Original Article

Factors Affecting the Use of Protective Measures of Farmers to Prevent Falling during the Walnut Collection Period in Tuyserkan County

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Abstract

Background and Objectives: Fall is one of the main reasons for serious injuries in workplaces. Protective measures are not frequently used by farmers and farm workers. In Iran, there are no adequate data in recognizing the various effective factors of falls from height in the agricultural sector. Thus, we used the PRECEDE model to recognize causes and factors which can affect the acceptance of the protective measures for the prevention of fall from the walnut tree. **Materials and Methods:** From July until November 2018, a cross-sectional research was conducted in Tuyserkan County in the west of Iran among 222 farm workers and farmers from 12 villages. A questionnaire was developed to measure demographic features, history of injuries, and constructs recommended in the PRECEDE model. Data were gathered by face-to-face interviews. **Results:** Predisposing factors ($\beta = 0.348$, $t = 5.116$), enabling factors ($\beta = 0.131$, $t = 3.672$), and reinforcing factors ($\beta = 0.164$, $t = 2.128$) had a positive impact on protective measures, with an explained variance of 35.3%. In this study, the goodness-of-fit value was obtained as 0.455, indicating an excellent overall fit of the model to the data. **Conclusions:** The results of this research recognized the causes of protective measures among farmers and farm workers. Our findings suggest that the PRECEDE model could help as a guide for developing a more effective intervention for the prevention of fall from the walnut tree.

Keywords: Accidental falls, farmers, Iran, protective factors, trees

Introduction

Fall is one of the main reasons for fatal injuries in the workplace.[1] Fall is the main cause of death among farmers and farm workers; most common falls happen when descending or climbing a tree or vehicle.[2] Especially, falling from trees in the agricultural areas due to climbing the trees to harvest yields is another form of falling from heights.[3-5] Falling from

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a tree can result in main visceral, disabling spinal, and complex facial injuries.[6] In the USA in 2017, falls to the lower level estimated for 887 deaths in the private industry and 28 deaths in the section of agriculture.[7] Fall from the tree is one of the most common types of injuries in Iran and leads to a great number of admissions to health centers and hospitals.[8] Hence, during September until October 2017, a total of 52 injured cases due to falling from walnut trees in Tuyserkan County were reported.[9]

The walnut trees are cultivated in rural areas of Iran.[10] Tuyserkan is one of the natural places of walnut trees in worldwide. Walnut production has the most role in the economy of Tuyserkan with an overall zone of about 5100 ha which even lies in the first area in Iran.[11] However, the methods of harvesting walnuts in Tuyserkan are still traditional and nontechnical method, and gardeners climb the trees and harvest walnuts.[9] This action imposed them at risk of falling trees.[12] Falls frequently occur in the agriculture segment because no protections are taken or any equipment that is used is flawed, not suitable, or used wrongly.[8]

Studies indicate that unsafe working conditions and workers' behavior are effective in fall and injuries in the workplace.[13] Protective methods are not commonly used by farmers and farm workers.[14] The use of personal protective devices and engaging in protective behaviors by farmers depend on a diversity of factors.[15] Factors including knowledge and attitude about risks and right use of protective measures,[16] reinforcing factors and enabling factors about preventive behaviors and measures.[17] Identifying the effective factors in using protective measures is necessary to any interventional plan.[3] Nevertheless, studies considering the role of an extensive series of factors based on a definite framework are restricted.[18] Selecting the model of health education is the first step in identifying the various effective factors.[19]

The PRECEDE framework was developed and introduced to find behavioral, designing, planning, and evaluation problems of health.[20] The study by Rezapur-Shahkolai *et al.* indicated that the PRECEDE model can be useful in determining the predictive causes of injuries.[17] In the world, there are no enough data in identifying the various effective factors of falls from height in the agricultural sector. Data about reasons type or other specific features of falling from height incidents are unknown. Besides, there are no studies in this area, especially addressing falling from height in farmers and farm workers. Because of the unavailability of the agricultural databank and lack of researches concerning reasons and factors of fall-related injuries, taking preventive PRECEDE measures to reduce the potential risk of injuries is difficult.

Thus, in this study, we used the model to recognize causes and factors that can be related to the acceptance of the protective measures for prevention farmers and farm workers from falling from the walnut tree.

METHODS

Research design

This cross-sectional study was conducted in Tuyserkan County, placed in the Hamadan province (west of Iran), from July 1, 2018, to November 30, 2018. Tuyserkan County with a harvest level of 54,000 ha is an important county of walnuts production in Iran.[21]

Sampling

According to the values derived from Darçin and Darçin,[8] and considering the 95% confidence level and a precision of 2%, the overall required sample size was obtained as 240 farmers and farm workers.

The inclusion criteria were farmers and farm workers residing in one of these villages and having a history of climbing from the walnut trees. The farmers and farm workers who changed their living location or who had not experienced the climb of walnut trees and farmers and farm workers not willing to participate in this research were considered as exclusion criteria. Multistage sampling method (stratified-cluster-random) was used for this purpose so that first Tuyserkan county was divided into five districts based on the distribution of walnut orchards (Tuyserkan city and Sarabi orchards, Sarkan orchards, orchards of the villages located in the central part of the county, orchards of Khorramrud district, and orchards of Qhelqhelrud district). A sample size of 50 people is considered for each district. Then, two villages were selected from each district in rural areas using the cluster sampling method and the sample size assigned to each village was based on random sampling among gardeners whose names were already provided to the team by the village council or village mayor. In connection with the city of Tuyserkan, the city was divided into four districts: Sarabi, Ainabad and its suburbs, Mir Razi al-Din and its suburbs, and Ghale-ghazi and its suburbs, and a sample size of 10 people was allocated to each part. Samples were randomly selected from these areas.

Data collection

We gathered data in cooperation with community health workers in health houses from 12 villages. Data were gathered by face-to-face interviews with certain farmers and farm workers. Interviews were conducted in the health houses of villages. The questionnaire was developed according to the review of literature.[2,8,13,17] We measured the predisposing factor (knowledge), predisposing factor (attitude), enabling factors, reinforcing factors, protective measures, and demographic data through a self-reported questionnaire. To collect the data, five expert health workers held interviews with individuals.

Data collection instruments

We collected data on key factors influencing the protective measures to fall from the walnut tree by farmers and farm workers using the PRECEDE model. The study involved a questionnaire that involved three sections. The study involved questions about demographics, injured farmers, history of injuries, and PRECEDE model constructs including predisposing factors (knowledge) about protective

measures (10 items), predisposing factors (attitude) about protective measures (10 items), enabling factors to approve protective actions (3 items), reinforcing factors to approve protective actions (2 items), and protective measures for reducing fall of the walnut tree (12 items).

Validity and reliability

The primitive version of the questions was developed by investigators. Afterward, to measure content validity and face validity, the questions of the questionnaire were appraised by ten specialists in occupational health and health education. At first, the content validity ratio was considered by specialists' judgment and items with the score ≤0.62 kept on in the questionnaire. Then, the content validity index was considered by researchers. The score of 0.79 was measured as the minimum appropriate content validity index. In addition, the face validity of questions was testified by eight farmers and farm workers. so that the questions were recited for them, and we considered the level of difficult questions.

To estimate the reliability, Cronbach's alpha was used. Cronbach's alpha was assessed although directing a pilot study on 30 farmers and farm workers. The Cronbach's alpha for reliability was above 0.76 for all constructs. The validity and reliability step recommended minor changes to the questionnaire before finalization.

Data analysis

SPSS 24, IBM, Armonk, NY, United States of America) and the partial least squares (SmartPLS GmbH P.O. Box 1123 D-25474 Bönningstedt Germany) approach were applied to examine the reliability of the measures. Furthermore, data were recorded in SPSS (version 24) and were analyzed using Chi-square. We directed the confirmatory factor analysis to review homogeneity (factor loading and t-value),[22] reliability (composite reliability and Cronbach's alpha),[23] and convergent validity (average variance extracted [AVE])[23] of the latent variable indicators. In the study, the t-value was more than ±1.96 and factor loading measurements of ≥0.6 were approved. The composite reliability score was ≥0.81 and Cronbach's alpha value was 0.72 and above for each construct. In addition, the results of the AVE test show that the score constructs were ≥0.51. Therefore, any items of the construct were not removed from the model. At last, after the model was found to meet the criteria for the measurement model, the structural models were confirmed [Table 1].

Ethical approval

After clarifying the purpose of the study, clearly, and confidentiality of information for farmers and farm workers, all of them participated in the study voluntarily. Verbal informed consent was obtained from them. This study was approved by the Ethical Committee of Hamadan University of Medical Sciences (No.: IR.UMSHA.REC.1397.266).

Results

The study response rates were 92.5%, and the information of

7.5% did not include in the analysis due to failure to answer the questions. Demographic features of the farmers and farm workers are indicated in Table 2.

According to Table 3, our findings also indicated that 10 farmers and farm workers (4.5%) had a history of falling from walnut trees.

Farmers' protective measures were inadequate as follows

Avoiding go out of the walnut tree during fatigue and decentralization (43.2%), avoiding go out of the walnut tree when the wind starts (49.5%), and avoid of going out of the walnut tree during the bad physical condition (52.3%) were the most frequent protective behaviors (PBs). There were no significant differences between the protective measures of participants and their demographic characteristics ($P > 0.05$) (data not shown).

Figure 1 shows the conceptual framework of PRECEDE model used in the study.

We experienced all paths proposed by the PRECEDE model. According to the suggested paths by the PRECEDE model, predisposing factors (β =0.348, $t = 5.116$), enabling factors (β =0.131, $t = 3.672$), and reinforcing factors (β =0.164, $t = 2.128$) had a positive impact on protective measures, with an explained variance of 35.3%. In this study, the goodness-of-fit value was obtained as 0.455, showing an excellent overall fit of the model to the data. The predictive validity (Q2) value for protective measures was 0.320. These values confirm that the PRECEDE model has the power to forecast the variations in protective measure constructs [Table 4].

Discussion

This current study developed a research model that was to enrich our understanding of the effective factors on protective measures among farmers and farmworkers. The study results show that a significant amount of variance in the proposed model's dependent constructs was explained by the model's independent constructs. There is a lack of data supporting the
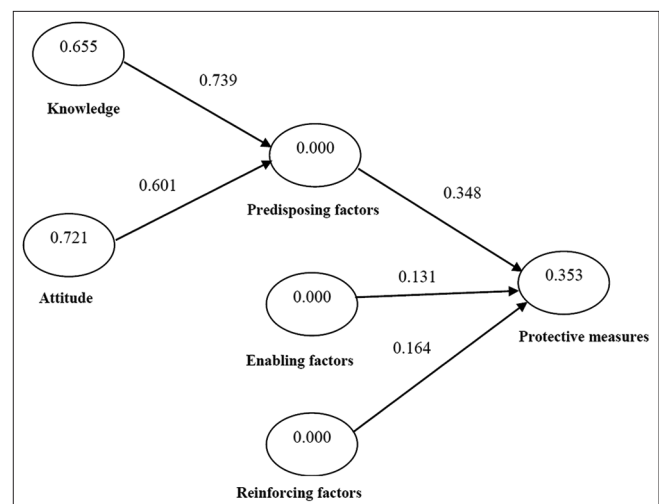

Figure 1: Structural model in the forecast of path coefficients

Table 1: The validity and reliability of the PRECEDE model scales

Factor	Construct and questions	Scoring	Factor loading	Cronbach's alpha	Composite reliability	AVE*	T
And predisposing factors (knowledge)*	Which item is the most common place to fall	0-10	0.721	0.72	0.81	0.52	15.14
	How are people at risk of falling		0.726				13.93
	What is the risk of fall from the tree in what kind of climate is more		0.730				17.91
	What is the risk of fall from the tree in what kind of physical and mental condition is more		0.742				16.24
	How to prevent the fall of the walnut tree		0.701				9.95
	Which factor is more effective in the fall of the walnut tree		0.766				7.51
	Which feature do individuals have more impact on the fall		0.754				10.78
	What trees increase the likelihood of falling people		0.738				11.81
	What age is the risk of falling from the tree		0.765				8.95
	At what time is the risk of falling further		0.712				8.23
Predisposing factors (attitude)**	Because I am so cautious when climbing a walnut tree, I do not fall from the tree	10-50	0.715	0.75	0.84	0.54	10.45
	Because I have been growing up from a walnut tree for years, I never fall		0.683				11.21
	I am not in danger of falling		0.817				11.70
	I can play a major role in the fall		0.722				14.89
	I believe the fall of the tree is generally preventable		0.788				15.94
	I believe that inexperience can cause injury when climbing a walnut tree		0.810				17.99
	When I feel tired, it is a serious risk to my fall from the tree		0.614				14.29
	I believe my physical characteristics are not related to the fall of the tree		0.613				15.62
	I believe older and obese people are more likely to fall from the tree		0.688				19.22
	Safety in preventing falls is very effective		0.744				10.93
Enabling factors***	So far, you have trained or learned about the prevention of the fall of the walnut tree	0-3	0.775	0.77	0.86	0.55	14.65
	So far, you have come to the treatment after the injury and fall		0.782				18.23
	In the walnut season, you have been covered by accident insurance coverage		0.734				17.11
Reinforcing factors***	When you experience health and job problems due to walnuts, what kind of person/organization do you support	0-2	0.865	0.85	0.89	0.57	10.95
	Who are encouraged to learn about the fall		0.823				7.19
Protective measures****	I do not go out of the walnut tree during fatigue and decentralization	12-60	0.764	0.73	0.84	0.60	17.51
	When the wind starts to blow, we will immediately go down from the walnut tree		0.742				12.38
	Whenever I feel I am not physically present, I do not go up from the walnut tree		0.724				18.60
	When I climb a walnut tree, I use comfortable clothes and comfortable shoes		0.736				12.63
	When climbing a walnut tree, I do not use dry branches to stand and climb		0.742				13.19
	When I harvest walnuts, I use wood for this purpose		0.777				11.47
	I do not get up from the walnut tree when it gets dark or rainy		0.751				15.59
	I use a person who is young and fit to climb a walnut tree and do not do it myself		0.643				11.29
	When I feel I do not have a balance, I do not go up from the walnut tree		0.720				13.45
	I use safety equipment, including a belt and protective helmet when climbing a tree		0.716				11.11
	I am not going up from very tall trees and pulling the shoots to shorten it		0.743				18.23

Contd...

Bashirian, *et al.*: Prevent falling during the walnut collection period

Table 1: Contd...

Factor	Construct and questions	Scoring	Factor loading	Cronbach's alpha	Composite reliability	AVE*	T
	The dried and semi-arid branches cut out the walnut trees to avoid danger to me		0.761				12.96

*Multiple-choice of: true (1 point) and false (0 point), **5-point Likert of: Strongly agree (5 point), agree (4 point), no ideas (3 point), disagree (2 point), and strongly disagree (1 point), ***Two-choice of: Yes (1 point) and no (0 point), ****5-point Likert of: Always (5 point), often (4 points), sometimes (3 points), rarely (2 points) and never (1 point). AVE: Average variance extracted

Table 2: Demographic characteristics of the participating farm workers and farmers (*n*=222)

Characteristics	Total, *n* (%)	With falling experienced, *n* (%)	Without falling experienced, *n* (%)	P
Sex				
Male	221	211 (95.0)	10 (4.5)	0.426
Female	1	0	1 (0.5)	
Age (years)				
≤25	32	1 (0.5)	31 (14.0)	0.326
26-35	74	2 (1.0)	72 (32.0)	
36-45	42	2 (1.0)	40 (18.0)	
46-55	33	2 (1.0)	31 (14.0)	
56-65	31	2 (1.0)	29 (13.0)	
≥66	10	1 (0.5)	9 (4.0)	
Mean±SD	-	40.23±10.06	37.53±11.54	
Level of education				
Illiteracy	66	4 (2.0)	62 (28.0)	0.411
Elementary school	50	2 (1.0)	48 (21.5)	
Middle school	91	3 (1.5)	88 (39.5)	
High school	12	1 (0.5)	11 (5.0)	
≥College	2	0	2 (1.0)	
Marital status				
Married	184	8 (4.0)	176 (79.0)	0.145
Single	38	2 (1.0)	36 (16.0)	
Divorced or widowed	0	0	0	
Annual income				
Excellent	1	0	1 (0.5)	0.256
Good	53	3 (1.5)	50 (22.5)	
Moderate	121	2 (1.0)	119 (53.0)	
Poor	47	5 (2.5)	42 (19.0)	
Body mass index				
Under weight (<18.5)	2	0	2 (1.0)	0.089
Normal weight (18.5-24.9)	131	2 (1.0)	129 (58.5)	
Over weight (25-29.9)	74	4 (2.0)	70 (32.0)	
Obesity (≥30)	11	4 (2.0)	7 (3.5)	
Size of walnut tree garden (acres)				
<2	99	2 (1.0)	97 (43.5)	0.142
≥2	123	8 (4.0)	115 (51.5)	
Number of walnut trees				
<100	191	9 (4.5)	182 (82.0)	0.078
≥100	31	1 (0.5)	30 (13.0)	
Experience climb of the walnut trees (years)				
≤10	108	6 (3.0)	102 (46.0)	0.253
11-20	71	3 (1.5)	68 (30.0)	
21-30	33	1 (0.5)	32 (14.0)	
31-40	7	0	7 (3.5)	
≥41	3	0	3 (1.5)	
Mean±SD	-	9.83±5.23	14.83±7.75	

SD: Standard deviation

role of a number of surveyed structures in agricultural health and injuries studies.

Our research is one of the few theoretical framework studies considering farmers' protective measures. Our findings showed that the implementation of protective measures by the farmers and farm workers is poor. This result is in line with the results of Singh and Gupta[24] and Zveglich *et al.*,[25] indicating that most fall injuries occur in conditions where prevention practices are not done. Farmers do not use protective equipment for various reasons. These reasons included unattractiveness of protective measures, perceived fewer hazards, knowledge and attitude fewer about hazards, cumbersome protective measures, and slowing down work by

Table 3: Background information of farmers falling from the walnut tree (*n*=10)

Characteristics	*n* (%)
Fall height	
<5	7 (70.0)
≥5	3 (30.0)
How to exit the place of fall	
By emergency	2 (20.0)
By other people	3 (30.0)
By family and friends	5 (50.0)
Time of injury	
Morning	1 (10.0)
Noon	4 (40.0)
Afternoon	4 (40.0)
Evening	1 (10.0)
Farmers injured limb	
Head and face	2 (20.0)
Foot and leg	1 (10.0)
Internal organs	7 (70.0)
Action following the fall	
No certain action	4 (40.0)
Going to hospital	5 (50.0)
Private clinic	1 (10.0)
Type of treatment*	
Outpatient	2 (20.0)
Inpatient	4 (40.0)
Consequences of falling	
Complete recovery	5 (50.0)
Temporary disability	3 (30.0)
Permanent disability	2 (20.0)

*Type of treatment just for poisoned farmers and farm workers referring to health centers

farmers.[26] In addition, in this study, farmers and farm workers believed that the use of protective measures for the prevention of fall from the walnut tree is not hard. The above reasons point out the need to incorporate farmers' safety preferences in interventional programs that are designed to promote protective measures for fall prevention from the walnut tree among farmers and farm workers.

Our study showed that knowledge and attitude have a positive influence on protective measures so that the knowledge and attitude of the farmer are effective in taking protective measures in farmers and agricultural workers. Consistent with another study,[27] the results confirmed that a rise in knowledge and attitude enhanced safety behaviors. Contrary to our results, the results of the Derafshi *et al.*'s[28] study showed the lack of significant relationship between knowledge and attitude and use of personal protective equipment. Usually, the support of public health prevention, work on the hypothesis that poor knowledge and attitude result in protective measures that cause injuries. By increasing their knowledge and proper attitudes, they will involve in safer behaviors.

We also found that the enabling factors were associated with protective measures, which was consistent with the results suggested in previous studies.[17,29] Enabling factors are those internal and external conditions directly related to the issue that helps people accept and continue healthy or unhealthy behaviors or to embrace or discard specific environmental conditions.[20] Based on previous studies, several of these factors include the resource,[30] and safety education and experience[31] are the most usually cited enabling factors to protective measures. Maybe, these factors make an item to carry out.

Findings supported that the reinforcing factors are effective on the protective measures. These results are consistent with the results of the previous study.[32] Reinforcing factors are the individual and community attitudes that support or make it difficult to adopt healthy behaviors or fostering healthy environmental conditions.[20] Probably, farmers who have experienced the social pressure of others indicated the heightened concern about the health effects of fall and were more likely to do behaviors.

Limitations

The results of this study should be considered in light of its limitations. First, the findings of the study might be affected via self-report bias. Second, this study was directed in a restricted

Table 4: The result of the structural model for examining paths in the PRECEDE model

Relationships hypothesis	*T*	*R*²*	Predictive validity (*Q*²)**	Size of the effect (*f*²)***
Predisposing factors to protective measures	5.116	0.353	0.320	0.06
Enabling factors to protective measures	3.672			0.03
Reinforcing factors to protective measures	2.128			0.02

GOF=√average *R*² × average communalities=√ 0.560 × 0.370=0.455

*R^2=0.19, 0.33, and 0.67 as small, medium, and large criterion value for coefficients determination, respectively,[24] **Q^2=0.02, 0.15 and 0.35 as small, median and large predictive power, respectively,[24] ***f^2=0.02, 0.15, and 0.35 as small, median and large size of the effect, respectively.[24] GOF: Goodness of fit

zone, and therefore, caution should be exercised regarding its generalizability.

Conclusions

The findings of this research recognized the causes of farmers' and farm workers' protective measures. In addition, farmers' and farmworkers' protective measures to prevent falling during the walnut collection period were inadequate. Considering the direct effect of the PRECEDE model component on protective measures, it seems that the PRECEDE model could serve as a guide to developing a more effective intervention for safety measures of Iranian farm workers and farmers. According to the study, the results suggested that safety education among farmers could raise awareness and attitude of falling during the walnut collection risk and the adverse health consequences. Therefore, there is a critical need to educate and create knowledge regarding the use of protective measures. Hence, must training programs to focus on safety education. Further, policy and regulations on safety should be made stringent in Iran.

Conflicts of interest

There are no conflicts of interest.

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