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Validation of the Persian version of the Workplace Physical-Ergonomic Conditions Evaluation (PECE) Questionnaire

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ABSTRACT

Aim: The workplace physical-ergonomic conditions have a great impact on the health, well-being, and productivity of employees. One of the ways to assess the general condition of office work environments is to use valid questionnaires, so the purpose of this study is to determine the validity and reliability of the Persian version of the Workplace Physical-Ergonomic Conditions Evaluation (PECE) questionnaire for its applicability in Iran.

Method and Materials: The present study is an analytical study that was conducted on the administrative staff of a public university of Iran to Validate the Persian version of the PECE questionnaire. First, the Persian version of the questionnaire was prepared using the backward-forward translation method and then the translated questionnaire was filled out by 70 employees. Content Validity Index (CVI), Content Validity Rate (CVR), Test re-Test and Intra-class correlation coefficient (ICC) method were used to measure validity and reliability respectively t SPSS 26. In the validity analysis, Kappa and Spearman coefficients were used for agreement and correlation between the answers to the questions, respectively.

Findings: Totally 70 staffs including (15 men and 55 female) with mean age of 35.65 (7.89) took part in the study. CVI and CVR showed acceptable range for the valid questionare. The kappa and Spearman coefficients ranges were 0.634 to 1 and 0.681 to 1 in the first and second questionnaires' distribution. In the reliability analysis of the questionnaire, the ICC coefficient was 0.93. A significant relationship was found between gender and satisfaction with ergonomic issues

Conclusion: The Persian version of the PECE questionnaire is a useful tool for evaluating the general conditions of office work environments that can be used as part of workplace evaluation programs and occupational care to prevent occupational diseases such as WMSDs, Vision and eye, hearing, and Pulmonary disorders.

Keywords: Ergonomic-physical conditions, PECE questionnaire, Office workplace, Validation.

Introduction

Today, most people and employees spend most of their time in office environments [1]. One of the most important priorities of any organization is to protect and maintain its workforce [2]. The work environment is a set of physical factors (noise, light, and indoor climate conditions), chemical factors (cleaners, perfumes, odors), biological factors (virus and bacteria), psychosocial and other factors that affect people [3]. Work environments do not always have ideal conditions so that poor lighting, high noise, cold and heat stresses, ventilation problems, ergonomics problems, etc. are among the main challenges that people face in work environments [4]. The ergonomic study of the work environment in terms of measuring the physical and chemical environmental factors of the work environment is called engineering psychology, which is one of the ergonomic dimensions [2]. Noise, which is one of the most common occupational safety and health hazards, exists in most work environments and the major adverse effects of the work environment are related to this detrimental factor [5]. Many studies have mentioned the negative impact of perceived adverse noise on the well-being, behavior, and productivity of office workers [6-9]. One study found that 32% of office workers suffered from noise and the resulting discomfort and mental fatigue of it[10]. Lighting

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is one of the most important physical factors that effect on well-being and occupational health of individuals [11]. Providing optimal lighting in the workplace is one of the most important issues to meet the proper physical conditions [12]. Inadequate lighting is one of the causes of job stress and MusculoSkeletal Disorders (MSDs) in the workplace, which causes negative effects on human health and productivity [13, 14]. Ergonomic issues and poor lighting are the main reasons of increased prevalence of MSDs in the workplace [15-17]. Inadequate lighting in the workplace can cause abnormal posture in office workers. Undesirable ergonomic conditions in office environments due to improper posture at work, can increase the pressure on the musculoskeletal system and cause long-term disorders [18]. A study conducted by Pirmoradi et al. found that the office workers suffered from Work-Related Musculoskeletal Disorders (WMSDs) due to poor lighting [18]. Another factor affecting the efficiency and well-being of people in the workplace is paying attention to ergonomic issues themselves [19]. Despite common opinions that office works are so easy, the prevalence of occupational diseases, especially complications and MSDs, leads to an increase in work absences, so that more than half of workplace absences are related to the MSDs which the main reason for that is the existence of ergonomic problems in office environments such as repetitive work, improper postures, improper workplace layout, cramped conditions, etc. [20]. A study conducted by Chandwani et al. on office workers found that 80 percent of employees suffered from at least one musculoskeletal problem in their work environment, and other studies showed that MSDs cause people concentration and productivity reduction and as well as the correct workplace layout increases the morale, productivity, and health of employees in office environments [10, 21, 22]. In another study, it was shown that the overall prevalence of WMSDs among office workers is 80% and there is a significant relationship between WMSDs with age, gender, job postures, repetitive tasks, etc. [1]. Other affecting factors in the work environment are indoor climate conditions, proper ventilation system, and as well as cases related to chemical harmful agents such as cleaners, disinfectants, solvents, cleaner liquid, dyes, perfumes, etc. Main damages of chemical agents are for the respiratory system and human skin and also have many side effects that affect the long-term performance of people [23, 24]. Many studies have mentioned the long-term effects of exposure to chemicals in the workplace, including mental disorder, aggression, dry skin, chronic headaches, nausea, dilated blood vessels, and mental concentration reduction in staff, job stress, job dissatisfaction, etc. [25]. Other factors such as good indoor climate conditions in the workplace can be mentioned. In general, many factors such as cold, heat, humidity, airflow, odor, ventilation system, etc. affect the performance and efficiency of people. Atmospheric and temperature problems in the work environment cause physiological and mental responses, increase in blood pressure, increase in heart rate, increase in accidents, psychological strain, work stress, health problems, job dissatisfaction, etc. [26-28]. Measuring various factors such as physical, chemical, biological, and ergonomic aspects is to control their adverse effects on employees' health and increase their productivity and efficiency. All the above are among the most important problems that employees face in their office environments. Although, as is clear, there are more factors associated with job satisfaction and comfort, they are the main problems that have caused the most complaints of administrative staff. Therefore, ergonomic evaluations of work environments to measure all physical and chemical conditions with measuring devices need much higher cost and time than employee self-assessment

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through standard and valid questionnaires, because one of the best ways to evaluate the work environment is to use questionnaires [2], Therefore, one of the ways of self-assessment of employees is to use valid questionnaires, so the need for translation and development of comprehensive, valid and reliable questionnaires to assess the work environment is very clear. Numerous attempts have already been made to develop tools and questionnaires to evaluate the ergonomic conditions of work environments [2, 29, 30], However, since all of these questionnaires incompletely examined and assessed various factors of the work environment, so it was decided to use the Workplace Physical-Ergonomic Conditions Evaluation (PECE) questionnaire from Aarhus University 2008 in the administrative staff of one of Iran's public universities. This questionnaire is one of the newest and most complete workplace ergonomics evaluation questionnaires. Muftić and et al. conducted a study using the PECE questionnaire, the aim of the study was to analyze the working conditions and workplace, to determine the influence of ergonomic factors on the health of physiotherapists [31]. Since there is no valid questionnaire in the field of general ergonomic evaluation of the work environment using the questionnaire, so the purpose of this study is to evaluate the reliability and validity of the PECE questionnaire using the existing standards in the administrative staff of one of Iran's public universities, in order to use it as an efficient tool for workplace ergonomics research to prevent occupational diseases.

Method and Materials

The present study is a descriptive-analytical study that was performed on the staff of a public university of Iran to determine the validity and reliability of the Persian version of the PECE Questionnaire. There are two main and necessary steps to prepare a translation of each questionnaire from the original language into another language (32): A) The translation stage in which the linguistic validity of the translated version is determined. B) Evaluation of psychological characteristics. Both steps A and B are complementary and are necessary to ensure that the translated version is equivalent to the original version. In the first step, the original version of the questionnaire was translated from English to Persian to perform the linguistic validity stage using the standard Backward-Forward technique [33]. In this method, first, the original version of the questionnaire was translated from English to Persian by two independent translators simultaneously, then this version was translated back into English by two other independent translators, and finally, one person as a coordinator put together the obtained Persian and English translations, and prepared the Persian version of the questionnaire. The questionnaire was translated by two Persian translators. Each translator individually translated a copy of the questionnaire into Persian and after discussion between the translators, the translations combined, and the final translation of the first stage was prepared. In the second stage, the translated questionnaire was translated back into English by two experienced English translators and fluent in the Persian language who were unaware of the original version, and then to ensure that both English versions were equivalent and had the same semantic load, the Back Translation version was compared with the original version, and finally, after discussion between the translators, the translations were combined and the final translation was prepared.

To evaluate the content validity quantitatively, the Content Validity Ratio (CVR) and the Content Validity Index (CVI) were used. The CVI will be calculated by aggregating the agreed scores for each item

divided by the total number of specialists, and to determine the CVR, experts will be asked to review each item on a three-part scale [34]. Since the purpose of this study was to determine the validity and reliability of the Persian version of the questionnaire in Persian, the translated questionnaire was distributed among the administrative staff of an Iran's public university. Inclusion criteria were having more than one year of work experience, no mental illness, and exclusion criteria were the use of special medical drugs, pregnancy and incorrect completion of the questionnaire. The questionnaire generally consists of 21 items, of which item 1 is about the address and location of the work environment, the next 10 questions are about physical factors (sound, vibration, lighting), question 11 is about the indoor climate conditions of the environment (heat, cold, odor, wind flow), questions 12 and 13 are about ergonomic issues (posture, repetitive work, lifting), questions 14 and 15 are about chemical agents, questions 16 is about biological agents, questions 18 and 19 are about hazardous areas for occurrence of accidents, question 20 is about the conditions in the physical workplace that lead to job absences, and question 21 is about access to legal documents related to their job. Since age, gender, and type of shift work are effective in people's perceptions and cause cognitive effects of harmful factors in the work environment, so these 3 items were added to the questionnaire. In this 7-day study, to evaluate the validity and reliability of the Persian version of the PECE Questionnaire, the questionnaire was distributed among 70 employees of the Iran's public university.

In this study 70 people (15 men and 55 women) were asked to participate in this study. First of all, the purpose and conditions of the study was explained to the potential participants and then all of them participated in this study voluntarily. Data were analyzed using SPSS software version 26. Kappa and Spearman correlation coefficients were used to determine the validity of the questionnaire questions. To determine the reliability of the questionnaire, the test-re test method and intra-class correlation coefficient (ICC) were used. In this method, to measure reliability, questionnaire questions were given to a single group at two different times under the same conditions and using ICC, the obtained scores were compared and used as a reliability coefficient. The ICC operating range is between 1 and 0, the closer the final number to zero, the lower the reliability, and the closer to 1, the higher the reliability.

Findings

In this study, 70 administrative staff of a public university in Iran including 15 female staff and 55 male staffs were assessed. The mean age of participants was 35.65 years with a standard deviation of 7.89. The normality test showed that the data did not have a normal distribution. In evaluating the reliability of the questionnaire using the test-retest method and ICC coefficient, the reliability was obtained 0.93. The closer the ICC to unity, the higher the reliability of the questionnaire. The validation results of the answers given by the individuals in the first and second series using the Spearman and Kappa test which are presented in Table 1. Kappa coefficient was calculated to examine the agreement and Spearman coefficient was calculated to examine the correlation between the answers to the questions in the first and second distributions.

Moreover, CVI and CVR tests were used to assess the validity of the content, which all the items received acceptable scores. The results of the study showed that 59% of people had problems with the physical condition of their work environment, 50% of people considered the problems

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Table 1) Validation of the answers given by the employees in the first and second series for similar questions

Questionnaire questions	Questions agreement (Kappa test)	Questions correlation (Spearman coefficient)	P-value
2) Problems with the physical condition	0.945	0.935	< 0.05
3) Problems with physical conditions in the workplace	0.857	0.866	< 0.05
4) Determining workplace problems4	0.902	0.7	< 0.05
5) Problem with Noise	0.842	0.853	< 0.05
6) Determine the source of the noise problem	0.826	0.960	< 0.05
7) Problem with vibration	1	1	< 0.05
8) Problems with lighting	0.857	0.866	< 0.05
9) Determine the source of the lighting problem	0.906	0.979	< 0.05
10) Problems with indoor climate conditions	0.857	0.866	< 0.05
11) Determining the source of the problem of indoor climate conditions	0.907	0.956	< 0.05
12) Problem with ergonomic issues	1	1	< 0.05
13) Determining the source of the problem with ergonomic issues	0.813	0.937	< 0.05
14) Problem with chemical conditions	0.783	0.845	< 0.05
15) Determining the source of the problem of chemical conditions	0.688	0.682	< 0.05
16) Problems with biological conditions	0.868	0.888	< 0.05
18) Risk of accidents in the workplace	0.634	0.681	< 0.05
20) Determining the existence of problems leading to job absences	0.843	0.853	< 0.05
21) Access to the necessary legal documents related to the job	0.762	0.807	< 0.05

of the physical condition related to their work environment, 30% and 17% of people considered the problems related to their work environment to be due to workspace (cramped conditions and limited working space, etc.) and workplace layout, respectively and 53% considered other problems as workplace problems. 48% of people considered physical problems to be caused by noise, of which, 35%, 22%, and 18% of people considered noise problems to be due to equipment, people/animals, and the ventilation system, respectively. Moreover, 25% of people cited other reasons as the main source of the noise. 13% and 42% of people said that the problems related to the physical condition were caused by vibration and lighting, respectively. Furthermore, 32%, 23%, 8%, and 37%, reported lighting problems were due to room lighting, letting in daylight, equipment lighting, and other items respectively. Also 49% of people considered the problems related to physical conditions to be due to indoor climate conditions, and of which, 49%, 25%, 25%, 17%, 11%, 8%, and 15%, said that the indoor weather conditions problems are due to heat, cold, airflow, cleaning, odor and other items respectively. Moreover, 65% of people stated that they deal with ergonomic problems in their work environment, of which, 65%, 47%, 25%,

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5%, and 24%, reported their ergonomic problems are due to work postures, repetitive tasks, lifting, and Other reasons respectively. Also, 65% of people stated that they deal with ergonomic problems in their work environment, of which, 65%, 47%, 25%, 5%, and 24%, reported their ergonomic problems are due to work postures, repetitive tasks, lifting, and Other reasons respectively. 13% of people stated that there are problems related to chemical conditions in their work environment, and of these, 20%, 10%, 8%, 2%, and 61%, reported chemical conditions problems are related to fire substances, materials hazardous to health, safety precautions, waste, and other reasons respectively. Also, 12% of people said that there were biological problems in their work environment, and of these, 12%, 13%, 9%, 4%, 2%, and 72%, reported they were related to Infectious material, safety precautions, waste, genetically modified organisms (GMO) and other reasons respectively. Furthermore, 23% of people confirmed that there were conditions in their job or workplace that increased the risk of accidents, and of these, 13%, 13%, 12%, 4%, and 58% said that the conditions that increased the risk of accidents existed during fieldwork on land, at the workshop, in the laboratory, during fieldwork in the air, and other places, respectively. About 20% of people stated that there were conditions in their work environment (such as heavy lifting, allergies, eczema, etc.) that lead to job absenteeism. Finally, 26%, 34%, and 40% of people chose yes, no, and I don't know options about accessibility to the necessary legal documents related to their job, respectively.

Discussion

Principled use and validating data collection questionnaires in ergonomic research are very important to conduct health evaluations [32]. This study aimed to translate and validate the PECE questionnaire of Aarhus University (2008) and to determine its application in Iran and create a suitable tool and questionnaire for ergonomic research. Translating the questionnaire into Persian and assessing its semantic load was using standard methods [35] under the supervision of university professors and experts in this field. This questionnaire consists of 21 items that generally examine physical, chemical, ergonomic, biological, and safety factors, since age, gender, and type of work shift are important in people's perceptions about harmful factors in the work environment, therefore, these 3 items were added to the questionnaire with the opinion of professors and experts. In this study, the physical-ergonomic conditions of the work environment were evaluated using the PECE questionnaire for 70 administrative staff of one of Iran's public universities. To validate the questions, the kappa coefficient for agreement and the Spearman coefficient for correlation between the answers given by the employees for the first and second series questions were calculated. The kappa coefficient ranged from 0.634 to 1, indicating complete agreement between the answers [36]. The range of Spearman coefficient for the first and second series responses was 0.681 to 1, which indicates that there is a positive correlation between the first and second series responses. Also, to evaluate the reliability of the questionnaire, the test-retest method, and the ICC coefficient, so that the questionnaire questions are given to a single group at two different times under the same conditions and using ICC The results scores are compared and used as a reliability coefficient, the reliability of the questionnaire using ICC was obtained 0.93. The closer the ICC to unity, it means that the questionnaire has high reliability. CVI and CVR tests were also used to assess

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content validity [34] CVI and CVR tests were also used to assess content validity, in which all questions, obtained acceptable scores. In a study conducted by Yarandi et al. To develop a general questionnaire for ergonomic evaluation of office environment, the overall reliability of the questionnaire was obtained 0.882 [2]. In another study conducted by Ahmadi Kivanani et al., the reliability of the questionnaire was obtained 0.8 [29]. In the results, among all the questions, only question 12 (ergonomic issues) had a significant relationship with gender. Limited numbers of participants and limitations due to covid19 can be listed as the limitations of the current study. In the end, it is suggested to use this questionnaire on a wider level and scales and compare its results with other standard questionnaires to get a better view of the advantages and disadvantages of this questionnaire.

Conclusion

The results of the present study show that the Persian version of the PECE questionnaire is an effective and useful tool in assessing the general conditions of the workplace in terms of engineering psychology to identify harmful factors and prevent occupational diseases such as WMSDs, Vision and eye, hearing, and Pulmonary disorders. Using this questionnaire, Since the evaluation is done by the employees themselves, can be performed simultaneously and for all people. It also saves time and money compared to other environmental assessment methods.

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Author Contribution: MJSh analyses and interpret the data and wrote the first and final draft of the manuscript. PMA reviews the literature and designed the study and collect data. OA supervised all stages of the study. All authors read the manuscript and approved it.

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