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Improvement of Cardiovascular Risk Factors by Applying a Modified Educational Model of Planned Behavior Among the Employees of a Large Petrochemical Company

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Abstract

Background: One of the most important non-communicable diseases (NCDs) is cardiovascular disease (CVD). CVDs caused an increase in treatment costs and sick-leave hours in employees. These diseases are originated from unhealthy behaviors. Education and training health behaviors are a necessity in the workplace. Worksites that are exclusively situated to provide interventional education would effectively reduce the risk of cardiovascular disease in employees. Petrochemical industries are regarded as the key industry and improving the working conditions leads to employees' satisfaction and remarkable productivity levels.
Objectives: The current study was aimed at investigating the impacts of the theory of planned behavior (TPB)-based nutritional education on the risk factors of CVD in the employees of petrochemical companies.
Methods: The current study was a randomized controlled field trial. The subjects were male employees aged 30 to 60 years, with at least 3 years of work experience. The employees had at least one type of blood lipid abnormalities according to their medical checkups. One hundred and four participants were randomly selected and divided into 2 groups of intervention and control. Educational program was performed in 5 educational sessions. Individuals' data were collected before and 3 months after the intervention using demographic, TPB questionnaires and serum lipid profiles.
Results: Totally, 92 participants were included in the study: 49 participants in the intervention group with the mean age of 42.30 $\pm$ 9.13 years, and 43 in the control group with the mean age of 43.18 $\pm$ 8.75 years. Significant differences between the scores of knowledge and other items of TPB model as well as nutritional indices were observed in the intervention group after 3 months (P value $<$ 0.05). The mean serum levels of low-density lipoprotein (LDL) reduced significantly, after the intervention (P value $<$ 0.05). Improvements in serum cholesterol (intragroup) and high-density lipoprotein cholesterol (HDL-C) (intergroup) levels were near-significant post-intervention group (P value $<$ 0.06).
Conclusions: Tailored nutrition education program was effective in improving of nutritional behaviors and serum level of LDL-C in the employees of the petrochemical companies.

Keywords: Cardiovascular Disease, Training Programs, Employees, Behavior

1. Background

Non-communicable diseases (NCDs) are the increasingly significant factors behind disability and early fatality in both developing and recently developed countries. The fast transition in meal behaviors, lifestyle, and the cultural variations are the major factors that contribute to NCDs burden. Both equally preventive and corrective steps are required to reduce the disease burden and ensure a healthy and productive workforce. One of the most important NCD diseases is cardiovascular disease (CVD) (1) as the leading global cause of death, accounting for 17.3 million deaths per year (2). Moreover, the World health organization (WHO) estimated that about 20 million people in the world will die from CVDs in 2030 (3). In Iran, more than 40% of mortality is caused by cardiovascular diseases (4); age, family history, dyslipidemia, hypertension, obesity, physical inactivity, atherogenic diet, and tobacco smoking are the major risk factors for CVDs (5). Based on the research conducted by Leyr et al., various environmental factors such as abnormal work time, poor eating habits, low nutrition knowledge, working stress, and risk factors of CVD can be easily advanced among employees. Further-

more, organizational employees are at-risk of CVD. High prevalence of CVD risk factors is reported in the employees of a giant petrochemical company. The prevalence of hypercholesterolemia, hypertriglyceridemia, and elevated degrees of atherogenic low-density lipoprotein (LDL) was observed in 41.4%, 32.7%, and 85.6% of the employees, respectively. These diseases increase the treatment costs and sick-leave hours in the employees of petrochemical companies, which reduce their effectiveness and finally make them ineffective (6). Because cardiovascular diseases are originated from unhealthy behaviors, education and training of health behaviors are necessary at the workplace (7). Worksite health programs are regarded as successful techniques to prevent major risk factors of CVD including tobacco use, overweight, hypertension, dyslipidemia, physical inactivity, and diabetes. Historically, health programs include education and screening programs to increase individual employees' knowledge regarding the risk factors, and suggest the methods to modify health behaviors (8). Several studies have reported the benefits of educational intervention and workplace health programs on the risk factors of CVD (9, 10).

Furthermore, worksites that exclusively provide interventional education would effectively reduce the risk of cardiovascular diseases in employees (11). Finally, reducing these diseases and underlying risk factors through educational intervention brings about economic benefits, decreased health medical care costs, and higher employee productivity at the workplace (12).

Nutrition education helps employees investigate their own nutritional behaviors, learn proper lifestyle, and solve their nutritional problems. Specifically, nutrition education provided at work is especially beneficial for the employees that cannot visit the medical centers, because of the work schedule. From the welfare view, it can also boost the work ambition of employee (13). The importance of nutrition education programs depends on the level of their effectiveness (14). Nutrition education programs can be more effective if they are supported by a model or theory specifically addressing changes in nutrition behavior (15).

The theory of planned behavior (TPB) is an individual level of health behavior theory used to understand a variety of health behaviors (16). The components of the TBP include attitudes towards the behavior, subjective norms, perceived behavioral control, and behavioral intention (16). The TPB is extensively used to identify the determinants of a wide range of behaviors (17). The TPB is applied to a range of diet and weight related behaviors including fruit and vegetable consumption (18); healthy eating behaviors (19) and weight control (20).

Petrochemical industries are regarded as the key industries, and improving the working conditions, which leads to employees' satisfaction, has a remarkable role in improving the productivity levels. The current study was aimed at assessing the efficiency of modified TPB regarding nutrition education to reduce the CVD risks in a giant petrochemical company.

According to the authors' best knowledge, although some previous studies investigated health-related factors among the employees of petrochemical companies (21, 22), no research is conducted to measure the effectiveness of a tailored educational program to correct healthy nutritional behaviors and control CVD among the employees of a giant industrial company, using TPB model.

Some studies have reported the effects of TPB-educational models on health behaviors, however, their impacts on metabolic status and risk factors of CVD are not investigated yet. Therefore, our study was conducted to evaluate the effects of modified educational model of planned behavior on improving the CVD risk factors including serum lipid profile and nutritional behaviors in the employees of a petrochemical company.

2. Objectives

The current study was aimed at investigating the impacts of TPB-based educational intervention to correct nutritional behaviors and reduce the cardiovascular risk factors in the employees of Razi petrochemical company in Mahshahr (South-West of Iran, located by the Persian Gulf, Iran).

3. Methods

3.1. Study Design

The current study was a randomized controlled field trial. All subjects signed written informed consent before enrollment in the field trial. The sample size was determined based on the primary information obtained from the study by Allen et al., for serum cholesterol (10). For the α-value of 0.05 and power of 90%, the sample size was computed as 43 subjects per group. However, considering possible sample loss of 20%, a total of 104 patients were evaluated. The number of subjects increased to 52 per group to accommodate the anticipated dropout rate. Participants who attended Razi petrochemical company in Mahshahr (Khuzestan province, Iran) and met the inclusion criteria were selected by a randomized sampling method.

A pre/post-test was used to evaluate the program employed to improve the participants' dyslipidemia, including serum total cholesterol, high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), triglycerides, and TPBs' components of attitude,

subjective norms, behavioral intention, and nutritional behaviors. The primary outcome measures were changed in serum levels of lipid profile. The Medical ethics committee of Ahvaz Jundishapur University of Medical Sciences approved the study protocol (IR.AJUMS.REC.1395.153). There was just one observer throughout the study.

3.2. Participants

All subjects were male employees, aged 30 to 60 years with at least 3 years work experience. The current intervention compared the effect of a tailored educational program on cardiovascular risk factors of employees who received education (intervention) with those of age matched employees who did not receive any education as the control group.

3.3. Inclusion/Exclusion Criteria

Participants included 104 male employees, aged 30 to 60 years with at least 3 years work experience and 1 type of blood lipid abnormality that were randomly divided into the intervention and control groups (52 subjects in each group). Employees who were not willing to participate in the educational classes, had any types of thyroid dysfunction or cardiovascular diseases or took aspirin, and had statins were excluded from the study. Individuals who intended to discontinue the study were also excluded. Finally, 92 participants were included in the study. The details of the sampling are given in the method section (Figure 1).

Data were collected from June until September 2016 at Razi petrochemical company (RPC), one of the greatest private petrochemical companies in the region located in Mahshahr, South-West of Iran, by the Persian Gulf. The subjects were, then, invited to a briefing session at the clinic of RPC. The main investigator explained the study and its purposes. All participants signed the written informed consent.

3.4. Blood Sampling and Biochemical Assays

Fasting blood samples were obtained at the start and end of the 3 months intervention. The subjects were asked to fast overnight for 12 to 14 hours. Fasting blood samples (5 mL) were taken from the subjects to evaluate the lipid profile. Serums were stored at -70°C and analyzed according to the lipid research clinics protocol (23). Serum total cholesterol, triglycerides, and HDL-C were measured after dextran sulfate–magnesium chloride precipitation (24) by enzymatic method using Pars Azmoon Kits and LDL-C was calculated by Friedewald formula (25). All equipments were routinely calibrated at the beginning of each work day using the standard protocol provided by the manufacturers.

3.5. The Study Questionnaire

To evaluate the reliability and validity of the questionnaires, a cross sectional study selected 30 male employees aged 30 to 60 years in RPC. The questionnaires were developed based on the TPB contents and modified in accordance with the individuals' needs. The first part included demographic and anthropometric questions such as age, height, weight, body mass index (BMI), education level, marital status, occupational status, and disease history. The second section included the questions on the structures of the TPB. A self-designed questionnaire was used to assess behavioral intention, attitude, subjective norms, and perceived behavioral control (PBC) using the guidelines for TPB questionnaire construction (26). Considering several different measures on TPB construct, a set of specific items were produced for the current study. After careful examination, a final set of 35 items was approved. Questions included 11 items on attitude, 6 items on subjective norms, 7 items on perceived behavioral control, and 11 items on behavioral intention. Answers were scored based on a 5-point Likert scale, ranging from 5 (strongly agree) to 1 (strongly disagree). The third section consisted of 20 questions on nutritional behavior, weight management, and exercises such as walking during in the past 3 months (scores from one to five; 1 for never and 5 for always).

The questionnaire validity was measured by the content validity and face validity evaluation methods. For this purpose, based on valid prepared sources and references, and for the final examination of content validity, comments of 5 experienced professors, received by correspondence, were considered and applied in the questionnaire. The researcher-designed questionnaire was given to 30 male employees (homogenous and non-participants) to obtain its face validity. Comments, questions, and notes pointed out by this group were also considered. The reliability of the questionnaire was measured by the test-retest method for awareness and r = 0.75 was obtained. Questions and internal consistency of other items were evaluated by Cronbach's alpha in which $\alpha = 0.8$ was obtained.

3.6. Educational Sessions

The educational intervention, performed in 5 educational sessions, aimed at avoiding trans-fatty acids intake, using less saturated fat, and simple carbohydrates, and increasing fruits, vegetables, and whole grains consumption while emphasizing eating breakfast and healthy snacks at work. The details of training sessions were as follows:

First and second sessions: The sessions included CVD and its signs, complications and diagnosis, risk factors, dyslipidemia, normal ranges of blood lipids, and weight management. In these sessions the subjects were provided

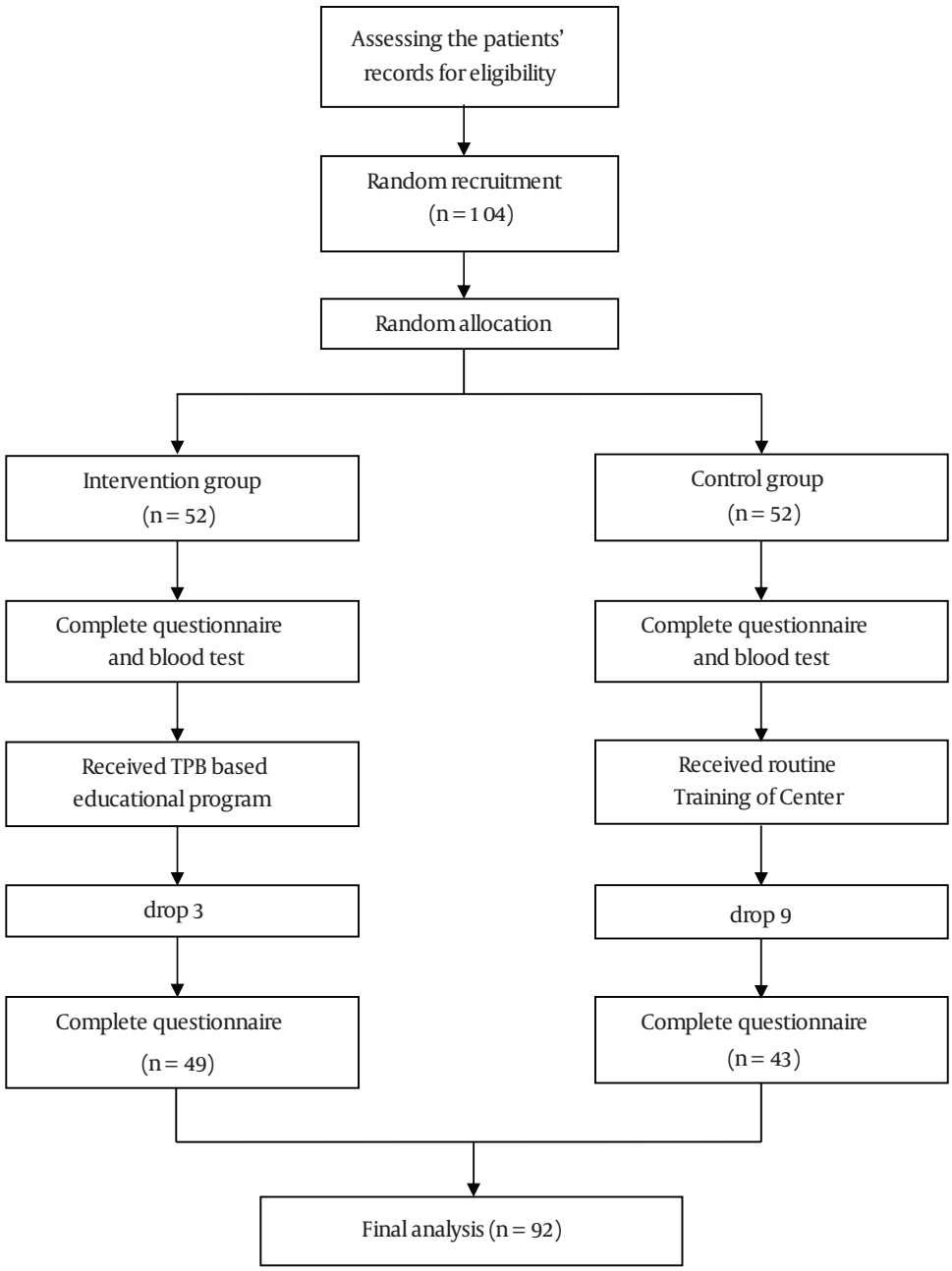

Figure 1. Diagram of the Research Method

with all educational materials as a pamphlet prepared by the research team to educate the intervention group and their families.

Third and fourth sessions: These sessions included the role of healthy nutrition and physical activity in preventing dyslipidemia and cardiovascular diseases, and benefits of following proper dietary recommendations. In each session, important nutritional questions and answers that affected the awareness of the subjects were distributed.

Educational contents delivered through making

speech, question and answer sessions, and group discussions along with distribution of healthy snacks ended with giving prizes related to healthy diet. Finally, the last session was conducted for the families of the intervention group subjects. In this session, the important role of family members in preparing, facilitating, and providing suitable foods and also the importance of physical activity programs were explained. Question and answer sessions and telephone follow-ups were performed in weeks 4 and 8, post-intervention to emphasize the educational contents and the role of family, and also to provide the answers to possible questions.

To observe research ethics code, the aforementioned contents were given to the control group at the end of the study. Follow-up investigations were carried out 3 months after the training intervention, and the subjects answered the questionnaires again.

3.7. Data ANALYSIS

Data analysis was carried out by SPSS version 20 software (SPSS Inc., IBM, Chicago, IL, USA) on per-protocol analysis, using Chi-square, independent t, paired t, and repeated measurement ANOVA tests. Demographic variables were compared between the 2 groups with the Chi-square test. Components of TPB, nutritional behaviors, and lipid profile were compared between the 2 groups with an independent t test. Statistical significance was determined at P-value <0.05 level. Normal assumption was checked and all data were normally distributed. There were no missing values in the study.

4. Results

Totally, 92 participants were included in the study: 49 participants in the intervention group with the age of 42.30 $\pm$ 9.13 years, and 43 controls with the age of 43.18 $\pm$ 8.75 years. The mean age of the subjects was 42.3 $\pm$ 9.1 years in the intervention group and 43.2 $\pm$ 8.8 years in the control group. There were no significant differences regarding age, work experience, BMI, marital status, and educational level between the 2 groups (Table 1).

Results of independent t test showed that before intervention there was no significant difference between the 2 groups in terms of awareness, attitude, subjective norms, PBC, behavioral intention, and nutritional behavior. However, 3 months after educational intervention, the intervention group showed a significant increase in all aforementioned aspects (P value $<$ 0.05) except PBC; while, the control group indicated no significant changes in all aspects (P value $>$ 0.05) except subjective norms (P value $<$ 0.05); while, the mean score of subjective norms was not different between the groups, before the intervention. It increased in the education group after intervention. However, there were no significant differences between the 2 groups at the end (Table 2).

Table 1. Demographic Variables of the Study Participants

Variable	Control Group	Intervention Group	P Value
Age, y	43.18 $\pm$ 8.75	42.30 $\pm$ 9.13	0.640
Work experience, y	19.55 $\pm$ 8.67	18.5 $\pm$ 9.33	0.580
BMI	28.46 $\pm$ 3.57	28.72 $\pm$ 3.12	0.713
Marital status, No. (%)			
Married	41 (95.3)	45 (91.8)	0.681
Education level, No. (%)			
High school diploma	12 (28)	16 (26.5)	0.630
BSc	24 (55.8)	26 (53.1)	
MSc and higher	7 (16.3)	7 (14.3)	

Baseline values of lipid profile showed no significant differences between the groups (Table 3).

At the end of the intervention, the average serum levels of LDL in the intervention group reduced about 18.08 mg/dL (P value $<$ 0.05), while that of the control group increased more than 10 mg/dL (P value $>$ 0.05). Improvements in serum cholesterol (intragroup) and HDL-C (inter group) levels were near-significant (P value $<$ 0.06, Table 3)

5. Discussion

It is crucial for employers in the private and public sectors to maintain a healthy and productive workplace. There are various environmental factors in the workplace to increase the risk of CVD among employees (6). Although CVDs are the main and most costly diseases in the health sector, at the same time they are most preventable. Therefore, education and training healthy behaviors are regarded as a necessity in the workplace because CVD result from unhealthy behaviors (6).

To the authors' best knowledge, the current study was the first work that applied a modified nutrition education program, based on TPB model and was effective in the improvement of nutritional behaviors and serum levels of LDL-C in a giant industrial company. The results of the current study were supportive of the hypotheses derived from the TPB (27).

The obtained results indicated that the mean of attitude, subjective norms, and behavioral intention regard-

Table 2. Comparison of Mean Scores of Awareness, TPB Model Components, and Nutritional Behaviors Between the Control and Intervention Groups (N = 92)[a,b]

Variable	Control Group (N = 43)	Intervention Group (N = 49)	P Value[c]
Awareness			
Baseline	45.81 ± 20.84	50.72 ± 21.87	0.330
Follow-up	47.81 ± 17.48	75.29 ± 17.07	< 0.005
P value[d]	0.536	<0.005	
Attitude			
Baseline	39.93 ± 4.21	40.04 ± 3.87	0.876
Follow-up	40.72 ± 3.56	42.89 ± 3.81	< 0.005
P value	0.143	<0.005	
Subjective norms			
Baseline	19.27 ± 2.43	19.31 ± 1.95	0.953
Follow-up	20.97 ± 2.58	21.29 ± 3.07	0.601
P value	<0.05	<0.05	
PBC			
Baseline	21.30 ± 4.03	21.89 ± 4.58	0.553
Follow-up	21.84 ± 4.14	22.72 ± 4.55	0.320
P value	0.302	0.216	
Intention			
Baseline	39.46 ± 4.92	40.22 ± 5.35	0.458
Follow-up	41.41 ± 6.30	42.06 ± 5.63	0.608
P value	0.215	0.005	
Nutritional behavior			
Baseline	62.81 ± 7.60	62.75 ± 7.93	0.999
Follow-up	64.79 ± 9.54	66.06 ± 8.21	0.696
P value	0.215	0.005	

Abbreviation: PBC, Perceived Behavioral Control.
[a]Values are expressed as mean (SD).
[b]All tests are conducted at significant level of 5%.
[c]Based on independent t test.
[d]Based on the paired t test.

Table 3. Serum Levels of Lipids of the Control and Intervention Groups[a,b]

Variable	Control Group (N = 43)	Intervention Group (N = 49)	P Value[c]
TG, mg/dL			
Baseline	182.81 ± 84.94	153.45 ± 66.03	0.06
Follow-up	225.48 ± 70.75	161.39 ± 76.36	0.119
P value[d]	0.380	0.247	
TC, mg/dL			
Baseline	188.39 ± 32.06	189.25 ± 23.28	0.827
Follow-up	198.18 ± 49.34	180.83 ± 35.97	0.057
P value[d]	0.078	0.136	
HDL-C, mg/dL			
Baseline	40.34 ± 5.54	41.25 ± 5.75	0.469
Follow-up	41.10 ± 6.45	42.60 ± 5.52	0.235
P value[d]	0.479	0.054	
LDL-C, mg/dL			
Baseline	113.02 ± 33.89	117.45 ± 21.73	0.404
Follow-up	123.62 ± 42.05	99.37 ± 25.10	< 0.005
P value[d]	0.606	< 0.005	

Abbreviations: HDL, High-Density Lipoprotein; LDL, Low-Density Lipoprotein; TC, Total Cholesterol; TG, Triglyceride.
[a]Values are expressed as mean (SD).
[b]All tests are conducted at the significant level of 5%.
[c]Based on the independent t test
[d]Based on the paired t test

ing the nutritional aspects increased post-intervention in the intervention group. Hence, it can be concluded that the intention of healthy nutritional behaviors increased in them. Meanwhile, attitude and behavioral intention had a prominent role among the components of the theory. In fact, the results proved that educational intervention led to reinforcing the beliefs and attitudes of employees and also elevated the score of behavioral intention in nutrition dimension; revealing their tendency to have healthy diets.

Before the intervention, there were no significant differences between the scores of subjects' nutritional behaviors, but they showed significant improvement after the educational intervention. Shafieinia et al., reported that a theory-based educational intervention could increase physical activity behavior in female subjects (28). Unlike the current study, Kinmonth et al., found that an educational intervention based on the TPB had no effect on the amount of physical activity (29). Similarly, Kothe et al., reported that intervention and control groups did not differ in terms of fruit and vegetable consumption after an educational intervention (30).

Although awareness is not a part of TPB, however, the impact of education on the level of awareness is an important issue in every educational intervention (31). Based on the current study results, the educational program increased the awareness scores in the intervention group. It was consistent with the results of Caperchione et al., on working adults (32). However, some studies did not indicate any improvements in subjects' awareness (33), while other investigators demonstrated positive effects (31). Easy access of the current participants to the educational materials of healthy nutrition provided by the researchers can be a reason for their awareness increase. Distinguished scientific communities recommend primary prevention in-

cluding promotion of awareness about diseases and their risk factors as the most fundamental and cost effective method to control the CVD (34). Attitude toward behavior also significantly increased after 3 months of intervention in the intervention group. Numerous studies are performed to increase the attitude toward behavior using TPB model. Kothe et al., in a study on evaluating the effect of a TPB-based educational intervention on fruit and vegetable consumption, reported that attitudes toward fruit and vegetable consumption statistically improved by education, which was in the line with the current study findings (30). White et al., in a study on evaluating the effect of a TPB-based educational intervention on the promotion of physical activity and healthy eating in adults with type 2 diabetes, reported that the attitudes toward practicing in regular physical activities statistically improved by education, which was in the line with the current study findings (35). However, White et al., reported no statistically significant changes after the intervention in the attitudes toward healthy diet (35). Furthermore, changing attitudes followed by educational intervention is not always possible. As mentioned above, differences in educational methods based on the theory and measurement tools can cause conflicting results.

TPB-based intervention led to significant increases in subjective norms in the intervention group. However, there were no significant differences between the 2 groups. Subjective norms are a component of the TPB and refer to an individual's perception about a particular behavior influenced by the judgment of others, including family members (especially spouse), employer, health experts, and friends (36). If the key members of life (especially spouses) agree to perform certain healthy behaviors, then it is more likely that the patient will engage in such behaviors (14). Shafieinian et al., also reported that the TPB-based intervention aimed at promoting physical activity had no effect on the subjective norms of the study participants, which were both consistent with the results of the current study (28). In contrast, Kothe reported that the mean score of subjective norms for fruit and vegetable consumption in Australian young adults increased significantly after the TPB-based intervention (30).

As mentioned earlier, the last educational session was conducted for the families of the intervention group subjects to influence their subjective norms. It seems that there were no adequate measures available to increase the social support (i.e., subjective norms) among subjects in the current study; for this purpose, more time should be spent to educate patients as well as their families, employer, and the friends in direct contact with the patients. Doo et al., emphasized the important role of families and other subjective norms in the participants' nutritional behaviors (37).

PBC refers to individuals' beliefs about their ability to organize activities and successfully perform an intended behavior to achieve specific results in certain situations. If there are restrictions on performing the behavior, then the individual may not experience a strong intention to perform that behavior, despite a positive attitude and high subjective norms (38). Shafieinia et al., reported significant improvements in the scores of PBC for the regular physical activity among female employees after an educational intervention that differed from the results of the current study (28). However, Kothe et al., found no statistically significant difference between the participants' PBC before and after the TPB-based intervention for fruit and vegetable consumption (30).

It can be suggested that as PBC depends on the presence or absence of perceived facilitators or barriers to an ability or behavior, there might be numerous barriers to the program or previously existing barriers that were not completely resolved via the educational program. Similarly, Baghianimoghadam et al., found that in a group of people with type 2 diabetes, individuals' understanding of their level of control over their behavior toward walking was associated with age; specifically, greater age was associated with reduced understanding of their control over their own behavior (39).

Although the TPB-based intervention led to significant increase in mean scores of behavioral intention in the intervention group from the baseline, the scores were not significantly different between the 2 groups. The study by Senior Angulo et al., (40) stated that the mean score of intention increased significantly after the TPB-based intervention. However, White et al., reported that the intention to engage in healthy diet was not significantly different between the intervention and control groups, post-intervention (35). It should be noted that although interventions targeting behavioral, normative, or control beliefs may succeed in producing the changes attributed to attitudes, subjective norms, and PBC, and finally individuals' intention toward desired direction, the intervention would have no effect unless the individuals are able to carry out these intentions. Perhaps the most effective means to succeed is a specific plan detailing when, where, and how the desired behavior should be performed (41).

Serum levels of LDL-C in the intervention group decreased significantly at the end indicating that LDL-C levels were decreased to lower than 100 mg/dL that is of clinical importance. According to the current survey, there are no TPB-based interventions that measured serum levels of lipids and other risk factors of cardiovascular diseases. Participants' psychological states could have affected their responses. Controlling this limitation was difficult for the re-

searchers. Although it was tried to separate the groups, all participants were in the same workplace complex; hence, there was a possibility to transfer data between the participants.

5.1. Conclusion

The results of the current study showed the effectiveness of nutrition interventional program in a large workplace and also the importance of nutrition educational interventions to improve nutritional behaviors. Implemeting a tailored and appropriate educational model can be quite applicable in a mother industry.

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Footnotes

Authors' Contribution: Reza Amani, study design and supervision, manuscript editing; Bahar Hassani, study design and data collection, manuscript drafting; Marzieh Araban, consultation on the study design and implementation; Mohammad Hussein Haghighizadeh, statistical data analysis.

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