A Predictive Model of Health Outcomes for Young People with Type 2 Diabetes

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SUMMARY

Purpose: This study was conducted to develop and test a hypothetical model to predict health outcomes in young people with type 2 diabetes.

Methods: Data were collected from 190 adults aged 23–45 with type 2 diabetes mellitus who visited the endocrinology outpatient department of the two university hospitals in South Korea from November 2, 2012 to March 7, 2013. Data collection used the structured questionnaires and patient medical records. The descriptive and correlation statistics were analyzed using PASW 18.0 and structural equation modeling procedure was performed using the AMOS 18.0 program.

Results: The fit of the hypothetical model was appropriate with the ratio of the chi-square statistic to degrees of freedom at 17.00, goodness-of-fit index at .975, adjusted goodness-of-fit index at .930, root mean square error of approximation at .061, normed fit index at .926, Tucker-Lewis index at .929, comparative fit index at .966. Behavioral skills were a critical factor that directly affects self-management behaviors. Through behavioral skills, motivation had a statistically significant indirect effect on self-management behavior. Self-management behavior had a statistically significant direct effect on health outcome. Through self-management behavior, behavioral skills had a statistically significant indirect effect on health outcome. These variables explained 17.9% of the total variance for the health outcome in young people with type 2 diabetes.

Conclusions: The results suggest that self-management behavior could be improved through nursing interventions promoting personal motivation (positive attitude), social motivation (social support), and behavioral skills (self efficacy), which can result in better health outcomes for young people with type 2 diabetes.

Introduction

According to the International Diabetes Federation, the global population suffering from diabetes will increase by 51.1%, from 366 million in 2011 to 552 million people in 2030 [1]. Even in Korea, the prevalence of diabetes is estimated to rise to 61.6%, from 3.2 million in 2010 to 5.17 million people in 2030 [2]. In the past, type 2 diabetes, accounting for 90–95% of diabetes mellitus cases, has been regarded as a chronic disease occurring in people after their 40s. However, as the onset age of the type 2 diabetes has been lowered steadily, the prevalence of the type 2 diabetes has been increasing in young people and even children [3]. This increase is associated with poor health habits of young people, such as western dietary patterns, more intakes of trans fats, decreasing physical activity, heightened stress, alcohol consumption, and smoking.

Furthermore, the early onset type 2 diabetes has distinctive clinical characteristics compared with diabetes in an older population. Specifically, the young people with type 2 diabetes has an even higher level of hemoglobin A1c and treatment with more insulin is frequently required at the time of initial diagnosis. In addition, the typical symptoms, such as polydipsia, polyuria, and decreases in weight, are displayed more obviously [3,4]. It is also reported that recovery time after the insulin treatment for patients...
who contracted diabetes before the age of 45 is slower than it is for patients who contracted diabetes after age 45 [5]. The patients who contracted diabetes before the age of 45 are also reported to be at an even higher risk for complications because they will be exposed to the disease for a longer time [5]. In other words, the lower onset age of type 2 diabetes has serious symptoms and a worse prognosis. Therefore, the patients suffering from type 2 diabetes at a younger age should put a consistent effort into managing their disease. However, it has been reported that blood glucose of young patients with diabetes was not controlled well. According to the Korea Health Statistics 2010, the rate of patients who have been diagnosed by doctors among those with diabetes was lower in younger group than in older age group: 80.5% of people over 65 years of age and 48.1–56.1% of those in their 30s and 40s [2]. In addition, it was reported that the young patients tend to control blood glucose, which maintains less than 6.5% of the level of hemoglobin A1c, more poorly than do older individuals: 34.5% of people over 65 years of age and 22.4–26.1% of those in their 30s and 40s [2]. This result may be explained by the developmental and social characteristics of the younger age group.

In general, type 2 diabetes cannot be controlled by medication alone. Change of lifestyle and health related behaviors, such as diet, exercise, self-monitoring of blood glucose and coping, foot care, and stress management, are required. Carrying out such self-management requires the patient’s active participation and assertive coping. However, young patients are occupied with various developmental tasks, such as marriage, childbirth, parenting, and employment. Throughout these tasks, they experience changing roles in society and are focused on socioeconomic activities to establish a stable base [6]. On the other hand, they tend to neglect healthy life habits and decrease their interest in health because they are busy without the currently subjective symptoms [7]. Even some of the most conscientious patients, when faced with the competing life demands of the young adult period, will have difficulty giving their diabetes self-management a high priority [8]. In addition, young people with type 2 diabetes tend to spend a lot of time at work and must self-manage their illness within multiple social situations [9]. Excessive work and stress can have physical burdens, including tiredness, irregular life patterns, and a shortage of time, all of which can lead to the formation of poor health habits [10,11]. Furthermore, they have difficulty with dietary control because of the wide range of social activities structured around food, such as dining with work colleagues and get-togethers with friends [12]. Given these characteristics, young people with type 2 diabetes might find it hard to control their blood glucose on their own. In addition, the interests and demands of young patients would be different from those of the elderly [13]. Hence, to successfully manage health in young people with type 2 diabetes, it is necessary to understand their characteristics and needs, and to provide them with opportunities to learn self-management skills appropriate for their age [14].

Therefore, the purpose of this study was to provide the foundation for developing nursing interventions to improve the health of young people with type 2 diabetes through constructing and examining a hypothetical model to predict their health outcomes.

Theoretical framework

This study constructed a hypothetical model based on the Information—Motivation—Behavioral Skills (IMB) model [15], which includes the necessary core determinants of health behavior change [16,17]. The IMB model suggests three prerequisite conditions for the initiation and maintenance of health behaviors: information, personal and social motivation, and behavioral skills [15,18,19]. The first prerequisite, information, refers to personal knowledge about health behavior that includes accurate knowledge about specific self-management performance required or recommended. It also includes heuristic and implicit knowledge about diabetes self-management [19]. The second prerequisite, motivation, is composed of personal and social motivation. Personal motivation is an individual’s attitudes and evaluations about the consequences of behavior change. In other words, it refers to the belief that the disease can be controlled by self-management behaviors. Social motivation is the perception of the social norms related to behavior change. It also refers to perceived social support from significant others with regard to performing specific self-management behaviors [15,19]. The third prerequisite, behavioral skills, refers to objective and perceived abilities for performing the complex health behavior and a sense of self-efficacy for doing so (i.e. one’s confidence in implementing the behavior in a variety of settings) [19].

According to the IMB model, information is an essential ingredient as a behavioral guideline for the enactment of behavior change. However, information is not enough to initiate and maintain behavior change. In addition, motivation is needed to activate behavior change. Information and motivation interact because knowledge results in a change in attitudes toward the consequences of behavior, and, at the same time, the change of attitudes leads to the pursuit of knowledge. Simple behavior not requiring complex skills can be performed by using information about the behavior or the intention to perform without specific behavioral skills. The information and motivation in simple behavior can directly affect behavior change without behavioral skills. However, although a person has sufficient information and is motivated, specific behavioral skills are needed for performing complex behavior. The information and motivation of the individual are manifested as actual behavior through behavioral skills. The IMB model identifies behavioral skills as a critical core determinant of complex health behaviors. Finally, health behavior change affects an individual’s objective and subjective health outcome [17,19,20] (Figure 1). Therefore, this study constructed the paths on which information and motivation about diabetes self-management interact; they affect self-management behavior directly or indirectly through behavioral skills, and self-management behavior affects health outcome directly (Figure 2).

Methods

Study design

This study used a cross-sectional design and structural equation modeling (SEM) to analyze the relationships among the variables related to health outcomes of young people with type 2 diabetes.

Setting and samples

This study was conducted at the outpatient department of endocrinology in two university hospitals in Korea. A convenience sample of 190 patients with type 2 diabetes was chosen from the patients who met the inclusion criteria, understood the purpose of this study, and consented to participate in this study. The specific inclusion criteria for the study were the following: (a) 23–45 years of age, (b) diagnosed with type 2 diabetes less than 5 years prior to the study, (c) no severe diabetes-related complications or other diseases (e.g., mental diseases, dementia), (d) no surgeries or hospitalizations within the past month, and (e) understood the purpose of this study and agreed to participate.

According to Levinson [21], early adulthood includes the ages between 17 and 45. However, the initial 5 years from 17 to 22 is
classified as a transitional phase between adolescence and early adulthood [21]. Therefore, this study excluded the transitional phase and included only participants aged between 23 and 45 years.

By consensus, the sample size for an SEM analysis is 5–10 times the number of parameters to be estimated, and at least 150 participants were needed to reduce the estimation error [22]. As the number of parameters to be estimated in this study was 18, the necessary number of participants was 90–180. Considering the sample dropout rate, 200 participants were asked to respond to the survey. Of those, 10 respondents were excluded because of incomplete or inappropriate responses. The data of 190 individuals was used for data analysis.

**Ethical considerations**

This study was approved by the Institutional Review Boards at each hospital where the study was conducted (AN12238-002, AS12100-002). In collecting data, all participants were given oral and written explanations of the purpose and necessity of the study, the possibility of withdrawing at any time, notification of voluntary participation, the questionnaire completion method, and the time required. The participants who voluntarily gave informed consent were included in the study. Moreover, the participants were informed that they could refuse to participate at any time, the collected data would not be used for any purpose other than this research, and their private information would be protected by the

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**Figure 1.** Theoretical framework of the Information—Motivation—Behavioral Skills model.

**Figure 2.** The hypothetical model. Note. DSM = diabetes self-management; x1 = knowledge; x2 = attitudes; x3 = perceived social support; y1 = self efficacy; y2 = self-management behavior; y3 = hemoglobin A1c; y4 = subjective health status.
Data collection

Data were collected using a structured self-completion questionnaire between November 2, 2012 and May 7, 2013. Based on the inclusion criteria of the study, the researcher identified the patients who had scheduled an outpatient consultation in the university hospitals. The participants were asked to complete the informed consent form when they visited the hospital for consultation. Before the participants completed the questionnaire, the researcher explained the overall type of questionnaire items and their meaning in person. The researcher offered supplementary explanation for the items if the participants had any difficulties. It took approximately 20 minutes to complete the survey. Using electronic medical records, hemoglobin A1c level were collected that examined within 7 days before or after the date of the completion of the survey.

Measurements

The seven measurement instruments included 79 items. Confirmatory factor analysis (CFA) was conducted to examine the validity of the instruments. The factors identified on each instrument were used to test a hypothetical model. CFA allows for assessing both the convergent and discriminatory validity of the instrument [23]. Based on the CFA result, nine items with factor loadings of less than .50 were removed. The average variance extract of the items was 0.44–0.72. As the R² value (.00–.41) for the factors was less than the average variance extract, the convergent and discriminant validity was confirmed [22].

Information

The self-management information was individual knowledge about managing diabetes and was measured using the Diabetes Knowledge Questionnaire [24]. This instrument consists of 14 true/false items; one point is given for the correct answer, and no points for a wrong answer. A higher score indicates a higher level of knowledge about the self-management of diabetes. Based on the results of the CFA, the factor loading coefficients of all items were over .50. Cronbach’s alpha coefficient was .94 when the questionnaire was developed [24] and .61 in this study.

Personality motivation

This represents attitudes about the outcome of performing diabetes self-management behaviors and was measured by the Diabetes Self-management Attitude Scale. This instrument was developed by the researcher, based on the previous literature [19,25,26] and reviewed by experts. This instrument contains 10 items rated on a 5-point Likert scale, ranging from 0 (strongly disagree) to 4 (strongly agree). A higher score indicates a more positive attitude about the outcomes of self-management behavior. In addition, exploratory factor analysis was conducted using the data collected to verify the factor structure of the scale. There was one factor with an eigenvalue exceeding 1.0 and the total explained variance was 68.8%. Based on the results of the CFA, the factor loading coefficients of all items were over .50. Cronbach’s alpha coefficient was .95 in this study.

Social motivation

This refers to perceived social support from significant others regarding self-management behavior and was measured by a portion of the Diabetes Care Profile developed by Fitzgerald et al. [27]. In the current study, Rhee’s Korean version was used [28]. This instrument contains 12 items rated on a 5-point Likert scale, ranging from 0 (strongly disagree) to 4 (strongly agree). A higher score indicates greater perceived social support. Based on the results of the CFA, the factor loading coefficients of all items were over .50. Cronbach’s alpha coefficient was .72 when the profile was translated into Korean [28] and .96 in this study.

Behavioral skills

Behavioral skills refer to the confidence in implementing effectively the specific diabetes self-management behavior and were measured by the Self-Efficacy Scale developed by Paek for diabetes patients [29]. This instrument contains 16 items rated on a 10-point Likert scale, ranging from 0 (not confident) to 9 (very highly confident). A higher score indicates a higher level of self-efficacy. Based on the results of the CFA, one item with a factor loading coefficient of less than .50 was removed, leaving the 15 items in this study. Cronbach’s alpha coefficient was .86 when the scale was developed by Paek [29] and .93 in this study.

Self-management behavior

Self-management behaviors are performed by diabetes patients in everyday life to control blood glucose and prevent complications. These behaviors were measured by the Diabetes Self-Management Behaviors Scale developed by Kim [30]. This scale contained 23 items rated on a 5-point Likert scale, ranging from 0 (strongly disagree) to 4 (strongly agree). A higher score indicates higher self-management behavior performance. Based on the result of CFA, 8 items with factor loading coefficients of less than .50, were removed, and leaving 15 items remaining in this study. Cronbach’s alpha coefficient was .85 when the scale was developed [30], and .89 in this study.

Objective health outcome

Objective health outcome was measured by hemoglobin A1c level, which is a 3-month average of blood glucose results. Patients’ most recent hemoglobin A1c value, within 7 days before or after the completion of the survey, was retrieved from medical record.

Subjective health outcome

Subjective health outcome refers to the perceived health status recognized by the individual. It was measured by the Health Self-Rating Scale developed by Lawton, Moss, Fulcomer, and Kleban [31]. In the current study, Cho’s Korean version was used [32]. This scale contains three items rated on a 5-point Likert scale, ranging from 0 (very bad) to 4 (very good). A higher score indicates a better subjective health status. The result of CFA showed that all factor loading coefficients were over .50; thus all items were kept. Cronbach's alpha coefficient was .88 when the scale was translated into Korean [32], and .84 in this study.

Data analysis

For data analyses, PASW version 18.0 and AMOS version 18.0 (IBM SPSS Statistics, Chicago, IL, USA) were used. Descriptive statistics were used to analyze demographic characteristics and study variables. To examine the validity of the instruments used in this study, CFA was performed to analyze factor loadings and average variance extractions. After the modification of the instruments, reliability was examined using Cronbach’s alpha. Multicollinearity between measured variables was examined by Pearson correlation coefficients and variance inflation factors. The normality of the distribution of the data was tested by assessing skewness and kurtosis coefficients. An absolute value of skewness less than 3 and...
an absolute value of the kurtosis less than 10 were considered acceptable [33].

The goodness-of-fit test for the measured model was checked by a fit index, standardized regression coefficient, and error variance using CFA. The structural equation modeling technique of maximum likelihood estimation was used to examine the hypothetical model. To evaluate model fit, the chi-square test and several indices were used. The chi-square test is sensitive to sample size and rigorously tests the null hypothesis; therefore, fit indices for the SEM were also taken into comprehensive consideration [22]. The fit indices used in this study included the ratio of the chi-square statistic to degrees of freedom, goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), root mean square error of approximation (RMSEA), normed fit index (NFI), Tucker-Lewis index (TLI), and comparative fit index (CFI). These indices were used to determine the goodness of fit and parsimony of the hypothesized model. Values of the GFI, AGFI, NFI, TLI, and CFI at .90 or greater indicate a good fit. The value of RMSEA at .08 or less indicates a reasonable fit. A ratio of the chi-square statistic to degrees of freedom at 2 or less is indicative of an excellent fit. In addition, statistical significance of the indirect effects in the hypothesized model was tested using the bootstrapping procedure in the AMOS 18.0 program.

**Results**

**General characteristics of participants**

Of the 190 participants, 106 were male (55.8%) and 84 were female (44.2%). The ages ranged from 23 to 45 years old, and the mean age was 38.3 years old. The majority of the participants completed high school or some amount of higher education (n = 186, 97.9%). The number of participants who lived with other family members, such as a parent, spouse, or child, was 169 (88.9%) and 21 (11.1%) lived alone. Most of the participants lived with family members. The types of current treatment for diabetes included an oral hypoglycemic agent (n = 126, 66.3%), insulin (n = 20, 10.5%), and the combination of insulin and an oral hypoglycemic agent (n = 25, 13.2%). Participants were diagnosed with diabetes an average of 3.5 years before this study.

**Descriptive statistics and correlations between variables**

The descriptive statistics of the measured variables are presented in Table 1. Before SEM, in the review of the multivariate normality, the skewness and kurtosis for each measured variable was found to be 0.03—1.62 and 0.17—2.67 respectively. As both absolute values were less than 3, the assumption of multivariate normality was met [33]. Moreover, multicollinearity between measured variables was examined by Pearson correlation coefficients. If a correlation coefficient is greater than .70, the variables might have an interaction [22]. However, in this study, the correlation coefficients of the variables were less than .70 (range: .15—.85) and the variance inflation factors of the variables were less than 10 (range: 1.09—1.86), which indicated that the multicollinearity between measured variables was not problematic.

**Test of hypothetical model**

The hypothetical model was examined in two phases including goodness of fit of the measurement model and the analysis of the structural equation model. First, the goodness of fit of the measurement model was undertaken by CFA to examine if the covariance structure model fit the assumption. The results were \( \chi^2 / df = 1.37\), RMSEA = .04, GFI = .98, AGFI = .93, NFI = .95, TLI = .96, and CFI = .99. The regression coefficient between the latent variable and measured variable was statistically significant. No negative error variance was found. Thus, the measured variable and latent variable were identified as adequate for the model in this study [34].

Second, the structural equation model analysis confirmed the chi-square test and fit index for exploring the path through which each latent variable affected the health outcome and identifying the proposed hypothetical model fit to the sample data. The chi-square was 17.00 (\( p = .074 \)) and the absolute fit indices and the incremental fit indices evaluating overall goodness of fit of the model were as follows: \( \chi^2 / df = 1.70\), GFI = .98, AGFI = .93, RMSEA = .06, NFI = .93, TLI = .93, and CFI = .97 (Table 2). Therefore, the modified model was not taken into consideration because all of the goodness-of-fit indices were within the recommended levels, the modification index was not high (4.00—5.57). Thus, the study model reflected well for the IMB model.

**Direct, indirect, and total effects of variables on health outcomes**

The path coefficient of the final model was evaluated by estimates of the magnitude of the parameter and its significance. The result indicated that three of the six paths suggested by the model were statistically significant (\( p < .01 \)). Higher motivation toward self-management was related to higher behavioral skills (\( \beta = .31\), critical ratio [CR] = 2.27), explaining 10.3% of the variability in behavioral skills. Higher behavioral skills were related to better performance of self-management behavior (\( \beta = .76\), CR = 11.06), explaining 57.7% of the variability in self-management behavior. Moreover, greater diabetes self-management behavior was associated with health outcome (\( \beta = .41\), CR = 4.49), explaining 16.5% of the variability in health outcome. The correlation between exogenous variables showed that self-management information was correlated with motivation, \( r = .40\) (CR = 4.39, \( p < .001 \)), indicating an interaction between the two variables (Figure 3).

With regard to the direct, indirect, and total effect of the measured variables on the health outcome, the motivation of self-management showed high direct, indirect, and total effects on the health outcome. Based on the moderation effect of motivation, the intervention strategies should be provided to enhance diabetes self-management behavior.
management directly affected behavioral skills (β = .31, p = .009). It did not directly affect self-management behavior (β = −.08, p = .285), but there was indirect influence through behavioral skills (β = .24, p = .006). Behavioral skills directly affected self-management behavior (β = .76, p = .003) and there was an indirect effect on health outcome through self-management behavior (β = .31, p = .004). Furthermore, self-management behavior directly affected health outcome (β = .41, p = .003). Health outcome was most affected by self-management behavior, followed by behavioral skills. However, the information about diabetes self-management was not significantly related to behavioral skills, self-management behavior, or health outcome (Table 3).

**Discussion**

The results showed that information and motivation related to diabetes self-management interacted. In addition, higher personal and social motivation was associated with higher self-management behavioral skills, which are self-efficacy. Higher behavioral skills led to better performance in self-management behavior, which resulted in a better health outcome. Thus, the causal relationship between these variables was verified.

Of the predictor variables in this study, behavioral skills (self-efficacy) for self-management had the strongest direct effect on self-management behavior. At the same time, this variable was also a mediating factor for the effect of social motivation on self-management behavior. This finding confirms the result of previous studies [35–39], which reported that self-efficacy is the most important core factor influencing the performance of diabetes self-management behavior. In other words, when individuals engage in self-management behavior, their personal determination and confidence in controlling and performing the behaviors successfully are the core factors leading to behavior change. Moreover, the value of the direct effect of behavioral skills on self-management behavior (β = .76, p = .003) was found to be relatively high compared to that of Choi’s study [35] which had patients over 65 years of age (β = .62, p = .006) and that of Osborn et al.’s study [19] which had patients in their 50s and 60s (β = .45, p < .001). This suggests that the effect of self-efficacy on self-management behavior is stronger for young people with type 2 diabetes than it is for older patients.

**Table 3** Effects of Exogenous Variables in Final Model (N = 190).

<table>
<thead>
<tr>
<th>Endogenous variable</th>
<th>Exogenous variable</th>
<th>β</th>
<th>CR (p)</th>
<th>SMC</th>
<th>SDE (p)</th>
<th>SIE (p)</th>
<th>STE (p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSM behavioral skills</td>
<td>DSM information</td>
<td>.03</td>
<td>0.32 (.747)</td>
<td>.10</td>
<td>.03 (.802)</td>
<td>.03 (.802)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DSM motivation</td>
<td>.31</td>
<td>2.27 (.023)</td>
<td></td>
<td>.31 (.009)</td>
<td>.31 (.009)</td>
<td></td>
</tr>
<tr>
<td>DSM behavior</td>
<td>DSM information</td>
<td>.10</td>
<td>1.42 (.155)</td>
<td>.58</td>
<td>.10 (.172)</td>
<td>.02 (.849)</td>
<td>.12 (.255)</td>
</tr>
<tr>
<td></td>
<td>DSM motivation</td>
<td>−.08</td>
<td>−0.08 (.378)</td>
<td></td>
<td>−.08 (.285)</td>
<td>.24 (.006)</td>
<td>.16 (.279)</td>
</tr>
<tr>
<td></td>
<td>DSM behavioral skills</td>
<td>.76</td>
<td>11.06 (&lt;.001)</td>
<td>.17</td>
<td>.76 (.003)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health outcome</td>
<td>DSM information</td>
<td>.41</td>
<td>4.49 (&lt;.001)</td>
<td></td>
<td>.41 (.003)</td>
<td>.41 (.003)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DSM motivation</td>
<td>.05</td>
<td>(.204)</td>
<td></td>
<td>.05 (.204)</td>
<td>.05 (.204)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DSM behavioral skills</td>
<td>.06</td>
<td>(.248)</td>
<td></td>
<td>.06 (.248)</td>
<td>.06 (.248)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DSM behavior</td>
<td>.31</td>
<td>(.004)</td>
<td></td>
<td>.31 (.004)</td>
<td></td>
<td>.31 (.004)</td>
</tr>
</tbody>
</table>

Note. CR = critical ratio; SMC = squared multiple correlation; SDE = standardized direct effect; SIE = standardized indirect effect; STE = standardized total effect; DSM = diabetes self-management.
Motivation, which is another latent variable affecting self-management behavior, is composed of the subject's attitude toward self-management behavior outcome and social support. Even though motivation did not directly affect self-management behavior, it indirectly affected self-management behavior through the mediating factor of behavioral skills (i.e., self-efficacy). This result is somewhat different from the findings of previous studies [36,39–41], which reported that belief about treatment effect, family support, or social support significantly affected self-management behavior directly. This might result from the characteristics of patients who were under 45 years of age. Although they had very positive attitudes toward the outcome of self-management behavior, they tended to manage their life and disease independently, rather than seeking help from others. This tendency may lead to a less direct effect of support on self-management behavior. Furthermore, even though motivation was satisfactory, it did not directly lead to self-management behaviors. Under such circumstances, the behavior skills, which mean self-efficacy, should be improved to enhance self-management behavior. Therefore, to create change and encourage maintenance of the behaviors used to control blood glucose level in young people with type 2 diabetes, the appropriate intervention should improve self-efficacy for applying self-management behavior into daily life.

Additionally, the explanatory power of predictors for self-management behavior was 58.0%. This result is even higher than it was in Choi's study [24.1%] [35]. Based on the IMB model, Choi surveyed older patients with type 2 diabetes to investigate the causal relationship between information, motivation, and behavioral skills (but excluded health outcome) [35]. In light of these results, the self-management behavior of young people with type 2 diabetes is more influenced by motivation and behavioral skills compared to older patients. Moreover, Osborn and Egede [42] examined the causal relationship using only three predictors—information, motivation, and self-management behavior (excluding behavioral skill)—in their IMB model. They reported that the explanatory power of information and motivation for self-management behavior was 17%, which is far lower than the power of this study. This result shows that behavioral skills (self-efficacy) are very important to the patients' performance of self-management behavior.

Information about diabetes self-management did not have a statistically significant influence on behavioral skills and self-management behavior, either directly or indirectly. This result is different from the results of previous studies [19,35,37,39,42], which reported that patient's knowledge of diabetes self-management had a direct or indirect effect on self-management behavior. This finding could be interpreted to be the limitation of young patients with type 2 diabetes. They have indicated a high level of knowledge about self-management behaviors, but did not internalize and practice that knowledge. In other words, the level of knowledge held by young people with type 2 diabetes did not lead to self-management behaviors. However, the interaction between motivation and information, which was the same exogenous variable, was found to be statistically significant in this study. This result implies that a higher level of knowledge increases personal and social motivation. Through motivation, information could affect behavioral skills and self-management behavior. Therefore, rather than offering prescriptive education solely for the improvement of patient knowledge, individualized education—which can motivate patients by considering their personal needs, expectations, abilities and environment—is necessary [18]. In addition, education should focus on specific behavioral skills required to perform self-management in daily life.

Finally, self-management behavior was found to be a significant predictor of health outcomes in young people with type 2 diabetes. In other words, better performance of self-management behavior leads to a better control of glucose level and better subjective health status. Behavioral skills (self-efficacy) had an indirect effect on the health outcome through self-management behavior. This finding confirms the results of the previous research [19,36,37,42]. Moreover, this study found that the explanatory power of predictor variables for the health outcome was high (17.9%) compared to that of Osborn and Egede's study, which found an explanatory power for health outcome of 4% [42]. This might be because they only measured hemoglobin A1c as the objective index for health outcome [42]. On the other hand, this study used subjective health status and an objective index. Nevertheless, the explanatory power for the health outcome (17.9%) in this study is hardly considered high. In light of this, further research is needed to examine additional factors affecting the health outcome of young people with type 2 diabetes.

Most previous studies on the self-management of the patients with type 2 diabetes were conducted with patients over 60 years old. This study is significant because it verified the causal relationship between factors affecting health outcome for young people aged 23–45 years of age, with type 2 diabetes. Moreover, this study constructed and tested a comprehensive structural model to explore the causal relationships among all the components of the IMB model [15], and verified the model. However, this study has a limitation stemming from the instrument which was used to measure the diabetes self-management knowledge. The internal consistency reliability of the instrument was found to be lower in this study (Cronbach's alpha at .61) than when originally developed (Cronbach's alpha at .94). In several studies that used this scale, Cronbach's alpha value was reported from .55 to .81. Therefore, in the future studies, it is necessary that would be used the reliable instruments to measure the self-management knowledge or examined through another appropriate method for its reliability.

Conclusion

The results of this study suggest that young people with type 2 diabetes should be provided with accurate information about self-management to enhance their health outcomes. In addition, patients should be motivated by cultivating positive attitude toward self-management results and increasing social support to turn their knowledge into practice. Furthermore, self-efficacy should be improved by providing young people who have type 2 diabetes with specific information addressing their needs and environment. These findings can be used to develop and apply personalized nursing interventions for improving the self-management behavior and health outcome of young people with type 2 diabetes.

Conflict of interest

The authors declare no conflict of interest.

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References
