

# Effect of an educational intervention based on the Theory of Planned Behaviour in type 2 diabetic patients at a foot and eye care practice

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**Background:** Eye and foot problems are two of the most common consequences of diabetes. The goal of this study was to investigate the impact of an educational programme based on the Theory of Planned Behaviour (TPB) on foot and eye care among patients with type 2 diabetes mellitus in Fasa City, Fars Province, Iran.

**Methods:** A total of 100 individuals with non-insulin-dependent diabetes mellitus (Type II) who met the study's inclusion criteria were included. The participants were randomly assigned to one of two groups (intervention = 50, control = 50). The questionnaires were completed by all groups and included demographic information, TPB constructs, foot and eye care, and patients' HbA1c levels. Questionnaires were completed prior to, immediately following, and three months after the intervention by members of the experimental and control groups. During the intervention period, the experimental group attended 10 instructive sessions. SPSS 22 software was used to analyse the data. Paired t-tests, independent t-tests, chi-square, and RMA (Repeated Measurement ANOVA) were all used ( $p < 0.05$ ).

**Results:** Knowledge and all TPB components were significantly increased in the experimental group compared with the control group after intervention. In addition, foot and eye care practice and HbA1c level improved significantly among the experimental group compared with the control group ( $p < 0.001$ ).

**Conclusion:** Applying the TPB is quite helpful in designing an educational programme for diabetic people to control their blood sugar and improve behavioural foot and eye care. Aside from such programmes, follow-up education on regulating and monitoring is strongly advised.

**Keywords:** eye care, foot care, knowledge, Theory of Planned Behavior, type 2 diabetic patients

## Background

Diabetes is one of the most prevalent chronic diseases on a global scale.<sup>1</sup> Due to the expanding number of affected individuals and the disease's severity, these individuals should seek immediate medical assistance.<sup>2</sup> Lack of precise blood glucose monitoring has been identified as a major issue for diabetics.<sup>3,4</sup> According to the World Health Organization (WHO), diabetes affects over 346 million people globally. Without intervention, this figure is anticipated to more than double by 2030.<sup>5</sup> By 2030, it is anticipated that 9.2 million Iranians will have diabetes.<sup>6</sup> Diabetes patients are at an increased risk of developing acute and fatal complications (diabetic retinopathy, peripheral neuropathy, myocardial infarction, peripheral vascular disease, end-stage renal disease, and diabetes-related foot problems and amputation) due to poor blood sugar control.<sup>7</sup> In the absence of therapy, diabetic foot is one of the most serious and debilitating complications of diabetes, resulting in infection, soft-tissue infection or necrosis, and amputation.<sup>8</sup> Jordan believes that with attentive care, 80–85% of diabetic foot amputations can be avoided. Optimal diabetic foot management entails doing daily self-foot inspections, frequently washing and drying feet, avoiding walking barefoot, using orthopaedic shoes, clipping toenails straight across, avoiding manipulation of calluses and corns, and consulting a doctor on a regular basis.<sup>9</sup>

Diabetic retinopathy is another condition that can occur as a result of diabetes. Diabetes can gradually damage the capillaries (small blood vessels) of the retina by altering the veins at artery-vein junctions. These blood arteries may become weaker and bulge, obstructing blood flow, which may be minor and go undiagnosed for extended periods of time.<sup>10</sup> According to studies, diabetes patients have a 25-fold increased risk of blindness compared with non-diabetics.<sup>11</sup> Diabetes, namely diabetic retinopathy, is the main cause of new incidents of blindness in Americans aged 20–74 years.<sup>12</sup> Blood glucose level, hypertension, triglyceride and cholesterol levels, sex, type of diabetes, duration of disease, and age are all major risk factors for diabetic retinopathy.<sup>13</sup> As a result, researchers should focus their efforts on diabetes and its consequences as a global public health priority.

Due to the close relationship between the majority of health problems and human behaviour, behavioural theories and patterns can be utilised to understand better how to avoid and control health problems (including diabetes management and reducing its complications). Indeed, theories can provide answers to some concerns, such as why people behave poorly or what individuals must do to improve their conduct.<sup>14</sup> The Theory of Planned Behaviour (TPB) is one of the most influential and well-supported social psychological theories for forecasting human behaviour. It can be used to evaluate individuals'

subjective norms, values, and attitudes with an emphasis on behaviour prediction dimensions. According to this idea, the most critical determinant of an individual's conduct is behavioural intent, which is impacted by three factors: attitude, subjective norm, and sense of behavioural control.<sup>15</sup> Various studies have pointed to the effectiveness of TPB in explaining, predicting, and intervening in the self-care behaviours of diabetic patients.<sup>16–21</sup> Similarly, Chellan *et al.* noted that the patients in their study lacked awareness regarding proper foot care methods.<sup>22</sup> According to Ayele *et al.*, education has a substantial effect on the self-care actions of people with diabetes.<sup>23</sup> Given the importance of promoting self-care activities in diabetic patients and the need for educational interventions in foot and eye care based on health education and health promotion models, the purpose of this study was to determine the effect of an educational intervention based on planned behaviour theory on foot and eye care practices in type 2 diabetic patients referred to Fasa diabetes clinic in Iran in 2019.

## Methods

This quasi-experimental intervention study was conducted on 100 type 2 diabetes patients referred to the Fasa Shariati Hospital's diabetic clinic in Iran in 2019. Simple random sampling was used to choose samples based on the inclusion criteria (intervention = 50, control = 50).

The estimation of the sample size was calculated based on similar studies<sup>16,17</sup> and by considering the test power of 80%, the confidence coefficient of 95%, the accuracy of 0.05, and the sample loss of 10%, 50 people in each group.

$$n = \frac{s^{\text{Symbol}} \left( Z_{1-\frac{\alpha}{2}} + Z_{1-\beta} \right)^{\text{Symbol}}}{d^{\text{Symbol}}}$$

To enrol participants, we first validated referred patients' medical records against the inclusion criteria and created a sample list; subsequently, participants were randomly picked using random number generation. The following criteria were used to determine inclusion: the ability to read and write, a diagnosis of diabetes for at least six months, a minimum age of 30, the absence of diabetic foot ulcers confirmed by the clinic's physician, and the absence of uncontrolled underlying disease, such as hypertension or psychiatric disorders. Patients who refused to participate or were unable to attend a minimum of three training sessions were excluded from the trial. The study enrolled a total of 200 type 2 diabetic patients who met the inclusion criteria. The remaining 170 were referred to a clinic's expert for eye and foot assessments. Thirty individuals opted out of the trial and 40 participants were omitted from the trial due to issues with their eyes and feet. Finally, 100 individuals were randomly assigned to one of two groups: intervention or control; each group contained 50 people. It should be emphasised that this study was conducted with the approval of the Fasa University of Medical Sciences' research council and ethical committee (Ethical code: IR.FUMS-REC.1396.138). Additionally, participants were informed of their position in the study and the importance of maintaining the confidentiality of their data before providing signed consent for inclusion.

The data collection instrument was a well-validated questionnaire that had been utilised in earlier investigations.<sup>16,17,24</sup> The questionnaire was divided into three sections: the first section

collected demographic data (age, gender, marital status, educational level, type of medical treatment, family history of diabetes, history of smoking, history of other non-diabetes diseases, and duration of diabetes by year); and the second section assessed participants' knowledge of foot and eye care practices (20 items). The second section included dimensions from the TPB (attitude = 19 items) (e.g. "all patients with diabetes are always at risk of foot ulcer and lower extremity amputation" or "I am able to prevent blindness by visiting an ophthalmologist on a regular basis"), subjective norm = 7 items (e.g. "My physician or nurse believes that I should perform daily foot and eye care practices"), and perceived behavioural control = 7 items (e.g. "It is difficult for me to do foot care activities on a daily basis"). The third section assessed care practices via four questions (e.g. "How many times in the last seven days did you wash your feet?") and eye care via five questions (e.g. "Have you seen an ophthalmologist in the recent six months?"). The questionnaire items were developed using Ajzen and Fishbein's TPB,<sup>25,26</sup> and each section was rated separately using a five-point Likert scale ranging from "I completely agree"<sup>5</sup> to "I completely disagree".<sup>1</sup>

In terms of knowledge evaluation, a score of one was assigned for each correct response to each question, and a score of zero was assigned for the absence of an answer or an incorrect response. Foot self-care was assessed using the Toobert *et al.*<sup>27</sup> Summary of Diabetes Self-Care Activities-Revised, which included four questions on a scale of 0–7 based on relevant activities in the preceding seven days and was quantified by asking questions such as "How many times have you seen the inside of your shoes in the preceding seven days?" The results were expressed as a percentage. Cronbach's alpha was calculated for each portion of the questionnaire to determine its reliability. Cronbach's alpha values were 0.71, 0.77, 0.86, 0.71, 0.87, 0.84, and 0.74 for knowledge, attitude, subjective norms, perceived behavioural control, behavioural intention, foot care, and eye care surveys, respectively. The gathered data indicated that the study questionnaires had an acceptable level of reliability greater than 0.7. Both groups completed the questionnaire, and participants were directed to the unit lab (Fatemiyeh Clinic) for HbA1c testing prior to and during the intervention. This intervention was based on TPB constructs.<sup>17</sup> The intervention group then received an educational intervention that included a lecture, group discussion, demonstration and practice of proper foot care practices, as well as question-and-answer sessions over the course of 10 training sessions, each lasting 55 minutes. These sessions were hosted at the Diabetes Centre Hall and included instructive videos, graphics, and PowerPoint presentations. Additionally, a meeting was organised in the presence of the Diabetes Centre's physician and staff, as well as a family member, to explain the subjective standards. The objective of these seminars was to convey information on diabetes, its influence on the eyes and feet, environmental neuropathy, damage to large and small capillaries, various ocular problems, and the impact of correct food and medication use. Additionally, patients received information and instructions on how to prevent ocular complications and foot ulcers, the importance of physical activity in controlling blood sugar levels, daily foot care, the importance of wearing certain types of shoes, the importance of washing and drying feet, and the importance of routine ophthalmologist visits. A learning leaflet was distributed to the intervention group. A telegram channel was established to share information and send weekly messages to patients. Additionally, a monthly follow-up meeting was arranged for care and discussion. Following

that, all subjects in both the intervention and control groups completed the questionnaire immediately. Three months after the intervention, individuals in both groups completed a questionnaire and were referred for HbA1c testing. The results were then documented. SPSS 22 software (IBM Corp, Armonk, NY, USA) was used to analyse the data. Paired t-tests, independent t-tests, chi-square, and RMA were all used.

## Results

The mean age of the patients in the intervention group was  $47.25 \pm 7.14$  years, and in the control group, it was  $7.20 \pm 47.44$  years ( $p = 0.176$ ). The mean diabetes duration in the intervention group was  $8.55 \pm 4.45$  years, and for the control group, it was  $4.26 \pm 8.94$  years ( $p = 0.124$ ), showing no significant difference between the two groups. A chi-square test showed that there was no significant difference between the two groups in terms of sex ( $p = 0.156$ ), marital status ( $p = 0.452$ ), educational level ( $p = 0.231$ ), type of medical treatment ( $p = 0.155$ ), history of smoking ( $p = 0.180$ ), history of non-diabetes disease ( $p = 0.367$ ), and family history of diabetes ( $p = 0.28$ ) (Table 1). According to the results, there was no significant difference between the two groups before the intervention in terms of knowledge ( $p = 0.139$ ), attitude ( $p = 0.195$ ), subjective norms ( $p = 0.25$ ), perceived behavioural control ( $p = 0.162$ ), behavioural intention ( $p = 0.246$ ), foot care ( $p = 0.170$ ), and eye care practice ( $p = 0.183$ ). However, there was a significant increase in scores in each of the intervention group constructs compared with the control group immediately and three months after the intervention ( $p < 0.001$ ). No significant change was observed in the control group (Table 2). Based on the results of the paired t-test in the intervention group, the mean value of HbA1c was found to decrease three months after the intervention ( $p < 0.001$ ), while there was no significant difference between two groups in the mean value of HbA1c before the intervention and three months following the educational intervention ( $p < 0.09$ ) (Table 3).

## Discussion

The purpose of this study was to determine the effect of an educational intervention based on the TPB on foot and eye care

practice in type 2 diabetic patients in Fasa, Iran. According to the results, a significant increase was observed in the mean score of the patients' knowledge in the intervention group compared with the control group immediately after the intervention and three months later, showing the effect of an educational intervention in increasing the knowledge level of patients and their ability to continue to perform the activities. In addition, it was shown that presenting educational content through film, group discussions to share the information, and a booklet improved the knowledge level of subjects in the intervention group. In the studies by Kashfi *et al.*,<sup>28</sup> Sharifirad *et al.*,<sup>29,30</sup> Pal *et al.*,<sup>31</sup> Khani Jeihooni *et al.*,<sup>32</sup> Chubbs,<sup>33</sup> and Haza-vehei *et al.*,<sup>34</sup> educational interventions raised the knowledge level of diabetic patients.

The results of this study indicated that the participants had a poor attitude towards eye and foot care practices before the intervention, but a significant increase was observed immediately and three months following the intervention, which is consistent with the studies of Maleki *et al.*, Raman *et al.*, Mirzaei-Alavijeh *et al.*, and Poore and Hosseini Nodbe.<sup>21,35–37</sup> In our study, TPB-based intervention and use of educational slides related to ocular and foot complications, as well as group discussion and question-and-answer techniques, improved patient attitudes in the intervention group.

The mean value for subjective norms increased in the intervention group following the educational intervention, which is consistent with the studies of Zeidi *et al.* and Sabouri *et al.*<sup>38,39</sup>

This can be attributed to holding an educational session for a family member, physician, and staff in the Diabetes Centre as well as the engagement of an ophthalmologist. Similarly, a study by Baghianimoghadam *et al.* showed that diabetic patients are greatly affected by physicians and health providers for the management and treatment of their illness, i.e. those other than the family and people without specialised knowledge.<sup>40</sup>

The findings of our study also showed that the mean score of the perceived behavioural control construct was significantly

**Table 1:** Frequency distribution of intervention and control group according to demographic characteristics

| Variable                        |                                 | Intervention group |    | Control group |    | p-value     |
|---------------------------------|---------------------------------|--------------------|----|---------------|----|-------------|
|                                 |                                 | No.                | %  | No.           | %  |             |
| Sex                             | Female                          | 28                 | 56 | 26            | 52 | $p = 0.156$ |
|                                 | Male                            | 22                 | 44 | 24            | 48 |             |
| Marital status                  | Married                         | 6                  | 12 | 5             | 10 | $p = 0.452$ |
|                                 | Single                          | 44                 | 88 | 45            | 90 |             |
| Educational level               | Elementary school               | 6                  | 12 | 5             | 10 | $p = 0.231$ |
|                                 | Guidance school                 | 10                 | 20 | 12            | 24 |             |
|                                 | High school                     | 18                 | 36 | 20            | 40 |             |
|                                 | Academic Degree                 | 16                 | 32 | 13            | 26 |             |
| Type of medical treatment       | Use of antidiabetic medications | 41                 | 82 | 43            | 86 | $p = 0.155$ |
|                                 | Insulin                         | 9                  | 18 | 7             | 14 |             |
| History of smoking              | Yes                             | 12                 | 24 | 10            | 20 | $p = 0.180$ |
|                                 | No                              | 38                 | 76 | 40            | 80 |             |
| History of non-diabetic disease | Yes                             | 16                 | 32 | 18            | 36 | $p = 0.367$ |
|                                 | No                              | 34                 | 68 | 32            | 64 |             |
| Family history of diabetes      | Yes                             | 20                 | 40 | 17            | 34 | $p = 0.128$ |
|                                 | No                              | 30                 | 60 | 33            | 66 |             |

**Table 2:** Comparison of the mean score for knowledge, attitude, subjective norms, perceived behavioural control, behavioural intent, and foot and eye care practice in the intervention and control groups before and immediately after intervention, and three months after the intervention

| Variable                      | Group        | Before intervention<br>M ± SD | Immediately after<br>intervention M ± SD | Three months after<br>intervention M ± SD | p-value test<br>RMA |
|-------------------------------|--------------|-------------------------------|------------------------------------------|-------------------------------------------|---------------------|
| Knowledge                     | Intervention | 83 ± 36                       | 14 ± 31                                  | 14 ± 31                                   | $p < 0.001$         |
|                               | Control      | 67 ± 13                       | 80 ± 95                                  | 80 ± 95                                   | $p = 0.137$         |
|                               | p-value      | 0.139                         | $p < 0.001$                              | $p < 0.001$                               |                     |
| Attitude                      | Intervention | 26 ± 58                       | 57 ± 38                                  | 57 ± 38                                   | $p < 0.001$         |
|                               | Control      | 88 ± 11                       | 100 ± 91                                 | 100 ± 91                                  | $p = 0.180$         |
|                               | p-value      | 0.195                         | $p < 0.001$                              | $p < 0.001$                               |                     |
| Subjective norms              | Intervention | 29 ± 25                       | 18 ± 39                                  | 18 ± 39                                   | $p < 0.001$         |
|                               | Control      | 82 ± 22                       | 11 ± 2                                   | 11 ± 2                                    | $p = 0.112$         |
|                               | p-value      | 250/0                         | $p < 0/001$                              | $p < 0/001$                               |                     |
| Perceived behavioural control | Intervention | 23 ± 56                       | 43 ± 77                                  | 43 ± 77                                   | $p < 0.001$         |
|                               | Control      | 19 ± 98                       | 66 ± 9                                   | 66 ± 9                                    | $p = 0.286$         |
|                               | p-value      | 0.162                         | $p < 0.001$                              | $p < 0.001$                               |                     |
| Behavioural intent            | Intervention | 2 ± 5                         | 4 ± 24                                   | 4 ± 24                                    | $p < 0.001$         |
|                               | Control      | 2 ± 11                        | 2 ± 15                                   | 2 ± 15                                    | $p = 0.259$         |
|                               | p-value      | 0.246                         | $p < 0.001$                              | $p < 0.001$                               |                     |
| Foot care practice            | Intervention | 1 ± 1                         | 29 ± 1                                   | 29 ± 1                                    | $p < 0.001$         |
|                               | Control      | 1 ± 1                         | 1 ± 1                                    | 1 ± 1                                     | $p = 0.288$         |
|                               | p-value      | 0.170                         | $p < 0.001$                              | $p < 0.001$                               |                     |
| Eye care practice             | Intervention | 1 ± 1                         | 29 ± 1                                   | 29 ± 1                                    | $p < 0.001$         |
|                               | Control      | 1 ± 1                         | 1 ± 1                                    | 1 ± 1                                     | $p = 0.288$         |
|                               | p-value      | 0.183                         | $p < 0.001$                              | $p < 0.001$                               |                     |

\*Repeated measurement.

**Table 3:** Comparison of mean HbA1c values in patients in the intervention and control groups before and three months after the intervention

| Variable | Group              | Before intervention | Three months after intervention | Paired t-test |
|----------|--------------------|---------------------|---------------------------------|---------------|
| HbA1c    | Intervention       | 69 ± 85             | 53 ± 36                         | $p < 0.001$   |
|          | Control            | 71 ± 79             | 69 ± 73                         | 0.09          |
|          | Independent t-test | 0.460               | $p < 0.001$                     |               |

increased immediately and three months following the educational intervention in the intervention group. These results can be attributed to the use of TPB-based interventions, including training through educational videos and slides, providing foot care education and the necessary instructions for managing blood sugar level and eye care, periodic eye examinations by researchers, and establishing communication among the type 2 diabetic patients to facilitate caring practices as well as creating a telegram group for sharing information and sending educational and motivational messages. According to the results of the studies by Darker *et al.*,<sup>41</sup> Poore and Hosseini Nodbe,<sup>37</sup> and Dydarlu,<sup>42</sup> TPB-based intervention gave rise to an increase in perceived behavioural control score after intervention.

Although the scores at follow-up showed a significant increase in behavioural intention immediately and three months after educational intervention. In other studies by Poore and Hosseini Nodbe<sup>37</sup> and Maleki *et al.*,<sup>21</sup> TPB-based intervention has increased the behavioural intention of the subjects under study. It seems that promoting foot and eye care in diabetic patients under study, acquiring sufficient and appropriate knowledge along with a positive attitude towards preventable eye complications and diabetic foot injuries in diabetic patients led to the improvement of behavioural intention in the intervention group.

Although the scores at follow-up showed a significant increase in self-care behaviour immediately and three months after educational intervention, which is consistent with the studies of White *et al.*, Beiranvand *et al.*, Dydarlu, Yamaguchi, and Naderimagham *et al.*<sup>18,23,42–45</sup> Also in the current study, the average HbA1c level was found to decrease after 3 months, which is consistent with the studies of Sharifirad *et al.*, Hazavehei *et al.*, Naderimagham *et al.*, Shahbaz *et al.*, Afshari *et al.*, Salinero-Fort *et al.*, Burnett, Gallegos *et al.*, Shahbodaghi and Bohrani, Naderimagham *et al.*, and Elabbassy<sup>29,34,45,46,47–53</sup> According to the results of the present study, the use of the TPB can play an effective and beneficial role in the eye and foot care practice of diabetic patients. The major limitation of this study was the self-orientation of foot and eye care practice in diabetic patients, which made it impossible for the researcher to examine some behaviours objectively. However, this study makes a major contribution to research on diabetics by examining an HbA<sub>1c</sub> indicator in patients for controlling blood glucose level and use of a community-based study.

## Conclusion

The results of the present study support the idea that the use of an educational intervention based on the TPB regarding eye and foot care practice in diabetic patients not only improves the constructs of this theory but also enhances the performance of foot and eye care in patients and reduces the level of HbA<sub>1c</sub>

in patients with type 2 diabetes. In addition, it plays a significant role in reducing the complications of this disease and its mortality rate. Due to the lack of a national programme for the prevention and control of diabetes in Iran, a key policy priority should therefore be to plan for the long-term use of educational interventions based on the TPB to provide appropriate information for the public concerning diabetes and its complications through staff at health centres as well as mass media such as TV and radio. In addition, it is essential for diabetics to receive continuous foot and eye care training and regular examinations.

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**Abbreviations** – TPB: Theory of Planned Behaviour; RMA: Repeated Measurement ANOVA.

### Declarations

**Ethical approval and consent to participate** – Ethical approval was obtained from the Human Research Ethics Committee at the Fasa University of Medical Sciences. All study participants provided written informed consent. Permission was also obtained to record all interviews digitally. Informed consent was obtained from legally authorised representatives for study participation for illiterate participants. Confidentiality and anonymity were ensured. The ethics committee approved the procedure for verbal consent because the study is observational and respected the code of ethics as stated in the Declaration of Helsinki.

**Consent for publication** – None.

**Availability of data and materials** – The datasets used and/or analysed during the current study are available from the corresponding author upon reasonable request.

**Competing interests** – Not applicable.

**Disclosure statement** – No potential conflict of interest was reported by the authors.

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**Authors' contributions** – BP, SO, SMK, PAH, and AKHj assisted in the conceptualisation and design of the study, oversaw data collection, conducted data analysis, and drafted the manuscript. AKHj and SO conceptualised and designed the study, assisted in data analysis, and reviewed the manuscript. BP, SO, SMK, PAH, and AKHj assisted in study conceptualisation and reviewed the manuscript. All authors read and approved the final manuscript.

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