RELATIONSHIP BETWEEN POSTURAL IMBALANCE AND CERVICAL DISABILITY IN VISUALLY IMPAIRED INDIVIDUALS

Relação do desequilíbrio postural com incapacidade cervical em pessoas com deficiência visual

Relación del desequilibrio postural e incapacidad cervical de personas con discapacidad visual

Original Article

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ABSTRACT

Objective: To identify the relationship between postural imbalance and cervical disability in visually impaired individuals. **Methods:** Retrospective cross-sectional study conducted at the Association for the Visually Impaired in Ribeirão Preto, SP, Brazil, in the period from January 2014 to December 2014, with 26 participants of both sexes, with an average age of 31.92 years, featuring complete or partial visual impairments. The postural assessment was performed by means of photogrammetry associated with the Neck Disability Index (NDI), which identifies cervical disability. To assess the statistical significance of 5%, the Chi-square test of independence was applied. **Results:** In the front view, there was a 2.82cm cervical inclination to the left. In the rear view, there was left shoulder elevation of 9.15cm in relation to the right one. In the right and left views, a 2.44cm cervical flexion-extension of the head against the cervical and thoracic hyperkyphosis of 0.67cm were found. There was a difference in the scapular alignment of the right side to the left in 5.08cm. The NDI showed 33.3% of the individuals with mild disability due to pain, while 66.7% had no disability. **Conclusion:** The study found compensatory postural changes adopted by the visually impaired in an attempt to adjust the center of gravity. However, these postural changes do not coincide with cervical disability and pain.

Descriptors: Vision Disorders; Posture; Disabled Persons.

RESUMO

Objetivo: *Identificar a relação entre o desequilíbrio postural e a incapacidade cervical em pessoas com deficiência visual.* **Métodos:** *Estudo transversal retrospectivo, realizado na Associação dos Deficientes Visuais de Ribeirão Preto, SP, Brasil, no período entre janeiro de 2014 e dezembro de 2014, com 26 participantes, de ambos os sexos, com idade média de 31,92 anos, apresentando deficiências visuais total ou parcial. Realizou-se a avaliação postural por meio da biofotogrametria associada ao Neck Desability Index (NDI), que identifica incapacidade cervical. Para avaliar a significância estatística de 5%, realizou-se o teste de independência de Chi-quadrado.* **Resultados:** *Na vista anterior, houve inclinação cervical à esquerda em 2,82cm. Na vista posterior, houve elevação de ombro esquerdo em relação ao direito em 9,15cm. Nas vistas laterais direita e esquerda, encontraram-se flexo-extensão cervical de 2,44cm da cabeça em relação à coluna cervival e hipercifose torácica de 0,67cm. Encontrou-se diferença do alinhamento escapular do lado direito em relação ao esquerdo em 5,08cm. O NDI evidenciou 33,3% com incapacidade mínima devido à dor, enquanto 66,7% não apresentam incapacidade.* **Conclusão:** *Encontraram-se alterações posturais compensatórias adotadas pelos deficientes visuais analisados na tentativa de ajustar o centro de gravidade. No entanto, essas alterações posturais não coincidem com incapacidade cervical e dor.*

Descritores: *Transtornos da Visão; Postura; Pessoas com Deficiência.*

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RESUMEN

Objetivo: *Identificar la relación entre el desequilibrio postural y la incapacidad cervical de personas con discapacidad visual.* **Métodos:** *Estudio transversal retrospectivo realizado en la Asociación de Discapacitados Visuales de Ribeirão Preto, SP, Brasil en el período entre enero y diciembre de 2014 con 26 participantes de ambos los sexos con edad media de 31,92 años con discapacidades visuales total o parcial. Se realizó una evaluación de la postura a través de la biofotogrametria asociada al Neck Desability Index (NDI) que identifica la incapacidad cervical. Se realizó la prueba de independencia de Chi-cuadrado para evaluar la significación estadística del 5%.* **Resultados:** *En la vista anterior se encontró la inclinación cervical para la izquierda de 2,82cm. En la vista posterior hubo elevación del hombro izquierdo sobre el derecho de 9,15cm. En las vistas laterales derecha e izquierda, se encontraron la flexión-extensión cervical de 2,44cm de la cabeza sobre la columna cervival e hipercifosis torácica de 0,67cm. Se encontró diferencia en la alineación de la escapula del lado derecho sobre el izquierdo de 5,08cm. El NDI evidenció el 33,3% con incapacidad mínima por el dolor mientras el 66,7% no presentan incapacidad.* **Conclusión:** *Se encontraron alteraciones posturales compensatorias adoptadas por los discapacitados visuales analizados con la tentativa de ajuste del centro de gravedad. Sin embargo, esas alteraciones posturales no coinciden con la incapacidad cervical y el dolor.*

Descriptores: *Trastornos de la Visión; Postura; Personas con Discapacidad.*

INTRODUCTION

According to the World Health Organization, the onset of 1 to 2 million new cases of blindness is estimated to occur by 2020. In Brazil, the number of blindness cases is around 0.4% to 0.5% of the population, totaling 4 to 5 thousand people per million inhabitants[1]. The visual system plays an important role in sensory perception[2], thus, the visually impaired promote postural adaptations in the positioning of the joints during the orthostatic position and in ambulation[3].

The balance of the body, as well as the movements of the head, are originated by the alignment between the skull and the cervical region, thus determining the posture of the individual[4]. Since the temporomandibular joint (TMJ) is directly related to the cervical and scapular region through a neuromuscular system, postural alterations of the cervical spine can provoke TMJ disorders and vice versa[4]. Temporomandibular dysfunctions cause, among other factors, orofacial pain and the occurrence of painful complaints in the cervical region, thus causing the overlap of signs and symptoms between the joint and the cervical spine[5].

Other factor that might provoke a new postural organization is the masticatory muscle imbalance as a function of its articulation, causing various clinical manifestations, with a high prevalence of postural alterations and impact on the quality of life, as this musculature is directly or indirectly linked to internal or external structures by means of their fascias[6]. The lack of stability in this musculature can cause global postural deviations that require a readaptation and body realignment, and may also present problems in the joint where it is inserted, in this case, the temporomandibular joint, reflecting on the structures associated through the anatomy trains or myofascial rails[7], which consists in the interaction between individual muscles, forming the functional complexes, each with a different anatomy and meaning, in which it becomes possible to understand the patterns of the body as a whole, in posture and function, constituting the link between movement and stability[8].

Body posture can be defined by the position the body adopts in space, as well as the direct relation of its parts to the line of the center of gravity[2]. To be in good posture, a balance between the neural, muscular and skeletal systems is needed[3]. Postural problems have been considered a serious public health problem because they reach a large part of the economically active population, temporarily or permanently incapacitating it for professional activities[9]. Blindness, as a predisposing factor of postural deviations, besides leading the individual to conditions of lower performance and physical agility, can also represent a great risk factor for isolation, loss of motivation and disinterest in the participation in the domestic and social routine[3].

The clinical manifestations of postural imbalance are: chronic pain, fatigue, sensitivity in masticatory muscles, noise and movement limitation, being responsible for a diverse symptomatology of difficult diagnosis and treatment, which involves pain manifestations and lack of muscle coordination, related to the biomechanical imbalance not only of the joint itself, but also of surrounding areas, including the cervical region[10].

Cervical pain is an increasingly common problem, being one of the three most frequently reported conditions as complaints of musculoskeletal origin. Its incidence is a growing phenomenon, with implicated costs for the society[10]. Recently, pain in the cervical region has been widely classified as idiopathic or induced by some trauma in the cervical region, such as a whiplash injury, and it is not possible to reach a definitive anatomopathological diagnosis in most cases[11].

Visual impairment is characterized by partial or total vision loss, and many are the causes of loss of this ability, which may be related to biological and environmental

factors, leading the individual to a limitation in their habitual performance[4,12].

The visually impaired adopts inadequate postures through the misuse of posture-related reflex schemes[13] because, as blindness causes distortions in some mechanisms (proprioceptive and tonic mechanisms in the cervical spine) in order to compensate for the lack of vision, it generates hypotonia or hypertonia in the neck, thus resulting in the existence of an inadequate vertical conception with tendency of forward inclination of the body during gait, interfering with posture that is also affected by the limited knowledge of body image[14].

In developing countries, visual impairment is a serious public health problem and derives from possibly preventable causes, such as cataracts, glaucoma, corneal infections, and measles[15].

Motor impairments, related to the total visual impairment (TVI) and all pathologies associated with the condition, propose a method for assessing postural aspects and pain perception, favoring an early diagnosis to recommend suitable parameters for a future clinical intervention[16].

Studies addressing the relationship between postural imbalances and cervical disability in the visually impaired population are rare. The visually impaired generally adopt inappropriate postures related to distortions in certain mechanisms. Because of the limited knowledge of their body image, gait tends to tilt the body[3]. Blindness is a predisposing factor for postural deviation, inducing the individual to present decreased conditions of physical agility and performance, leading to isolation, loss of motivation and disinterest in social routine[17].

In this context, the objective of this study was to identify the relationship between postural imbalance and cervical disability in people with visual impairment.

METHODS

This cross - sectional retrospective study was carried out at the Association for the Visually Impaired in Ribeirão Preto (*Associação dos Deficientes Visuais de Ribeirão Preto* - ADEVIRP), in São Paulo, SP, Brazil, between January and December 2014.

The selection of this institution, a non-profit organization belonging to the civil society, was motivated by its contribution to global human development and the educational and social inclusion of people with visual impairment, considering that the institution promotes, through actions, resources and services for the improvement of the quality of life and the social and family living, in partnership with families, schools, companies and the community in general, being a reference in the care for visually impaired people.

The study was carried out with participation of 26 individuals with total or partial visual impairment. This sample reflects the total number of subjects attended to by ADEVIRP (Table I). Inclusion criteria were individuals with total or partial, congenital or acquired impairment, aged above 18 years, and presenting adequate cognitive level to understand the objectives and procedures related to the research. As an exclusion criterion, subjects presenting other associated impairments and/or who were taking analgesic or anti-inflammatory medication.

The researcher attended the institution to conduct the data collection, personally scheduled with the ADEVIRP managers.

In order to avoid the embarrassment of the participants, the assessment was conducted individually in a room reserved by the institution itself, where only the individual and the researcher remained. Initially, an Informed Consent Form (ICF) translated into Braille by the institution was presented to the participant. After reading the form in Braille, the printed form was read by the researcher in a clear and precise way. Prior to the signing by the volunteers, the printed form and form in Braille were compared by the institution's social worker, and signed by her to ensure veracity. All participants filled out and signed the ICF using a reference ruler, and those who were not able to write their signature used their fingerprint registration.

Table I - Representation and identification of the population evaluated according to sex, mean age, total impairment, partial impairment, congenital or acquired total impairment. Ribeirão Preto, SP, 2014.

Sex	Mean age	Total impairment	Partial impairment	Congenital/acquired total impairment
Male (n=15)	34.40	05	10	02 – 03
Female 11 (n=11)	25.55	07	04	05 – 02
Total (n=26)	31.92	12	14	07 – 05

Postural examinations were performed by means of the biophotogrammetry, evaluated by SAPO version 0.69 (Software for Postural Evaluation) and classified through the New York scale[18] in association with a questionnaire that identifies how neck pain affects daily life activities, the Neck Desability Index (NDI)[19].

For evaluation of functional disability and pain in the cervical spine region, the study used the NDI questionnaire[20], adapted and validated for the Portuguese language[19], through a direct interview for a better understanding of the evaluated population. The instrument is recommended to evaluate functional disability associated with cervical pain, being easy to apply[21]. It contains 10 items, each item composed of 10 questions, among which: seven are related to activities of daily living, two are related to pain, and one relates to concentration, except for question number five, about headache. The alternatives, numbered from zero to five, describe increasing degrees to which the cervical pain interferes with the performance of the activity in question. Question 8 was excluded from the present study, since it did not apply to the investigated population, as it was related to driving vehicles.

The questionnaire was directly and impartially applied by the researcher, who presented the question to the individual and explained all the alternatives (6 alternatives for each question), so that the volunteer later indicated the alternative that they most identified themselves with. Only after the question was answered, they proceeded to the next one. The scores were obtained by summing the scores and subsequently converting the result into a percentage value, considering only the items answered by the individual. The NDI value consists in the sum of the scores, from 0 to 5 of each of the 10 questions, totaling a maximum of 50 points.

The obtained value can be expressed as a percentage, on a scale from 0% (without disability) to 100% (complete disability). The number of answered questions multiplied by the number 5 divides the total score. For instance, if all the questions in the questionnaire are answered, the total score will be divided by 50 (10 x 5), whereas, if one question remains unanswered, it will be divided by 45 (9 x 5). The result of this division is multiplied by 100, and the final values are presented in percentage, ([score ÷ (number of questions answered x 5)] x 100). Therefore, when the value is below 10% (less than 5 points), it is considered without disability; with a minimum disability, 10 – 28%; with moderate disability, 30-48%; severe disability, 50-68%; and, above 72%, complete disability[22].

For the static posture assessment, photographic records of the participants were performed with parameters of the biophotogrammetry evaluation[16,23], an effective kinetic analysis tool consisting of an image recording process, obtained through body postures, which were later interpreted through bone and joint references in the anterior, posterior, right lateral and left lateral planes, with their respective axes, allowing the calculation of angle and body segments related to the research, with different tasks and with various precautions and control measures adopted. This evaluation occurred with the male participant in shorts and, in the female case, wearing shorts and crop top. Prior to performing each experiment, the instructions and information were given, always asking the participant to remain as calm as possible, breathing slowly and pausingly, to ensure a reliable and reproducible examination.

In order to standardize the postural evaluation procedure, the participant was positioned on a three-dimensional leveling platform in front of a symmetrograph with dimensions of 200x100 cm and 10 cm of quadrangular; an 8.5-megapixel Nikon® camera, model DSC COOL PIX S2600-PTP, placed on a tripod positioned at a 3-meter distance between the camera's focal lens and the subject's body center. Another measure used for standardization was the height of the tripod, which remained 0.90 m high in relation to the ground.

After standardization of the equipment, the biophotogrammetry evaluation was performed, followed by the positioning of the following reference points: bilateral tragus, bilateral acromia, bilateral anterior superior iliac spine, bilateral femur greater trochanter, bilateral knee joint line, bilateral medial patella, bilateral tibial tuberosity, bilateral lateral malleoli, bilateral medial malleoli, spinous process C7, bilateral posterior superior iliac spine, point between 2nd and 3rd bilateral metatarsal head, bilateral upper and lower angle of scapula, thymic process of T3, point on the midline of bilateral leg. point on the Achilles tendon at the mean height of the two bilateral malleoli and bilateral calcaneus.

For postural assessment, we used SAPO version 0.69, an unrestricted and free Brazilian software developed at the University of São Paulo (USP) by a multidisciplinary team[23], and the images were analyzed according to the protocol of the program, acquiring angulations or distances referring to the postural levels. The images with the demarcations were calibrated by using a 1-meter measuring tape in order to transform pixels into centimeters. The New York Scale[18] was also used so that the data identified in the SAPO program could be classified and compared to the NDI results. The images were obtained by a single evaluator, without zoom and in four planes of delimitation: anterior, lateral (right and left) and posterior. For the analysis of the results of this study, the following angular axes were used: cervical inclination, shoulder elevation, shoulder abduction, flexion-extension of the neck, thoracic hyperkinesis, and scapular alignment. Some precaution was taken not to expose the images of the participants of the present study.

From the results, the subjects were classified according to the reports of some cervical disability by the NDI and analysis was conducted by cross-checking with the postural changes of the subjects. SPSS® software version 22 was used to create a double-entry (or crossover) table associating disability due to neck pain and posture, as well as to perform the chi-square test with 5% significance to evaluate the independence between the two factors.

The project was submitted and approved by the Ethics and Research Committee of the University of Franca (UNIFRAN) under no. 495,565.

RESULTS

The means related to the main postural changes evidenced during the postural evaluation show the following alterations: in the front view, there was a 2.82cm cervical inclination to the left. In the rear view, there was left shoulder elevation of 9.15cm in relation to the right one; there was a 2.44cm flexion-extension of the head in relation to the cervical spine in the right and left lateral views; thoracic hyperkyphosis of 0.67cm and a 5.08cm difference in the scapular alignment of the right side in relation to the left one.

Table II - Relationship between the cervical disability questionnaire (NDI*) and the New York Scale. Although the subjects present moderate and severe postural changes, this does not result in cervical disability according to the NDI*. Ribeirão Preto, SP, 2014.

NDI*	New York Scale		Total of individuals
	Moderate	Severe	
Minimum disability	1	2	3
Without disability	2	21	23
Total	3	23	26

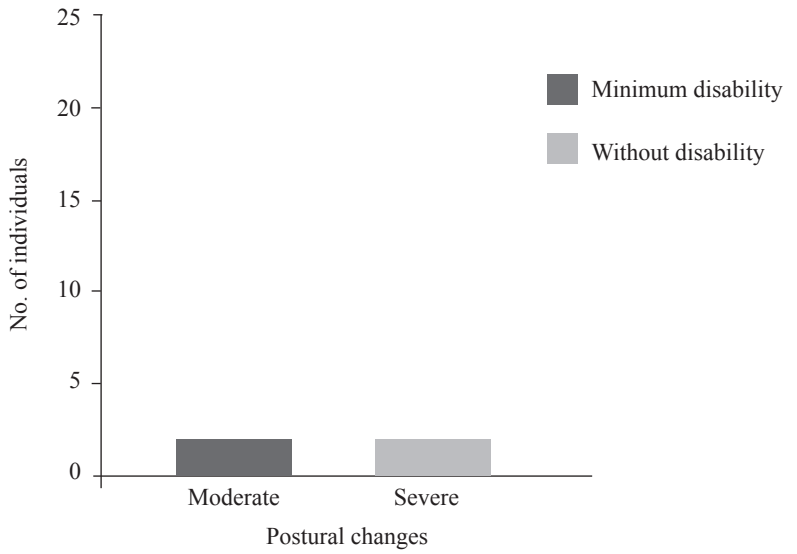

Figure I - Relationship between posture and cervical disability in numbers of subjects. Moderate postural change (1 with minimal disability and 2 without disability) and severe postural change (2 with minimal disability and 21 without disability). Ribeirão Preto, SP, 2014.

According to the New York scale, of the 26 participants evaluated, 23 presented severe postural changes and 3 had moderate postural changes.

The results obtained in the NDI questionnaire indicate that, of the participants with moderate postural problem, one presented minimal disability due to pain, while two participants did not present any disability. Still, considering the participants with severe postural problem, 2 had minimal disability and 23 had no disability. Table II shows the relationship between the NDI and the New York Scale findings.

In the graph (Figure I), it can be observed that, either regarding cases with severe postural changes and cases with moderate postural changes, most of the subjects did not present any declared disability due to neck pain.

In order to evaluate with statistical significance the previous affirmation, a Chi-square independence test was performed, based on the test result [$\chi^2(1)=1.578$; p-value=0.209], at a 5% level of significance and p-value>0.05. It is not possible to reject the initial hypothesis of the test, which suggests an independence between the two factors. Thus, it is verified that the postural problem is not associated with the occurrence of disability, that is, the postural problem that can lead to neck pain does not interfere with the subject's disability.

DISCUSSION

The present study shows that a majority of the population investigated presents severe postural changes according to the New York scale. Individuals with blindness adopt compensatory posture, for example: increased thoracic kyphosis, anteriorized head, protrusion of the shoulder girdle, and pelvic anteversion for alignment or adjustment of the center of gravity. The visual information is very important for the balance control and accuracy in the speed of movement of objects and body segments, and for the time and accuracy of the motor reaction as well, and its decrease could lead to postural misalignments and/or disharmony[17-24].

Individuals with visual impairment promote postural adjustments in head positioning, increase in dorsal kyphosis, lumbar lordosis exacerbation, rotation and tilt of the head to one side, abdominal ptosis, and alteration in body awareness[25].

Other studies show the existence of postural asymmetries in visually impaired individuals, in which the postural evaluation by biophotogrammetry has shown a significant difference in relation to knee and shoulder symmetry. The presence of these postural asymmetries stimulates the acquisition of mechanisms to compensate for vision loss[26]. A study developed with the objective of defining the main postural pattern adopted by the visually impaired observed that the main alteration affects the cervical region, presenting 60% of thoracic hyperkyphosis and 90% of head protrusion[27].

In a case study[3] with the objective of evaluating the occurrence of postural changes, using the classic method and muscle imbalances in a visually impaired patient, muscle retractions were observed in 7 of the 13 groups evaluated, with possibility to become an important predisposing factor for changes in posture, since the subject presented several postural changes related to the evaluated musculature, indicating that the presence of such postural alterations occur as a consequence of the vision impairment.

In the present study, severe postural changes were evidenced, as 23 of the 26 evaluated individuals had some type of left lateral postural deviation, such as cervical tilt, shoulder elevation and a difference in scapular alignment, which occurs in relation to lack of vision.

In an assessment of the postural control of adult individuals with congenital or acquired complete blindness using the Brazilian version of the Berg Balance Scale and the motor domain of the functional independence measure, it was concluded that the ability to control posture can be acquired through compensatory mechanisms and is not affected by visual loss[10]. In the present study, vision loss may contribute to the onset of such mechanisms.

Neck pain is the second complaint among people, ranked after back pain only[28]. The muscles of the neck must always be alert to support the weight of the head and, when undergoing overloads, they contract and reduce the blood flow to the region, generating pain, which can radiate to the shoulders and even cause tension headache. Poor posture, among other factors, can cause this type of pain, and its mensuration is essential for the evaluation and treatment of its effects, even though there is no standard tool for assessment of the pain magnitude[29].

In a study of cervical kinesthetic alteration, the reduction in the ability to remain with the head in a neutral position may contribute to the maintenance of inadequate postures, generating overload and pain in the cervical spine. The maintenance of the anteriorized posture of the head overloads the non-contractile structures and increases the muscular tension in the posterior cervical structures, generating myofascial pain[28,30].

The relationship between head posture and the presence of pain in the cervical region has been widely discussed in the literature; however, the authors diverge in opinions about the subject. Nevertheless, the direct biomechanical relationship of the muscles and cervical spine in head balance maintenance supports the hypothesis that postural

changes, such as the head anterioration, are more significant in individuals with cervical pain complaints when compared to asymptomatic individuals[31].

The present study shows that there is a trend of postural change among the evaluated subjects with visual impairment, which can be described as posteriorization and tilt of the head to the left and shoulder asymmetry. It is important to make a postural evaluation in individuals with some visual impairment, whether total or partial, aiming to identify changes in posture, gait and balance. From the findings, develop a suitable approach for each person in order to correct the postural changes, offering a suitable posture model for improvement of their performance and quality of life.

In spite of the correlations found in the present study, it is important to emphasize as a limitation the small number of individuals evaluated and the instruments used in the collection, suggesting that new studies be conducted with a larger sample number and other evaluation instruments, in order to investigate the changes and their specific mechanisms. Even so, it is believed that the results can be useful in the scientific rationale of professionals involved in the clinical evaluation and rehabilitation of people affected by postural changes and neck pain.

CONCLUSION

The results obtained under the studied conditions corroborate with the literature findings that show compensatory postural changes adopted by the visually impaired in an attempt to adjust the center of gravity. However, these postural changes do not coincide with cervical disability and pain.

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