente, A. (2013). Un sistema de clasificación de los diseños de investigación en psicología. Anales de psicología, 29(3), 1038-1059. https://doi.org/10.6018/analesps.29.3.178511

Balius, R. Balius, R. & Balius, X. (1987). Columna vertebral y deporte. Apunts.; 24:223-229.

Clarkson, HM. (2005). Validity and Reability of Selected Instruments Used to Measure Joint Range of Motion. Joint motion and function asessement.Philadelpia; 283-296.

Contreras, MJ,; Miranda, JL.; Ordoñez, MF.; Miranda, M. & Díez, F. (1981) Semiología del dorso curvo juvenil. En: Jornada Monográfica vertebral. Madrid: Servicio de Rehabilitación, Hospital La Paz.

Cristóbal, RV., Esparza-Ros, F., Gómez-Durán, R., Martínez-Ruiz, E., Muyor, J. M., Alacid, F., & López-Miñarro, PA. (2015). Morfología de las curvaturas torácica y lumbar en bipedestación, sedentación y máxima flexión del tronco con rodillas extendidas en bailarinas. Archivos de medicina del deporte: revista de la Federación Española de Medicina del Deporte y de la Confederación Iberoamericana de Medicina del Deporte, (166), 87-93.

Espada, R. (1997) La danza española su estudio y su conservación. Librería Deportiva. España.

Espejo Aubero, A. & Espejo Aubero, A. (2001). Glosario de términos de la Danza Española. Librería deportiva Esteban Sanz. España.

Gómez-Lozano, S., Vargas-Macías, A., Medina, F. S., & Jordana, M. C. (2013). Estudio descriptivo del morfotipo raquídeo sagital en bailarinas de flamenco. Descriptive study of sagittal spinal morphotype in female flamenco dancers. Rev Cent Investig Flamenco Telethusa, 6(7), 19-28.

López-Miñarro, PA., Muyor, J. M., Alacid, F., Isorna, M., & Vaquero-Cristóbal, R. (2014). Disposición sagital del raquis e inclinación pélvica en kayakistas. Revista internacional de Medicina y Ciencias de la Actividad Física del Deporte. López- Miñarro, PA. & Medina, J.(1999) Mitos y creencias erróneas acerca de la actividad física y el deporte(I): descripción. Revista de Educación Física, 74:5-12.Facultad de Educación. Universidad de Murcia.

López-Miñarro, PA. (2009). La postura corporal y sus patologías: implicaciones en el desarrollo del adolescente. Prevención y tratamiento en el marco escolar. Facultad de Educación. Universidad de Murcia.

López-Miñarro PA, Rodríguez PL, Santonja FM, Yuste JL, García A. (2007) Disposición sagital del raquis en usuarios de salas de musculación. Arch Med Deporte 122: 435-441.

López–Miñarro, P.A.; Rodríguez P.L. (2001) Ejercicios físicos desaconsejados para la columna vertebral y alternativas para su corrección. Selección, 10 (1):9-19.

Muyor, JM.; López-Miñarro, PA. & Alacid, F. (2011). Comparación de la disposición sagital del raquis lumbar entre ciclistas de élite y sedentarios. Cultura, Ciencia y Deporte, 16: 37-43.

Muyor, JM., López-Miñarro, PA. & Alacid, F. (2016). Disposición sagital del raquis lumbar en ciclistas de élite y sedentarios/Sagittal lumbar curvature in elite cyclists and non-athletic subjects. Revista Internacional de Medicina y Ciencias de la Actividad Física y del Deporte, (46).

Netter, FH. (1999) Atlas de Anatomía Humana. 2º edición. Masson S.A. Barcelona.

Nilsson, C.; Wykman, A. & Leanderson, J. (1993) Spinal sagittal mobility and joint laxity in young ballet dancers. Knee Surg Sports Traumatol Arthrosc 1: 206-208. https://doi.org/10.1007/BF01560208

Pastor, A. (2000). Estudio del morfotipo sagital de la columna y de la extensibilidad de la musculatura isquiosutal de jóvenes nadadores de élite Españoles. Tesis doctoral, Universidad de Murcia.

Pozo Municio, MC. (2003). Perfil antropométrico, biomecánico y clínico del bailarín de danza española. Tesis doctoral, Universidad complutense de Madrid.

Rodríguez, PL. (1998). Educación Física y salud del escolar: programa para la mejora de la extensibilidad isquiosural y del raquis en el plano sagital. Tesis doctoral, Universidad de Granada.

Rodríguez, JM., López-Miñarro, PA. & Cárceles, FA. (2012). Valoración del raquis torácico, lumbar e inclinación pélvica en ciclistas de categoría élite y máster 30/Assessment of the Thoracic Spine, Lumbar Spine and Pelvic Tilt in Elite and Master 30 Class Cyclists. Apunts. Educació física i esports, (108), 17.

Sainz de Baranda, P.; Santoja, F. & Rodríguez- Iniesta, M (2009). Valoración de la disposición sagital del raquis en gimnastas especialistas en trampolín. Revista Internacional de Ciencias del Deporte. 16 (5), 21-33. https://doi.org/10.5232/ricyde2009.01602

Santoja, F. (2010). Exploración de la columna vertebral- II (plano sagital). DL: Mu 1919-2010. Murcia.

Santoja, F. (1996). Las desviaciones sagitales del raquis y su relación con la práctica deportiva. En Ferrer V, Martínez, L; Santoja F. Escolar: Medicina y Deporte. Albacete: Diputación provincial. 251-268.

Santoja, F. & Martínez I. (1992). Valoración Médico- Deportiva del Escolar. Murcia: Secretariado de Publicaciones e Intercambio Científico. Universidad de Murcia.

Santonja, F. (1993). Exploración clínica y radiográfica del raquis sagital. Sus correlaciones (premio SOCUMOT- 91). Murcia: Secretariado de publicaciones e intercambio científico. Universidad de Murcia.

Santonja, F. & Martínez, I. (1995). Raquis y deporte ¿cuál sí y cuándo? Selección, 4, 28-38.

Uetake, T.; Ohtsuke, F.; Tanaka, H. & Shindo, M. (1998). The vertebral curbature of sportmen. Journal of Sports Sciences, 16, 621-628. https://doi.org/10.1080/026404198366425

Wodecki, P.; Guiguí, P.; Hanotel, M.; Cardine, L. & Deburge, A. (2002) Sagittal aligment of the spine: Comparison between soccer players and subjects without sports activities. Rev Chir Orthop Reparatrice Appar Mot 88:328-36.