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The Predictive Effect of Protection Motivation Theory Structures on the Protective Behaviors of Painting Workers: An Analysis of Threat Appraisal and Coping Appraisal Processes

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ABSTRACT

Background: Maintaining workers' safety in the workplace can be achieved by promoting protective behaviors. The purpose of this study was to investigate the status of protective behaviors in relation to the theoretical structures of the protection motivation theory.

Methods: This cross-sectional study was conducted on 100 paint workers in Rafsanjan city. A researcher-made questionnaire was used to assess knowledge, attitude, protective behaviors, and theoretical structures. A structural equation model was employed to investigate the impact of motivational theory structures on protective intentions and behaviors.

Results: The present study showed that, despite a relatively acceptable level of knowledge, the status of protective behavior in painting workers was not favorable. Correlation tests indicated that protective behaviors had a positive relationship with knowledge, self-efficacy, and response efficacy structures, while negatively and significantly related to the perceived cost structure ($p < 0.05$). Overall, the protection motivation theory structures had acceptable goodness of fit.

Conclusion: It is recommended that the structures of the protection motivation theory be utilized to persuade painting workers to comply with protective behaviors. Greater emphasis should be placed on creating a sense of threat caused by the lack of protective behavior in this group.

1. Introduction

Although work can have positive effects on individuals' health, both psychologically and financially, it can also pose serious health risks [1]. The World Health Organization (WHO) has identified the workplace as a priority for health promotion in the 21st century [2]. Workers are exposed to a variety of hazards in different types of work, including

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chemicals, biological agents, physical agents, and unfavorable ergonomic conditions, which can have negative consequences on their health [3]. For instance, studies have shown that the solvents used in the paint industry cause disruptions in the central and peripheral nervous system as well as other body systems, leading to adverse health outcomes. Several studies have reported on the neurobehavioral effects of organic solvents in paint on workers in painting factories [4]. Additionally, certain chemicals used in the paint industry contain heavy metals that are known to pose health risks. Paint production typically involves using various raw materials that contain heavy metals, including lead, cadmium, and chromium pigments, as well as fungicides such as mercury oxide [5]. Exposure to heavy metals is associated with medium and long-term health risks, and individuals who are exposed to these substances through their work may experience a range of disorders, such as high blood pressure, fatigue, kidney failure, brain disorders, and skin damage [6]. Moreover, occupational exposure to heavy metals among individuals working in the paint industry has been linked to an increased risk of cancer [7]. Strategies are recommended to control these medical risks, especially for workers working in polishing and painting workshops. These include providing appropriate education and training, as well as promoting the use of personal protective behaviors and equipment, such as gloves, glasses, aprons, safety shoes, and dust masks which are designed to minimize exposure to hazardous substances [8]. While personal protective devices (PPDs) are usually the last line of defense and are used in combination with other control measures, studies have indicated that the status of protective behaviors in individuals and businesses involved in paint and related products is not favorable [9]. Increasing people's knowledge is one method of encouraging them to engage in protective behaviors, as false beliefs can cause serious injuries and undermine individuals' ability to protect themselves from risks [10]. The appropriate use of health education theories is essential in improving the effectiveness of educational interventions [11]. The protection motivation theory is one such theory proposed in the field of preventive behavior to encourage individuals to engage in protective behaviors. According to this theory, individuals are more likely to adopt recommended health behaviors when they perceive the highest level of threat (perceived vulnerability and high perceived severity) and believe that the recommended behaviors will be effective (high response efficacy) and that they possess the ability to perform the recommended behavior (self-efficacy) [12]. Numerous studies have been conducted on the effectiveness of using the protection motivation theory to improve the level of protective behaviors in various groups and communities, such as workers [13] and farmers [14], and have shown the theory's ability to predict protective behaviors. However, few studies have investigated the status of protective behaviors and the factors that influence them according to the structures of a motivational theory in high-risk groups. Considering the presence of many harmful factors in the work environment for this societal group and the severe consequences that the lack of protective behaviors can have on the health of individuals in society, this study aimed to analyze the status of protective behaviors, the constructs of the protection motivation theory, and the degree to which these variables influence the creation of protective behavior.

2. Materials and Methods

This cross-sectional study was conducted on 100 people working in the car painting industry in Rafsanjan city in Southeast of Iran. The following formula was used to determine the sample size in structural equation studies.

$$n = [\frac{1}{2H}(A\left(\frac{\pi}{6} - B + D\right) + H$$

$$+\sqrt{(A(\frac{\pi}{6} - B + D) + H)^2 + 4AH(\frac{\pi}{6} + \sqrt{A} + 2B - C - 2D))}]$$

Where *A* is calculated by the following formula:

$$A = 1 - \rho^2 \quad B = \rho\, arcsin\left(\frac{\rho}{2}\right) \quad ,C = \rho arcsin(\rho), \quad D = \frac{A}{\sqrt{3-A}} \text{ , } H = (\frac{\delta}{Z_{1-\alpha/2} - Z_{1-\beta}})^2$$

And ρ is equal to the Gini correlation coefficient for two variables and δ is equal to the effect size and α and β are equal to the first type error and the second type error, respectively. According to previous studies, the correlation between Threat Appraisal and Coping Appraisal is 0.26. To achieve a statistical power of 90 % and a confidence level of 95 %, a minimum sample size of 112 participants was determined. In this study, a census of all 115 eligible individuals was conducted, and ultimately, 100 individuals who met the inclusion criteria and consented to participate were enrolled. The inclusion criteria specified that participants must possess at least one year of work experience in paint and solvent workshops, and have the ability to read and write. A researcher-developed questionnaire was used for the initial evaluation of participants' demographic information and constructs related to the protection motivation theory, specifically regarding self-protection behaviors in individuals working in painting and polishing workshops. The questionnaire was designed based on guidelines for protective behaviors in this population and underwent qualitative validation by experts in health and environmental education, as well as quantitative validation through the Content Validity Ratio (CVR) and Content Validity Index (CVI). Eight professors from the Departments of Health Education, Epidemiology, and Environmental Health provided their opinions on the questionnaire to determine the CVI. The initial questionnaire consisted of 60 questions, and constructs with a CVR greater than 0.78 and a CVI index greater than 0.80 were retained. Construct validity was established using confirmatory factor analysis, and reliability was assessed using Cronbach's alpha,

which yielded a value of 0.76 for this study. The present questionnaire was designed to investigate participants' knowledge, attitudes, and protective behaviors, as well as their perceived susceptibility, perceived cost, rewards, self-efficacy, response efficiency score, and intention to perform protective behaviors. The Likert format was used to collect data, with the final questionnaire comprising 54 questions. Nine questions were designed to measure knowledge, which was scored in three parts: correct, incorrect and do not know. The degree of carrying out protective behaviors was evaluated using 10 questions with a five-point Likert Scale. Protective behaviors recommended for individuals working with paint and its products, such as wearing gloves, washing hands regularly, and using suitable protective masks to prevent inhalation of airborne particles, were included. The status of protective motivation theory constructs was measured using 29 questions. Questionnaires were administered face-to-face, after explaining the objectives of the project and assuring participants that their information would remain confidential. The conceptual model employed in this study was based on the protection motivation theory structures, which explain protective behaviors. According to this theory, two types of appraisal, namely threat appraisal and coping appraisal determine individuals' intention to engage in protective behaviors. In the threat appraisal, individuals are motivated to perform recommended behaviors when they perceive a high level of severity and sensitivity and when the rewards from implementing incompatible behavior are minimal. In the coping appraisal, protective behavior is performed when self-efficacy and response-efficacy constructs are in the highest possible state, and perceived costs are minimal [12]. Pearson's correlation method was used to determine the relationship between behavior and theoretical constructs.

3. Results and Discussion

The average age of the participants in this study was 39.6 ± 11.2 and the majority of them had less than a diploma. The investigation of protective behaviors among individuals working with paint revealed a relatively favorable knowledge score of the situation (15.04 ± 2.19). The score for intention to perform the behavior was also relatively favorable (9.81 ± 2), while the protective behaviors had an average score of 17.7 ± 7.23, indicating that they were not in good condition. The score of the protection motivation theory constructs is reported in Table 1. The results of the correlation test showed that the intention to engage in protective behaviors had a positive and significant relationship with the constructs of knowledge, perceived severity, and self-efficacy, while it had a negative relationship with the construct of perceived rewards. Also, the score of protective behaviors had positive significant correlation with the constructs of knowledge, self-efficacy, response-efficacy, and intention. However, a negative and significant correlation was found with the construct of perceived cost (Table 2).

Table 1. Mean, standard deviation and range of scores of variables study

construct	Means	SD	Min	Max	Range
knowledge	15.04	2.19	9	18	9-18
attitude	17.7 2	7.23	5	24	0-24
Susceptibility	11.6 2	3.17	2	16	0-16
Severity	12.58	2.6 2	3	16	0-16
Self-Efficacy	10.90	2.52	4	16	0-16
Response Efficacy	14	3.26	4	20	0-20
Cost	7.41	3.74	0	17	0-20
Rewards	4.98	3.58	0	16	0-16
Intention	9.81	1.95	3	12	0-12
Behavior	17.72	7.23	5	40	0-40

Confirmatory factor analysis using the maximum likelihood method at the level of the variance-covariance matrix was conducted to investigate the factor structure of the questionnaire. The conceptual diagram of the first-order confirmatory factor analysis, along with standardized coefficients and fit indices, is presented in Figure 1.

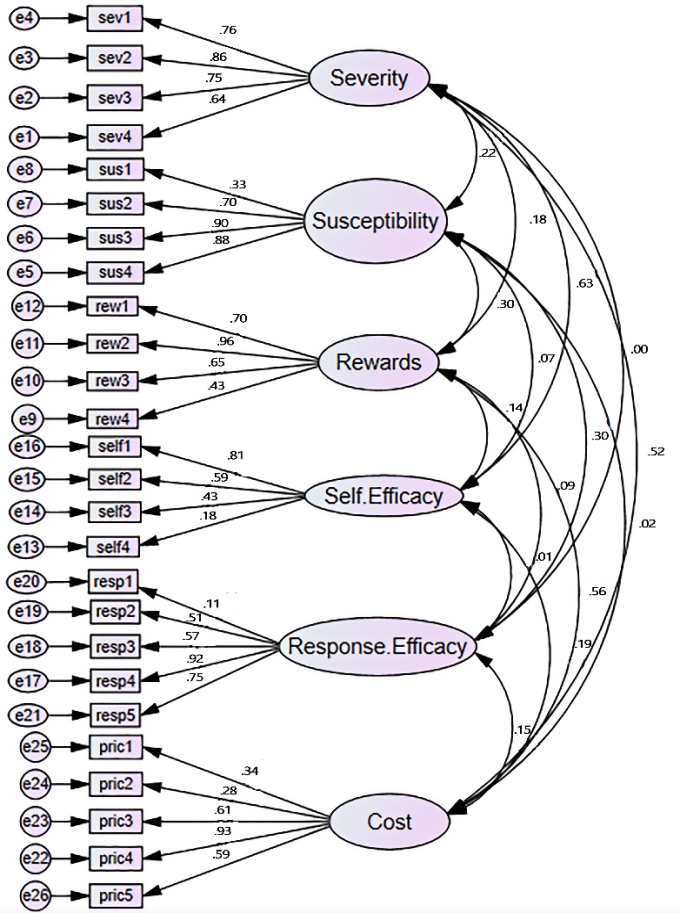

Figure 1. Conceptual diagram of first-order confirmatory factor analysis of the questionnaire with 6 first-order factors

Table 2. Matrix of correlation coefficient between protection motivation theory structures and protective behaviors in the painting workers

construct	1	2	3	4	5	6	7	8	9	10
1. knowledge	1									
2. attitude	0.12	1								
3. Susceptibility	0.17	0.11	1							
4. Severity	0.33**	0.11	0.19	1						
5. Self-Efficacy	0.36**	0.20	0.20	0.38**	1					
6. Response Efficacy	0.13	0.03	0.28*	0.05	0.18	1				
7. Cost	-0.14	-0.04	-0.18	-0.18	0.097	-0.20	1			
8. Rewards	-0.25*	-0.06	-0.25	-0.25*	0.097	-.21	0.51**	1		
9. Intention	0.26*	0.097	0.45	0.45**	0. 59**	.097	-0.19	-0.33**	1	
10. Behavior	0.31**	0.14	0.10	0.21	0.36**	0.47**	-0.24*	-0.23	0.44**	1

* Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).

To evaluate the goodness of fit of the model, the chi-square index, divided by the degree of freedom (CMIN/DF) was used, which was found to be 1.77 for this model. The model introduced by the questionnaire was examined, and the coefficients and the effects of each question on different dimensions were analyzed. In this six-factor model, the effect of all questions, except question number four of the Self-Efficacy dimension and question number one of the Response Efficacy dimension, on the relevant dimensions was found to be significant. Assuming that the questions of the questionnaire consist of six latent dimensions that constitute two other latent dimensions, a second-order factor analysis model was used to investigate the effect of different questions on the relevant dimensions (first order) and the effect of these dimensions on the other two latent dimensions (second order). The conceptual diagram of this model is shown in Figure 2. The goodness-of-fit index for the second-order model was 1.79, indicating an acceptable model fit. The coefficients and the impact of the six dimensions on the dimensions of threat appraisal and coping appraisal were examined, and the details of these coefficients along with the significance of their effect are presented in Table 3.

Table 3. Coefficients, standard error (SE), and significance level of different questions in second-order confirmatory factor analysis

Factor	Item	Coefficients	SE	*P* value
Threat Appraisal	Severity	814	0.382	0.033
	Susceptibility	1.000		
	Rewards	-1.755	0.671	0.009
Coping Appraisal	Self-Efficacy	1.000		
	Response Efficacy	0.782	0.520	132
	Cost	-2.140	0.841	0.011

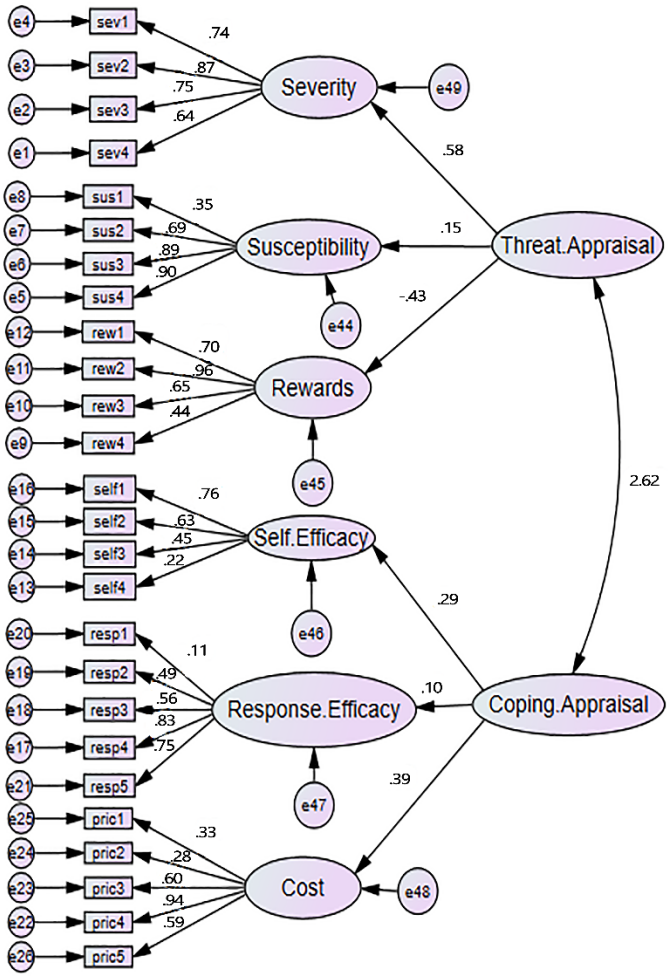

Figure 2. Conceptual diagram of second-order confirmatory factor analysis of the questionnaire with 6 first-order factors and 2 second-order factors

Table 3 shows the Reward variable has a negative and significant effect on the Threat Appraisal factor (p <0.05). For every unit increase of the Reward variable, the Threat Appraisal variable decreases by 1.75 units. The Severity constructs had a positive and significant effect on the Threat Appraisal variable. The Cost variable has a negative effect on the Coping Appraisal factor, and for every unit increase of the Cost variable, the Coping Appraisal variable decreases by 2.140 units (P<0.05). Self-Efficacy and Response Efficacy had a positive but insignificant effect on the Coping Appraisal variable. In the third step, a structural equation model was used to investigate the effect of the Threat Appraisal and Coping Appraisal factors on the intention variable and the effect of the intention variable on protection behavior in addition to the second-order confirmatory factor analysis model. The conceptual diagram of this model is shown in Figure 3.

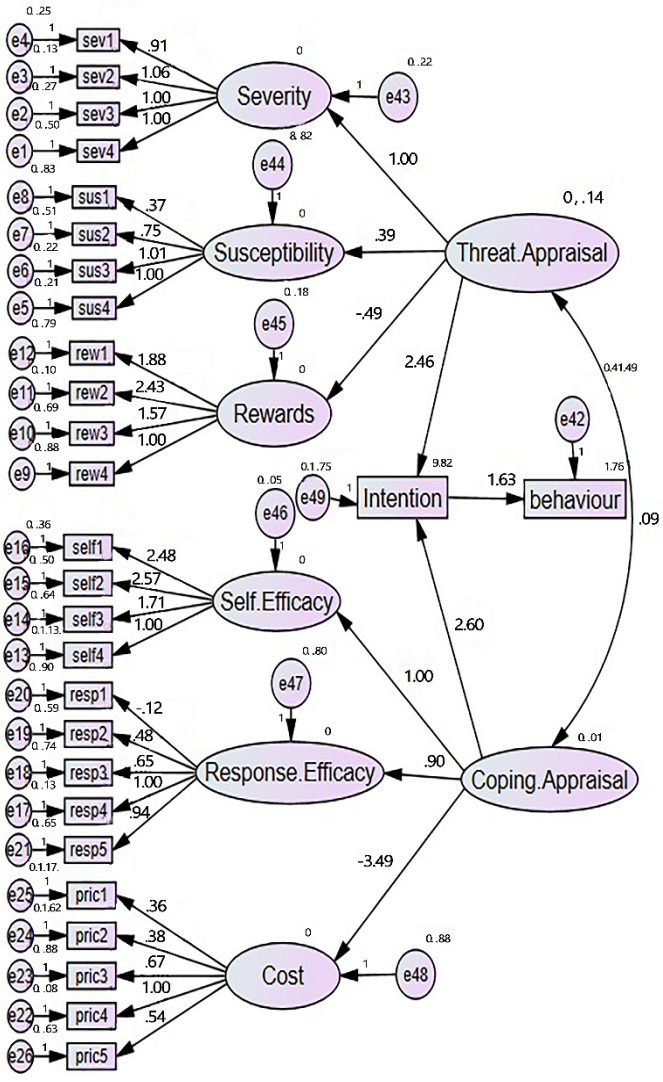

Figure 3. Conceptual diagram of the structural equation model of protection motivation theory

The goodness of fit index for the structural equation model was 1.74, indicating an acceptable model fit. The coefficients and the impact of each question on different dimensions were examined, and the details of these coefficients along with the significance of their effect are presented in Table 4.

Table 4. Coefficients, standard error (SE) and significance level of variables in the structural

Factor	Item	Coefficients	SE	*P* value
Threat Appraisal	Severity	1.000		
	Susceptibility	0.386	0.302	0.202
	Rewards	-0.492	0.219	0.025
Intention	Threat Appraisal	2.464	0.767	0.001
	Coping Appraisal	2.598	2.615	0.321
Coping Appraisal	Self-Efficacy	1.000	0.414	
	Response Efficacy	0.896	0.862	0.219
	Cost	-3.48	2.384	0.143
Behavior	Intention	1.626	0.414	<0.001

As shown in Table 4, the Reward factor had a negative and significant effect on the Threat Appraisal factor (p < 0.05), while the Cost factor had a negative and insignificant effect on the Coping Appraisal factor. In this model, the effect of the Threat Appraisal and Coping Appraisal factors on the intention variable was also examined, and both factors were found to have a positive effect on this variable. The effect of the Threat Appraisal factor was significant (P= 0.001), while the effect of Coping Appraisal was not significant (P= 0.321). Further, the effect of the intention variable on the behavior variable was statistically significant. The purpose of this study was to investigate the status of protection motivation constructs regarding protective behaviors in painters and to determine their relationship to perform protective behavior in this group. The findings of the study revealed that the score of protective behaviors among painters was not very favorable. These results are consistent with previous studies in this field, which have also indicated the inappropriate status of protective behaviors among workers. [8, 15]. The results of the present study showed a significant relationship between knowledge and both intention and protective behaviors, which is consistent with the results of the study conducted by Suppa *et al.* [16]. in Italy, which showed that students' knowledge about skin cancer affects their protective behaviors [16]. According to the Knowledge-Attitude-Practice (KAP) model, changes in human behavior occur in three stages: acquiring knowledge, creating beliefs, and forming behavior [17]. Therefore, increasing knowledge about protection methods and raising awareness about the complications caused by not implementing protective behaviors can be effective in promoting protective behaviors among workers. However, in the present study, no

significant relationship was observed between attitude and intention and performing protective behaviors, which is inconsistent with some previous studies conducted in this field. For instance, the study conducted by Ikinger *et al.* (2016) highlighted the attitude toward protective behaviors as an effective factor in predicting protective behavior [18]. The difference in the level of attitude and the nature of the behavior may explain this contradiction. In the present study, the attitude score was favorable, but protective behavior in this group was influenced by factors such as lack of equipment or cost. The results of this study demonstrated that perceived severity and self-efficacy had a positive and significant relationship with the intention score of protective behaviors, while perceived susceptibility did not have a significant relationship. However, there are conflicting results regarding the effect of severity and susceptibility on the intention of protective behaviors. Some studies have found that severity is a determining factor, while others have suggested that susceptibility plays a role, and some have shown that both factors are equally important. For example, in Maleki's study, perceived susceptibility was found to be a determining factor [19], while susceptibility, had the least relationship with behavior in Morowati's study [20]. In Tazval's study [14], both factors played an equal role. The results of the present study showed that the protective motivation theory constructs can predict protective behaviors among painters, which is consistent with the studies conducted in the field of protective behavior [21]. Also, the results of the study by Xiao *et al.* (2014) showed that the protection motivation model is able to predict schistosomiasis prevention behaviors [22]. The results of the model investigation in this study showed that the reward of non-compliant behaviors had a negative and significant effect on the threat appraisal. Although severity and susceptibility had a positive but not significant effect on the improvement of the threat appraisal. These results have also been reported in some other studies. Hanus *et al.* (2016) found that perceived severity could not predict safety behaviors [23]. However, the results of the present study are not consistent with the results of Kim *et al.'* study [24] which showed that perceived rewards have less weight than perceived susceptibility and severity in the evaluation of the threat caused by contracting Covid-19. In the case of protective behaviors among painters, it appears that the reward associated with non-compliant behaviors may reduce threat appraisal. On the other hand, in the context of a disease such as Covid-19, where the severity and immediacy of potential complications are high, perceived susceptibility and severity may exert a greater impact on the development of protective behaviors. It is noteworthy, however, that contrary to the present findings, some studies have suggested that perceived costs, rather than the reward of non-compliant behavior, are more salient in shaping the intention to engage in protective behaviors in the workplace [25]. This may be contingent upon the specific costs associated with performing the protective behavior in question. In the third model, the results showed that while both threat appraisal and coping appraisal were found to have an effect on the variable of protective behavior intention, only the relationship with threat appraisal was significant. These findings are not consistent with those of some previous studies, such as Ezati Rad *et al.* (2021) which found that both threat and coping appraisal significantly influenced the creation of intention [26]. According to the theoretical framework, both components of threat appraisal and coping are expected to play a role in creating the intention to protective behavior intentions, however, different effects have been reported in different studies based on the nature of the behavior. A review of studies has shown that in the case of behaviors aimed at preventing cancer, threat appraisal had the greatest impact while coping appraisal had the highest effect in creating protective behaviors related to smoking [27]. It appears that complex behaviors that require more skill and self-efficacy are more affected by coping appraisal. Finally, the present model showed a significant relationship between protective behavior and behavior in this group. The relationship between intention and behavior has also been reported in similar studies. For example, Mortada *et al.* (2021) found that individuals with a high intention to engage in protective behaviors against Covid-19 were more likely to engage in such behaviors most of the time [28]. The present study represents a unique contribution to the literature as it uses a structural equation method to investigate the power of protection motivation theory constructs in predicting protective behaviors regarding occupational injuries caused by exposure to paint in small painting and polishing workshops. While previous research has evaluated the effectiveness of this theory in predicting various protective behaviors, this study was the first attempt to examine the predictive value of the constructs of the theory in this high-risk group in terms of injuries and occupational poisoning. Path analysis is not only a tool for identifying relationships between variables but also a method for testing the fit of the specified pattern of causal relationships between variables within a particular population [29]. Therefore, this study elucidates the existing relationships between the theoretical constructs of protective motivation and protective behavior, thereby demonstrating the potential of this theory as a framework for influencing protective behaviors and improving health outcomes in this group. Overall, the study provides evidence supporting the effectiveness of the constructs of the theory in explaining protective behavior. The correct use of protective equipment is crucial for individuals working in industries that handle paint and its products, as exposure to toxic substances can result in injuries and diseases. However, research suggests that these individuals fail to use protective equipment properly. To address this issue, educational programs based on motivational theories such as the protection motivation theory may prove beneficial in promoting recommended protective behaviors.

3.1 Limitations and future research

Although our study sheds light on the protective behaviors of individuals working in small painting and polishing

workshops, it is not without limitations. The self-reported nature of the data on protective behaviors may have been subject biases, which could affect the accuracy of the findings. Additionally, due to the limited sample sizes and employing more objective measures of protective behavior. Nevertheless, our findings suggest that the structures of the protection motivation theory could be leveraged to design educational interventions aimed at promoting the adoption of recommended protective behaviors, such as wearing gloves and using masks when working with colored materials, to improve the health outcomes of this group.

4. Conclusion

The results of the present study showed that the constructs of the protection motivation theory can effectively explain protective behavior in people working in the painting industry. Specifically, our results highlight the importance of increasing perceived severity and susceptibility, as well as reducing perceived rewards for incompatible behaviors, with a greater emphasis on the latter, in promoting threat evaluation and ultimately driving protective behavior. Additionally, the relatively strong relationship between self-efficacy and the intention to engage in protective behaviors underscores the need to prioritize interventions that promote a sense of empowerment and belief in the ability to comply with protective protocols. These findings suggest that leveraging the constructs of the protection motivation theory can be an effective approach for promoting protective behaviors among individuals in this industry.

Authors' Contributions

Mohsen Rezaeian: Conceptualization; writing original draft preparation; writing-review and editing. Mostafa Nasirzadeh: methodology; writing original draft preparation. Mahmood Mahbobirad: methodology; data gathering; writing-review and editing. Hassan Ahmadinia: formal analysis. Mahdi Abdolkarimi: Conceptualization; methodology; writing original draft preparation; writing-review and editing. Alireza Taheri Fard: data gathering.

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Conflicts of Interest

The authors have no potential conflicts of interest to declare.

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Ethical considerations

The present study is derived from a research approved by the Research Council of Rafsanjan University of Medical Sciences. (Ethics code: IR.RUMS.REC.1398.117).

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