



Effect of Educational Intervention Based on the Extended Parallel Process Model on the Adoption of Behaviors Preventing Physical Injuries from Working with Computers among Female Employees

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ABSTRACT

Aims Using correct ergonomic principles is the main preventive factor while employees use computers. This study aimed to investigate the effect of applying the Extended Parallel Process Model in adopting preventing behaviors of physical injuries caused by the computer on female employees of comprehensive service health centers.

Methods This semi-experimental study was performed on 166 female employees of the Health Centers of West Ahvaz in 2018-2019. Participants were selected by census method, and after completing the pre-test questionnaire, they were randomly divided into two experimental groups and one control group. The educational intervention was performed based on the Extended Parallel Process Model by sending a daily educational SMS for one month. Two months after sending the last SMS, participants completed the research questionnaire again. Data were analyzed by SPSS 22 software using ANOVA, Kruskal-Wallis, paired T, Wilcoxon, and Friedman tests.

Findings There was no significant difference between the scores of the Extended Parallel Process Model constructs in the experimental and control groups before the intervention ($P>0.05$). A significant difference was observed in the mean scores of the perceived sensitivity and severity, response effectiveness, self-efficacy, and behavior in the intervention groups two months after the intervention ($P<0.05$).

Conclusions Training by the Extended Parallel Process Model enabled the test group participants to be in a position to adopt protective behavior. The findings showed that focusing on high-performance content messages promotes preventive behaviors for computer-assisted physical injuries.

Keywords Extended Parallel Process Model; Vision Disorders; Musculoskeletal Diseases

CITATION LINKS

[1] Technology use, exposure to natural hazards, and being ... [2] Practice of ergonomic principles and computer ... [3] A comparison of symptoms after viewing text ... [4] A systematic review of work-related musculoskeletal disorders ... [5] Association between objectively measured sitting time ... [6] Evidence of health risks associated with prolonged ... [7] The effect of stage-matched educational intervention ... [8] Exposure to computer work and prevalence of musculoskeletal ... [9] Prevalence of musculoskeletal disorders among ... [10] Evaluation of musculoskeletal disorders risk factors ... [11] Myopia ... [12] Embedding ergonomics in hospital culture ... [13] The impact of ergonomics intervention on musculoskeletal ... [14] Evaluation of the health promotion lifestyle and ... [15] Health behavior and health education: Theory ... [16] Seat-belt use among drivers and front passengers ... [17] Fear as motivator, fear as inhibitor: Using ... [18] Testing the theoretical design of a health risk ... [19] Randomization in randomized clinical trials: From ... [20] Student ratings: Validity, utility, and ... [21] Evaluation of validity and reliability of the ... [22] The effect of education based on extended parallel ... [23] Evaluation of a school-based intervention for ... [24] Use of the extended parallel process model (EPPM) to predict ... [25] Design and evaluation of educational interventions ... [26] Effectiveness of a theory-based mobile phone text ... [27] Predictor of pregnant women's self-care behavior against ... [28] The effect of educational program based on health ... [29] Messages for men: The efficacy of EPPM-based ... [30] Encouraging early preventive dental visits for preschool ... [31] Educational diagnosis of self-management behaviors ...

Introduction

Advances in new technologies such as computers, televisions, cell phones, and many other devices in human life have accelerated activities as well as increased production and productivity. However, it has caused some complications such as inactivity, fatigue, neuropsychological stress, and musculoskeletal disorders in humans [1, 2]. It has increased the number of patients who complain of ocular symptoms such as eye fatigue, eye irritation, red eyes, dry eyes, blurred vision, called computer vision syndrome. Computer vision syndrome occurs in 90% of computer users and is almost a global problem [3]. Administrative occupations have a high prevalence of musculoskeletal disorders. Long sitting while working with the computer, repetitive movements, static postures, and unfavorable environmental conditions can cause the disorders [4-6]. Computer users are prone to musculoskeletal disorders with a prevalence of 50% [7]. The three most common complications of working with a computer are back pain (60%), neck pain (58%), and shoulder pain (49%) [8].

The study by Samai et al. showed a significant relationship between work experience and the duration of working with a computer daily with musculoskeletal disorders. Increasing one unit of work experience and duration of computer use can increase musculoskeletal and vision disorders by 17.2% and 15.8%, respectively. In other statistics, musculoskeletal disorders comprised 7%, 48%, 19%, and 14% of the disease of the whole society, hospitalization cases, work-related diseases, and cases referred to physicians, respectively [9, 10]. Improving myopia costs more than \$ 20 billion in the world. However, due to mobile phones, tablets, and computers, the prevalence of myopia is increasing [11]. The health sector is a considerable part of female employees so that 75% of these staff are female employees [12, 13]. According to the United Nations, women's health is one of the indicators of development because of the vulnerability of women due to their physiological conditions [12]. The extended Parallel Process Model is among the used models in providing health messages and preventing diseases and high-risk behaviors. The Extended Parallel Process Model is a comprehensive model developed by Kim Witt in 1992. According to this model, fear-provoking messages initiate two judgments, threat and effectiveness assessment (threat assessment is determined by perceived severity and perceived sensitivity, and efficiency assessment is a combination of self-efficacy and response efficiency). One of the advantages of the Extended Parallel Process Model is that the model is based on theories of fear motivation. Therefore, it can effectively prevent many high-risk behaviors before and after exposure to a risk factor [14-16]. According to the Extended Parallel Process Model, people follow the risk and fear control process in response to health

messages. If the message contains both the perceived threat and perceived efficiency, people follow the risk control way. It means that they react to a threat with sufficient knowledge and offer solutions to eliminate the threat. People who receive a message with a high threat rate and low efficiency are driven to the fear control process, and fear of danger acts as a deterrent factor in adopting protective behavior [17-19]. At the time of this study, no studies had been performed using computer-Extended Parallel Process Models on health centers' staff, who worked with computers. So this study aimed to investigate the effect of educational intervention based on the Extended Parallel Process Model on behaviors preventing physical injuries from working with computers among female employees.

Instrument and Methods

This semi-experimental study was performed on 166 female employees of West Ahvaz health centers in 2018-2019. The participants were selected by census and were divided into different groups, first by clustering the centers and then randomly assigning the clusters to study groups by lottery considering the volume of 238 female employees working in the urban health centers of western Ahvaz and 25% statistical drop and non-cooperation of some employees due to unstable job situation. After completing the questionnaire, in the pre-test stage, 15 urban health centers in western Ahvaz were divided into three equal clusters in terms of population by simple lottery. Each of the clusters was randomly assigned to one of the three groups. The first experimental group included centers 3, 5, 6, 14, 15, the second experimental group included centers 2, 7, 10, 11, 13 and the control group included centers 1, 4, 8, 9, and 12. Participants and researchers did not know about the sampling stage and the type of study groups. Out of 238 people, 180 subjects filled out the pre-test questionnaire (first intervention group= 54 questionnaires; second intervention group= 55 questionnaires; the control group= 57 questionnaires).

Inclusion criteria were having a mobile phone, no musculoskeletal problems, no history of eye disease, eye surgery, contact lenses, and ophthalmology, and having at least one year of experience working with computers, and having no second job. The inclusion criteria were the inability of individuals to continue research due to relocation, failure to answer at least 40% of the items, history of participating in similar training programs, and not receive text messages more than twice.

Data were collected using a researcher-made questionnaire with two parts. The first part included demographic information of individuals to control the influential variables (including marital status, education level, employment status, history of working with a computer, duration of computer use at the workplace). Based on the Extended Parallel

Process Model, the second part included perceived sensitivity, perceived intensity, response effectiveness, self-efficacy, and behavior. The final questionnaire was designed with 56 items in 5 parts. The 5-point Likert scale scored from 1 to 5 was used to assess the variables. To assess the perceived sensitivity, 12 items were used. Each item had 5-options, including "strongly agree, agree, have no opinion, disagree, and strongly disagree" (with a minimum score of 12 and a maximum score of 60); for example, "working with a computer at the workplace makes me more susceptible to musculoskeletal disorders. Seven items were considered to assess the effectiveness of the answer (with a minimum score of 7 and a maximum score of 35); for example, " I can prevent musculoskeletal disorders caused by working with a computer by simple stretching exercises at the workplace." Self-efficacy was measured by eight questions using 5-options Likert scale "I am sure, I am relatively sure, I have no opinion, I am a little confident, and I am not sure at all " (with a minimum score of 8 and a maximum score of 40); for example "I can devote my time to do simple stretching, despite not having enough time". Behavior was also assessed with 21 questions. 2 items were designed as yes, and no (with a minimum score of 2 and a maximum score of 4), and 19 items were designed by the 5-points Likert scale, including "always, most of the time, sometimes, rarely and never" (with a minimum score of 19 and a maximum score of 95). Formal and content validity were used to assess the validity of the items. Formal validity was evaluated by qualitative and quantitative methods. To determine the face validity by qualitative method, a questionnaire was provided to 10 eligible people. The questionnaire was examined in terms of the difficulty of the phrases, their ambiguity, and the degree of relevance of the phrases to the subject. The items were then edited in terms of writing and content. In the next step, the Item Impact Score method was used to reduce and remove inappropriate expressions. To calculate the index, the items of the questionnaire were scored based on the 5-points Likert scale, including 1 (not important), 2 (low importance), 3 (moderate importance), 4 (relatively important), and 5 (absolutely important). If the score obtained was equal to or greater than 1.5, the phrase was saved. content validity index (CVI) and content validity ratio index (CVR) were used to determine the validity of the questionnaire. To assess the content validity, the questionnaires were provided to 10 experts in health education and promotion, ergonomics, rehabilitation, and ophthalmology. They were asked to assign one of the three options of "not necessary", "useful but not necessary," or "necessary" to each item. This method saved items with a content validity ratio higher than 0.62 based on the Lawshe table. Then, to check the appropriateness of the tool, the sum of the items identified as relevant were divided into all the

questions. The minimum favorable occasion has been considered to be 80% [20, 21]. To determine the reliability of the items, the questionnaires were filled out by 30 employees working in health centers in East Ahvaz who had similar conditions to the target group. After three weeks, the questionnaires were provided to the people again, and the internal reliability of the tool was examined. The content validity ratio was higher than 0.80 for each item and 0.94 for the instrument. The content validity index was calculated higher than 0.90 for each item and 0.99 for the questionnaire. The total reliability was calculated to be more than 0.75 (0.98), and the reliability of the questionnaire was also calculated using the retest method, which was 0.97, and indicates the optimal reliability. After obtaining a license from Ahvaz Jundishapur University of Medical Sciences, a pre-test questionnaire was distributed. Experimental group 1 received educational content, contained more fear-motivation and fewer efficiency messages. Experimental group 2 received educational messages containing more efficiency and less fear motivation, and the control group did not receive training. The groups completed the questionnaire before the educational intervention and two months after sending the last text messages. After analyzing the information obtained from the pre-test questionnaire, the educational content was designed in the form of educational messages related to the research subject. To determine the validity of the educational messages, a draft of the messages designed by two experts and experts in the field of research was examined. The draft of the designed messages was reviewed by two experts in the field of research. Also, 30 employees in the Health Centers of East Ahvaz, who had similar conditions to the target population, filled out the questionnaires. The questionnaires had six items, including you are likely to read any of the following messages; the following messages will motivate you, the following messages are attractive, the following messages are written, the following messages are applicable, messages are designed for me or people like me [21]. All the items were evaluated by the Likert scale, from completely agree to disagree. After applying the required comments and corrections, educational messages were designed to provide to the intervention groups. The subjects completed the informed consent form, and the necessary explanations about the study and its objectives were provided to them. Short messages (SMS) were sent to people daily for four weeks. Intervention group 1 received text messages containing more fear-motivation training messages, and intervention group 2 received text messages containing more efficient content (Table 1). It should be noted that some educational messages were repeated some days due to their importance. The number of messages sent to the intervention groups and the SMS days was determined after analyzing the pre-test results and consulting with the research

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 team. To determine whether the recipient read or did not read the sent message, the subjects were asked to send a blank text message to the researcher if they received an educational message.

Table 1) Details of the program to implement the educational intervention

Intervention	Description
Threat group	% of physicians' visits in the world are related to musculoskeletal disorders.
	Employees who use a computer for at least three hours a day experience vision problems such as dry eyes.
	Physical injuries from working with a computer can lead to loss of ability to work.
	High blood pressure from working with a computer can cause permanent eyes injury, reduced productivity, and job satisfaction.
Efficiency group	The easiest way to prevent computer vision syndrome is to blink regularly.
	Resting for 30 seconds every 30 minutes works with a computer can prevent visual disorders caused by working with a computer.
	Doing stretching exercises twice a day for the upper limbs is one of the important measures in preventing musculoskeletal disorders.

It is best to stand up and walk around for 3 to 5 minutes every hour during continuous work and 10 to 15 minutes every two hours. Data were analyzed using SPSS 22 software. Kolmogorov-Smirnov test was used to investigate the distribution of the data. One-way analysis of variance (Fisher) was used to compare the quantitative variables with normal distribution, and the Kruskal-Wallis test was used in the case of abnormal distribution of data or qualitative ranking variables. Paired T-test was used to compare the results before and after the intervention, and Wilcoxon and Friedman's intervention was used for abnormal quantitative variables. The significance level was considered 0.05.

Findings

The average age of the threat, efficiency, and control groups were 34.00 ± 6.08 , 33.74 ± 6.15 , and 33.84 ± 5.88 , respectively. The lowest and highest ages were 25 and 65, and this variable was the same in the three groups ($p=0.872$). There was no significant difference between the demographic variables ($p<0.05$; Table 2).

Some information has been shown in Table 3, including descriptive data of the constructs before the intervention, the mean score of the constructs, the maximum and minimum scores, and the range of possible points in each construct in the three study groups.

Due to the abnormality of data distribution, the Kruskal-Wallis test was used to compare the groups before and after the intervention. Friedman test was used for intragroup comparison (Table 4). There was a significant difference in mean scores of the

experimental and control groups before the intervention and two months after the intervention in the experimental groups 1 and 2 ($p<0.05$). In contrast, no significant difference was observed in the control group over time ($p<0.05$). Also, no difference was observed between the three groups before the intervention ($p<0.05$), but there was a significant difference between the three groups two months after the intervention ($p<0.05$).

Table 2) Results of number (percent) of demographic characteristics of the participants (N=166)

Variable	Threat group=54	Efficiency group=55	Control group=57	p-value
Marital status				
Single	18 (33.33)	18 (32.72)	16 (28.07)	0.800
Married	36 (66.66)	37 (67.27)	41 (71.92)	
Education level				
Diploma	1 (0.85)	1 (1.81)	1 (1.75)	0.690
Associate Degree	8 (14.54)	8 (14.54)	11 (19.29)	
Bachelor	38 (70.37)	39 (70.90)	39 (68.42)	
Masters and higher	7 (12.96)	7 (12.72)	6 (10.52)	
Employment status				
Official	15 (27.77)	8 (14.54)	11 (19.29)	0.224
Contractual	39 (72.29)	45 (85.47)	46 (80.70)	
History of computer use at work (year)				
<5	20 (37.03)	17 (30.90)	13 (22.80)	0.460
≥5	34 (62.96)	38 (69.09)	44 (77.19)	
Duration of computer use at work (hours)				
<4	23 (42.59)	16 (29.09)	20 (35.08)	0.362
≥4	31 (57.40)	39 (70.90)	37 (64.91)	

Table 3) Results of information of Extended Parallel Process Model structures in three groups

Group	Mean±SD	Minimum	Maximum	Skewness %	Score range
Perceived sensitivity					
Threat	48.35±6.98	35	60	50.25	12-60
Efficiency	49.94±7.10	30	60	51.86	
Control	48.73±6.53	29	60	50.47	
Severity perceived					
Threat	31.98±4.05	26	40	33.08	8-40
Efficiency	32.45±5.68	18	40	33.99	
Control	31.05±6.19	16	40	32.69	
Response efficiency					
Threat	29.94±3.54	21	35	30.91	7-35
Efficiency	28.61±4.58	19	35	29.85	
Control	29.73±4.41	14	35	30.90	
Self-Efficacy					
Threat	18.29±5.88	10	33	19.90	8-40
Efficiency	19.50±8.97	8	40	21.93	
Control	19±5.50	8	29	20.42	

Also, the rate of preventive behavior from physical injuries was higher before and two months after the intervention in experimental group 2, which received educational content containing higher efficiency messages ($p<0.05$; Table 4).

There was a significant difference between the two experimental groups before and after the intervention in terms of the behavior of the subjects referred to an orthopedist and optometrist for periodic medical examinations ($p<0.05$), and the number of referrals in experimental group 2 was higher (Table 5).

Table 4) Results of mean comparing of model variables between study groups before and two months after the intervention

Constructs	Group	Before	After	Difference	p-value
Perceived sensitivity	Threat	48.35±6.98	52.38±4.93	4.30±3.63	0.001
	Efficiency	49.94±7.10	51.38±5.94	1.43±2.20	0.001
	Control	48.73±6.53	48.78±6.45	0.05±0.22	0.081
	p-value	0.282	0.015	0.001	-
Severity perceived	Threat	31.98±4.05	35.01±3.42	3.03±2.50	0.001
	Efficiency	32.45±5.68	33.94±4.49	1.49±2.14	0.001
	control	31.05±6.19	31.26±5.74	0.21±0.97	0.120
	p-value	0.414	0.001	0.001	-
Response efficiency	Threat	29.94±3.54	31.78±2.89	1.01±2.75	0.001
	Efficiency	28.61±4.58	31.78±2.32	3.16±3.20	0.001
	Control	29.73±4.41	29.78±4.38	0.05±0.29	0.152
	p-value	0.331	0.031	0.001	-
Self Efficacy	Threat	18.29±5.88	21.24±5.35	2.94±2.97	0.001
	Efficiency	19.50±8.97	24.81±6.40	5.30±3.76	0.001
	Control	19±5.50	19.14±5.17	0.14±0.76	0.073
	p-value	0.412	0.001	0.001	-
Behavior	Threat	51.25±13.22	53.48±12.11	2.22±3.59	0.001
	Efficiency	51.05±10.32	57.18±8.72	6.12±4.40	0.001
	Control	50.77±11.40	50.85±11.41	0.08±1.19	0.423
	p-value	0.932	0.012	0.001	-

Table 5) Comparison of specialist referral before and after intervention in the experimental and control groups

Visit Specialist	Threat N (%)	Efficiency N (%)	Control N (%)	p-value
Ophthalmologist				
Before intervention	8 (14.81)	19 (16.36)	10 (17.54)	0.945
After intervention	18 (35.18)	27 (49.09)	11 (22.05)	0.001
p-value	0.001	0.001	0.123	-
Orthopedist				
Before intervention	4 (7.40)	4 (7.27)	6 (10.52)	0.723
After intervention	13 (24.07)	21 (38.18)	8 (14.03)	0.001
p-value	0.001	0.001	0.300	-

Discussion

Employees' use of the correct principles of ergonomics during work with computers is one of the most important cases of preventing physical injuries from working with computers. Failure to apply these principles during working with a computer will reduce productivity, injuries, musculoskeletal disorders, and vision disorders that impose high costs on the health care system. The results of the present study were compared with the findings of previous studies. Although many interventions have been performed in the area of musculoskeletal disorders as well as visual disorders, few studies have been performed with the same model and the target group in this study. In the studies based on the Extended Parallel Process Model, most of the studies have examined the explanatory nature of the structures of this model.

The results showed no significant difference between the experimental and control groups before the intervention in the perceived sensitivity and intensity, response effectiveness, self-efficacy, and behavior. However, after the educational intervention, the results showed an increase in the score of model constructs in the threat and efficiency groups. The sensitivity and perceived severity scores were higher in the threat group who received more fear-motivation messages. The rate of increase in response effectiveness and efficiency and behavior was higher in the efficiency group that received more self-efficacy messages. This significant difference showed the impact of the training program two

months after the intervention. In the control group, the mean scores increased slightly, but this increase was not significant. Karimi *et al.*, which examined the effect of education based on the Extended Parallel Process Model on self-medication status in the elderly of Zarandieh, revealed no significant difference in the mean score of perceived sensitivity structure before the training intervention.

However, the results showed a significant difference in the mean score after intervention [22]. These findings follow other studies [16, 23]. Previous studies have shown that increased sensitivity and perceived severity of illness or health problems can be effective in adopting preventive behaviors from health problems such as self-medication [24]. This study's results do not follow the study of Hashemiparast *et al.* [25] and Jasemzadeh *et al.* [26] that, after the educational intervention, no significant change was observed in the mean score of the perceived sensitivity construct. The inconsistency of the results with the mentioned research may be due to different teaching methods and techniques.

According to the results, there was no significant difference between the three groups regarding response effectiveness score before the intervention, but there was a significant difference after the intervention. Studies have also shown that messages with fear-motivation content combined with effective strategies to deal with a threat will play a very effective role in behavior change [26]. This study followed the results of Karimi *et al.* [22] and Jasemzadeh [27]. Also, changes before and after the structure of response effectiveness in the intervention groups showed that the changes in experimental group 2 were more than in experimental group 1. In this regard, it can be said that the subjects of group 2 have achieved a higher level of awareness of the favorable results of the behavior.

Changes before and two months after the intervention were higher in the efficacy group who received educational content containing higher self-efficacy messages. The present study results showed an increase in self-efficacy score and its significance in the experimental groups after the educational intervention. This finding follows the results of a study by Shamsi *et al.* [28], who revealed an increase in self-efficacy and decreased self-medication in pregnant women by training based on the Health Belief Model. However, the results are not following the study of Kinzler *et al.* [23]. As self-efficacy increases, people become more confident in their abilities, and therefore they are more inclined to perform healthy behaviors. More participation in healthy behaviors leads to positive health consequences such as improved quality of life. The results of this study were in accordance with McKay's intervention study entitled application of the Extended Parallel Process Model in a relationship between cardiovascular disease and increased

Homocysteine. As the results of this interventional study showed, people who received educational content pamphlets with messages of fear and high self-efficacy had more self-confidence and stronger and more significant responses than people whose educational content included high-fear and low self-efficacy educational content [23]. Attention to increasing the self-efficacy and effectiveness of the perceived response has been recommended as facilitators of acceptance of healthy behavior in future educational programs, which was consistent with the Hatchell study [29]. The present study showed that messages containing higher efficiency increased the mean score of self-efficacy structure in the efficiency group. Therefore, it can be concluded that the use of messages with higher efficiency in educational content has played a role in increasing and improving participants' self-efficacy.

The study results on the adoption of preventive behaviors showed that the three groups did not differ significantly in terms of behavior scores before the intervention, but a significant difference was observed after the intervention. Also, there was a significant difference in the score of the intragroup in the threat and efficiency groups before and two months after the intervention, but no significant difference was observed in the control group. The differences were higher in the efficacy group who received educational content containing higher self-efficacy messages before and two months after the intervention. The present study's findings showed that the intervention using the Extended Parallel Process Model indicates that the higher self-efficacy of the individual, the higher the motivation to change behavior. In Mickelson's cross-sectional study aimed at increasing dental visits among preschool children in oral health in the United States, the Extended Parallel Process Model was a potential tool for understanding parents' decisions about preventive care for the oral health of the oral health their children. The cross-sectional studies recommended paying attention to increasing the perceived response's self-efficacy and effectiveness and showed that the Extended Parallel Process Model structures are a good predictor for evaluating behavioral intention. A study by Chiang on the self-care of children with asthma; Explained self-efficacy and perceived effectiveness of self-care behavior with 50.2% variance [31].

One of the limitations of this study is the use of a self-reported questionnaire that can have errors in providing information and the short follow-up time (two months), which may affect the study results.

It was suggested that further studies using the extended parallel processes model in the field of work with computers, and qualitative studies in this field, longer follow-up studies (more than two months), investigate the effectiveness of The Extended Parallel Processes Model. Also, necessary measures and planning should be done considering

the importance of the role of health forces and their effectiveness in promoting the health of other people in the community to empower these forces.

Conclusion

Using messages with self-efficacy content in an educational intervention based on the extended parallel process model causes the incidence of behavior in the target population and higher protective motivation. Also, the prevention of physical injuries from working with computers will be of particular importance. Therefore, it is recommended to use this model and strengthen its structures to improve the correct behavior during working with computers.

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