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Design and Evaluation of Measurement Tool for Sitting Situation Using Validity and Reliability

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ABSTRACT

Aims The sitting posture and its related problems are of high importance. The current research was conducted with the aim of design and evaluation of a measurement tool for sitting situation, using validity and reliability.

Materials & Methods In this semi-experimental (field trial) study, a number of questions about knowledge, attitude, and behavior were designed and content validity and face validity were utilized to assess the validity. Then, questionnaire was given to 10 specialists in health education, physiotherapists, and ergonomists. Moreover, Content Validity Ratio (CVR) and Content Validity Index (CVI) were calculated to determine content validity, and for reliability assessment, two criteria were used, including internal consistency through Cronbach's alpha and test-retest through Intra-class Correlation Coefficient (ICC) and Pearson correlation coefficient. Consequently, 30 students were enrolled in the study. The data were analyzed by SPSS 22 software.

Findings Firstly, of all 29 questions in terms of knowledge, attitude, and behavior, 23 items remained with CVR higher than 0.6 and CVI tables were higher than 0.7. From 23 items referring to the 3 mentioned spectra, 12 questions were in the field of knowledge, 6 questions were in the field of attitude, and 5 questions were in the field of behavior. Then, the Cronbach's alpha coefficient was 0.87, the ICC was 0.983, and Pearson correlation coefficient was 0.966 ($p<0.001$).

Conclusion The designed questionnaire can appropriately examine sitting situation in terms of the knowledge, attitude, and behavior; therefore, it is an excellent tool for measuring these characteristics owing to satisfactory validity and reliability.

Keywords Musculoskeletal Diseases; Health Knowledge, Attitudes, Practice; Posture; Reproducibility of Results

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[1] Electromyographic responses of back muscles during load carriage walking in children [2] The effects of unilateral backpack carrying on postural changes and gait pattern in rural children during treadmill walking [3] Recovery of brachial plexus lesions resulting from heavy backpack use: A follow-up case series [4] Match between school furniture dimensions and children's anthropometric dimentions in male elementary schools [5] Survey of relationship between ergonomic and environmental conditions of classrooms and pain sensation in students [6] Analysis of postural changes in 2nd cycle students of elementary school [7] Prevalence of musculoskeletal disorders in primary school students in Abadan-Iran in 2014 [8] Guidelines For Work In Sitting Postures [9] Assessment of validity and reliability of attitudes to health professionals questionnaire (AHPQ) in Iran [10] Validation measuring tool for evaluating the HSE culture in a manufacturing company [11] Coefficient alpha and the internal structure of tests [12] Exploratory factor analysis [13] 4 Reliability coefficients and generalizability theory [14] A basis for analyzing test-retest reliability [15] An introduction to concept mapping for planning and evaluation [16] On various intraclass correlation reliability coefficients

Introduction

Among the organized and formal institutions, schools are the most important ones, which can promote the physical and mental health of children by providing a suitable environment [1]. Schools have a profound and lasting impact on pupils in a cascade of ways, such as body, mind, and emotion, and if this environment is not properly organized, it causes problems both in childhood and adulthood [2, 3].

One of these problems can be musculoskeletal pain and discomfort in students due to the inappropriate position of their bodies, how to sit on the bench or behind the computer, and the improper carrying of the backpack [2]. Students' sitting position on the bench takes a lot of time and, thus, if this condition is inappropriate due to lack of awareness, many problems, including pressure on the muscles and the spine should be expected [4].

While the occurrence of musculoskeletal problems associated with sitting can be seen at any age, this issue is more important in vulnerable groups such as children and adolescents leading to serious repercussions in adulthood. Hundreds of studies on the complications of the body's poor condition are conducted, such as poor sitting posture and misuse of the ergonomics principles.

A study showed that more than 50% of students had musculoskeletal pain and discomfort [5]. In another study, post-scapular musculoskeletal discomfort was the second most common problem in students. A similar study was conducted, drawing a conclusion that the highest musculoskeletal disorders in the shoulder, neck, and waist are 37.9%, 28.5%, and 17.4%, respectively [6].

A research in Khuzestan province (Abadan) has been conducted, finding the most common skeletal disorder in the shoulder area about 81.7% and 85.4% in deviation of the spine [7]. The roots of these problems lie in the lack of adequate education in educational facilities, particularly in schools. Appropriate training in this field can increase students' awareness about the principles of good sitting posture and, consequently, change their attitude and behavior. This strategy not only prevents secondary risks in the future but also could be used as a suitable program on the agenda of educational systems, especially primary and secondary schools [6]. In order to design appropriate interventions to raise the awareness of the attitude and behavior of students, however, we must have proper tools for measuring these variables.

Therefore, the aim of this research was to design appropriate tools, using the related research, and then examine the validating the reliability of the proposed methodology.

Instruments and Methods

Questionnaire design: In the present semi-experimental (field trial) study, regarding the fact that the tools considered by the researchers were based on 3 sets of knowledge, attitude, and behavior, we first studied a number of books and papers on the subject of the sitting principles and appropriate sitting posture and, subsequently, we prepared the primarily draft of questionnaire with 29 items [8]. To give it a clear explanation, 16 questions were for awareness topics and the options were “Yes”, “No”, and “I do not know”; 8 questions were for the topic of attitude (I agree, I have no opinion, and I disagree) and 5 questions for the field of behavior with “Yes “and “No” options.

Confirmed by the relevant experts, the proposed questionnaire was entered in the stage of validity and reliability of the tools according to the set of criteria. Likert spectrum was used to score the options of knowledge section (Yes=2, No=1, I do not know=0), the attitude section (I agree=3, No idea=2, I disagree=1), and the behavior section (Yes=1, No=0).

It is important to note that, firstly, the behavioral section has two options compared to the knowledge and attitude sections that have 3 options and, secondly, scoring knowledge section is different with attitude section. Owing to these two facts, the final scores in these 3 areas became similar in the examination of the statistical results. In addition, to ensure the reliability of each section of the questionnaire, the mentioned statistical criteria (Cronbach's Alpha, Intra-class Correlation Coefficient [ICC] and Pearson Correlation Coefficient) were calculated separately. In other words, in addition to the overall reliability of the questionnaire, the reliability of each section was examined.

Validity: Validity simply means that whether or not the method measures what it is supposed to measure. To put it in another word, validity refers to the accuracy of an assessment and how appropriate it is in addressing the aim of the experiment. Without the knowledge of the validity of the measuring instrument, the accuracy of the data obtained cannot be guaranteed. Validity methods include content validity, empirical validity, and structural validation. To calculate the content validity, a questionnaire was handed out among 10 experts with related field of study (health education, physiotherapist, ergonomist). In general, there are two types of content validity, including quantitative content validity and face verdict. The content validity ratio (CVR) and Content Validity Index (CVI) use to measure the quantitative content validity. CVR and CVI can be calculated via the following equations for each question:

$$CVR = \frac{n_E - (\frac{N}{2})}{(\frac{N}{2})}$$

$$CVI = \frac{n}{N}$$

, where
n_E=the number of specialists, who state that an item is essential.
N=total number of specialists
n=the number of specialists who give 3 or 4 scores.
To confirm the content validity, the obtained CVR should be more than 0.62 (according to the Lavasheh Table and considering the fact that 10 experts filled the questionnaire [9]) and CVI should be more than 0.79.

Face validity: To determine the face validity of the questionnaire, two qualitative and quantitative methods were used and, consequently, the questionnaire was first given to 12 students. To assess the qualitative face validity, they stated their views about whether the words and expressions in each question are clear to understand or not and whether there is any misleading and misunderstanding statement in questions. The test group was changed. Afterward, to evaluate the quantitative face validity, 16 students were assigned to answer the questions and the significance of each statement was measured, using a coefficient of influence. In this method, if the effectiveness score of each phrase is greater than or equal to 1.5, that statement is retained [10]. It could be calculated based on the following equation:

$$\text{SCORE} = \text{F}(\%) \times \text{IMIM}$$

, where
Score=item method impact score
F (%)=percentage of participants, who have reviewed the item
IMIM=average total company response

Reliability: Reliability is the degree, to which an assessment tool produces stable and consistent results. There are 3 types of consistency (reliability), including over time (test-retest reliability), across items (internal reliability), and across different researchers (inter-rater reliability) [11, 12]. The reliability of a test is indicated by the reliability coefficient. It is denoted by the letter "r" expressed as a number ranging between 0 and 1.00 with r=0, indicating no reliability and r=1.00, indicating perfect reliability. The larger the reliability coefficient, the more repeatable or reliable the test scores (Table 1).

Table 1) General guidelines for reliability

Reliability coefficient value	Interpretation
0.90-1	Excellent
0.80-0.89	Good
0.70-0.79	Adequate
0-0.70	May have limited applicability

At this stage, the questionnaire was given to 30 students twice within 2 weeks (apart from the students, who will participate in the study in coming months), and the questionnaires were completed by the students. Two methods of test-retest reliability and internal consistency were used to check the reliability of the questionnaire. The subsequent sections clarify how they work. The results showed that the questionnaire has a desirable reliability and the coefficients of all questions are higher than 0.7.

Test-retest method: Test-retest reliability indicates the repeatability of test scores with the passage of time. In other words, the method is a measure of reliability obtained by administering the same test twice over a period of time to a group of individuals. The scores from Time 1 and Time 2 can, then, be correlated in order to evaluate the test for stability over time. Two widely used correlation coefficients called the Pearson Correlation Coefficient and ICC was applied in this paper to determine test-retest reliability [13- 15].

Internal consistency: Internal consistency reliability indicates the extent, to which items on a test measure the same thing. A high internal consistency reliability coefficient for a test indicates that the items on the test are very similar to each other in content (homogeneous). It is important to note that the length of a test can affect internal consistency reliability. Cronbach's alpha is the most widely used internal-consistency coefficient.

Regarding knowledge, the score was between 0 and 2, and according to this, people's knowledge could be good (above 1.5), moderate (between 1 and 1.5), or low (less than 1). Similarly, from the perspective of attitude, each person's score could range from 0 to 3, and people with a score of larger than 2 were of good attitude; individuals with a score between 1 and 2 were of average attitude, and those with a score of lower 1 were of low attitude.

In the behavior section, the score of a person was between 0 and 1, and a person, who had a score above 0.77, behaved well and a person with a score of between 0.5 and 0.7 had moderate behavior and otherwise, she/he did not behave appropriately.

The data were analyzed by SPSS 22 software.

Findings

Looking firstly at validation, of the 16 questions designed to raise awareness, a question needed to be redefined and after correction, it favored expert opinion. Moreover, of 5 items with CVR value less than 0.4 and 4 items were deleted and one of the questions was preserved according to the notion of researcher and experts. In short, 12 questions were considered for awareness section. Regarding attitude, of 8 questions, 2 points were eliminated and 6 items were retained. With regard to the behavioral spectrum, both CVI and CVR were good and face validity also was more than 1.5 and, consequently, all 5 questions remained without any change.

Looking secondly at reliability, considering internal consistency, the value of the Cronbach's alpha

coefficient for the whole tool was 0.87 and for each of the knowledge, attitude, and behavior, spectra were 0.83, 0.81, and 0.76, respectively.

Pearson correlation coefficient of knowledge, attitude, and behavior were 0.941, 0.946, and 0.972 in a row, respectively, and overall Pearson correlation was equal to 0.966. Regarding ICC, the calculated value for the knowledge section, attitude section, behavioral section, and total questionnaire were 0.986, 0.980, 0.986, and 0.983, respectively. Briefly, the reliability of the questionnaire was clarified in terms of Cronbach's alpha, Pearson correlation coefficient, and ICC (Tables 2 and 3).

The correlation between knowledge and attitude was 0.653, the correlation between knowledge and behavior was 0.382, and the correlation between attitude and behavior was 0.162 (Table 3).

As a result, individuals with knowledge had a good attitude and those, who did have a good attitude, were not necessarily well-behaved. To put it in another word, while knowledge and attitude were strongly related, there was a weak relation between attitude and behavior.

The number of people in each of the groups was presented (Table 4). On this basis, most of the people had favorable attitude and awareness were good. In stark contrast, however, they did not behave well. That is the reason why education and intervention seem necessary. The designed questionnaire was presented in the form of a table (Table 5).

Table 2) Value of coefficients show the reliability of questionnaire

Areas	Pearson correlation coefficient	Intra-class correlation coefficients	Cronbach's alpha coefficient
Knowledge	0.941	0.980	0.83
Attitude	0.964	0.980	0.814
Behavior	0.972	0.980	0.761
Total	0.959	0.980	0.884

Table 3) Correlation between 3 parts of questionnaire

Areas	Knowledge	Attitude	Behavior
Knowledge	1		
Attitude	0.653	1	
Behavior	0.382	0.162	1

Table 4) Comprehensive analysis of 3 sections

Areas	Bad	Middle	Good
Knowledge	11	6	13
Attitude	3	3	24

Table 5) The designed questionnaire

Sections	Answers		
Section 1: Knowledge			
1- The pressure in the sitting position is lower than in the standing position.	No	I do not now	Yes
2- In normal condition, the spine of a particular arc draw in the form of a letter S.	No	I do not now	Yes
3- It is necessary to have a waist arch to sit properly.	No	I do not now	Yes
4- Sitting on a bench will put lower pressure on the spine rather than recline on a bench.	No	I do not now	Yes
5- Stretching is useful after sitting for a long time.	No	I do not now	Yes
6- When sitting on the bench, the trunk should be flat and the buttocks should be placed at the bottom of the bench?	No	I do not now	Yes
7- Failure to adhere to the principles of sitting on the bench leads to musculoskeletal pain.	No	I do not now	Yes
8- To prevent musculoskeletal pain, it is important to use a table and chair while sitting and doing homework.	No	I do not now	Yes
9- Using a footrest while sitting on the bench can reduce pressure on the spine.	No	I do not now	Yes
10- Sitting for a long without observing the correct principles causes back pain.	No	I do not now	Yes
11- After 75 minutes sitting (during a class alarm), you should get up to stretch out for a few minutes?	No	I do not now	Yes
12- Can bench design affect how to sit down?	No	I do not now	Yes
Section 2: Attitude			
1- It is important for me to observe the correct principles of maintaining spinal cord while sitting.	I disagree	No idea	I agree
2- Sitting on a bench, I have to use the footer attached to it.	I disagree	No idea	I agree
3- Sitting on a bench, I have to recline on the back of the bench.	I disagree	No idea	I agree
4- If I do not observe the correct principles of sitting on the bench, I will get skeletal pain.	I disagree	No idea	I agree
5- If I get tired or sore while sitting, I get back pain.	I disagree	No idea	I agree
6- I must respect the right principles of sitting at home and school.	I disagree	No idea	I agree
Section 3: Behavior			
1- The student leans back to the back of the bench, and the buttocks are at the bottom of the buttock.	NO	Yes	
2- The student's thigh is fully supported by the bench and he has not raised his thighs.	NO	Yes	
3- The legs are located on the sub-foot attached to the bench.	NO	Yes	
4- The knees are either hips or slightly higher.	NO	Yes	
5- Waist curvature is preserved. (The waist is not bent forward)	NO	Yes	

Discussion

Regarding the growing prevalence of musculoskeletal disorders in the community, one of the key reasons for these discomforts is related to how people sit [5, 6, 7]. Considering the crucial importance of the issue, this undoubtedly needs to be seen as a sensitive matter and we decided to examine sitting condition, the areas of knowledge,

attitude, and behavior, using a new questionnaire.

The aim of this study was to design and evaluate the validity and reliability of the questionnaire considering knowledge, attitude, and behavior of the siting. Given the fact that questionnaire was designed and developed for the first time, no similar study and evaluation of its validity and reliability have been carried over the last decades. In this research, we tried to design a tool for this task. The questionnaire was designed in 3 dimensions, including knowledge, attitude, and behavior in a 29-item format. After determining its validity and reliability, 23 items remained. Of all 23 items referring to the 3 spectra mentioned, 12 questions were in the field of knowledge, 6 questions were in the field of attitude, and 5 questions were in the field of behavior.

To determine the reliability, two methods of test-retest and internal consistency were used. Regarding test-retest, ICC, and Pearson correlation coefficient were used, which were 0.983 and 0.966, respectively. With regard to internal consistency, total Cronbach's alpha was 0.87. The internal consistency of the questionnaire showed that all questions have almost the same role in the overall score and if anyone was eliminated, alpha would not significantly increase. As a result, all questions of the questionnaire had acceptable reliability and there was no need to change or remove any question; the questionnaire gained deep satisfaction in terms of internal consistency. Considering the validity of the questionnaire, content and face validity methods were used according to many studies [16], which confirmed the validity of the present questionnaire.

Conclusion

The questionnaire has a desirable validity and reliability; therefore, it can be used as an appropriate tool for assessing knowledge, attitude, and behavior of the sittings.

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