Original Article

Analysis of relationships between the use of visual display terminals, craniocervical angle and physical activity: A pilot study

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ABSTRACT

Grounds: The neck posture alterations can cause cervical pain and implicitly produce changes in the neck movement patterns, resulting in a greater risk of musculoskeletal disorders of the neck. The forward head position implies bending of the lower cervical spine and extension of the upper cervical spine. This is a common clinical observation in patients who have a sore neck and shoulders. The main objective of the study is to identify the relationship between the posture, the use of visual display units and physical activity in young adults. Method: This is a descriptive correlational study with a crossover design, with a sample of 26 university students. Data were collected from an ad-hoc questionnaire, physical activity habits questionnaire (SHRI) and a photogrammetry test processed by the postural assessment software (PAS). Results: Statistically significant differences were obtained between physical activity and the craniocervical angle ($p = .007$) and between the performance of physical activity of students pursuing different university degrees ($p = .000$). Conclusions: The practice of physical activity of moderate intensity can be a preventive factor for the forward head position. **Key words:** POSTURE, PHOTOGRAMMETRY, EXERCISE, COMPUTER, FORWARD HEAD POSTURE

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INTRODUCTION

Posture has been defined as the alignment of body segments at a particular time (Gangnet, Pomero, Dumas, Skalli & Vital, 2003), which is an important indicator of the musculoskeletal health (McEvoy & Grimmer, 2005). The ideal skeletal alignment used as a model is compatible with scientific principles, and involves a minimum of stress and distortion, leading to the attainment of maximum efficiency of the body (Kendall, McCreary, Provance, Rodgers & Romani, 2005; Watson & Mac, 2000; Santos, Silva, Sanada & Alves, 2009; Gasparotto, Reis, Ramos & Santos, 2012). In the ideal body alignment, the head is upright in a balanced position, which minimizes cervical muscle tension (Kendall, et al., 2005).

However, the forward head posture is increasingly common (Yoo, 2013) which implies a bending of the lower cervical region and an extension of the upper cervical region, a common clinical observation in patients with neck and shoulder pain (Szeto, Straker & Raine, 2002; Moore, 2004; Burgess-Limerick, Plooy & Ankrum, 1998; Hyouk & Hyun, 2012).

The neck posture alterations can cause cervical pain and implicitly produce changes in the neck movement patterns (Yoo, Yi, Cho, Jeo, Cynn & Choi, 2008). The increased forward flexion of the neck can result in an increment of the compression force in the joints of the cervical spine, resulting in a greater risk of musculoskeletal disorders of the neck (Yoo & An, 2009).

Despite the long timespan of the research study and clinical interest in the cervical posture, there is still much to learn about posture classification of the cervical spine, especially in terms of pain and dysfunction (Grimmer, Milanese & Louw, 2008). This is also the case of the relationship between the performance of physical activity and pain and posture of this region.

It can be concluded that the main objective of the study is to identify the relationship between the posture, the use of visual display units and physical activity habits in young adults.

MATERIAL AND METHODS

Participants

The study sample included 26 participants (24 females and 2 males), students at the University of Vigo, aged between 18 and 31 years (with a mean of 22.54 years). The sample was made up of 15 students enrolled in the Bachelor's Degree in Sciences of Physical Activity and Sport (CCAFD) courses and 11 students enrolled in the Primary Teacher Training Degree courses.

Inclusion criteria involved were: being a student enrolled in the Bachelor's Degree in Sciences in Physical Activity and Sport (CCAFD) courses, or the Primary Teacher Training Degree courses.

Exclusion criteria involved were: having a diagnosed illness which justified a posture problem, not providing an informed consent form, or not having fully completed the questionnaire.

This is a descriptive correlational study with a crossover design, with a non-probabilistic sample of volunteer subjects, through the collection of data that students were requested to provide by means of questionnaires and a photogrammetric test. The study was approved by the Autonomous Ethics Committee of Research in Galicia (2015/192) and was in line with the Declaration of Helsinki.

Instruments

Photogrammetry

Photogrammetry is being developed as a potential diagnostic tool for physical therapists to measure the body angles. Among the existing methods, the Postural Assessment Software (PAS/SAPO) is an easy-to-use tool, having its reliability evaluated through numerous studies (Gonçalves, Pedroso & Azevedo, 2008; Ferreira, Duarte, Maldonado, Burke & Marques, 2010; Iunes, Castro, Salgado, Moura, Oliveira & Bevilaqua-Grossi, 2005). In a study conducted by Gonçalves et al. (2008), aimed at verifying the intra- and inter-evaluator reliability and validity of the angle measurements of the PAS, it was concluded that this was a valid and reliable instrument for measuring the angle values in the body segments. Ferreira et al. (2010) designed a study to estimate the accuracy of the PAS for measuring angles and distances, as well as for the intra- and inter-evaluator reliability. They also concluded that it was useful to measure angles and body distances, and it should be considered a tool for postural assessment.

Questionnaire

The questionnaire was divided into two parts:

"Back Pain Questionnaire" (Martínez, Rodríguez, López, Zarco, Ibañez & Echevarría, 2009) initially an anamnesis was carried out (age, gender, height, weight, handedness, profession), and subsequently questions were asked about back pain and the factors that have an impact on it (physical activity, new technologies, efforts, medication, background, etc.).

"Self-Report Habit Index (SRHI)" (Gutiérrez & Pino, 2011) for measuring physical activity habits, previously validated for the same population type. All measurements were coded so that higher values indicate strong habits regarding performing physical activity and lower values otherwise. A scale is employed, composed of decreasing levels of intensity ranging from 5 'always', 4 'almost always', 3 'sometimes', 2 'hardly ever' and 1 'never'.

Procedure

After signing the informed consent form, participants individually answered the *Back Pain Questionnaire*, followed by the *SRHI questionnaire*.

The postural analysis was performed at the Laboratory of Physiology of the Faculty, in a spacious and bright room, within the same time frame for all individuals. The position was evaluated with a Panasonic DMC-FZ100 digital camera (14.1 MP, 3 inches, 24 x optical zoom) supported on a tripod (Manfrotto 055 CLB). The following anatomical points were previously flagged with 15mm Styrofoam balls with double sided tape: ear lobe, acromion, and spinous process of C7. All evaluations were performed by the same evaluator, using for calibration purposes a plumb line attached to the ceiling, marked using two Styrofoam balls, and with a 1-meter distance between them.

The participants were photographed in their underwear, for better observation of the landmarks. The camera was placed at a height of 0.95 meters and a three-meter distance from the participants who were instructed to stand still and maintain a relaxed posture while standing on an ethylvinylacetate carpet.

After photographing, an analysis of the points was performed, generating an individual postural evaluation, in which the craniocervical angle of each participant was determined. This is defined as the intersection of the lines connecting the marker and C7, with the horizontal line.

Statistical analysis

A descriptive statistical analysis was performed using mean, standard deviation, and maximum and minimum values. The Shapiro-Wilk normality test showed that all variables are normally distributed. Next, comparisons between groups were conducted using the independent samples t-test in order to assess the differences in the craniocervical angle depending on the degree course students were enrolled in, the Mann-Whitney U test to assess students performing more physical activity, and finally, the ANOVA test, seeking links between the craniocervical angle and the number of hours spent in front of the visual display units. The criterion for statistical significance was set at $p < .05$. The data analysis was performed using the SPSS 19.0 statistical program for Windows.

RESULTS

Descriptive analysis of the studied variables

All participants had practiced sport at school age. Regarding the age at which they began using new technologies, the minimum was 8 years and the maximum was 22 years old, with a mean age of 13.88 years and a standard deviation of 3.192.

Most subjects (69.23%) reported pain over the past year, assessing it subjectively with an average score of 4.5 out of 10, according to the Visual Analogue Scale (Table 1).

Table 1. Subject characteristics

	N	Min	Max	Mean	SD
Age (years)	26	18	31	22,54	3,11
Height (cm)	26	152	177	164,15	6,96
Weight (Kg)	26	43	82	60,42	8,98
Age use visual display terminals (years)	26	8	22	13,88	3,19
Daily hours of use visual display terminals (hours)	26	0	3	1,38	,85
Craneocervical angle (º)	26	41,70	59,50	50,01	4,35
SRHI (scale)	26	0	35	18,38	12,19

Comparative analysis between studied groups

After performing the t-test in order to assess the relationship between the craniocervical angle and students' degree course, it was noted that the mean angle for students enrolled in Primary Teacher Training is larger than for those enrolled in CCAFD (Table 2).

Table 3 shows that Levene's test is not significant ($p = .696$), thus homogeneity of variance is assumed, statistical t-value is 2.930 (with 24 degrees of freedom) and the associated p-value is .007. Therefore, it can be stated that there is an association between the students' degree course and the craniocervical angle at the alpha significance level = .05.

Table 2. Mean, SD and Std. Error mean for craneocervical angle in relation to the degree

	Degree	N	Mean	Std. Deviation	Std. Error mean
Craneocervical angle	CCAFD	15	51,89	3,69	0,95
	PRIMARY	11	47,45	3,98	1,20

Table 3. Independent Samples Test

	Levene´s test		T-test for equality of means		
Craneocervical angle	F	Sig.	t	df	Sig.
	0,157	0,696	2,930	24	0,007

Note. Equal variances assumed

When assessing whether students enrolled in CCAFD perform more physical activity than those enrolled in Teacher Training, using the SRHI questionnaire by means of the Mann-Whitney U test, a statistically significant difference (p = .000) was observed between the two samples tested (Figure 1).

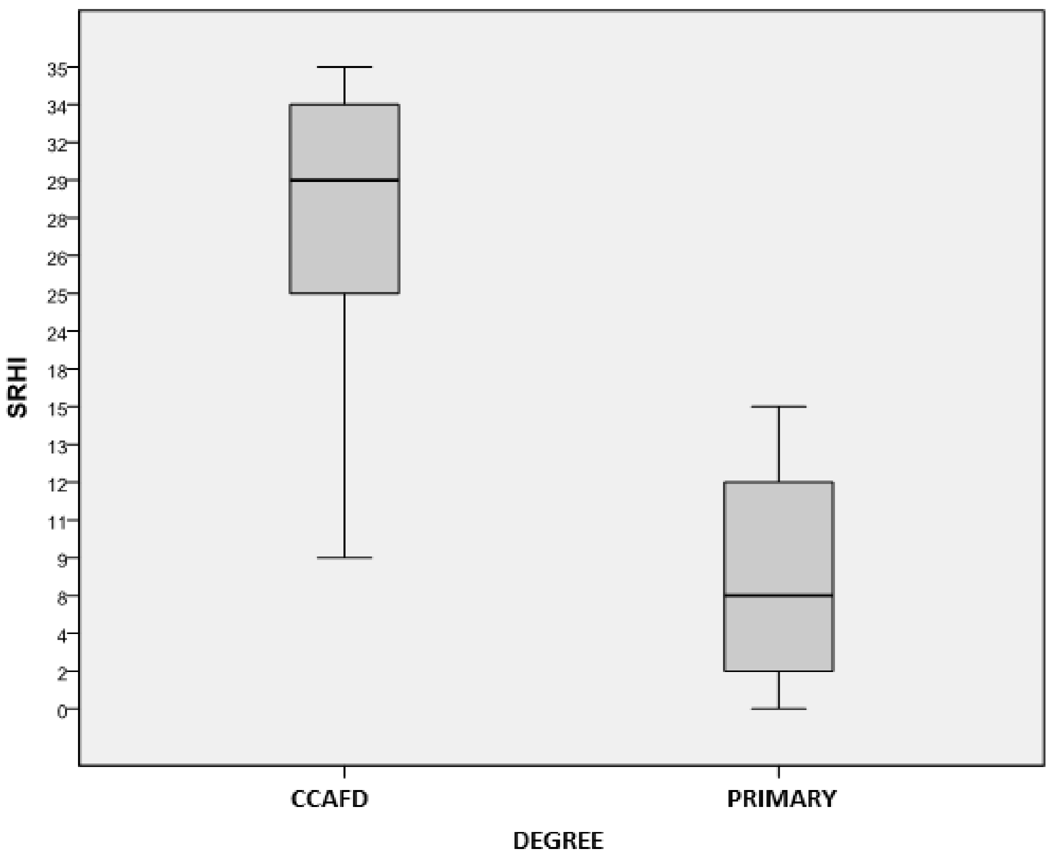

Figure 1. Physical Activity / Degree

However, when analyzing the craniocervical angle and its relation to the hours that participants spend using new technologies, employing the ANOVA test, no statistically significant differences were noted between these two variables (Table 4).

Table 4. Relationship between the hours of use of new technologies and cervical angle

	Sum of squares	df	Mean	F	Sig.
Between Groups	10,48	3	3,49	0,166	0,918
Within Groups	464,21	22	21,10		
Total	474,69	25			

DISCUSSION AND CONCLUSIONS

The results show that students enrolled in CCAFD perform more physical activity than those enrolled in Teacher Training, which is consistent with a study conducted by Pino et al. (2013) (Pino, Gutiérrez & Alvariñas, 2013) for a similar population. This study showed that the majority of students (63.96%) had practiced some kind of sport during their school years, with the percentage being higher for males than females. In the aforementioned study, the majority of students had internalized the need for physical activity as routine in their daily lives and applied this activity automatically. However, when analyzing the different groups, mixed results were found, noting that physical activity habits were stronger in students enrolled in CCAFD than in those enrolled in Pre-School and Primary Teacher Training, as in our work.

In a study carried out by Ho et al. (Ho, Tai & Tung, 2008) with a sample of 114 subjects, the head forward posture was measured by means of the craniocervical angle and the administration of a pain questionnaire, as in the present study. They obtained significant differences in the craniocervical angle between subjects with and without neck pain. These data agree with those found by Ruivo et al. (Ruivo, Pezarat-Correia & Carita, 2014), who, in a research conducted with cases and controls, showed that subjects with neck pain had a more marked forward head posture, 68% of subjects exhibiting this postural disorder. According to these authors, the inappropriate use of heavy backpacks, as well as the psychosocial factors such as depression or stress, the lack of ergonomic furniture, the hours spent in incorrect postures in front of visual display units, may be some causes for this problem. For (Meira et al. 2014) (Meira, Felicio, Rodrigues, Carvalho, Ribeiro & Vigário, 2014), the pain is associated with too short break periods, non-use of an ergonomic chair, poor quality of life, and in a high proportion of subjects with forward head posture and shoulder postural alignment when the computer mouse is used.

In our case, the difference was not significant between the craniocervical angle and the pain assessed by the VAS scale, possibly because the sample analyzed in the pilot study was rather small.

The results of this work show that the craniocervical angle is significantly increased in students enrolled in Primary Teacher Training compared to that of students enrolled in CCAFD, the latter exhibiting a less prominent head forward posture. Long-term forward head posture may increase the burden of non-contractile structures and the abnormal stress on the posterior cervical structures, leading to myofascial pain (Bonney & Corlett, 2002). Moreover, this posture can stretch the anterior structures of the neck and shorten posterior muscles that could result in pain (Silva, Punt, Sharples, Vilas & Jonhson, 2009). This may increase muscle tension in the angle of the scapula and other muscles involved, resulting in greater pressure on the cervical discs (Bonney & Corlett, 2002).

Casas & Patiño (2012) determined that the results regarding physical activity and back pain are contradictory, showing that the practice of certain sports and the abandonment of sport increase the likelihood of back pain. In addition, low levels of physical activity may be linked to increased weekly hypoactivity, which was associated with the presence of chronic pain.

Therefore, it seems that the recommendation for the prevention of musculoskeletal disorders, such as forward head posture, is the regular practice of moderate physical activity, not only to maintain a healthy physical condition, but also to contribute positively to people's quality of life.

The conclusion of this study is that students enrolled in CCAFD have a stronger habit of physical activity, as well as a statistically significant craniocervical angle, and consequently, they have a less advanced forward head posture than that of students enrolled in Primary Teacher Training. The physical activity may therefore be a protective factor for the forward head posture. Finally, it was observed there were no statistically significant differences between the hours of daily use of new technologies and the craniocervical angle in the aforementioned sample.

The main limitation of this pilot study is the small sample size, making it difficult to determine sweeping conclusions. In addition, and because the participants are still very young and postural changes are adaptive and longitudinal over time, it would be interesting to compare the results with those from another population sample with the same features, but using a more advanced age group (Secondary teachers of Physical Education and Primary Education teachers) in order to determine whether these types of postural changes were caused by new technologies.

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