Postural body: a systematic review about assessment methods

Postura corporal: uma revisão sistemática sobre métodos de avaliação

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ABSTRACT

Introduction: There are different methods for assessing body posture used in physiotherapeutic research, however, there is still no consensus on what would be the most widely used. **Objective**: Review the methods for body postural assessment used in research today. **Method**: A literature review was performed on Brazilian papers published from 2010 to 2014. This papers were found Virtual Health Library database, with Health Sciences Descriptors: posture and assessment. **Results**: Ten assessment methods were found, as follows: Postural Assessment Software (PAS), digital photography, photogrammetry, photography, Kendall et.al. method, Kendall et.al. method with photography, New York Postural Assessment method (NYPAM), biophotogrammetry, evaluation form, and posturograma. Among others, the most used method is PAS (15 papers), followed by Kendall et.al. method with photography (six papers). **Conclusion**: Various methods for body postural assessment are employed, among PAS show us that is the most used.

Keywords: Evaluation; Posture; Physical therapy specialty.

RESUMO

Introdução: Existem diferentes métodos para avaliação da postura corporal que são utilizados em pesquisas por fisioterapeutas, no entanto, ainda não existe um consenso sobre qual seria o método mais utilizado em estudos nesta área. **Objetivo**: Realizar uma revisão sobre métodos de avaliação da postura corporal utilizados em pesquisas na atualidade. **Método**: Foi realizada uma busca bibliográfica de artigos brasileiros publicados entre 2010 e 2014, na base de dados da Biblioteca Virtual em Saúde, com os Descritores em Ciências da Saúde: Postura e avaliação. **Resultados**: Foram encontrados 10 métodos de avaliação, sendo eles: Software para Avaliação Postural (PAS), Fotografia digital, Fotogrametria, Fotografia, Método de Kendall et al., Fotografia com método de Kendall et al., Método de Avaliação Postural de Nova York (MAPNY), Biofotogrametria, Ficha de avaliação e Posturograma. Dentre os métodos utilizados, o mais frequente foi o PAS (15 artigos), seguido da Fotografia com método de Kendall et al. (seis artigos). **Conclusão**: Foi verificado que são empregados diversos métodos para a avaliação da postura corporal, dentre os quais o PAS mostrou-se como o mais utilizado.

Palavras-chave: Avaliação; Postura; Fisioterapia.

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INTRODUCTION

Posture is defined by Academia Americana de Ortopedia as an equilibrium state between muscles and bones with the ability of protecting from trauma other structures of the human body.[1] According to Magee posture is composed of different positions of body's joints at a certain moment.[2]

There are many definitions of posture, but it should be emphasized that posture involves a dynamic relationship in which body parts, specially muscles, adapted in response to stimuli received, reflecting the lived experiences on the body.[1]

To evaluate postural alignment is necessary to be a standardization of posture. Standard posture is defined as one that involves a minimum effort and overload and leads to maximum efficiency of the body.[3]

In standard posture the spine presents normal curvatures and the bones of the lower limbs are in perfect alignment for weight bearing. The pelvis neutral position leads to good alignment of the abdomen, trunk and lower limbs. The chest and upper spine are in a position that promotes optimal function of the respiratory organs. The head is upright in a well-balanced position that minimizes the burden on the cervical muscles.[3]

When the individual is in upright position the rear of the skull, the back and the buttocks are tangent to a vertical plane, thus showing that the spine should be rectilinear in posterior plane. The sagittal plane has four curvatures: cervical lordosis, thoracic kyphosis, lumbar lordoses and sacral curvature.[4]

There are different methods for evaluation of body posture which are used in research by physiotherapists, however, there is no consensus on what would be the most widely used method in studies in this area. Thus, the aim of this article is to review about evaluation of body posture methods used in nowadays research.

METHODS

This study is characterized as a systematic review of articles published in the last five years (from 2010 to 2014) and indexed in the database of the Virtual Health Library (VHL). The terms used to search for articles, according to the Health Sciences Descriptors (DeCS), were: Posture and evaluation.

As inclusion criteria it was decided that the studies should deal with investigations into methods for assessing body posture, to be conducted by at least one physiotherapist and be published in Brazil. Exclusion criteria were: review articles, articles that did not have the full text available in the database and studies that only evaluated the posture of a body part. So, 33 articles about methods of assessment of body posture were selected for analysis, as can be seen in Figure 1.

RESULTS

From search, 33 studies were found, which are arranged in chronological order of publication in Table 1.

Ten evaluation methods were found, as follows: Postural Assessment Software (PAS), Digital photography, Photogrammetry, Photography, Method of Kendall et al., Photography with method of Kendall et al., New York Postural Assessment Method, Biophotogrammetry, Evaluation form and Posturograma. The frequency of use of these methods is illustrated in Figure 2.

Regarding the presentation of the data was also no standardization observed, as some studies showed quantitative values describing the angles related to the alignment of the body posture, while other studies conducted a qualitative analysis, describing the changes. In Figure 3, it can be seen the most frequent ways of presenting the data of the investigated studies.

About the studied population, studies were found with people of different age groups, as shown in Figure 4.
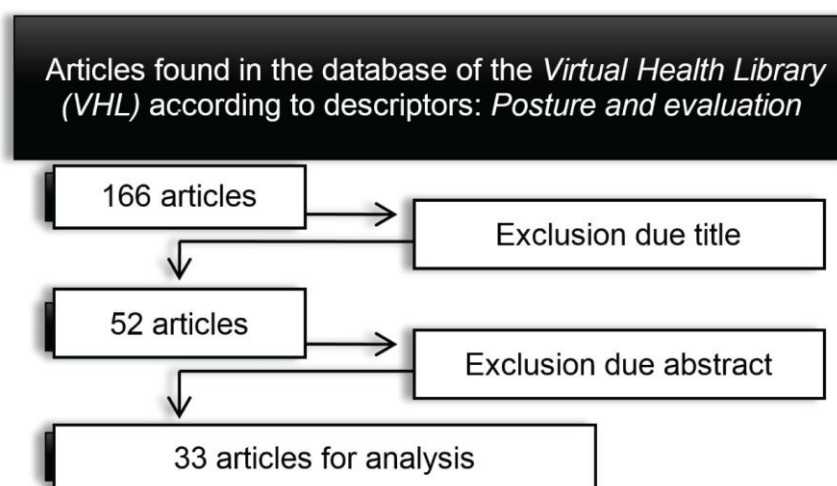

Figure 1. Selection of items searched in the electronic databases.

Table 1. Summary of articles found.

Author	Periodic	Study Theme	N sample	Individuals Age	Method Used	Presentation Form of Results
Moraes et al. 2010[5]	Fisioter. mov. (Impr.)	Different type of footwear and body posture	15 women	23,2 ± 3,36 years	Photogrammetry (PAS®)	Average and standard deviation of the measured angles
Lima et al. 2010[6]	Rev. bras. Educ. Fís. Esporte	Gymnastics program, posture and flexibility	10 elderly	67,5 ± 5,76 years	Digital photography	Frequency changes
Bigaton et al. 2010[7]	Rev Soc Bras Fonoaudiol.	Posture and function of the cranio-cervical region	28 dysphonic women	31,25±8,14 years	Photogrammetry	Average and standard deviation of the measured angles
Coelho Júnior et al. 2010[8]	Rev Bras Fisioter	Head and shoulders alignment in patients with unilateral vestibular hypofunction (UVH)	30 individuals with UVH and 30 individuals with normal vestibular function and without complaints of dizziness	Study group 52,63 ± 6,97 years and control group 52,13 ± 7,25 years	Photography, Kendall et al. e Magee	Average, standard deviation, median and percentiles of the angles
Graup et al. 2010[9]	Rev Bras Ortop.	Sagittal postural changes in the lumbar spine in students	288 teens, 156 male and 132 female	Male 16 ± 1,06 years and female 15,87 ± 1,05 years	Photogrammetry	Percentage changes
Molinari et al. 2010[10]	Health Sci Inst	Posture and plantar support	20 obese children with Down Syndrome	The average age was 10.3 years (G1) and 10.5 years (G2), with extremes between nine and twelve years.	Photography Kendall et al.	Frequency changes
Okama et al. 2010[11]	ConScientiae Saúde	Posture in the patients bearers of Duchenne and Becker Muscular Distrophy	13 patients	16,75 (± 6,9) years	Photogrammetry (PAS)	Dendogram
Vasconcelos et al. (2010)[12]	Fisioter. mov. (Impr.)	Postural changes of the spine in students	32 deaf students	Aged between 7 to 21 years	Kendall et al.	Frequency changes
Ferreira et al. 2011[13]	Distúrb Comun	Voice and posture of teachers	4 University Professors	28 and 45 years	Photogrammetry (PAS)	Descriptive analysis of changes
Machado et al. 2011[14]	Rev. CEFAC	Voice and posture of aqua aerobics teachers	14 women and 03 men	The age of individuals ranged 22-55 years with an average of 31.33 years for males and 31.1 for females	Kendal et al.	Average and standard deviation
Meereis et al. 2011[15]	R. da Educação Física/UEM	Postural changes in classical ballet dancers	10 ballet dancers	Average ± DP: 15,7 ± 2,2 Median (P25 -75): 16,0 (14,0 - 17,8)	Photogrammetry (PAS)	Frequency; Average; Standard Deviation; Median (Interquartile range) of measured angles
Conti et al. 2011[16]	J. Pediatr.	Body posture and mouth breathing (MBr)	306 MBr (mouth breathing group) e 124 NBr (healthy group)	Children and teens 5-14 years	New York postural assessment method	Body posture classification (Normal, Moderate and Severe)
Souza Melo et al. 2011[17]	Arq. int. otorrinolaringol. (Impr.)	Posture of the spine and hearing impairment in students	44 students	Average age 12±3,2 years	Photography, Kendall et al. and Kisner and Colby	Frequency changes

Table 1. Continued...

Author	Periodic	Study Theme	N sample	Individuals Age	Method Used	Presentation Form of Results
Melo et al. 2011[18]	Rev. bras. cancerol	Posture and modified radical mastectomy surgery	22 women	Average age 53,8±6,6 (DP) years	Photogrammetry (PAS)	Average and standard deviation of measured angles
Rossi et al. 2011[19]	Fisioter. mov.	Global Postural Re-education and posture	30 voluntary women	20 ± 2,4 years	Photogrammetry (PAS)	Average and Standard deviation
Candotti et al. 2011[20]	Rev Paul Pediatr	Postural education program and posture	34 participants	Children 10,5 ± 0,8 years; teens 13,2 ± 1,0 years	Photography Kendall et al.	Average and Standard deviation
Meliscki et al. 2011[21]	Fisioter. mov.	Posture and type of breathing in swimming athletes	60 athletes: 29 women and 31 men	Men 19,2 ± 2,7 years; women 19,2 ± 3,8 years	Photography	Descriptive analysis and frequency changes
Veiga et al. 2011[22]	Rev. Bras. Ciênc. Esporte (Impr.)	Sports injuries, postural changes and flexibility of the posterior chain	28 male athletes	Aged between 17 to 20 years	Photogrammetry	Descriptive analysis of changes
Pachioni et al. 2011[23]	Fisioter. Pesqui.	Postural changes and Chronic Obstructive Pulmonary Disease	30 individuals	Control group age 70 ± 7 years and COPD group age 70 ± 8 years	Photogrammetry (PAS)	Median and interquartile range of measured angles
Gasparotto *et al.* 2012[24]	Ciênc. saúde coletiva	Posture to self-perception	18 elderly	Aged between 62 to 83 years, average of 70 years	Photography Kendall et el.	Descriptive analysis of changes
Bosso *et al.* 2012[25]	Rev. Bras. Med. Esporte	Postural changes in rhythmic gymnastics athletes	27 individuals	Aged between 7 to 15 years, average of 10,4 years	Photogrammetry (PAS)	Average, standard deviation, median, minimum and maximum of measured angles
Morimoto et al. 2012[26]	Fisioter. mov.	Postural changes and mouth breathing in students	117 children	Average age 9,017 ± 0,851 years	Photogrammetry (PAS)	Average and standard deviation
Porto et al. 2012[27]	Motriz: rev. educ. fis	Postural profile in the sagittal plane of elderly	Multidimensional Senior Study Group of Porto Alegre: 272 elderly. Program of Physical Exercise Group: 29 elderly	Multidimensional Senior Study Group of Porto Alegre: 68,23 ± 5,49 years. Program of Physical Exercise Group: 67,18 ± 6,12 years	Photography Kendall et al.	Frequency of changes
Vieira et al. 2013[28]	Pediatr. Mod.	Posture and lung parameters in children with bronchopulmonary dysplasia history and healthy children	18 children	Aged between 6 to 12 years	New York postural assessment	Average, standard deviation, median and percentiles of the angles
Tavares et al. 2013[29]	Scientia Medica (Porto Alegre)	Elderly posture and physical activity	40 elderly, 34 women e 6 men	68, 5 ± 5,1 years	Photogrammetry (PAS)	Average and standard deviation of measured angles
Simão et al. 2013[30]	Rev. CEFAC	Posture, breathing and swallowing in post-accident cerebrovascular patients in the chronic phase	1 patient	37 years	Photogrammetry (PAS)	Descriptive analysis of changes
Sinzato et al. (2013)[31]	Fisioter Pesq.	Ground pilates method, postural alignment and joint flexibility	33 women	Aged between 18 to 30 years	Photogrammetry (PAS)	Variable, average and standard deviation of measured angles

Table 1. Continued...

| Author	Periodic	Study Theme	N sample	Individuals Age	Method Used	Presentation Form of Results
Barbosa et al. 2013[32]	Rev. Bras. Ginecol. Obstet.	Body posture and breast cancer	39 women	Average age 50 ± 10,5 years	Biophotogrammetry	Average and standard deviation of measured angles
Borges et al. 2013[33]	Acta Ortop Bras.	Plantar arch, lumbar curvature and backaches	18 women	Average age 30,45 (±6,25) years	Photogrammetry (PAS)	Measured angles (lumbar angle)
Colpo et al. 2013[34]	Rev. dor	Aqua aerobics, subjective pain perception and their influence on activities of daily living, posture and physical fitness	20 women	42,45 ± 6,09 years	Observation of Evaluation sheet	Qualitative description, only the most incidents deviations were cited
Azato et al. 2013[35]	Rev. dor	Temporomandibular dysfunction and overall posture of individuals	30 patients	No age was described	Photogrammetry (PAS)	Average and standard deviation of the measured angles
Haddad et al. 2013[36]	Einstein (São Paulo)	Postural and upper limb range of motion in post-mastectomy women, lymphadenectomy and radiotherapy	16 post-mastectomy women with lymphedema and 14 post-mastectomy women without lymphedema	18 to 70 years; ML=58,9 e M=59,7	Posturograma Clinical, Fisiometer®, version 2.8	Descriptive analysis and frequency of changes in each group
Gimenes et al. 2013[37]	J Health Sci Inst	Water and ground physical therapy in posture of women with mastectomies.	15 patients	37 to 68 years, control group average 54,8 years and study group average 10,3 and 16,3 years	Photogrammetry (PAS)	Average, median and standard deviation of the measured angles
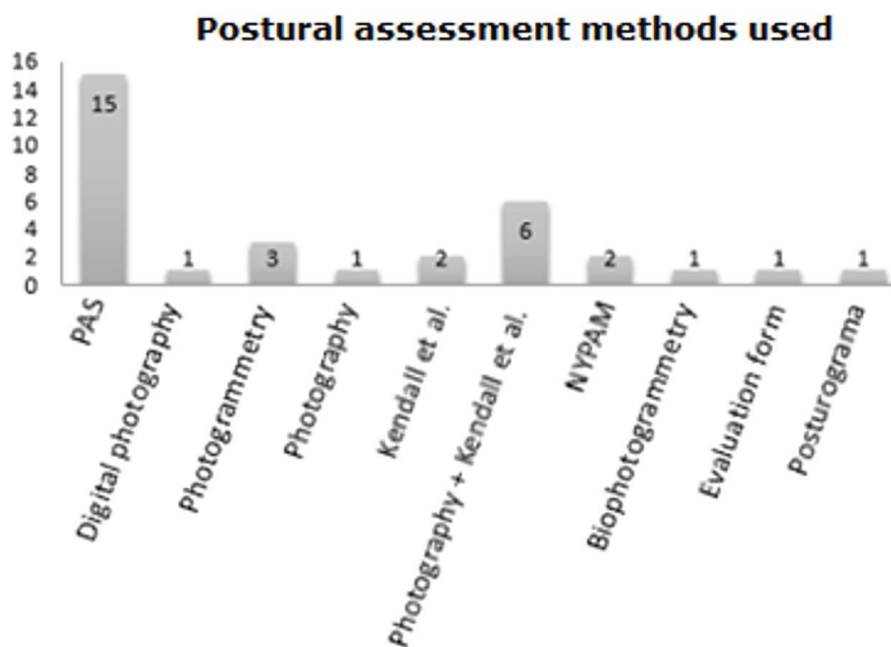
Figure 2. Frequency of methods used in the evaluation of body posture. Legend: PAS: Postural Assessment Software. NYPAM: New York Postural Assessment Method.
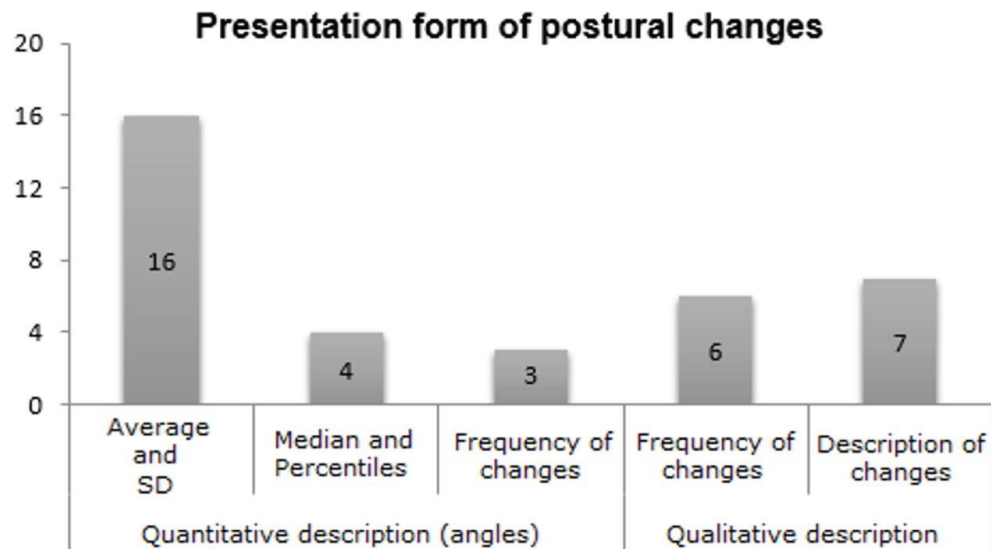
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Presentation form of postural changes

Figure 3. Frequency of presentation forms of results. Legend: SD: Standard Deviation
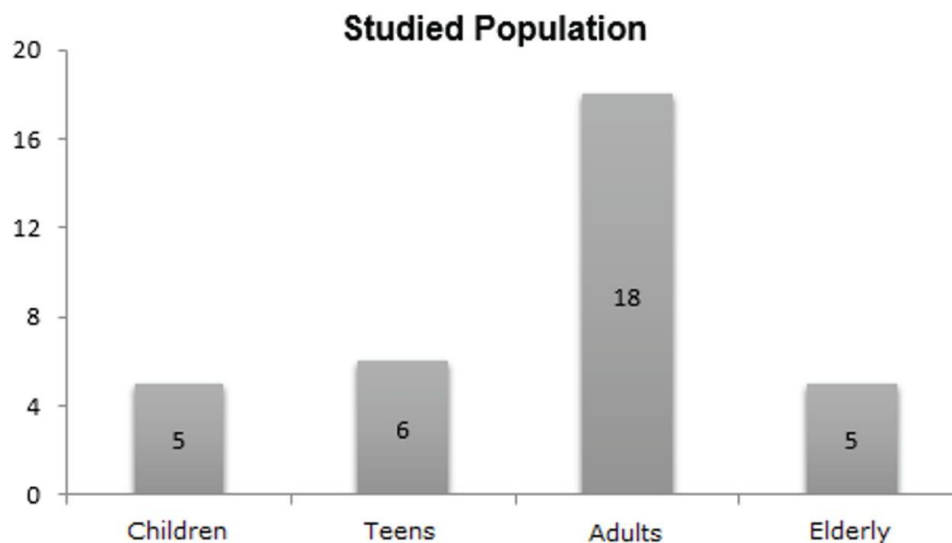
Studied Population

Figure 4. Frequency of studied population.

DISCUSSION

We found 33 studies that assessed body posture. The methods used for the evaluation of body posture were many, as the approached theme, the population and the presentation of the results of each study.

The methods used in the studies were:

a) **Postural Assessment Software (PAS)** was used in 15 studies: Moraes et al.[5], Okama et al.[11], Ferreira et al.[13], Meereis et al.[15], Melo et al.[18], Rossi et al.[19], Pachioni et al.[23], Bosso et al.[25], Morimoto et al.[26], Tavares et al.[29], Simão et al.[30], Sinzato et al.[31], Borges et al.[33], Azato et al.[35], Gimenes et al.[37].

This method consists of a computer program that, after the acquisition of photographs of subjects wearing swimsuits, marked in specific anatomical points and photographed from a distance of three meters, next to a plumb line and subsequent scan to these images to measure: position, length, angle and alignment of the body segments of a person, which allows analyzing the static posture in frontal, posterior and lateral right and left players.[5]

Braz, Goes, Carvalho (38) demonstrated validity and reliability of PAS program when performing repeated measurements by three evaluators without obtaining substantial differences in 15 different angular measurements. In Souza et al.[39] study is described that photogrammetry determines a two-dimensional quantification of the body and the change of posture can be hidden by the evaluated plan. It is believed that this method should not replace clinical judgment, but complement it. It has been as positive

aspects of PAS software protocol its practicality, the ability to standardize the measurements and the comparison between studies. The negative points relate to the assessment profile, especially regarding the curvatures of the spine, which are best seen in postural clinical outcome. This situation, however, does not compromise the PAS program, but it is recommended additional analysis to the PAS software protocol for mainly sagittal plane.

b) **Photography and Kendall et al. method** was used in 6 studies: Coelho Júnior et al.[8], Molinari et al.[10], Candotti et al.[20], Souza Melo et al.[17], Gasparotto et al.[24], Porto et al.[27]. In the study of Coelho Júnior et al. (8) was also used Magee (2) and in the article of Souza Melo et al. (17) was used Kisner and Colby (40).

For this evaluation we use a symmetrograph. The assessed individual is positioned behind this equipament in standing position and without dress and bare feet, while the evaluator, situated in front of the simetograph, performs the photograph. It is requested that the individual remains naturally standing [27]. The camera was positioned on a tripod, perpendicular to simetograph in the distance of 1.80 m, allowing the capture of the image of the entire volunteer body. Image analysis was based on the protocol described by Kendall et al. (3), which classifies the position in four different alignments: ideal alignment, flat back, kyphosis/lordosis and sway back. Thus, each volunteer photography was compared to images of the alignments of the Protocol.

c) **Kendall et al. method** was used in 2 studies: Vasconcelos et al.[12], Machado et al.[14].

In postural assessment is observed the individual in anterior view, profile and posterior view. In anterior view is observed the head position, the height difference of the shoulders, which could indicate a scoliosis. The same for the heights of the iliac crests. Check if the legs and knees bow out (genu varum) or if your knees touch while the ankles are separated (genu valgum). [3]

In profile test is assesses head position again, shoulder girdle (shoulders), abdomen, hips, cervical spine, lumbar, dorsal, sacrum and knees. The dorsal region more convex indicates accentuation of kyphosis and the reverse in lower back indicates accentuation of lumbar lordosis. Very preceding shoulders indicate protrusion of shoulders. Knees very curved back indicate genu-recurvatum. [3]

On examination of the posterior view of the right and left halves must be symmetrical. The hindfoot must have symmetrical support, not supported very medial or lateral; calcaneus should be in vertical alignment with the Achilles tendon; medial malleolus should be of equal height on both sides; popliteal fossa, as well as the gluteal folds, should be of equal height; pelvis should be of equal height on both sides, with the anterior posterior iliac spines leveled on the horizontal plane; column must be aligned without presenting lateral deviations; Thales triangle should be symmetrical; shoulder

blades should be equidistant from the spine and flattened against the rib cage; inferior angle of the scapula should lie flat in the horizontal plane; shoulders should be of equal height; head and neck should be straight, with no inclination or side rotation. [3]

d) **Photogrammetry** was used n 3 studies: Bigaton et al.[7], Graup et al.[9], Veiga et al.[22].

According to Graup et al. (9), in this method is used photographic images from a digital camera. It allows scanning in a program with graphical software in which it is possible to identify the angle generated by the intersection of anatomical points. In this study the camera was placed on a tripod 1.20 meters above the ground and 3 meters from the individuals.

e) **New York State Postural Assessment Method** was used in 2 studies: Conti et al.[16], Vieira et al.[28].

This method objectively assesses 13 different body segments. It features a scoring system for quantitative analysis of body posture. Posture is classified with the following scores: 5.0 for the normal pattern; 3.0 to moderate postural change; and 1.0 for severe postural change. [28]

f) **Digital photography** was used in 1 study: Lima et al.[6].

In this method the symmetrograph is positioned in the background of photo and the plumb line between the individual and the camera (the plumb line is positioned slightly passing in front of the lateral malleolus right of the individual). The camera is positioned at a height of 0,78m and a perpendicular distance of 2,56m to the symmetrograph. The individual was placed in orthostatic position in profile to the evaluator, which recorded the posture through photographs.[6]

g) **Photography** was used in 1 study: Meliscki et al.[21].

In this evaluation was used a digital camera and a tripod. The postural evaluation was performed in anterior and posterior view and right and left profile. The photographs were obtained in isolated room, with the participants wearing appropriate clothing for the exam. The camera was positioned on a tripod at a distance of 4m, and this evaluation was performed by a qualified physiotherapist. [21]

h) **Biophotogrammetry** was used in 1 study: Barbosa et al.[32].

The images were acquired with the use of a camera positioned on a tripod with 1m tall. The volunteers were in appropriate costumes, positioned on a mark drawn on the ground with their feet parallel, at a distance of 2.2 m from the camera in anterior and posterior views. For image processing was used CorelDraw® Software.[32]

i) **Evaluation sheet- observation** was used in 1 study: Colpo et al.[34].

The evaluation was conducted through observation, using as a benchmark the posturography test in which the individual is wearing swimsuits and barefoot.[34]

j) **Clinical Posturogram** was used in 1 study: Haddad et al.[36].

Posture assessment was performed with the capture of six images with the individual in orthostatic position (ventral

and back sides, left and right profile) and anterior trunk flexion (anterior and lateral views). The postural evaluation program, named as clinical posturogram, issues reports with photos and graphic evaluation. All these data were analyzed quantitatively because the software performs exact averages between anatomical points marked on the assessed individual (acromion; anterior superior iliac spine; lateral malleolus; inferior angle of the scapula; posterior superior iliac spine and glabella. For range of motion assessments were checked: surface projection of the center of the glenohumeral joint laterally; greater and lesser tubercle of the humerus; center of the olecranon; styloid process of the ulna; acromion; surface projection of the center of the elbow joint; center between radius and ulna distally).[36]

Considering the analysis methods used, it can be seen that there was no uniformity in the choice of the method for the evaluation of body position. However, it was found that most of the reviewed studies used PAS [5,11,13,15,18,19,23,25,26,29-31,33,35,37]. Furthermore, it was found that most studies used methods of photography as a way for analysis. [5-11,13,15,18-27,29-33,35,37]

In relation with the picture, a very important issue that must be observed for the comparison of data from different studies is the distance of the tripod in relation to the evaluated individual. It was observed that there is no standardization of distance, while in methods that used PAS [5] and photogrammetry [9] was used a distance of 3m, in photography [21] was used 4m and in biophotogrammetry [32] was used 2.2m.

It was observed that most of the studies that performed a quantitative analysis illustrated average and standard deviation of angles [5,7,14,18-20,26,29,32,35]; others studies showed mean, standard deviation, median and percentiles of the angles [8,28], in addition to these variables, some showed the frequency [15]; other presented only median and percentile [23]; other used average, standard deviation, median, minimum and maximum [25]; other study used variable, average and standard deviation [31]; other used measured angles [33]; other study showed average, median and standard deviation of measured angles [37]. Only one study used the Dendogram to illustrate the results [11].

In relation to studies that perform a qualitative description, most made the description of postural changes found, others showed the frequency of postural changes [6,9,10,12,17,27], other studies used the frequency of changes and the descriptive analysis [21,36], others just used the descriptive analysis of changes [13,22,24,30,34], only two studies used the classification in regular, moderate and severe [16,28]. It was observed interested studies to assess the posture of children [10,12,16,26,28], of teens [9,12,15-17,25], of adults [5,7,8,11,13,14,18-23,30-34,36,37] and elderly [6,24,27,29,36]. Among adults it should be noted the interest in investigating women who had mastectomies [18,36,37] and athletes [21-22].

Based on this study, we observed heterogeneity in research related to body posture, making it difficult to compare data between studies. It indicates the necessity of choosing a standard method that is accessible to physiotherapists and that meets the needs of providing data reliably. Furthermore, the presentation form of results also requires a standardization in order to enable and facilitate comparison between evaluations performed in different studies. Seeing the importance of postural evaluation in order to prevent and monitor and objectively the evolution of postural correction treatments.

CONCLUSION

Based on this study, it was found that different methods are used for the evaluation of body posture, among which Postural Assessment Software (PAS) was the most used. In relation to the presentation form of postural changes, the average and standard deviation were the most used. It is suggested the standardization of evaluations to facilitate comparison between the data from different studies.

AUTHOR'S CONTRIBUTION
XBP: Systematic review and writing of the article; ECWM: Systematic review and writing of the article.

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