RELIABILITY OF A PHOTOGRAPHIC METHOD FOR ASSESSING STANDING POSTURE OF ELEMENTARY SCHOOL STUDENTS

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ABSTRACT

Objective: A high prevalence of poor standing posture among elementary schoolchildren indicates the need for the introduction of school-based interventions for improvement of postural alignments. For assessing the effect of intervention programs, reliable quantitative measures of standing posture should be used. Therefore, the purpose of this study was to examine the reliability of a photographic method for assessment of standing posture among elementary schoolchildren.

Methods: The study was conducted on a convenience sample of 273 male students between 10 and 13 years old. Each subject was photographed in habitual standing posture, 3 times in a front view and 3 times in a side view. Deviations from ideal postural alignment were calculated with Posture Image Analyzer software and UTHSCSA ImageTool software. Interitem reliability was estimated using intraclass correlation coefficient.

Results: Intraclass correlation coefficients for posture deviations assessed with Posture Image Analyzer ranged from 0.81 for knee joints deviation and ankle joints deviation in the coronal plane to 0.92 for trunk deviation and knee joints deviation in the sagittal plane. Intraclass correlation coefficients for posture deviations assessed with UTHSCSA ImageTool ranged from 0.80 for knee joints deviation in the coronal plane to 0.91 for trunk deviation and knee joints deviation in the sagittal plane.

Conclusions: This study showed a satisfactory interitem reliability of a photographic method for the assessment of standing posture among elementary schoolchildren. (J Manipulative Physiol Ther 2010;33:425-431)

Key Indexing Terms: Posture; Reproducibility of Results; Schools; Child

Ideal standing posture should allow for the maintenance of balance using the least musculoskeletal effort without a feeling of discomfort. The ideal alignment of body segments in standing posture should coincide with a vertical line passing through the center of gravity of the body. From a lateral view, the ear, axis, shoulder, bodies of lumbar vertebrae, hip, knee, and the point just in front of the lateral malleolus should be situated on the same vertical line. In the sagittal plane, the posture should be bilaterally symmetrical.

Large deviations from ideal postural alignment induce stress on spinal tissues, resulting in possible headaches, neck pain, back fatigue, and structural deformities of the spine, intervertebral discs, and spinal ligaments. We assume that a negative influence of poor standing posture on health is especially expressed in primary school age. Namely, in that, period poor standing posture affects spinal tissues in combination with other risk factors, such as rapid changes in growth, backpack use, faulty sitting posture, and the use of nonergonomic school furniture. Epidemiologic studies have shown that posture-related problems are very common among schoolchildren. Scoliosis was found in 4.2% of schoolchildren aged 8 to 15, whereas 22% of schoolchildren reported having headaches at least once a week. We assume that the high prevalence of such diagnoses could be, among other factors, a consequence of poor standing posture.

Kratěnová et al found that 38% of schoolchildren who were 11 years old had poor posture, which indicates a potential need for the introduction of school-based interventions for improvement of postural faults. Such interventions were well accepted among elementary school students. Results of the abovementioned study concerning effects of school-based interventions on children’s posture are somewhat limited because of the qualitative nature of the methods used for postural
In the last decades, various methods of quantitative assessment of standing posture have been developed. Recent technology improvements have paved the way for a development of highly reliable and applicable methods, such as low-dose x-ray scanning (Lodox Systems Ltd, Johannesburg, South Africa)\textsuperscript{15} and computer-assisted systems for the analysis of posture photographs.\textsuperscript{16–18} Posture assessment by Lodox allows a direct insight into the position of bones. This makes it a more valid method than photographic assessment, which determines the position of external anatomical points.\textsuperscript{19,20} However, because of its large dimensions and radiation exposure during imaging, Lodox is applicable only in clinical studies. Photographic methods, on the other hand, because of their simplicity, low costs, and complete noninvasiveness, are suitable for use in school-based intervention programs.

For assessing the effect of intervention programs at the individual level, highly reliable methods should be used. Otherwise, it would not be possible to determine whether the difference between 2 measurements in the same subject is a consequence of a real change or a random observational error. Studies on reliability of photographic methods for standing posture assessment have so far been performed on children 7 to 10 years old,\textsuperscript{21} adolescents,\textsuperscript{22} university students,\textsuperscript{23} young adults,\textsuperscript{18,24} and adults.\textsuperscript{25} The above listed studies address different aspects of reliability, such as intrarater agreement, interrater agreement, test-retest reliability, and automatic vs manual marker digitization process. Although one study\textsuperscript{10} has investigated reliability in elementary schoolchildren, a relatively small number of subjects question the statistical power of the results. For the purpose of this study and future studies, we developed new software for automatic digitization of body posture photographs named Posture Image Analyzer (Posture Image Analyzer, Faculty of Kinesiology, University of Split, Croatia). Measurement characteristics of the newly developed software have not been assessed before. The aim of this study was to examine the interitem reliability of photographic assessment of standing posture among elementary schoolchildren when photographs were digitized using Posture image analyzer software and UTHSCSA ImageTool software (UTHSCSA ImageTool, version 2.0; Department of Dental Diagnostic Science, University of Texas Health Science Center, San Antonio, Tex) and to investigate automatic vs manual marker digitization process as possible source of error.

**Methods**

**Subjects**

The study was conducted in 2007 on a convenience sample of male students from 2 elementary schools in Split, Croatia. Before the study, sample size requirements had been estimated using Bonett’s calculation.\textsuperscript{26} To achieve the expected reliability of 0.9 and desired 95% confidence interval (CI) of reliability of ±0.02 using 3 items, the required sample size was 251 subjects. To ensure this CI width, we included 273 subjects in the study. All subjects were between 10 and 13 years old. The inclusion criterion was that subjects had no structural deformities or aberrations of the locomotor system. The participation of all the examinees was voluntary, and students’ parents were informed about the procedure and signed the informed consent.

**Procedure**

The study was approved by the ethics committee of the Faculty of Kinesiology, University of Split. All measurements were performed by the same researcher experienced in the assessment of postural alignment. To establish the reliability of the photographic method for assessment of postural alignment, we took 6 photographs of each subject, 3 front views and 3 side views. Photography took place in the gymnasium of the 2 elementary schools. The area where photographing was performed was arranged identically in both schools. Landmarks were placed on the floor to ensure the same positioning of all subjects in front of the camera. A landmark was placed in front of a white screen to ensure a contrast of the subjects against the background. A Kodak Easyshare C513 (Kodak Easyshare C513; Eastman Kodak Company, Rochester, NY) digital camera was used. The camera was set on a tripod, 3.1 m away from the line marking the position of the subject. It was leveled on the stand by a spirit level to ensure that it was parallel with the floor. The height of the tripod was adjusted so the middle of the objective lens was 115 cm above the ground. Before photographing, the researcher put reflective markers on the following anatomical points on the left and right side of the subject’s body: tip of the pinna, acromion process, anterior superior iliac spine, lateral epicondyle of the femur, and medial malleolus. To enable precise positioning of the markers, we instructed subjects to wear shorts ending above the knee and to be naked from the waist up. After placing the markers, the subject was asked to stand on the designated spot facing the camera, to take a comfortable habitual standing position, and look straight ahead. After taking each photograph, the subject was instructed to make a few steps around the hall and then return to the designated spot and resume the position. During the break, the researcher checked the position of all the markers on the subject’s body and refastened them if necessary. After 3 front view photographs were taken, the whole procedure was repeated from the lateral perspective. Before taking side view photographs, the researcher changed the position of the reflective markers from the medial to the lateral malleolus. For the lateral views, the right side of the subject was photographed for right hand dominant individuals and the left side for left hand dominant individuals.
The photographs were analyzed by Posture Image Analyzer software. This software automatically digitizes reflective markers on the subject’s body and calculates the deviation of the anatomical points from the ideal postural alignment defined by Kendall et al.2 From front view photographs, the software calculates angle deviations of the lines connecting the same anatomical points on the left and right side of the body from a horizontal line. Angle deviations in the coronal plane were calculated as follows: head and neck deviation on the basis of tip of the left and right pinna position, trunk deviation on the basis of acromion processes position, pelvis deviation on the basis of left and right anterior superior iliac spine position, knee joint deviation on the basis of lateral epicondyles of femur position, and ankle joint deviation on the basis of the position of the medial malleolus of the left and right leg. From side view photographs, the software calculates the distance of anatomical points from the vertical line passing slightly in front of the lateral malleolus. Deviations in the sagittal plane were calculated as follows: head and neck deviation on the basis of the position of the tip of the pinna, trunk deviation on basis of the position of the anterior superior iliac spine, pelvis deviation on the basis of position of the anterior superior iliac spine, and knee joint deviation on the basis of position of the lateral epicondyle (Fig. 1). All photographs were also analyzed in the same way by UTHSCSA ImageTool software. Marker positions on all photographs were digitized by the same researcher. Because digitizing of marker positions in ImageTool software is performed manually, in this way, the accuracy of Posture Image Analyzer software in automatically recognizing the marker positions was checked.

Data Analysis

Data analyses were performed with SPSS 11.5 (SPSS Inc., Chicago, IL). Interitem reliability for 3 items of each postural deviation in a coronal plane (head and neck deviation, trunk deviation, pelvis deviation, knee joints deviation, and ankle joints deviation) and sagittal plane (head and neck deviation, trunk deviation, pelvis deviation, and knee joints deviation) was evaluated using intraclass correlation coefficient (ICC) type (A,3) case 3A.27 To estimate the interitem reliability in a population of subjects, we calculated 95% CIs for ICCs for each postural deviation. To estimate the possible magnitude of error in interpreting an individual’s score, we calculated standard error of measurement (SEM) for each postural deviation. All the statistical parameters were calculated separately for postural deviations determined by Posture Image Analyzer and UTHSCSA ImageTool. Agreement between postural deviations calculated by Posture Image Analyzer and UTHSCSA ImageTool was also evaluated using ICC type (A,1) case 3A.27 To give insight into the variability of the data, we calculated the mean and standard deviation for each postural deviation in the coronal and sagittal planes.

RESULTS

This study showed high interitem reliability of a photographic method for the assessment of postural alignment, regardless of whether digitizing of reflective
Markers was performed automatically by Posture Image Analyzer software or manually by UTHSCSA ImageTool software. It is important to emphasize that high reliability coefficients presented in the following section are generalizable only to postural deviations analyzed in this study.

Intraclass correlation coefficients for posture deviations assessed with Posture Image Analyzer ranged from 0.81 for knee joint deviation and ankle joint deviation in the coronal plane to 0.92 for trunk deviation and knee joint deviation in the sagittal plane (Table 1). Respective SEMs for postural deviations in the coronal plane ranged from 0.61 for pelvis deviation and trunk deviation to 0.83 for head and neck deviation (Table 1). SEMs for postural deviations in the sagittal plane varied between 0.55 for knee joints and 0.88 for head and neck (Table 1). If approximately 1.96 SEM is added and subtracted from the subjects’ results, the 95% CI of the true score is obtained. Accordingly, the width of the broadest 95% CI of a true score when postural deviations were calculated by Posture Image Analyzer software was ±1.63° (for head and neck deviation) and ±1.72 cm (for head and neck deviation) in the coronal and sagittal plane, respectively.

All values of interitem reliability parameters for postural deviations calculated by UTHSCSA ImageTool corresponded with the abovementioned results. Intraclass

<table>
<thead>
<tr>
<th>Plane</th>
<th>Postural deviation</th>
<th>Item (mean ± SD)</th>
<th>ICC</th>
<th>95% CI a SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coronal</td>
<td>Head and neck</td>
<td>0.06 ± 2.57</td>
<td>0.86</td>
<td>0.83-0.89</td>
</tr>
<tr>
<td></td>
<td>Trunk</td>
<td>0.06 ± 1.97</td>
<td>0.80</td>
<td>0.87-0.92</td>
</tr>
<tr>
<td></td>
<td>Pelvis</td>
<td>−1.49 ± 1.85</td>
<td>0.91</td>
<td>0.82-0.88</td>
</tr>
<tr>
<td></td>
<td>Knee joints</td>
<td>−0.91 ± 1.87</td>
<td>0.91</td>
<td>0.77-0.85</td>
</tr>
<tr>
<td></td>
<td>Ankle joints</td>
<td>−1.04 ± 1.87</td>
<td>0.91</td>
<td>0.77-0.85</td>
</tr>
<tr>
<td>Sagittal</td>
<td>Head and neck</td>
<td>−4.03 ± 2.85</td>
<td>0.92</td>
<td>0.86-0.91</td>
</tr>
<tr>
<td></td>
<td>Trunk</td>
<td>−2.90 ± 2.82</td>
<td>0.92</td>
<td>0.89-0.93</td>
</tr>
<tr>
<td></td>
<td>Pelvis</td>
<td>−4.97 ± 2.68</td>
<td>0.92</td>
<td>0.84-0.90</td>
</tr>
<tr>
<td></td>
<td>Knee joints</td>
<td>−2.05 ± 2.11</td>
<td>0.92</td>
<td>0.90-0.93</td>
</tr>
</tbody>
</table>

a Ninety-five percent CI of ICC.

Table 1. Interitem reliability of postural deviations in coronal and sagittal plane assessed with Posture Image Analyzer

<table>
<thead>
<tr>
<th>Plane</th>
<th>Postural deviation</th>
<th>Item (mean ± SD)</th>
<th>ICC</th>
<th>95% CI a SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coronal</td>
<td>Head and neck</td>
<td>0.06 ± 2.57</td>
<td>0.84</td>
<td>0.81-0.87</td>
</tr>
<tr>
<td></td>
<td>Trunk</td>
<td>0.06 ± 1.99</td>
<td>0.90</td>
<td>0.87-0.92</td>
</tr>
<tr>
<td></td>
<td>Pelvis</td>
<td>−1.55 ± 1.93</td>
<td>0.85</td>
<td>0.82-0.88</td>
</tr>
<tr>
<td></td>
<td>Knee joints</td>
<td>−0.92 ± 1.94</td>
<td>0.80</td>
<td>0.76-0.84</td>
</tr>
<tr>
<td></td>
<td>Ankle joints</td>
<td>−1.07 ± 1.90</td>
<td>0.81</td>
<td>0.77-0.85</td>
</tr>
<tr>
<td>Sagittal</td>
<td>Head and neck</td>
<td>−4.02 ± 2.93</td>
<td>0.88</td>
<td>0.85-0.90</td>
</tr>
<tr>
<td></td>
<td>Trunk</td>
<td>−2.92 ± 2.86</td>
<td>0.91</td>
<td>0.89-0.93</td>
</tr>
<tr>
<td></td>
<td>Pelvis</td>
<td>−4.98 ± 2.76</td>
<td>0.87</td>
<td>0.83-0.89</td>
</tr>
<tr>
<td></td>
<td>Knee joints</td>
<td>−2.04 ± 2.14</td>
<td>0.91</td>
<td>0.89-0.93</td>
</tr>
</tbody>
</table>

a Ninety-five percent CI of ICC.

Table 2. Interitem reliability of postural deviations in coronal and sagittal plane assessed with UTHSCSA ImageTool

<table>
<thead>
<tr>
<th>Plane</th>
<th>Postural deviation</th>
<th>Digitization (mean ± SD)</th>
<th>ICC</th>
<th>95% CI a SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coronal</td>
<td>Head and neck</td>
<td>−0.22 ± 2.17</td>
<td>0.998</td>
<td>0.997-0.998</td>
</tr>
<tr>
<td></td>
<td>Trunk</td>
<td>0.13 ± 1.87</td>
<td>0.996</td>
<td>0.995-0.997</td>
</tr>
<tr>
<td></td>
<td>Pelvis</td>
<td>−1.46 ± 1.57</td>
<td>0.992</td>
<td>0.985-0.995</td>
</tr>
<tr>
<td></td>
<td>Knee joints</td>
<td>−0.92 ± 1.72</td>
<td>0.998</td>
<td>0.995-0.997</td>
</tr>
<tr>
<td></td>
<td>Ankle joints</td>
<td>−1.03 ± 1.71</td>
<td>0.997</td>
<td>0.995-0.997</td>
</tr>
<tr>
<td>Sagittal</td>
<td>Head and neck</td>
<td>−4.26 ± 2.59</td>
<td>0.998</td>
<td>0.997-0.998</td>
</tr>
<tr>
<td></td>
<td>Trunk</td>
<td>−3.27 ± 2.65</td>
<td>0.998</td>
<td>0.997-0.998</td>
</tr>
<tr>
<td></td>
<td>Pelvis</td>
<td>−5.21 ± 2.32</td>
<td>0.998</td>
<td>0.997-0.998</td>
</tr>
<tr>
<td></td>
<td>Knee joints</td>
<td>−2.07 ± 1.93</td>
<td>0.997</td>
<td>0.996-0.997</td>
</tr>
</tbody>
</table>

a Ninety-five percent CI of ICC.
correlation coefficients ranged from 0.80 for knee joints deviation in the coronal plane to 0.91 for trunk deviation and knee joints deviation in the sagittal plane (Table 2). SEMs for postural deviations in the coronal plane varied between 0.61 for trunk deviation and 0.86 for head and neck deviation (Table 2). Standard error of measurements for postural deviations in the sagittal plane varied between 0.59 for the knee joints and 0.91 for the head and neck (Table 2). The width of the broadest 95% CI of a true score when postural deviations were calculated by UTHSCSA Image-Tool software was $\pm 1.69^\circ$ (for head and neck deviation) and $\pm 1.78$ cm (for head and neck deviation) in the coronal and sagittal plane, respectively.

Intraclass correlation coefficients calculated in the sample of 273 subjects allowed us to make a rather precise reliability assessment in the population. Neither of the 95% CIs of the ICC was greater than 0.08 (Tables 1 and 2). Means of postural deviations varied randomly and irrelevantly among items of measurement (Tables 1 and 2).

The agreement between posture deviations assessed by different types of software was almost perfect. Intraclass correlation coefficients ranged between 0.992 and 0.998 (Table 3). Likewise, means of all corresponding posture deviations assessed with different types of software matched almost perfectly (Table 3).

**Discussion**

Poor standing posture is a common problem among elementary schoolchildren.11 Because poor posture is associated with common health problems such as low back pain,28 it is important to act preventively in early childhood. To assess the effect of school-based intervention measures for improving standing posture, it is imperative to use noninvasive and simple methods. The method of photographic assessment of standing posture satisfies these criteria. Although there are some even less complicated noninvasive procedures for assessing posture than photographic methods, they are usually used for measuring only one postural deviation.26,30 Therefore, a photographic method seems to be the appropriate method for the assessment of standing posture in the school environment.

This study showed high interitem reliability of photographic assessment of standing posture among elementary schoolchildren regardless of whether the analysis of the photographs was performed by Posture Image Analyzer software or UTHSCSA ImageTool software. The sample in this study was large enough to enable a precise assessment of ICCs, thus, allowing us to draw trustworthy conclusions on the reliability of the method in a population. High reliability determined for all postural deviations is in accordance with the findings of several previous studies.16,18,23,25 The lowest ICCs were found for knee joint and ankle joint deviation in the coronal plane (Tables 1 and 2). Lower reliability of these measures may be a consequence of within-subject variability in the distribution of weight on the left vs right leg. Within-subject variability in the weight distribution is also a possible cause of the lower reliability of assessing the pelvis angle in the coronal plane. Weight transfer from leg to leg can result in a change of pelvis angle and translation of the pelvis in the coronal plane. Such explanation is supported by the findings of Normand et al,23 who found the lowest reliability precisely for the translation of pelvis in the coronal plane. Broadest CIs of individuals’ true score for postural deviations calculated by Posture Image Analyzer software imply that school-based or clinical interventions would have to produce a magnitude of change that exceeds $1.63^\circ$ in the coronal plane or 1.72 cm in the sagittal plane to be reliably detected. Because of relatively wide CIs of individuals’ true score, in spite of satisfying reliability, the photographic method tested in this study is not suitable for use in clinical setting.

An almost perfect agreement between postural deviations determined by Posture Image Analyzer and UTHSCSA ImageTool demonstrates the accuracy of both types of software. Differences between the methods probably occurred because of a different way of determining the coordinates of the markers (automatic digitizing in Posture Image Analyzer and manual digitizing in UTHSCSA ImageTool). Because these differences are indeed slight, it can be concluded that both automatic and manual digitization are acceptable for determining the coordinates of anatomical points on body posture photographs. Despite that, the advantage of automatic digitization in terms of time efficiency should not be ignored. The means of posture deviations revealed that there was no systematic effect between items of measurement or between automatic and manual digitization of markers.

Reliability of photographic assessment of postural alignment may be compromised by subject-related factors, such as a subject’s motivation for taking part in the measurement, pain in the back or some other part of the locomotor system, a subject’s postural instability, and normal postural sway. We find that motivation for taking part in the measurement is especially important when subjects are elementary schoolchildren. Therefore, to ensure subjects’ willingness to follow the instructions, researchers should follow the child-focused outreach strategy described by Claudio and Stingone.31 Subjects experiencing acute back pain or neck pain could try to adjust the habitual standing posture to avoid or reduce the pain.32 Consequently, possible inconsistency in pain-related posture adaptations could diminish the reliability of postural alignments. Because the prevalence of back pain in students is relatively high,6 before photographing, it is necessary to determine whether the subject feels pain at that point and take into consideration the possible influence of pain on postural alignment in interpretation of the results.
Maturation of sensory and motor systems in charge of postural stability normally ends by the age of 7 to 10 years. Because the youngest examinees in the sample were 10 years old, it could be assumed that postural stability affected reliability less than it would younger examinees. In future studies on younger subjects, a lower reliability could be expected because of possible postural instability. On the other hand, among subjects of all ages, posture measurement errors may be induced by balance control movements like postural sway or lateral shifting in the legs. Also, the head position and information perceived through the visual system have an important role in the control of standing posture. Therefore, we assume that to minimize between- and within-subject variability in postural control, it is important to instruct subjects to look straight ahead while they are being photographed. Also, postural sway is inevitably affected by respiration, so reliability of posture measures could be diminished if subjects exercised or performed endurance tests before the measurement. We assume that the negative influence of postural sway on reliability of posture measures could be minimized by asking subjects to hold their breath during photographing. To improve the assessment of standing posture, future studies should investigate the influence of the above-mentioned subject-related factors on the reliability of standing posture photographs.

**Limitations**

Certain limitations should be considered when interpreting the results of this study. First of all, the studied sample included only boys, which does not allow us to comment on the reliability of the method for girls. Although there is no evidence of the influence of sex on the reliability of the photographic assessment of posture, the results of this study cannot be extended to girls with absolute certainty. Furthermore, the sample included only subjects aged 10 to 13 years. It has been shown that age significantly influences postural angles, but not the difference in the angles between 2 measurements. Despite this, it is not possible to make conclusions on the reliability of the tested photographic method either among adolescents or among students younger than 10 years. Although previous studies showed satisfactory interrater reliability of photographic assessment of posture, similar studies on elementary schoolchildren are still lacking. Reliability of photographic assessment of standing posture depends on intrarater and interrater variability in the accuracy of positioning of the markers on subjects’ anatomical points and in the procedure of digitizing the markers, if digitizing is performed manually. Our study did not evaluate intrarater and interrater variability in positioning of the markers or interrater variability in the manual digitizing process as possible sources of error. Furthermore, no randomization of trials was done; thus, the order of photographs could have affected interitem reliability. This study did not assess between-day variability of subjects’ posture. The above-mentioned limitations should also be considered before making final conclusions about the applicability of photographic methods to track posture changes in school-based interventions.

Final conclusions about all aspects of reliability of the photographic assessment of standing posture among elementary schoolchildren cannot be drawn based upon the results of this study. Therefore, future studies should be conducted to assess interrater reliability and test-retest reliability of body posture photographs among elementary schoolchildren. Generalization of our results is limited to male students 10 to 13 years old. It would be useful to estimate the reliability of the photographic method among female students and among different age groups of elementary schoolchildren.

**CONCLUSION**

In spite of improvements in technology and scientists’ attempts to develop more and more precise measuring instruments, slight fluctuations in individuals’ posture, affecting SEM, are inevitable. Nevertheless, this study showed a satisfactory interitem reliability of the photographic method for the assessment of standing posture among elementary schoolchildren.

**Practical Applications**

- Photographic methods for assessment of standing posture are most suitable for use in elementary school environment.
- No prior studies have investigated reliability of photographic assessment of standing posture in elementary schoolchildren using appropriate methods.
- The aim of this study was to examine the reliability of photographic assessment of standing posture among elementary schoolchildren.
- This study showed high intrarater reliability of photographic assessment of standing posture among elementary schoolchildren.
- This study showed that automatic and manual digitization is acceptable for determining the coordinates of anatomical points on body posture photographs.

**ACKNOWLEDGMENT**

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No funding sources or conflicts of interest were reported for this study.

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