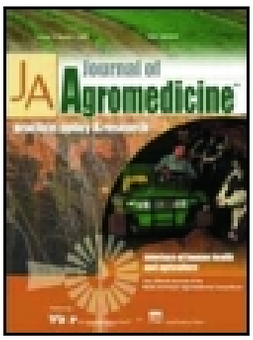

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# The Process Of Farmers' Occupational Health Behavior by Health Belief Model: Evidence From Iran

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**ABSTRACT**

Farm work is considered among the highest risk jobs throughout the world. Occupational health behavior is a critical factor that influences agricultural job-related injuries and diseases. Yet, while educational programs have been set up to encourage farmers to behave more safely, many of these programs do not sufficiently take into account the factors that induce farmers to exhibit risky behavior. The present study aimed to explore the factors underpinning farmers' occupational health behavior using the Health Belief Model (HBM). The study was conducted using aquestionnaire survey of 382 farmers representative of the farmers of Kermanshah province, Iran. The face and content validity of the questionnaire was confirmed by apanel of experts in occupational health, and its reliability by apilot study establishing internal consistency measured by Cronbach's alpha. The results showed that four dimensions of the HBM (perceived susceptibility, perceived benefits, cues to action, and perceived self-efficacy) influence farmers' occupational health behavior (FOHB), with the theoretical model accounting for 54.9% of the variance of FOHB. The findings confirm the potential of the HBM to explain FOHB and the relevance of using the theory in studying farmers' protective behaviors such as the use of chemical pesticides, protection against sunlight, protection of hearing, etc.

**KEYWORDS**

Occupational health behavior; health belief model; farmers' health; occupational health education; agriculture

## Introduction

The agricultural sector plays a vital role in sustainable development, especially in low-income countries, where this sector accounts for a great part of total income and labor.[1] It has been estimated that 1.3 billion workers are engaged in crop production worldwide,[2] accounting for half of the total labor force of the world. Only 9% of these workers are in industrial countries, as opposed to approximately 60% in developing countries. Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.[3]

The success of farming as a profession strongly depends on uncontrollable external factors, such as weather conditions, disease outbreaks, environmental changes, and legal restrictions. In addition, farmers are increasingly facing market pressure, and they are expected to adhere to high production standards as well as to environmentally friendly social practices. A combination of uncontrollable external factors, high expectations, and poor support by social networks may inflict adverse work conditions on farmers.[4] These conditions, combined with the assignment of farm work to individuals or family members who have not received sufficient training about safety and health, increase the risk for fatal incidents.[5] Along with other parameters, this has turned farm work into one of the most hazardous jobs worldwide,[6] as illustrated by the fact that out of a total of 335,000 work-related incidents in the world annually, 170,000 deaths occur among farm workers.[7]

Then again, the attitude towards safety has changed in the past decades. Across the world, safety is no longer considered simply a priority, but a value that should always be taken into account.[8] Among the long list of factors that can be blamed for incidents and injuries, the emphasis is increasingly placed on human behavior.[9] For example, Lee[10] suggests that a better forecasting

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and determination of risk behavior would be an effective way to reduce diseases and incidents among farmers and to enhance their health.[10] Safe behavior is the key to preventing injuries at work and indirectly affects the consequences of incidents before their occurrence or ones that are going to happen.[11] At the same time, a change in an individual's unsafe behaviors and attention to safety behaviors among workers is a key component of disease prevention measures. Occupational health behavior is the promotion and maintenance of the highest degree of physical, mental, and social well-being of workers in all occupations by preventing departures from health, controlling risks, and the adaptation of work to people and people to their jobs. In other words, occupational health behavior is one that avoids unsafe behaviors.[2]

However, while behavior change is often the main purpose of preventive programs, the difficulty of behavior change is often underestimated. Effective preventive interventions should be based on a sound understanding of the involved risk factors to enable appropriate preventive and protective actions.[12] Therefore, it is imperative to examine farmers' occupational health behaviors (FOHB) and their determinants. To that effect, use can be made of existing theories and models from the behavioral sciences that identify the factors that induce or influence health or safety-related behavior. In an effort to contribute to sound policies to safeguard the health of farmers, the present study aims to explore factors underpinning farmers' behavior with respect to occupational health using the health belief model (HBM).

## Health belief model

Models of health behavior have been developed in health psychology and behavioral sciences to identify the factors that influence behavioral responses that are related to health, such as smoking, eating habits, physical activity, participating in vaccination or screening programs, or protecting oneself against risks.[13] Among the several theories that have been proposed to explain the process of behavior change,[14] one of the most popular ones is the Health Belief Model (HBM).[15] Originally conceived in the 1950s, the HBM has been widely applied in health behavior research to describe the change in and the persistence of health-related behavior.[13,16] As Figure 1 shows,[17] the model posits that health-related behavior is based on specific beliefs, notably perceived susceptibility and severity of a health problem, perceived benefits of changing a behavior, and perceived barriers of potential preventive actions.[16] In later versions of the model, the dimensions of cues to action and self-efficacy were added as additional components.[18] *Perceived susceptibility* refers to an individual's belief in the possibility of a particular (negative) event happening to him/her. *Perceived severity* refers to the belief that the problem is serious, for instance that it may lead to death or

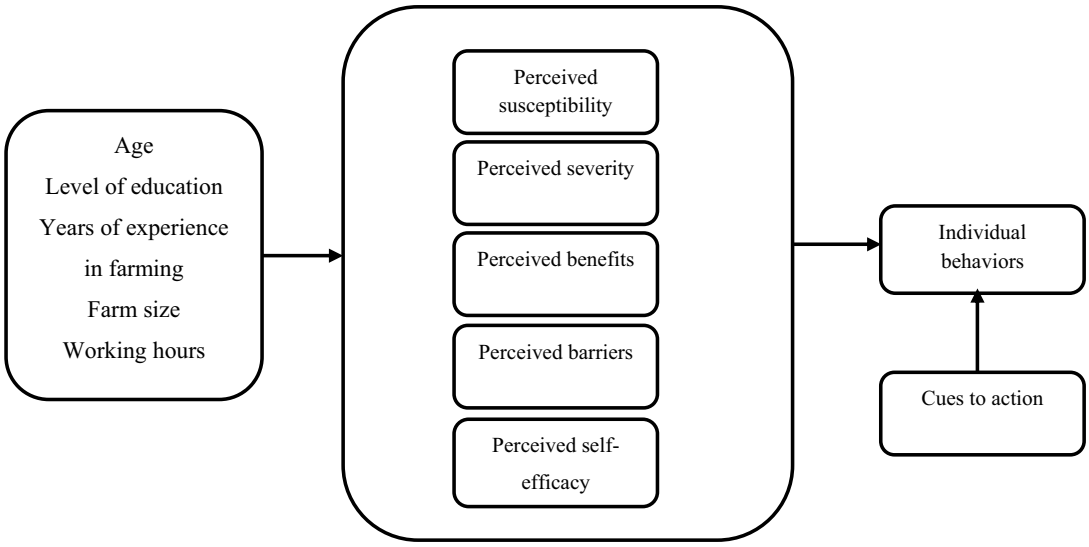


**Figure 1.** The theoretical framework of research (the health belief model Glanz et al. [17].

other serious consequences. *Perceived benefits* are the individual's belief in the efficacy of recommended activities to reduce the hazard and/or the seriousness of the consequences. *Perceived barriers* refer to an individual's belief in the objective and psychological costs of the recommended activities. *Self-efficacy* is the perception of one's own ability to pursue a chosen behavior. Lastly, *cues to action* are particular stimuli or events that create a sense of need for action in an individual.[19]

HBM has several advantages over other behavior models. For example, HBM has proven successful in predicting personal health behaviors and in designing and implementing health screening programs, and it also provides a theoretical framework to better understand and motivate cooperation of the deprived people in health training programs.[18] It also reveals factors that are effective in encouraging/discouraging an individual to take specific health-related actions.[20] But, the other behavior models have some drawbacks. For instance, although the theory of reasoned action considers attitudes and social norms, it ignores situational factors, personal norms, habits, and individual arguments; whereas, these can be important factors predicting an individual's intention and behavior. This theory fails to explain behavior, especially among people who are less capable or believe they are less capable of displaying behaviors. The theory of planned behavior and the theory of reasoned action deal with predicting behavior intention, but they do not explain behavior change, whilst this is the main concern of health promotion and training programs. Another limitation of these two models is that they do not consider personality factors, cultural factors, and demographic variables. These theories emphasize reasoned thoughts and do not consider unreasoned thoughts or fears. They also assume that behavior is the result of linear decision-making, and the likelihood of behavior change over time is overlooked.[21] Critics of the transtheoretical model argue that the steps of this model are arbitrary, and it is not so useful in classifying a population within different steps.[22] Precaution adoption process model does not consider a constant set of variables at different steps.[23] Some critics believe that social cognitive theory is about learning that can be mostly used for children and has been developed for behavior change and only considers individuals that are ready for behavior change.[24] The main limitation of protection motivation theory is that it does not consider all environmental and cognitive variables that can influence attitude change (e.g. pressures, difficulties, and problems for matching with subjective norms).[25] The PRECEDE-PROCEED model does not seem comprehensive enough for all situations. Investment in health training and promotion is often dedicated to activities in a specific field and no preparations are made for social or epidemiological assessment.[21]

The merit of the Health Belief Model lies in that it clarifies the relationships between these health beliefs and peoples' intentional health behavior.[26] More specifically, it assumes that an individual will adopt an intention to perform preventive behaviors when she/he believes that she/he is at risk of an injury or illness; that the injuries or illness will have important negative consequences; that preventive behaviors will effectively reduce the chance of injuries or illnesses and/or their severity; and that she/he is able to perform the behavior. Cues to action will then trigger the intentions into actual behavior (Figure 1).

## Review of literature

Several studies have used the HBM to explore safety behaviors among farmers. As such, it has been applied to such issues as the use of pesticides, exposure to sunlight, and exposure to noise.[27–30]

Kien found that farmers will use safety and protective equipment (such as sunglasses, hats, sunscreen, ear protection, etc.) and perform safety practices if they realize that their advantages outnumber the cost of their preparation and use.[31] Mazloomi et al. found that preventive behaviors are significantly correlated with perceived susceptibility, perceived barriers, and perceived self-efficacy.[32] If people are informed about the advantages of safe behaviors, they will be more motivated to adopt and employ health practices.[32] Jeihooni et al. state that people change their behavior when they perceive that the disease or incident is serious; otherwise, they will not change their behavior to healthy ones.[33] On the other hand, Raksanam et al. found that perceived barriers can also influence farmers' health behaviors.[34] Moradhaseli et al. reported that the financial problems of farmers are barriers to compliance with occupational health behavior.[35] Cues

to action can shift the focus toward safety at work so they can enhance the effect of training and promote health and safety behaviors among farmers.[36] Yazdanpanah et al. revealed that the HBM was appropriate to predict the intention to perform safety practices, in the sense that cues to action, perceived severity of dangers, and self-efficacy could capture 38.5% of the variance of intention to use chemical herbicides in a safe manner.[37] Rezaei et al. argue that health behavior depends on perceived susceptibility, severity of dangers, benefits, and barriers of adopting safety behaviors.[38]

According to Goodarzi et al., perceived severity is an effective factor underpinning health behavior.[39] Raksanam et al. reported a strong relationship of farmers' perceptions, perceived susceptibility, perceived severity, and perceived benefits with their safe behavior.[40] Støle et al. and Jeong and Ham indicated that the components of HBM were related to individuals' behavior significantly.[41,42] Various studies have indicated that behavior is influenced by several factors, some of which are internal and some external. In health beliefs theory and literature review related to the research areas, the focus is on interpersonal factors. But, a review of the literature suggests that some external factors, such as education and economic factors, influence intra-individual factors. For example, the level of knowledge, attitude, beliefs, motivation, and the like, are enhanced by the impact of education and lead to good decision-making. All in all, HBM holds that an individual is most likely to display a recommended behavior if he/she (a) feels that he/she is apt for a disease, (b) feels that the disease is very serious to him/her, (c) feels that health behaviors are to the benefit of himself/herself, (d) feels that there are few barriers to adopt the behavior, (e) knows that he/she will receive incentives for the behavior, and (f) finally feels self-efficacy or self-confidence to adopt the behavior.[38] According to what described above, HBM turns out to be a good model that can be used to change people's behavior. A summary of the studies is presented in Table 1.

## Methods

The present research was a descriptive-correlational study on the population of farmers in Kermanshah province, Western Iran. A sample was taken through stratified sampling with proportional allocation, using the counties of Kermanshan province as strata (Table 2). Table 2 lists the cities studied along with the population of the farmers in each. The sample size in each city was specified by proportional allocation. Given that the sampling method was multi-stage by proportional allocation, initially, Kermanshah province was divided into five parts (north, south, east, west, and center) in geographical directions, and then in each direction, the desired city was selected. The research population including all wheat farmers (N) amounted to 126,900. The sample size was determined to be 382 by Krejcie and Morgan's[43] table,[43] and the sample size in each county was specified by proportional allocation.

Data were collected with a 56-item questionnaire composed of two sections, one for demographic information and one measuring the components of HBM, including occupational health behavior (33 items: e.g., "The extent of using sunglasses, ear protection, and cabin-equipped machinery at work"); perceived barriers (6 items: e.g., "Expensive protective equipment leads to decreasing occupational health activities, negative public reaction to the use of safety devices [mock-up, etc.]"); perceived severity (3 items: e.g., "Fear of the cost of treatment leads to displaying occupational health activities, the fear of lag in works"); perceived benefits (4 items: e.g., "Treatment costs reduces using protective equipment"); perceived susceptibility (4 items: e.g., 'People who have experienced the events themselves are more concerned with safety and health behaviors, unbelief in the occurrence of an accident among people who have not had an accident'); perceived self-efficacy (3 items; e.g., "I am able to use protective equipment during working in farm"); and cues to action (3 items: e.g., "People's behavior influences my occupational health activities, attention of employers to the safety of agricultural workers"). The components of HBM were measured using a 5-point Likert scale. Farmers' occupational health behavior (as dependent variable) was investigated based on the five criteria (including protection against sunlight, job-related noise, ergonomics, application of chemical pesticides, and farm machinery). Farmers are faced with various factors related to safety and health such as sun, noise, ergonomics, pesticides, and machinery. Therefore, it is important to ask about specific topics to recognize farmers' behavior and activities. The Interval of Standard Deviation from the Mean (ISDM) criteria were used to extent the

**Table 1.** Some studies in field of the farmers' occupational health and health belief model.

| Authors | Research topic | Results |
|---|---|---|
| Kien[31] | Factors influencing safety pesticide use behavior among farmers in Thainguyen Province, Vietnam | Using safety and protective instruments and performing safety practices if it is realized that their advantages outnumbered the cost of their preparation and use. |
| Raksanam et al.[34] | Model development to reduce pesticide risk behaviors among rubber farmers in Khogyang Community | Perceived barriers can also influence farmers' health behaviors. |
| Moradhaseli et al.[35] | Analysis of occupational health challenges among farmers, Iran | Financial problems of farmers are barriers to compliance with occupational health behavior. |
| Bagheri et al.[36] | Pesticide handling practices, health risks, and determinants of safety behavior | Cues to action can shift the focus towards safety at work so that they can enhance the effect of training and promote health and safety behaviors among farmers. |
| Jeihooni et al.[33] | Application of the health belief model and social cognitive theory for osteoporosis preventive nutritional behaviors | People change their behavior when they perceive that the disease or incident is serious; otherwise, they will not change their behavior to healthy behaviors. |
| Yazdanpanah et al.[37] | Investigating Factors Influence Farmers' Intention Regarding Safe Use of Pesticides through Health Belief Model | The HBM was appropriate to predict the intention to perform safety practices, in the sense that cues to action, perceived severity of dangers, and self-efficacy could capture 38.5% of the variance of intention to use chemical herbicides in a safe manner. |
| Rezaei et al.[38] | Understanding farmers' safety behaviour towards pesticide exposure and other occupational risks | Health behavior depends on perceived susceptibility, severity of dangers, benefits, and barriers of adopting safety behaviors. |
| Goodarzi et al.[39] | Predicting oral health behaviors among Iranian students by using health belief model. | Perceived severity is an effective factor underpinning health behavior. |
| Raksanam et al.[40] | Factors associated with pesticide risk behaviors among Rice farmers | A strong relationship of farmers' perceptions, perceived susceptibility, perceived severity, and perceived benefits with farmers' safe behavior. |
| Støle et al.[42] | Beliefs, attitudes and perceptions to sun-tanning behaviour in the Norwegian population | The components of HBM were related to individuals' behavior significantly. |
| Jeong and Ham[41] | Application of the Health belief model to customers' use of menu labels in restaurants | The components of HBM were related to individuals' behavior significantly. |

status of FOHB (Formula 1).[44] First, the items of occupational health behavior were measured using 5-point Likert scales. Then, the items were computed in SPSS software packages. Mean (M) and standard deviation (SD) are two important indicators of ISDM formula. First, the mean and standard deviation of the dependent variable should be calculated. The mean score for any given question among all participants is compared to the score for a single participant. The single participant is ranked as having weak (less than the mean – ½ standard deviation), moderate (equal to the mean ± ½ standard deviation), or strong (higher than the mean + ½ standard deviation) health behaviors. Therefore, it can state that if on a scale of 1 to 5, the community mean is a 1.5 (SD:.2), a farmers who responded with a 2 could be classified as having "strong" health behaviors, even though in respect to the scale itself, these behaviors are actually relatively weak (2 out of 5). At weak level, the value of M- $\frac{1}{2}$ SD should be more than the dependent variable (In this study, occupational health behavior was considered as dependent variable). At moderate level, the dependent variable is placed between values of M – $\frac{1}{2}$SD and M + $\frac{1}{2}$SD. At strong level, the dependent variable should be more than value of M + $\frac{1}{2}$SD. Finally, based on the ISDM formula, occupational health behavior was calculated at three levels of weak, moderate, and strong. This formula is used to convert people's behavior scores into three levels, based on the mean score and standard deviation. In fact, this formula makes it easy to compare and analyze respondents' behavior.

FOHB < M- $\frac{1}{2}$ SD = at weak level

M – $\frac{1}{2}$SD ≤ FOHB ≤ M + $\frac{1}{2}$SD = at moderate level Formula (1)

FOHB >M + $\frac{1}{2}$SD = at strong level

The face and content validity of the questionnaire was confirmed by a panel of experts. In other words, expert opinion was used to assess face and content validity. For this purpose, both qualitative and quantitative methods were considered. In the qualitative review of the content, the researcher asked the experts to provide the necessary feedback on the tools on which the items will be modified. In quantitative content validity, content validity ratio (CVR) and content validity index (CVI) are used to determine the content validity. This study used qualitative methods, so the researcher asked a panel of experts that read the questionnaire and provided necessary feedback; after receiving their input, the final questionnaire was set. For conforming reliability of the questionnaire, a pilot

study was conducted, yielding internal consistency coefficients (Cronbach's alpha) ranging between 0.76 and 0.85 for the different scales of the questionnaire, suggesting acceptable levels of reliability for all variables (Table 3). The survey data were analyzed using $SPSS_{23}$ and $Amos_{22}$ software packages.

## Results

### Demographic features

Demographic data revealed that 91.6% of the respondents were male (8.4% were female). They had an average age of 46.5 years and an average time of 24.3 years in farm work. In terms of education, 2.7% were illiterate (no formal education), 21.4% were graduates of elementary school, 48.6% were graduates of intermediate school, 18.9% had a diploma, and 8.4% had an academic degree. Farming was the main job of 66.2% of the participants; whereas, the main job of 2.7%, 22.7%, and 8.4% were animal husbandry, farming-animal husbandry, and homemaking, respectively. The average land area of the farms was 8.25 ha. In the studied region, 62.7% of the farmers' products were agricultural crops (such as wheat, barley, and rapeseed), while horticultural crops (such as apple, peach, and date) accounted for 4.1% of the products. Summer crops (such as cucumber, tomato, watermelon, and melon) accounted for 2.7%, and 30.5% was accounted for by a mix of crops. Farmers participating in the survey worked an average of 8.3 hours/day on their farms, but they would spend more hours with an increase in farm work activities in peak farm work seasons. Nearly three out of four respondents (71.4%) had not taken part in occupational health-related training courses. Among the trained participants, 24.6% had been trained by Jihad-e Agriculture Organization and 4% by Rural Health House. Among the participants, 45.7% had experienced an incident during farm work and 41.4% had witnessed occupational incidents and injuries happened to others.

**Table 2.** The population and sample size by county.

| Counties | | Research population | Sample |
|---|---|---|---|
| Eslam Abadgharb | | 12,760 | 39 |
| Paveh | | 30 | 1 |
| Slasbabajani | | 3307 | 10 |
| Jvanrod | | 2033 | 7 |
| Dalahow | | 6707 | 22 |
| Ravansar | | 9554 | 30 |
| Songhor Koliaiee | | 15,440 | 46 |
| Sarpol zahab | | 10,021 | 30 |
| Sahneh | | 12,144 | 37 |
| Kermanshah* | | 35,230 | 101 |
| Kangavar | | 4418 | 13 |
| Gilangharb | | 6667 | 20 |
| Ghasreshirein | | 3434 | 10 |
| Harsien | | 5155 | 16 |
| Total | 126,900 | 382 | |

*There is a Kermanshah county within Kermanshah province.

**Table 3.** Cronbach's alpha for the variables.

| Variables | Number of items | Cronbach's alpha coefficients |
|---|---|---|
| Perceived severity | 3 | 0.92 |
| Perceived barriers | 6 | 0.89 |
| Perceived susceptibility | 4 | 0.76 |
| Perceived self-efficacy | 3 | 0.91 |
| Perceived benefits | 4 | 0.85 |
| Cues to action | 3 | 0.89 |
| Occupational health behavior | 31 | 0.91 |

### Occupational health behavior of farmers

The present research considered farmers' occupational health behavior (FOHB) with respect to five criteria, including protection against sunlight, protection against work-related noise, ergonomics, the use of chemical pesticides, and the use of farm machinery. Results for the protective behavior against sunlight showed that only half of the farmers used sunglasses (48.2%) or hats (41.4%) during farm work, and only one out of three stopped working at noon (35.7%). Many farmers were often exposed to sunlight at 10:00–14:00 (30%) and mostly worked under sunlight (32.2%). Most farmers never used ear protection (58.6%) or cotton (56.8%) (ordinary cotton balls or tissue paper was stuffed into the ear canals are very poor protectors; they reduce noise only by approximately 7 dB and are not considered as adequate protection) to protect themselves against work-related noise and never fixed or repaired noisy equipment (52.2%). With respect to ergonomic activities, a minority of farmers usually picked up loads from an appropriate height (28.4%), frequently changed their stance during weeding (39.5%), or took short breaks during work (35.9%). Also, they often carried loads not matched with their physical strength (64.6%) and rarely helped others carry heavy loads (31.6%).

Another occupational health risk of farmers is the use of chemical pesticides. According to the survey, only one out of three farmers never ate or drank (34.3%), smoked (29.5%), or stood in the wind direction (29.2%) during the application of pesticides (pesticides can spray on farmers' bodies by the wind). A quarter of the farmers never or seldom wore safety clothing during pesticide spraying, (27.6%) and only one out of three (35.1%) usually washed their equipment after spraying. Most farmers (61.9%) kept pesticide cans and containers for other applications, and half of them (50.5%) kept pesticides in food or beverage-specific containers. A large majority of the farmers never wore a seatbelt when operating agricultural machinery (71.6% never used cabin-equipped equipment [tractor with cabin or chamber] and 37% sometimes drove tractors on land with steep slopes). The precise percentages are presented in Table 4.

When using ISDM to check the status of FOHB, 29.4% of farmers had weak occupational health behavior. This means that nearly one-third of farmers rarely took protective measures as to sunlight, job-related noise, ergonomics, the application of chemical pesticides, and the use of farm machinery. In contrast, 39% and 31.7% of farmers displayed moderate or strong occupational health behavior, respectively. This implies that most farmers have moderate occupational health behavior. In this study, according to the definition of health behavior, which is the avoidance of incorrect behaviors and observance of correct behaviors, the behavior was examined. Therefore, the designed questionnaire was a combination of both types of unsafe behavior (such as eating and drinking during pesticide spray, and smoking during pesticide spray) and safe behavior (such as using sunglasses at work, wearing ear protection, and changing stance frequently during weeding or harvesting with hand). Finally, in SPSS, both types of behavior (safe behavior and unsafe behavior) were computerized, and one type of behavior was presented and analyzed. Using the ISDM criteria, farmers' behavior in the field of occupational agricultural health was divided into three levels: weak, medium, and strong. So, 29.4% of farmers had weak occupational health behavior. This means that nearly one-third of farmers rarely took protective measures related to sunlight, job-related noise, ergonomics, the application of chemical pesticides, and the use of farm machinery. In contrast, 39% and 31.7% of farmers displayed moderate or strong occupational health behavior, respectively. It should be mentioned that the present research considered FOHB with respect to five criteria, including protection against sunlight, protection against work-related noise, ergonomics, the use of chemical pesticides, and the use of farm machinery. But farmers' behavior was different in various fields. Findings indicated that 56% of farmers had strong protection behavior against sunlight, 48% had strong protection behavior against work-related noise, 63% had strong ergonomics activities, 68% had strong protection behavior in the use of chemical pesticides, and 56% had strong protection behavior about the use of farm machinery.

### Path analysis for the display of occupational health behavior by farmers

The causal model of farmers' occupational health behavior was studied by path analysis. This analysis

**Table 4.** Farmers' occupational health behavior.

| Behavior | Item | Never | Rarely | Sometimes | Often | Always |
|---|---|---|---|---|---|---|
| Protection against sunlight | Using sunglasses at work | 3.8 | 50.8 | 14.6 | 23.5 | 7.3 |
| | Working in shadow when sunlight is intense and direct | 3.5 | 21.4 | 25.4 | 32.2 | 17.6 |
| | Not exposure to sunlight at 10:00–14:00 | 3.5 | 28.6 | 23.8 | 30 | 14.1 |
| | Wearing long-sleeve and appropriate clothes | 4.4 | 12.7 | 19 | 49.1 | 14.8 |
| | Wearing hat | 11.9 | 41.4 | 16.8 | 14.6 | 14.4 |
| | Wearing sunscreen | 3 | 12.7 | 49.8 | 17 | 17.6 |
| | Stopping work at noon | 8.9 | 35.7 | 13.5 | 19.2 | 22.7 |
| Job-related noise | Wearing earmuffs | 58.6 | 20.3 | 10.8 | 8.1 | 2.2 |
| | Placing cotton in ears | 56.8 | 19.7 | 18.1 | 4.3 | 1.1 |
| | Fixing or replacing noisy equipment | 52.2 | 21.6 | 16.5 | 8.6 | 1.1 |
| | Working less in noisy places | 37.8 | 30.8 | 13.5 | 16.2 | 1.6 |
| Ergonomics | Bending to pick up a load | 25.4 | 23.2 | 15.9 | 30.8 | 4.6 |
| | Not bending the back while picking up a load | 26.2 | 26.2 | 2.03 | 21.6 | 5.7 |
| | Picking up a load from suitable height | 20.5 | 27.8 | 19.5 | 28.4 | 3.8 |
| | Changing stance frequently during weeding or harvesting with hand | 14.1 | 21.4 | 18.4 | 39.5 | 6.8 |
| | Taking short breaks during works that need bending or kneeing | 11.9 | 30.3 | 15.9 | 35.9 | 5.9 |
| | Matching the load with own physical strength | 14.9 | 35.4 | 22.7 | 19.2 | 7.8 |
| | Not rotating during picking up a load | 17.0 | 29.2 | 29.7 | 17.6 | 6.5 |
| | Giving a hand to peers to carry a load | 9.2 | 31.6 | 20.3 | 28.1 | 10.8 |
| Application of chemical pesticides | Eating and drinking during pesticide spray | 34.3 | 30.8 | 9.7 | 16.2 | 8.9 |
| | Smoking during pesticide spray | 29.5 | 22.2 | 17.0 | 18.6 | 12.7 |
| | Using the required protective apparatus | 8.9 | 30.3 | 31.6 | 25.1 | 4.1 |
| | Wearing safe clothes during pesticide spray | 9.2 | 18.4 | 32.7 | 31.1 | 8.6 |
| | Preventing the reach of children or animal to pesticide preparation and application places | 35.1 | 32.2 | 16.8 | 9.5 | 9.4 |
| | Keeping pesticide cans for further applications | 5.1 | 12.4 | 17.5 | 27.0 | 38.1 |
| | Keeping pesticides in food or beverage-specific containers | 15.1 | 18.4 | 23.0 | 20.0 | 49.5 |
| | Pouring pesticides carefully | 19.5 | 33.2 | 22.4 | 18.9 | 5.9 |
| | Washing all equipment after work | 15.1 | 18.4 | 35.4 | 23.0 | 8.1 |
| | Not standing in wind direction during pesticide application | 29.2 | 26.2 | 15.1 | 21.1 | 8.4 |
| | Preparing and using pesticides in the required quantity | 18.4 | 34.6 | 18.9 | 20.3 | 7.8 |
| Farm machinery | Fastening seatbelt during work with farm machinery | 71.6 | 1.9 | 4.9 | 18.9 | 2.7 |
| | Using cabin-equipped machinery | 1.4 | 61.1 | 12.2 | 21.9 | 3.5 |
| | Not driving tractors in lands with steep slope | 3.8 | 14.6 | 21.1 | 23.5 | 37.0 |

assesses the impacts of a set of variables on each other. Before path coefficients were calculated, the fitness indices of the HBM were examined. To find out the extent to which the research model is consistent with the applied data, the overall fit of the model was assessed by the relevant fitness indices. The conditions to ensure the data-model fitness is that the ratio of $\chi^2$ (Chi-Square) to degrees of freedom should be <5. Based on Chi-Square, the null hypothesis is that the model fits completely with the statistical population data. When the chi-square is statistically significant, it results in the rejection of the null hypothesis. GFI should be >0.9. The value of this index should be between zero and one, and a value of greater than 0.9 indicates an acceptable fit of the model. CFI should be >0.9. CFI show to what extent the model fits better than the baseline, which is the independence model. The values of all these indices are between 1 and 0. The closer it is to 1, the better the fit of the model will be. RMR should be <0.05. When this value is less than 0.05, it indicates an acceptable fit of the model. RMSEA should be <0.08. When this value is less than 0.05, it shows that the model is well fitted. If the value is between 0.05 and 0.08, the fit is acceptable, if it is between 0.08 and 0.1, the fit is average, and if it is greater than 0.1, the fit is poor. IFI should be close to 1. IFI is between zero and one. The closer it is to 1, the better the fit of the model will be . These indices are presented in Table 5. Accordingly, most reported indices are in the acceptable range for the theoretical model of the study, proving the overall fit of the model. So, it can be claimed that the HBM is generally consistent with the applied data.

An estimation of the structural model testing the significance of the path coefficients of the research model revealed that the demographic variables had a direct effect on individual beliefs (Table 6). Specifically, the farmer's age had a significant positive effect on perceived susceptibility ($\beta = 0.236$, $P < 0.01$), perceived severity ($\beta = 0.211$, $P < 0.01$), and perceived barriers ($\beta = 0.236$, $P < 0.000$),

**Table 5.** The fitness indices of the structural model.

| Test | Recommended value | Proposed model |
|---|---|---|
| Likelihood ratio Chi-square (x2) | Insignificant x2 (p > 0.05) | 0.000 |
| Normed chi-square (x2/df) | x2/df <5 | 3.45 |
| Root Mean Square Residual | RMR<0.05 | 0.07 |
| Root Mean Squared Error | RMSEA<0.08 | 0.07 |
| Goodness-of-Fit Index | GFI>0.90 | 0.92 |
| Incremental Fit Index | IFI = Values close to 1 | 0.93 |
| Comparative Fit Index | CFI>0.90 | 0.92 |

**Table 6.** The effect of demographic variables on the HBM components.

| Variables | Age | Level of education | Experience in farming | Farm size | Working hours |
|---|---|---|---|---|---|
| Perceived susceptibility | 0.236** | 0.049 | −0.013 | 0.185** | 0.141* |
| Perceived severity | 0.211** | −0.042 | 0.233** | 0.001 | 0.286** |
| Perceived benefits | 0.142 | 0.054 | 0.177* | 0.129 | 0.166* |
| Perceived barriers | 0.443** | 0.19** | −0.121 | 0.174* | −0.029 |
| Perceived self-efficacy | 0.121 | 0.268** | 0.016 | 0.170* | 0.198** |

** $p< 0.01$ * $p< 0.05$

indicating that the older the farmer is, the higher the perceived susceptibility, perceived severity, and perceived barriers are. Moreover, perceived severity ($\beta = 0.233$, $P < 0.01$) and perceived benefits ($\beta = 0.177$, $P < 0.05$) were also positively and significantly predicted by experience in farm work. This means that farmers who have been in the farming job for a longer time had a higher perceived severity for risks and perceived benefits of taking precautionary measures. In terms of structural characteristics, farm size also had a significant positive impact on perceived susceptibility ($\beta = 0.185$, $P < 0.01$), perceived self-efficacy ($\beta = 0.170$, $P < 0.05$), and perceived barriers ($\beta = 0.174$, $P < 0.01$), implying that the bigger the farms are, the higher the perceived susceptibility, perceived self-efficacy, and perceived barriers by the farmers. Working hours at farm had a significant positive impact on perceived susceptibility ($\beta = 0.141$, $P < 0.05$), perceived self-efficacy ($\beta = 0.198$, $P < 0.01$), perceived severity ($\beta = 0.286$, $P < 0.000$), and perceived benefits ($\beta = 0.166$, $P < 0.05$). Finally, the farmers' education level influenced perceived self-efficacy ($\beta = 0.268$, $P < 0.000$) and perceived barriers ($\beta = 0.190$, $P < 0.01$) positively and significantly. So, the higher the education level is, the higher his perceived self-efficacy and perceived barriers to taking precautionary measures are.

As Figure 2 shows, some demographic variables (age, experience in farming, farm size, working hours, and level of education) and components of the HBM (perceived susceptibility, perceived benefits, perceived self-efficacy, and cues to action) had a significant effect on the process of FOHB. With respect to the effects of the HBM components on FOHB, four components had a significant positive effect on protective behavior (Table 7): perceived susceptibility had the highest impact ($\beta = 0.420$, $P < 0.001$), followed by cues to action ($\beta = 0.399$, $P < 0.001$), perceived self-efficacy ($\beta = 0.159$, $P < 0.01$), and perceived benefits ($\beta = 0.118$, $P < 0.05$). Perceived severity was not significantly related to FOHB. The $R^2$ for the prediction of FOHB by the components of the HBM was estimated to be 0.549. This implies that 54.9% of the variance of FOHB is determined by the HBM components. But, the components of perceived severity and perceived barriers had not a significant effect on FOHB. Perceived severity refers to the degree farmers deem a particular disease or condition is serious in the workplace. In other words, perceived severity includes how farmers perceive the deleterious consequences of a serious health event or outcome. Also, perceived barriers refer to farmers' estimation of the level of challenge of social, personal, environmental, and economic obstacles to their occupational health behavior or their desired goal status on that behavior.

## Discussion

The results of this study revealed that most components of the HBM had a significant effect on FOHB in Iran. Perceived susceptibility was found

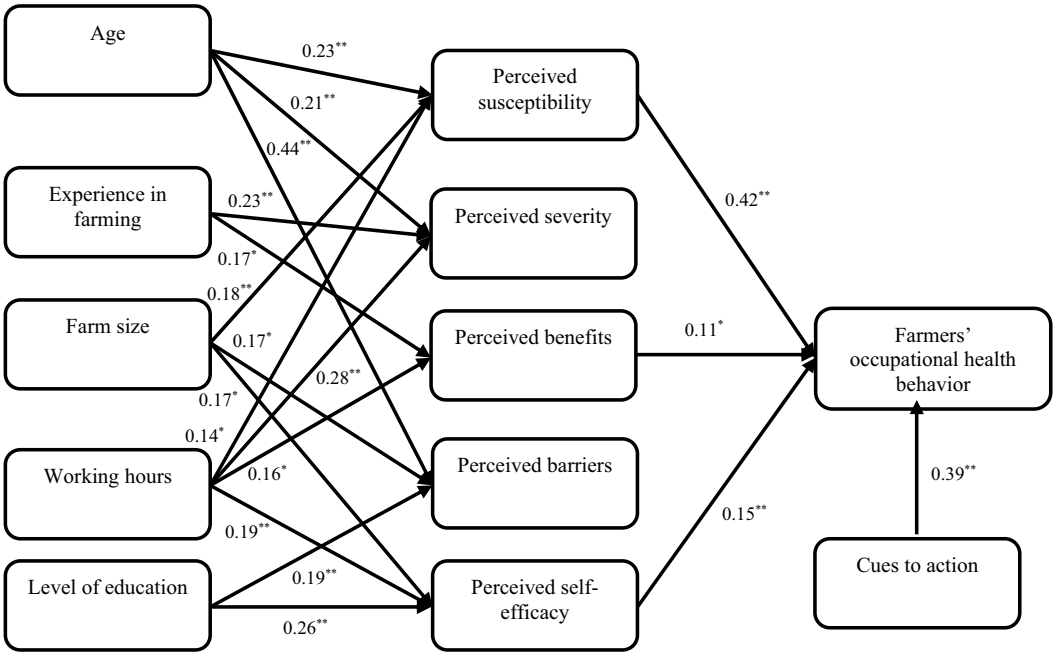


**Figure 2.** The structural model of farmers' occupational health behavior.

**Table 7.** Analysis of direct and indirect effects of variables on the farmers' behavior.

| Variables | Direct effect | Indirect effect | Total effect |
|---|---|---|---|
| Working hours | 0 | 0.141 | 0.141 |
| Farm size | 0 | 0.085 | 0.085 |
| Experience in farming | 0 | 0.06 | 0.06 |
| Level of education | 0 | 0.117 | 0.117 |
| Age | 0 | 0.071 | 0.071 |
| Cues to action | 0.399** | 0 | 0.399 |
| Perceived self-efficacy | 0.159** | 0 | 0.159 |
| Perceived barriers | 0.087 | 0 | 0.087 |
| Perceived benefits | 0.118* | 0 | 0.118 |
| Perceived severity | 0.074 | 0 | 0.074 |
| Perceived susceptibility | 0.420** | 0 | 0.420 |

** $p < 0.01$ * $p < 0.05$

to be the strongest predictor of FOHB. This confirms findings from previous research.[33,38,40,45] showing that farmers' perceived susceptibility for injuries is a determinant of their occupational health behavior, in the sense that farmers who perceive and believe that they are exposed to risk on the farm are more likely to avoid these risks and/or take protective actions. In other words, perceived susceptibility will not be established unless farmers are aware of the dangers and diseases caused by non-compliance and attention to safeguards in their work.

In addition, our study demonstrated that cues to action increase the predictive potential of the model and FOHB. This is consistent with other scholars[36,41,42,46,47] who found that occupational health behavior is influenced by health messages, collective interactions, and advice from respected people like physicians, local and religious leaders, and trusted mass media. Kamimura et al. [18] argue that human communication can enhance a sense of need for protective actions in individuals and thereby increase protective behavior.[18] To the extent that farmers are influenced by information from various sources in society, these messages can serve as cues to action to change the path towards appropriate behaviors inducing health, and the best is that these sources of information create a sense of notice to safety among farmers.

Perceived self-efficacy is another variable that affects occupational health behavior among farmers significantly. This is consistent with various

experimental studies demonstrating that perceived self-efficacy can affect people's behavior.[27,37,48,49] In other words, if farmers are well aware of their abilities and believe that they can protect themselves against the risk factors during agricultural activities, their protective behavior will be enhanced. So, in line with the HBM, farmers' perception of their ability to protect their own physical and mental health can improve their occupational health behavior.

Finally, our study also confirmed the significant role of perceived benefits in predicting FOHB, which has also been reported by others.[31,32,38,40] As personal belief in the effectiveness of recommended behavior to alleviate risks and/or the seriousness of its impact can influence people's behavior, perceived benefits lead to activities that positively influence farmers' health. If farmers understand the benefits of applying safety principles to agricultural work – in other words, they understand the objective and psychological costs associated with adhering to safety principles – their protective behavior will also improve. Based on the results, some educational priorities can be considered to improve farmers' occupational health behavior, such as occupational health training in local language, continuing occupational health training in agricultural work, recounting the dangers of work and showing concrete and tangible examples of affected people in agriculture activities, and the need for assessment and appropriate design of occupational health training in agricultural work.

In addition to the main constructs of HBM, our study also considered farmers' demographics as modifying factors of occupational health behavior. The results showed that demographic features had a significant effect on the process of adopting occupational health behavior by farmers. This is in agreement with Støle *et al.* and Jeong and Ham, who enumerated a list of demographic characteristics that affected the occupational health behavior of people.[41,42] For example, farmers with a higher level of education are more likely to believe in the objective and mental costs of the recommended activities and have a better perception of their abilities to perform the behavior. On the other hand, a high level of education is expected to enhance the ability to make informed decisions about health and compliance with health behaviors. On the other hand, farmers with a longer experience in farming activities have a more accurate risk perception and a stronger belief that if they do not adopt occupational health behaviors, they will expose themselves to serious risk. On the other hand, older farmers assume more physical, mental, and/or financial barriers against the adoption of occupational health behavior.

## Conclusion

People's safety at work has always been a priority in occupational health. In the agricultural sector, in which farmers are exposed to many risk factors for incidents, the focus on health and safety behavior is a priority for research and risk management.[50–55] The present study aimed to explore the factors that contribute to farmers' occupational health and safety behavior based on the HBM. The results showed that four components of the HBM, notably perceived susceptibility, perceived benefits, cues to action, and perceived self-efficacy, influence FOHB. Thus, farmers' belief in their chance of exposure to a risk situation (perceived susceptibility), as well as their belief in the efficiency of the recommended activities to reduce the danger and/or the seriousness of the impact (perceived benefits), and their perception of their ability to pursue occupational health behavior (perceived self-efficacy) will lead to an intention to display more adequate occupational health behavior, while the presence of factors or events in the context (cues to action) can induce them to put these intentions into practice and take protective action. As such, the findings confirm the capacity of the HBM to explain FOHB and the relevance of using the theory in studies of farmers' protective behaviors such as the use of chemical pesticides, protection against sunlight, protection of hearing, etc.

The study further demonstrated that demographic characteristics act as modifying factors for the impact of the HBM components on FOHB. So, to study and address FOHB, one should first consider the farmers' demographic characteristics, as farmers exhibit different occupational health behaviors depending on such characteristics as age, educational level, number of years working in agriculture, land area, and so on.

Based on these findings, policymakers and local stakeholders should be encouraged to motivate farmers and provide information to encourage farmers to adopt protective actions. Furthermore, training about occupational health in the workplace should not only instruct farmers about risks and about the need for

occupational health behaviors but also enhance perceived effectiveness of the recommended activities in risk mitigation at farms among farmers. In addition, it is necessary to comprehensively plan for farmers' active participation in different health projects and activities so that they can grasp their abilities to pursue occupational health behavior.

## Disclosure statement

No potential conflict of interest was reported by the authors.

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