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CORRELATION BETWEEN POSTURE DEVIATION, PHYSICAL ACTIVITY AND COGNITION IN SMART PHONE ADDICTED CHILDREN IN EGYPT

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ABSTRACT

Background: Smartphones now form a key element in children's daily routines, driven by advances in mobile internet capabilities. However, most smartphone content is designed for adults, exposing children to adult-oriented information without adequate protection, which may influence their socialization. In addition, long-term smartphone use can negatively affect children's physical and cognitive development by reducing physical activity and contributing to posture disorders.

Purpose: to evaluate the correlation between posture deviations, physical activity and cognition in smart phone addicted children in Egypt.

Methods: Participants totaled 60 individuals aged 8–18 years, showing body mass index (BMI) from 18.5 to 23.9 Kg/m^2 alongside Smartphone Addiction Scale–Short Version scores at or above 24. Each completed the addiction scale, postural software analysis, the Physical Activity Questionnaire for Older Children (PAQ-C) and Adolescents (PAQ-A) and Raven's Progressive Matrices test (RPM)for the assessment of intelligence.

Results: The correlation analysis revealed varying relationships between postural parameters and the study scales. Several variables showed large correlations with Raven's Progressive Matrices (RPM) and the Physical Activity Questionnaire (PAQ) across anterior, posterior, and lateral views, particularly head, trunk, and ankle angles. Some variables showed moderate or small correlations, while others were not statistically significant.

Conclusion: There was a strong direct correlation between using smartphone and posture deviation. However, there was a strong inverse correlation between using of smartphone and physical activity and between using of smartphone and cognition in smart phone addicted children in Egypt.

INTRODUCTION

Smartphones provide convenient access to educational materials, enable communication with family and friends, and allow users to develop new skills. However, this lifestyle increasingly shapes children's daily routines, often leading them to rely heavily on their mobile devices. Such excessive reliance may eventually contribute to smartphone addiction [1].

When smartphones are used for long periods, the device is typically held below eye level while the head is inclined forward. This position often results in improper sitting posture and may cause pain in the neck, back, and head, and contribute to structural misalignment and postural deviation [2]. Postural abnormalities arise when the body's natural anatomical alignment is disturbed, potentially leading to muscular tension and various musculoskeletal disorders. These conditions are commonly associated with prolonged sitting, poor ergonomic practices, limited physical activity, and extensive use of digital devices. Continuous smartphone utilization is linked to the development of spinal deviations like kyphosis, lordosis, and scoliosis [3].

With the rapid growth of internet access and continuous technological innovation, smartphone adoption will likely grow yearly. Among children, these handheld devices now rank as the most commonly utilized electronic tools. Previous research has indicated that children spend an average of about 28.5 hours per week using smartphones, exceeding the usage of other devices such as tablets and laptops [4]. Such pattern demonstrates the early and widespread exposure of children to smartphone technology. Today's children depend on these devices for a remarkably wide range of activities, encompassing virtual schooling, interpersonal communication, gaming, online shopping, and entertainment consumption. Notably, many children have replaced conventional books with smartphones as their primary reading and study tool [1].

Improper posture related to smartphone use can lead to forward bending of the neck and contribute to spinal conditions like kyphosis. Research has shown that individuals who frequently incorporate smartphones into their daily routines often develop forward head posture, which may result in musculoskeletal discomfort due to sustained head and neck flexion [5].

Excessive smartphone use compromises physical well-being by discouraging exercise, which promotes muscle loss alongside fat gain, both linked to adverse health outcomes [4]. Research examining the associations between smartphone addictive behaviors and physical activity levels during childhood and adolescence has reported that heavier smartphone addiction levels are linked to lower sports participation and poorer physical performance [6].

A few investigations have suggested that smartphone dependency lacks significant relationship to physical activity. However, the majority of research findings do not support this view[7]. Several studies have demonstrated that long-duration smartphone usage is closely linked to inactive behavior patterns and reduced engagement in physical activity [8].

Given that smartphones are becoming progressively integrated into daily routines, it becomes essential to assess their addictive nature and their possible influence on cognitive processes, particularly short-term memory retention. Heavy reliance on smartphones has been linked to attention difficulties and memory lapses. Continuous device availability promotes multitasking behaviors that strain the cognitive system, gradually diminishing working memory capacity and focus. Moreover, smartphone addiction has been associated with poorer academic performance, suggesting broader cognitive consequences of excessive device use [4].

Thus, the objective of the present study was to explore the correlation between posture deviation, physical activity and cognition among smart phone addicted children in Egypt.

METHODS

The study was Cross Section Study (Observational study).

In order to detect sample size (n) Cochran's formula was used

$$n = \frac{z^2 p(1-p)}{e^2}$$

where z = 1.96 (95% confidence level, $\alpha = 0.05$), p = 0.65 (estimated population proportion), and e = 0.12 (margin of error). This yielded n = 60 participants.

The kafr el sheikh University Ethics Committee provided approval to conduct this investigation, under the number KFSIRB200-358. Informed written consent was provided by all recruited individuals. All individuals taking part in the research were apprised of the clinical research and the procedural methodology of the operation. The researcher personally collected all data.

The study sample consisted of 60 participants. Participants were recruited from El Beheira governorate through study advertisements, and those who expressed interest underwent eligibility assessment in accordance with the predefined inclusion and exclusion criteria. The study encompassed children within the age range of 8–18 years and with a body mass index between 18.5 and 40 Kg/m^2 and a score of 24 or higher on the Smartphone Addiction Scale–Short Version. Exclusion criteria involved visual or hearing impairments, cachexia, nervous system disorders, musculoskeletal problems, or congenital abnormalities that could affect the study outcomes

Assessment tools

All participants underwent the following assessments:

A) Smart Smartphone Addiction Scale–Short Version

The Smartphone Addiction Scale–Short Version (SAS-SV) represents a psychometrically validated instrument comprising ten items. Respondents rate each item along a six-point dimensional continuum, anchored at one for "strongly disagree" and six for "strongly agree." Cumulative scores span a range from ten to sixty, where higher values reflect a greater degree of smartphone addiction. Scores reaching 24 or higher on the SAS-SV are considered addicted [9].

B) Postural assessment software (PAS/SAPO)

To evaluate posture, the Postural Assessment Software (PAS/SAPO) was utilized. This software analyzes posture from digital photographs and is accessible in the public domain (http://pesquisa.ufabc.edu.br/bmclab/sapo/). PAS enables the calculation of angles and distances between anatomical reference points. The software is simple to operate and includes instructional tutorials for researchers. During the assessment, photographs were obtained with participants standing and wearing shorts above the knee to ensure visibility of 32 anatomical landmarks, of which 14 were bilateral [10]. Postural evaluation was conducted using Postural Assessment Software (SAPO/PAS) with anatomical landmarks marked by Styrofoam balls and images captured using a digital camera mounted on a tripod. The postural assessment software (SAPO) is free and open source tool, the SAPO is easy installed and configure, the data for each project/analysis can also be exported and saved in PDF and some other formats, drawing and image editing toolbars allowing for various operations on the images, including edge detection, it included scale calibration, image rotation for vertical definition, zoom adjustment, measurement of angles and distances and point-free marking **table (1).**

C) The Physical Activity Questionnaire for Older Children (PAQ-C) and Adolescents (PAQ-A)

The PAQ-C represents a seven-day recall, self-administered instrument developed to measure children's physical activity patterns during the academic year. It targets elementary school students in grades 4–8, typically aged 8–14 years. The questionnaire can be completed within classroom settings and produces an overall physical activity score calculated from nine questions, each rated on a five-level rating system [11].

The PAQ-A represents a slightly adapted version of the PAQ-C, distinguished primarily by the exclusion of the recess-related item. Like the PAQ-C, the PAQ-A employs a self-administered, seven-day recall format and is designed to measure overall physical activity engagement in high school students across grades nine to twelve, generally those between fourteen and nineteen years of age. It can be administered in classrooms and generates an overall physical activity score calculated from nine questions, each rated on a five-level rating system [11]

D) Raven's Progressive Matrices test (RPM)for the assessment of intelligence

This test is designed to evaluate a participant's competence in performing systematic and organized intellectual reasoning. The test consists of a series of abstract geometric figures arranged in a 3 × 3 matrix, where the element located in the lower right corner is missing. Participants are required to determine the underlying pattern governing the arrangement of the figures and select the correct missing piece from six to eight alternatives provided below the matrix[12].

Statistical analysis:

To examine data distribution, researchers applied the Shapiro-Wilk normality test prior to further analysis. Descriptive statistics paired with an independent samples t-test served to compare age, height, and weight across the two groups, while a chi-square test addressed between-group differences in sex distribution. Descriptive statistics and unpaired t test were utilized for comparing mean values of the angles (HAASIS, AAASIS, RQA, and LQA) assessed from Anterior view, the angles (HA, and KA) assessed from right lateral view, and the angles (HAH, and HA) assessed from left lateral view between the two groups. Descriptive statistics and Mann-Whitney U test were conducted for comparison of Mean values of the scores of SAS, RPM, and PAQ between the two groups. A p-value below 0.05 was adopted as the threshold for statistical significance across all analyses. All statistical measures were performed through the statistical package for social studies (SPSS) version 27 for windows.

RESULTS

An overall of 60 children took-part in this study. Their mean ± SD age was 13.35 ± 3.45years, with a minimum of 8 years and a maximum of 18 years. The mean ± SD duration of height was 1.58 ± 0.2 meter with a minimum of 1.08m and amaximum of 1.85. The mean ± SD duration of weight was 62.13 ± 17.18 kg with minimum of 22 kg and maximum of 90 kg . The number of males is 55 with percentage 91.7% and the number of females is 5 with percentage of 8.3% (Table 2).

Correlation coefficient for HAH, HAA, HAASIS, AAASIS, FARLL, FALLL, LDRLL, HATT, RQA, and LQA for Children were (-0.374, -0.4, -0.609, -0.21, -0.546, -0.468, -0.306, -0.512, -0.662, and -0.574) respectively, the significance level for them were 0.05 which means that there was relation between postural deviation from anterior view and Raven 's progressive matrices for Children as p-value<0.05 except for AAASIS there was a no relation between them as p-value>0.05. Correlation coefficient for HAST3, RRA, and LRA for Children were (-0.637, -0.561, and -0.599) respectively, the significance level for them were 0.05 which means that there was a relation between postural deviation from posterior view and Raven 's progressive matrices for Children as p-value<0.05. Correlation coefficient for HAH, VAH, VAT, HA, VAB, HAP, KA, and AA for Children group were (-0.278, -0.644, -0.585, -0.168, -0.707, -0.537, 0.116, and 0.682) respectively, the significance level for them were 0.05 which means that there was a relation between postural deviation from Right lateral view and Raven 's progressive matrices for Children as p-value<0.05 except for HA, and KA there was no relation between them as p-value>0.05. Correlation coefficient for HAH, VAH, VAT, HA, VAB, HAP, KA, and AA for Children group were (-0.189, -0.602, -0.64, 0.05, -0.492, -0.608, -0.402, and 0.553) respectively, the significance level for them were 0.05 which means that there was a relation between postural deviation from Left lateral view and Raven 's progressive matrices for Children as p-value<0.05 except for HAH, and HA there was a no relation between them as p-value>0.05 as shown in table (3).

Correlation coefficient for HAH, HAA, HAASIS, AAASIS, FARLL, FALLL, LDRLL, HATT, RQA, and LQA for Children were (-0.413, -0.54, -0.668, -0.292, -0.534, -0.574, -0.488, -0.568, -0.605, and -0.755) respectively, the significance level for them were 0.05 which means that there was relation between postural deviation from anterior view and Physical activity questionnaire for Children as p-value < 0.05. Correlation coefficient for HAST3, RRA, and LRA for Children were (-0.718, -0.619, and -0.641) respectively, the significance level for them were 0.05 which means that there was a relation between postural deviation from posterior view and Physical activity questionnaire for Children as p-value<0.05. Correlation coefficient for HAH, VAH, VAT, HA, VAB, HAP, KA, and AA for Children group were (-0.298, -0.781, -0.678, -0.121, -0.781, -0.764, 0.187, and 0.648) respectively, the significance level for them were 0.05 which means that there was a relation between postural deviation from Right lateral view and Physical activity questionnaire for Children as p-value<0.05 except for HA, and KA there was no relation between them as p-value>0.05. Correlation coefficient for HAH, VAH, VAT, HA, VAB, HAP, KA, and AA for Children group were (-0.216, -0.779, -0.773, -0.027, -0.518, -0.793, -0.473, and 0.591) respectively, the significance level for them were 0.05 which means that there was a relation between postural deviation from Left lateral view and Physical activity questionnaire for Children as p-value<0.05 except for HAH, and HA there was a no relation between them as p-value>0.05 table (3).

DISCUSSION

This study assessed the correlation between posture deviation, physical activity and cognition in smart phone addicted children in Egypt. This study demonstrated that there was a strong correlation between posture deviation, physical activity and cognition in smart phone addicted children in Egypt.

The findings derived from this research suggested that the correlation analysis between postural parameters and the studied scales demonstrated varying degrees of relationships. Regarding Raven's Progressive Matrices (RPM), several variables showed large correlations , including HAASIS, FARLL, HATT, RQA, LQA in the anterior view; HAST3, RRA, and LRA in the posterior view; VAH, VAT, VAB, and HAP in the right lateral view; as well as VAH, VAT, and HAP in the left lateral view. Additionally, the ankle angle (AA) showed a large positive correlation in both lateral views. Moderate correlations were observed with HAH, HAA, FALLL, and LDRLL in the anterior view, as well as VAB and KA in the left lateral view. A small correlation was identified with HAH in the right lateral view. However, some variables, including AAASIS in the anterior view and HA and KA in the right lateral view, showed non-significant correlations .

Similarly, the correlation analysis with the Physical Activity Questionnaire (PAQ) revealed predominantly large correlations with several postural parameters. These included HAA, HAASIS, FARLL, FALLL, HATT, RQA, and LQA in the anterior view; HAST3, RRA, and LRA in the posterior view; VAH, VAT, VAB, and HAP in the right lateral view; and VAH, VAT, VAB, and HAP in the left lateral view. The ankle angle (AA) also demonstrated a large positive correlation in both lateral views. Moderate correlations were observed with HAH and LDRLL from the frontal plane and KA from the left-sided sagittal plane. Conversely, small correlations were found with AAASIS from the frontal plane and HAH from the right-sided sagittal plane. Nevertheless, HA and KA from the right-sided sagittal plane and HA from the left-sided sagittal plane showed non-significant correlations.

This study's findings correspond to **Chen et al.,** [13] that identified a substantial association connecting abnormal alignment to suspected scoliosis occurrence. Their study also indicated that prolonged electronic device usage and television viewing are linked to a higher likelihood of suspected scoliosis.

Further support for these results comes from **Fatma et al.** [14]**,** who found that smartphone addiction may contribute to poor posture and reduced awareness of ergonomic practices and postural risk factors. In addition, excessive smartphone use was associated with higher physical and psychological fatigue levels, increased pain levels, and impaired sleep patterns.

Our study finding is confirmed by **Fontenele et al.,**[15] who investigated that frequent smartphone usage in the typing position can lead to alterations in cervical posture, particularly among adolescents who are identified as smartphone-addicted.

Additionally, **Seyedahmadi et al.** [16] demonstrated stronger smartphone addiction tendencies were significantly more likely to exhibit exaggerated kyphotic curvature, increased lordotic angulation, and a more pronounced forward head posture.

The current findings corroborate **Lin et al.'s** [17] work, linking prolonged smartphone engagement to musculoskeletal pain (particularly back) through greater thoracic kyphosis and lumbar lordosis, along with disrupted muscular activity that precipitate posture problems.

Similar observations were reported by **Faisal et al.,** [18] that demonstrated that smartphone addiction frequently occurs during the transition into young adulthood and is strongly linked to cervical postural deviations, especially forward head posture.

The present study demonstrated that physical activity is correlated to postural deviation in children who demonstrate addictive smartphone use. Similarly, **Al-Amri et al.** [4] noted that children without addiction maintained much higher physical activity than addicted counterparts, highlighting addiction's role in reducing physical engagement.

The result of the present study agreed with **Zhu et al.,** [19] who showed a significant moderate negative correlation (r = -0.335) between smartphone dependence and physical activity. High-risk and at-risk users showed poorer sleep alongside less physical engagement.

The findings of this study correspond with **Pirwani et al.,** [20] who showed an inverse association between physical activity levels and smartphone addiction within undergraduate students.
The findings of the study agreed with **Kim et al.,** [21] who demonstrated that smartphone addiction and physical activity are inversely related among undergraduate students, a population already characterized by inadequate engagement in moderate physical exercise and heightened susceptibility to addictive device use. Excessive smartphone use may adversely influence physical health through decreased engagement in activities such as walking, which may lead to increased fat mass and decreased muscle accumulation, both factors being related to unfavorable health implications.
The result of the present study came into disagreement with the study done by **Salsali et al.,** [22] that showed that a significant relationship was absent when examining physical activity levels in relation to postural alignment.
The current study noted an inverse correlation linking smartphone addiction to cognition. In addition, **Al-Amri et al.,** [4] suggested that smartphone overuse could be linked to certain aspects of cognitive performance and physical activity among middle-school students. The results showed differences in attention accuracy between children exhibiting elevated device addiction compared to their less-affected peers, indicating that intensive smartphone exposure might influence cognitive processes related to concentration and attentional control. One possible explanation is that continuous exposure to rapidly changing digital stimuli, such as mobile games and social media applications, may alter the way children process information and maintain attention. Nevertheless, neither group differed significantly regarding reaction time. Such results may indicate that some aspects of cognitive functioning, such as processing speed, are not directly affected by smartphone addiction. It is also possible that frequent interaction with digital devices enhances certain skills related to quick responses to visual or digital stimuli.
The result of the present study came into agreement with the study done by **Mohta et al .,** [23] that found that adolescents who were addicted to smartphones showed poorer cognitive functioning, including problems with attention, concentration, and decision-making. They also experienced more emotional difficulties such as higher levels of anxiety, mood instability, and poor emotional regulation. In terms of social functioning, addicted adolescents had weaker interpersonal relationships and lower social adjustment compared to their peers who were not addicted to smartphones.
The findings of our study are supported by **Méndez et al.,** [24] that noted that excessive internet and smartphone usage is related to cognitive control function impairments in attention, decision-making, and impulse regulation. Brain imaging results showed altered activity in brain areas related to executive regulation, particularly the prefrontal cortex. These changes may reduce individuals' ability to control impulses and regulate their behavior.
The results of this study are reinforced by the work reported by **Qayyum et al.,**[25] where the evidence demonstrated that extensive smartphone use is linked to reduced concentration, lower academic performance, and increased distraction during learning activities.
The present study's findings aligned with **Yaakoubi et al.,**[26] who investigated the association between smartphone dependence and students' overall wellness plus educational outcomes among Tunisian middle schoolers. The findings demonstrated substantial smartphone engagement connects to sleep disturbances, elevated fatigue, and reduced cognitive performance, including difficulties with attention, memory, and concentration. These negative effects also contribute to lower academic achievement among students who show signs of smartphone addiction.
The study conducted by **Kumbhar et al.,** [27] supports our results that demonstrated that students exhibiting intense smartphone overuse suffer reduced immediate memory retention, likely due to constant distractions, multitasking, and reduced sustained attention caused by frequent smartphone use. These cognitive impairments can affect learning efficiency, information retention, and academic performance.

CONCLUSION

There was a strong direct correlation between using smartphone and posture deviation. However, there was a strong inverse correlation between using of smartphone and physical activity and between using of smartphone and cognition in smart phone addicted children in Egypt.

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Table (1) :Body Angles (Degrees) and Distances (Centimeters) Assessed Using the PAS/SAPO from Anterior , posterior and lateral view

Angles and Distances	Acronym	Definition
Anterior view		
1-Horizontal head alignment, anterior view	HHA-anterior	Angle between tragus of ear and horizontal
2-Horizontal alignment of ش cromions	HAA	Angle between both acromion processes and horizontal
3-Horizontal alignment of anterior superior iliac spine	HAASIS	Angle between both anterior superior iliac spine and horizontal
4-Angle between 2 acromions and 2 anterior superior iliac spines	AAASIS	Angle between 2 acromions and 2 anterior superior iliac spines.
5-Frontal angle of right lower limb	FARLL	Angle between right greater trochanter, midline of knee and Lateral malleolus
6-Frontal angle of left lower limb	FALLL	Angle between left greater trochanter, midline of knee and Lateral malleolus
7-Length difference between right and left limbs	LDRLL	{Distance between (Right anterior superior iliac spine&medial malleolus)- (Left anterior superior iliac spine&medial malleolus)}
8-Horizontal angle of tibial tuberosity	HATT	Angle between both tibial tuberosities and horizontal
9-Right Q angle	RQA	Angle between right greater trochanter,right Patella and right Tibial tuberosity
10-Left Q angle	LQA	Angle between left greater trochanter, left Patella and left Tibial tuberosity
Posterior view		
11-Horizontal asymmetry of scapula in relation to T3	HAST3	Horizontal asymmetry of scapula in relation to T3
12-Right rear foot angle	RRA	Angle between point under right gastrocnemius belly, right tendoachilis and right calcaneos
13-Left rear foot angle	LRA	Angle between point under left gastrocnemius belly, left tendoachilis and left calcaneus
Lateral view		

14-Horizontal head alignment, lateral view	HHA-lateral	Angle between right tragus, C7 and horizontal.
15-Vertical head alignment	VHA	Angle between right tragus, right acromion and vertical.
16-Vertical trunk alignment	VTA	Angle between right acromion, right greater trochanter and vertical.
17-Hip angle	HA	Angle between right acromion, right greater trochanter and lateral malleolus.
18-Vertical alignment of body	VAB	Angle between right acromion, right lateral Malleolus and vertical.
19-Pelvic horizontal alignment	PHA	Angle between right anterior superior iliac spine, right posterior superior iliac spine and horizontal.
20-Knee angle	KA	Angle between right greater trochanter, midline of knee and right lateral malleolus.
21-Ankle angle	AA	Angle between midline of knee, right lateral malleolus and horizontal.

Table (2): General characteristic of participants (n=60).

Items	**mean ± Standard deviation**	**Minimum**	**Maximum**
Age (years)	**13.35 ± 3.45**	**8**	**18**
Height (m)	**1.58 ± 0.2**	**1.08**	**1.85**
Weight (kg)	**62.13 ± 17.18**	**22**	**90**
Sex distribution	**N**	**%**	
Male	**55**	**91.7**	
Female	**5**	**8.3**	

SD: Standard deviation.

Table (3): Correlation coefficient represents the correlation between RPM, PAQ, and postural deviations in children (n=60).

Scale	**Outcomes (angles)**		**Children (n =60)**		
			Correlation coefficient (r)	**p-value**	**Relation degree**
	Anterior view	**(HAH)**	**-0.374**	**0.003**	**medium**
		(HAA)	**-0.4**	**0.002**	**medium**
		(HAASIS)	**-0.609**	**<0.001**	**large**
		(AAASIS)	**-0.21**	**0.107**	**-**
		(FARLL)	**-0.546**	**<0.001**	**large**
		(FALLL)	**-0.468**	**<0.001**	**medium**
		(LDRLL)	**-0.306**	**0.017**	**medium**
		(HATT)	**-0.512**	**<0.001**	**large**
		(RQA)	**-0.662**	**<0.001**	**large**
		(LQA)	**-0.574**	**<0.001**	**large**
	Posterior view	**(HAST3)**	**-0.637**	**<0.001**	**large**
		(RRA)	**-0.561**	**<0.001**	**large**
		(LRA)	**-0.599**	**<0.001**	**large**

RPM	**Right lateral view**	**(HAH)**	**-0.278**	**0.031**	**small**
		(VAH)	**-0.644**	**<0.001**	**large**
		(VAT)	**-0.585**	**<0.001**	**large**
		(HA)	**-0.168**	**0.199**	**-**
		(VAB)	**-0.707**	**<0.001**	**large**
		(HAP)	**-0.537**	**<0.001**	**large**
		(KA)	**0.116**	**0.379**	**-**
		(AA)	**0.682**	**<0.001**	**large**
	Left lateral view	**(HAH)**	**-0.189**	**0.147**	**-**
		(VAH)	**-0.602**	**<0.001**	**large**
		(VAT)	**-0.64**	**<0.001**	**large**
		(HA)	**0.05**	**0.703**	**-**
		(VAB)	**-0.492**	**<0.001**	**medium**
		(HAP)	**-0.608**	**<0.001**	**large**
		(KA)	**-0.402**	**0.001**	**medium**
		(AA)	**0.553**	**<0.001**	**large**
PAQ	**Anterior view**	**(HAH)**	**-0.413**	**0.001**	**medium**
		(HAA)	**-0.54**	**<0.001**	**large**
		(HAASIS)	**-0.668**	**<0.001**	**large**
		(AAASIS)	**-0.292**	**0.024**	**small**
		(FARLL)	**-0.534**	**<0.001**	**large**
		(FALLL)	**-0.574**	**<0.001**	**large**
		(LDRLL)	**-0.488**	**<0.001**	**medium**
		(HATT)	**-0.568**	**<0.001**	**large**
		(RQA)	**-0.605**	**<0.001**	**large**
		(LQA)	**-0.755**	**<0.001**	**large**
	Posterior view	**(HAST3)**	**-0.718**	**<0.001**	**large**
		(RRA)	**-0.619**	**<0.001**	**large**
		(LRA)	**-0.641**	**<0.001**	**large**
	Right lateral view	**(HAH)**	**-0.298**	**0.021**	**small**
		(VAH)	**-0.781**	**<0.001**	**large**
		(VAT)	**-0.678**	**<0.001**	**large**
		(HA)	**-0.121**	**0.356**	**-**
		(VAB)	**-0.781**	**<0.001**	**large**
		(HAP)	**-0.764**	**<0.001**	**large**
		(KA)	**0.187**	**0.153**	**-**
		(AA)	**0.648**	**<0.001**	**large**
	Left lateral view	**(HAH)**	**-0.216**	**0.097**	**-**
		(VAH)	**-0.779**	**<0.001**	**large**
		(VAT)	**-0.773**	**<0.001**	**large**
		(HA)	**-0.027**	**0.841**	**-**
		(VAB)	**-0.518**	**<0.001**	**large**
		(HAP)	**-0.793**	**<0.001**	**large**
		(KA)	**-0.473**	**<0.001**	**medium**
		(AA)	**0.591**	**<0.001**	**large**

(HAH) : Horizontal alignment of head,(HAA): Horizontal alignment of acromions,(HAASIS): Horizontal alignment of anterior superior iliac spine,(AAASIS): Angle between 2 acromions and 2 anterior superior iliac spines,(FARLL): Frontal angle of right lower limb,(FALLL): Frontal angle of left lower limb,(LDRLL) : Length difference between right and left limbs,(HATT): Horizontal angle of tibial tuberosity,(RQA): Right Q angle,(LQA): left Q angle, (HAST3) : Horizontal asymmetry of scapula in relation to T3,(RRA): Right rear foot angle, (LRA): left rear foot angle,(HAH): Horizontal alignment of head,(VAH): Vertical alignment of head,(VAT): Vertical alignment of trunk,(HA):Hip angle ,(VAB): vertical alignment of body ,(HAP): Horizontal alignment of pelvis,(KA): knee angle ,(AA): ankle angle