

Exploratory Study on the Relationship Between Health Literacy, Postural Awareness, and Postural Alignment in Healthy Adults

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Abstract

Background: Posture plays an essential role in human activity. Although the importance of correct posture is widely recognized, many individuals fail to notice their own postural deviations. Health literacy and postural awareness may contribute to the prevention of poor posture and musculoskeletal disorders, and this study aimed to examine the relationship among health literacy, postural awareness, and objectively measured posture in healthy adults.

Methods: Twenty-six participants (15 men and 11 women; mean age, 26 years; range, 19–50 years) without spinal or lower limb disorders were enrolled. Standing posture was assessed using AI-based image analysis software (Shisei Karte, Sapeet Inc., Japan). The postural parameters included trunk lateral tilt, cervical lateral deviation, shoulder height difference, thoracic deviation, trunk inclination, head tilt, and forward head translation. Health literacy was assessed using the 14-item Health Literacy Scale (HLS-14), and postural awareness was assessed using the Postural Awareness Scale. The participants were categorized into two groups: high and low health literacy. Statistical analyses were conducted using t-tests and Welch's tests, with significance set at $p < 0.05$.

Results: No statistically significant differences were observed between the high- and low-health literacy groups in either the frontal or sagittal plane posture parameters. However, several measures demonstrated moderate-to-large effect sizes (e.g., cervical lateral flexion and trunk inclination), although the 95% confidence interval included zero.

Conclusion: Although significant associations were not confirmed, the effect size estimates suggested potential links between health literacy, postural awareness, and posture. Further studies with larger sample sizes are warranted.

Introduction

Posture is a fundamental element of all human activity. Magnus stated that "all accurate movements occur between correct postures at the beginning and end" [1]. However, individuals often misperceive their own posture, and even after receiving guidance, they may revert to the same misalignment, thereby delaying their recovery.

Recently, increasing attention has been paid to health literacy and body awareness. Health literacy refers to the ability to access, understand, and use health-related information in daily life [2]. Previous research has shown both positive and inconclusive associations between health literacy and musculoskeletal outcomes [3–6]. Body awareness, defined as an attentional focus on internal sensations [7], is also considered essential. Reviews have suggested the potential benefits of body awareness interventions [8,9], but the evidence remains inconclusive. Validated questionnaires such as the Literacy in Musculoskeletal Problems (LIMP) [3,10], eHEALS [12], and HLS-14 [13] measure health literacy, whereas the Body Awareness Questionnaire [14,15] and Postural Awareness Scale [16,17] assess body awareness. However, few studies have investigated the relationship between these factors and objectively measured posture in healthy adults.

This study aimed to clarify the relationships among health literacy, postural awareness, and postural alignment in healthy adults.

Materials and Methods

Participants

Twenty-six healthy adults (15 men and 11 women; mean age, 26 years; range, 19–50 years) participated in this study. The exclusion criteria included spinal or lower limb injuries and scoliosis. Twelve participants were physical therapists, which may have introduced selection bias.

Participants

Standing posture was assessed in the frontal and sagittal planes using AI-based posture analysis software (Shisei Karte, Sapeet Inc.).

The measured parameters included:

-frontal plane: trunk lateral tilt angle, cervical lateral deviation, shoulder height difference, and thoracic deviation.

-Sagittal plane: trunk inclination angle, head tilt angle, and forward head translation.

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In addition, posture analysis images (Figure 1) were generated, in which the AI software automatically calculated each angle and distance using cloud-based processing. The trunk and cervical lateral flexion angles measured the lateral flexion angle of the trunk and head relative to the body center, calculated as positive angles for both the left and right sides. The shoulder height difference was calculated as the height difference between the xiphoid process and the acromion. Cervical and thoracic deviations were measured as the lateral displacement from the body center (cm), with values calculated as positive on both the left and right sides. The trunk inclination and head-tilt angles were calculated as the angles of inclination of the trunk and neck, respectively, relative to the center of the body in the sagittal plane, with both flexion and extension considered positive. Forward head displacement was measured as the forward displacement of the head relative to the center of the body (cm).

Health literacy and postural awareness assessment

Health literacy was measured using the 14-item HLS-14 [13]. Postural awareness was evaluated using the 13-item Postural Awareness Scale [16]. The participants were divided into high and low groups based on the cutoff values (HLS-14:80%; PAS: 65%).

Statistical analysis

The Shapiro-Wilk test was used to assess normality. For normally distributed variables, t-tests were performed, and for non-normally distributed variables, Welch's test was applied. SPSS ver. 28 (IBM) was used for statistical analysis. Statistical significance was set at $P < 0.05$.



Ethical considerations

This study was conducted in accordance with the Declaration of Helsinki and was approved by the Research Ethics Committee at Tokyo Metropolitan University, Arakawa Campus (Approval Number 23068).

Results

The mean Functional Health Literacy was 18.7 (SD = 4.9). In the low group (< 19; n = 10), the mean score was 13.5 (SD = 3.7), whereas in the high group (> 20; n = 16), the mean score was 21.9 (SD = 1.8). The total CHL score for Communicative Health Literacy was 19.7 (SD = 2.7). The low group (< 19; n = 10) scored 16.7 (SD = 1.7), while the high group (> 20; n = 16) scored 21.4 (SD = 0.9). The total Critical Health Literacy was 15.8 (SD = 2.1). The low group (< 15; n = 16) had a mean score of 14.0 (SD = 1.5), while the high group (> 20; n = 10) scored 17.3 (SD = 1.1).

The total Postural Awareness was 56.96 (SD = 6.69). In the low group (< 58; n = 16), the mean score was 52.67 (SD = 4.4), whereas in the high group (> 59; n = 10), the mean score was 63.85 (SD = 2.39).

The postural outcomes and comparisons between the groups are shown in Tables 1 and 2 ([Supplementary File](#)).

Standing posture analysis showed no statistically significant differences between the groups categorized by health literacy (functional, communicative, and critical) or postural awareness. Although effect size estimates (Hedges' *g*) indicated moderate-to-large values for several comparisons (e.g., cervical lateral flexion, trunk inclination, and pelvic alignment), all 95% confidence intervals included zero, indicating insufficient statistical evidence for group differences. Small-to-moderate effect sizes were consistently observed for both frontal and sagittal parameters, but none reached the conventional threshold for statistical significance ($p < 0.05$).

Discussion

This study investigated the relationship among health literacy, postural awareness, and postural alignment using AI-based analysis in healthy adults. Contrary to our hypothesis, no significant differences were observed between the groups. Possible explanations include:

1. A small sample size ($n = 26$), which resulted in wide confidence intervals.
2. Selection bias, as nearly half of the participants were physical therapists who likely had higher baseline awareness and literacy.
3. Low postural variability, with most participants exhibiting minimal frontal plane deviations, limiting the ability to detect differences.

In this study, the participants did not report musculoskeletal pain, which may explain why no significant differences were observed between the groups based on health literacy or postural awareness. In addition, the mean deviations in the frontal plane were within 1.5° or 1 cm, indicating that no participant had a marked malalignment, which likely contributed to the lack of group differences. One possible factor underlying this homogeneity was the inclusion of 12 physical

therapists among the 26 participants, introducing a potential selection bias. Given their professional engagement in guiding patients in body control, physical therapists may have a greater interest in their own posture and health, resulting in higher levels of postural awareness and health literacy compared to the general population.

In contrast, sagittal plane deviations were notable: the mean cervical tilt was 6.57° (SD = 4.68), and the forward displacement averaged 2.70 cm (SD = 3.47), with considerable inter-individual variability. According to the 2022 Comprehensive Survey of Living Conditions conducted by the Japanese Ministry of Health, Labor, and Welfare, stiff shoulders are the second most commonly reported symptom nationwide, and cervical alignment is thought to be closely related to these complaints. Moreover, with the rapid increase in the use of electronic devices, such as smartphones and computers, the associated usage time and posture are believed to impose substantial loads on the musculoskeletal system [18,19]. Device use has been linked to the onset of neck and shoulder symptoms [20] and the development of forward head posture (FHP), which exacerbates these complaints. Lauche et al. [17] reported that improvements in chronic neck pain were not related to specific therapeutic techniques but rather to increased postural awareness. Although the present study did not demonstrate a significant association between sagittal cervical alignment and postural awareness, the effect sizes were large (4.93 and 3.45, respectively), highlighting the need for future studies with larger sample sizes to further investigate the relationship between cervical alignment, health literacy, and postural awareness.

Finally, this study examined only static postures in relation to literacy and awareness. Musculoskeletal problems, however, typically occur during dynamic activities. Future studies should evaluate the influences of health literacy and postural awareness on movement-related tasks.

Clinical and Practical Implications

Beyond clinical settings, if postural deviations are associated with health literacy and body awareness, educational interventions could be designed to improve these abilities, thereby helping individuals maintain better posture and prevent musculoskeletal complaints. Such programs may not only benefit patients in rehabilitation, but could also be incorporated into workplace health promotion initiatives and school-based health education. In the context of increasing smartphone and computer use worldwide [18–20], interventions targeting literacy and awareness may play an essential role in mitigating posture-related health risks in the general population.

Future research should also move beyond an observational design. Randomized controlled trials examining the effects of targeted educational and awareness-based interventions on postural awareness and objective postural alignment would provide more substantial evidence for clinical and public health applications. Such studies can inform the development of cost-effective preventive strategies by clarifying whether improved literacy and awareness can lead to improved posture and reduced symptoms.

Limitations

This study had several limitations. First, the sample size was small ($n = 26$), which limited statistical power and resulted in wide confidence intervals. Second, the inclusion of 12 physical therapists may have

introduced selection bias, as their professional backgrounds could have contributed to higher baseline levels of health literacy and postural awareness. Third, only static posture was evaluated; however, musculoskeletal problems often manifest during dynamic activities, such as walking, lifting, or prolonged sitting. Fourth, the cross-sectional design precluded causal inferences regarding the relationships between literacy, awareness, and posture. Lastly, cultural and lifestyle factors unique to the Japanese population may limit the generalizability of these findings to other populations.

Future Directions

Future research should recruit larger and more diverse samples, including participants with musculoskeletal symptoms, and assess both static and dynamic postures. Educational interventions to improve health literacy and postural awareness should also be evaluated.

Conclusion

Although this study did not demonstrate significant associations, the effect sizes suggest that health literacy and postural awareness may influence posture. Therefore, larger longitudinal studies incorporating symptomatic populations and dynamic assessments are warranted.

Competing Interests

The authors declare that they have no conflict of interest.

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