

## A Conceptual Model for Quality of Life Among People with Type 2 Diabetes in the Philippines

Haruka Aoto,\* Chika Tanimura,\* Abir Majbauddin,† Nobuyuki Kobayashi,‡ Tetsuji Morita,§ Kazuoki Inoue,|| Shinji Otani,† Mika Fukada\* and Keiichi Hanaki\*

\*School of Health Science, Tottori University Faculty of Medicine, Yonago 683-8503, Japan, †International Platform for Dryland Research and Education, Tottori University, Tottori 680-0001, Japan, ‡Arid Land Research Center, Tottori University, Tottori 680-0001, Japan, §Tottori western Medical Association Department of Rehabilitation Misasa onsen Hospital, Tottori 682-0122, Japan, and ||Department of Community-based Family Medicine, Tottori University Faculty of Medicine, Yonago 683-8503, Japan

### ABSTRACT

**Background** The increased prevalence of chronic diseases is a social issue in developing countries.

**Methods** To create a conceptual model representing the quality of life of low-income people with type 2 diabetes in the Philippines, 117 low-income adult participants in a public support group were studied, and the Physical Component Summary (PCS) and Mental Component Summary (MCS) scores on quality of life (QOL) were analyzed in terms of their relationships with the following factors: basic attributes, physical factors (glycated hemoglobin level, complications, comorbidities, and symptoms), social factors (support, education, and financial status), and cognitive factors (knowledge, attitude, self-efficacy, and self-management behavior).

**Results** Based on correlation coefficients among variables and goodness-of-fit test results through a path analysis, 2 models representing causal relationships were created, both of which showed sufficient goodness-of-fit.

**Conclusion** Glycated hemoglobin levels, knowledge of blood glucose levels, self-efficacy, and self-management behavior (exercise) influenced PCS scores, while age, glycated hemoglobin levels, neuropathy, knowledge of insulin, self-efficacy, and self-management behavior (exercise) influenced MCS scores. The influence of self-efficacy was prominent in both cases, providing an important insight for healthcare professionals to develop effective support methods.

**Key words** knowledge; path analysis; quality of life; self-efficacy; type 2 diabetes

Diabetes has rapidly become a major issue in developing countries due to an increase in obesity as a result of rapid urbanization and diet changes, and people with type 2 diabetes are affected by delays in diagnosis and treatment as well as shortages of drugs such as insulin.<sup>1</sup> The Philippines was ranked fifth worldwide in GDP growth rate in a 2016 survey.<sup>2</sup> Thus, it is achieving markedly rapid growth, even among developing countries. As individuals gain wealth, anxiety about health issues becomes more prominent, with obesity and smoking receiving increasing attention. Accordingly, the government and other organizations in the Philippines have started various initiatives to improve the health of its people.

In the Philippines, the prevalence of diabetes is generally highest among the richest citizens, but it is also high in the poorest urban populations.<sup>3</sup> This finding suggests that there are more people with type 2 diabetes in urban areas characterized by greater westernization and richer lifestyles. In these regions, the poorest people have inadequate healthcare and have difficulty achieving good glucose control.

One of reasons for this failure may be that individuals buy junk food and beverages cheaply from local stores; however, there is currently no evidence to support this hypothesis. The disparity in income levels is large in developing countries; the difference in income between the richest and poorest individuals is approximately 10-fold.<sup>4</sup> Accordingly, there are also large inequalities with regard to healthcare access. The poorest individuals have difficulty accessing advanced healthcare services because of financial and practical obstacles.<sup>5,6</sup>

The goal of treating chronic diseases, including diabetes, is to prevent the progression of complications and to improve quality of life (QOL). However, the QOL of people with type 2 diabetes remains low, and this is a major social issue.<sup>7–9</sup> Factors influencing QOL include physical, social, and psychological conditions. One previous study showed that improvements in exercise habits and diet resulted in better QOL,<sup>8</sup> suggesting that self-management of diet and exercise are necessary for

---

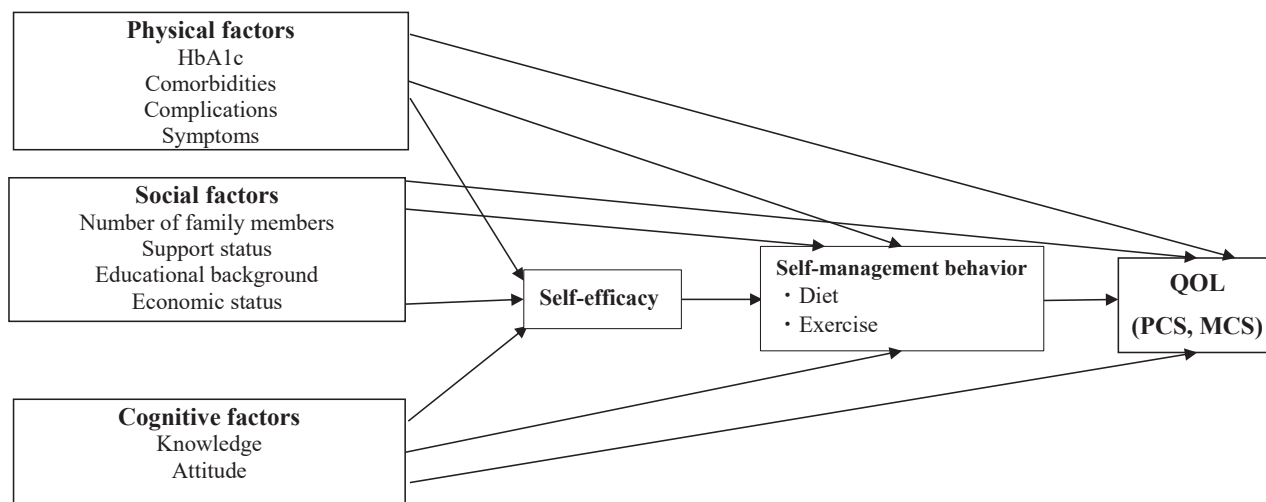
Corresponding author: Haruka Aoto, MNS

ao.haru@med.tottori-u.ac.jp

Received 2018 December 4

Accepted 2018 December 25

Abbreviations: AGFI, adjusted goodness-of-fit index; CFI, comparative fit index; GFI, goodness-of-fit index; MCS, Mental Component Summary; PAID, Problem Area in Diabetes; PCS, Physical Component Summary; QOL, quality of life; RMSEA, root mean square error of approximation; TTM, trans-theoretical model



**Fig. 1.** Conceptual framework of the study (QOL model). MCS, Mental Component Summary; PCS, Physical Component Summary; QOL, quality of life. HbA1c refers to glycated hemoglobin.

improving QOL. Moreover, a study using a path analysis indicated that cognitive and behavioral factors such as knowledge, attitude, and self-management are important for improving QOL, although HbA1c was a negative predictive factor for QOL.<sup>9</sup> Although the number of people with type 2 diabetes is rapidly increasing in developing countries, few studies have investigated the factors influencing QOL. Factors related to culture, the healthcare system, and poverty levels differ between developed and developing countries. Accordingly, determinants of QOL in people with type 2 diabetes are also expected to differ. A study conducted in a developing country, showed that people with type 2 diabetes who had a low income and less social support had a lower QOL.<sup>10</sup> As mentioned above, economic difficulty (low income) was identified as a negative predictive factor for QOL. It is difficult for healthcare professionals to directly improve economic factors through interventions, so people with diabetes in developing countries need to acquire knowledge and self-efficacy based on social support, and then engage in self-management behaviors to control blood glucose at a lower cost. However, in contrast to studies performed in developed countries, a relationship with QOL has not been clarified in developing countries with regard to modifying cognition and behavior (for instance, knowledge, attitude, and self-management) through interventions by healthcare professionals. Some studies from the Philippines demonstrated that greater knowledge and a positive attitude were associated with higher QOL.<sup>11, 12</sup> However, these data were derived from regression analyses that assume a one-way relationship between cause and effect, and the relevancy of the assumption used in a fixed mathematical model (e.g., mul-

ti-ple regression analysis) cannot be verified. That is also a framework that describes the process by which causal models are hypothesized, formulated, tested, analyzed, and modified. Furthermore, it was not possible to verify complex relationships among the observed variables. A path analysis may be employed to evaluate relationships among observed variables in a flexible manner and to establish whether the variables fit a particular model, i.e., if a hypothetical model explains a set of data. Therefore, we used a path analysis to test a conceptual model of QOL in people with type 2 diabetes in the Philippines.

The purpose of the present study was to investigate the QOL of low-income people with type 2 diabetes and to formulate a conceptual model of QOL that includes cognitive factors such as knowledge, attitude, self-efficacy, and self-management behavior.

## SUBJECTS AND METHODS

### Study design

This study was conducted as a cross-sectional survey in a diabetes clinic at the Municipality of Pateros, Metro Manila, Philippines in March and April 2017.

### Framework of this study (model)

The framework of this study was constructed with reference to the social cognitive theory of Bandura<sup>13</sup> and the model of behavior changes in people with chronic diseases proposed by Bourbeau et al.<sup>14</sup> According to Bandura, self-efficacy is a prerequisite for self-management. Bourbeau et al.<sup>14</sup> described their model of behavior changes as a process in which healthcare professionals conduct an intervention to teach people knowledge and skills. This will improve self-efficacy, which in turn will

promote behavior changes that will influence people's health. This model is considered to be useful for people with various chronic diseases. Based on these QOL-related theories and variables identified by previous studies, we created a conceptual model incorporating physical, social, and cognitive factors (Fig. 1).

### Study setting and participants

Participants comprised people with diabetes aged  $\geq 20$  years old who were members of the Diabetes Association and attended clinics in urban areas of the Philippines. The Diabetes Association was organized in 1997 and provides support to low-income people with type 2 diabetes (approximately 600–800 members). Following approval by the leaders of the Diabetes Association, an invitation to undergo a health check was distributed to Association members. Participants meeting any of the following criteria were excluded from the study: type 1 diabetes; pregnancy; dementia; cognitive impairment or mental illness making it difficult to answer the questionnaires and/or undergo physical measurements; significant musculoskeletal and/or incurable diseases making it difficult to undergo physical measurements or exercise interventions; cardiovascular disorders requiring hospitalization, such as myocardial infarction or stroke; the need for hospitalization due to worsening of complications such as serious renal impairment, retinopathy, and gangrene; and any other factors thought to render the participant unsuitable for enrollment as judged by the principal investigator.

A total of 146 people participated in health checks on the day of the survey and were initially enrolled. Participants with missing responses were excluded, as were those who met any of the exclusion criteria, resulting in a final total of 117 participants.

### Data collection

A questionnaire was distributed to people who received an explanation about the study and gave consent to participate. The completed questionnaire was brought to the health evaluation, and in a face-to-face interview, a researcher verified that the questionnaire was completed and inquired whether any questions had been difficult to answer.

### Survey items

The following items were evaluated: demographic profile (age, sex, and duration of diabetes), QOL, physical factors (HbA1c, comorbidities, complications, and symptoms), social factors (number of family members, support status, educational background, and economic status), and cognitive factors (knowledge, attitude,

self-efficacy, and self-management behavior related to diet or exercise).

Physical factors were assessed as follows. HbA1c was measured using a Clover A1c Self Analyzer (Infopia Co, Ltd, Gyeonggi-do, South Korea), and good glucose control was defined as HbA1c  $< 7.0\%$  according to the standards of the American Diabetes Association.<sup>15</sup> Comorbidities, complications, and symptoms were assessed by the survey, with answers about complications selected from five options (neuropathic symptoms, rest pain, intermittent claudication, and other medical issues). The neuropathy symptom score of Young et al.<sup>16</sup> was employed to assess neurological symptoms.

Social factors were assessed by the survey. The support status was assessed using the support status scale in the Diabetes Care Profile questionnaire developed by the University of Michigan Diabetes Research and Training Center.<sup>17</sup> This questionnaire contains six questions on each topic, including support needed, support received, and attitudes about support. We developed a new scale that included items on oral care in addition to the existing questions, and calculated Cronbach's alpha coefficient to investigate internal consistency. In a preliminary test of this index conducted to verify its reliability and appropriateness, Cronbach's alpha was 0.864, while it was 0.94 for support needed and 0.864 for support received. On the other hand, it was lower (0.583) for attitudes about support. Accordingly, only support needed and support received were adopted in this study. Financial status was assessed using a simple poverty scorecard, which is a questionnaire designed for evaluating poverty among individuals in the Philippines.<sup>18</sup>

Cognitive factors were assessed as follows. Knowledge about diabetes was investigated with a 30-question test based on the diabetes knowledge test<sup>17</sup> and the diabetes knowledge questionnaire.<sup>19</sup> Based on the items in the original questionnaires, new questions were prepared, including some on oral care. The face validity of the questionnaire was confirmed by a preliminary study, after which the final version, consisting of 30 questions, was prepared. Attitudes were assessed using the Problem Area in Diabetes (PAID) scale.<sup>20</sup> This is a single factor survey of problem areas in diabetes that consists of 20 items (Cronbach's  $\alpha = 0.90$ ). People scoring 40 or higher are classified as having "emotional burnout" and are considered to require special attention. PAID scores may improve by 10–15 points in response to educational and medical interventions.

Details on the evaluation of QOL and related factors (self-efficacy and stages of behavioral changes involving diet or exercise) are outlined below.

As a measure for quantifying QOL, we chose the

Eight-Item Short Form QOL Survey (SF-8). This instrument was developed to replace SF-36 in population QOL surveys. SF-8 is an eight-item version of SF-36 that yields a comparable eight-dimension health profile.<sup>21</sup> The eight items are weighted in order from the lowest scale to calculate two component summary scores, namely the Physical Component Summary (PCS) and the Mental Component Summary (MCS). The cut-off value of SF-8 is set at 50, with higher scores indicating better QOL. We used this scale with the permission of iHope International Co., Ltd., after a royalty payment.

Self-efficacy in relation to diabetes was assessed using the diabetes self-efficacy scale.<sup>22</sup> This scale consists of eight Likert-type items, each scored from 0 (“not at all confident”) to 10 (“totally confident”). The mean score for the eight items is the overall score for the scale, with a higher score indicating greater confidence. This scale is free to use without permission.

Self-management behavior was investigated according to the trans-theoretical model (TTM) of behavior change.<sup>23, 24</sup> This scale evaluates the extent to which the following health behaviors are practiced: precontemplation, contemplation, preparation, action, and maintenance. In this study, we used this scale to measure exercise and diet behaviors. TTM assesses an individual’s readiness to implement new, healthier behavior, and provides strategies or processes to guide the individual through the stages of change up to action and maintenance. The behaviors referred to in TTM are also known as the “stages of behavior change.” The participants in the action and maintenance stages were classified into the exercise habits and healthy diet group.

### Data analysis

Summary statistics were calculated for the parameters. Correlations among variables were investigated by Pearson’s correlation coefficient analysis. A structural analysis of co-variance was conducted to assess causal relationships, and allowed for an indirect/integrated effect assessment. To assess the fit of the model, the goodness-of-fit index (GFI) was used to evaluate its explanatory power and the adjusted goodness-of-fit index (AGFI) was used to delineate its stability. In addition, the comparative fit index (CFI) and root mean square error of approximation (RMSEA) were used as indicators of comparative fitness. Previous guidelines listed the following values as indicative of model acceptability: GFI and AGFI  $\geq 0.9$ ,<sup>25</sup> CFI  $\geq 0.95$ , and RMSEA  $\leq 0.06$ .<sup>26</sup> IBM SPSS Statistic version 25 and co-variance structural analysis/structural formula model software (IBM SPSS Amos version 25) were used for all analyses.

### Ethical considerations

Details of the study were explained with reference to documents stating that the individual could choose not to participate in the study or withdraw consent at any time during the study without prejudice; that the results obtained would only be used for investigational purposes; and that personal information would be strictly protected by de-identification, if data were presented at an academic meeting. This study was conducted after obtaining approval from the Ethical Review Board of the Faculty of Medicine of Tottori University, Japan (Approval No. 1608B013).

## RESULTS

### Participant characteristics

A total of 146 people with diabetes participated in health evaluations, and those who provided responses with missing items were excluded. The remaining 117 participants (80.1%) constituted the analysis set, comprising 27 males (23.1%) and 90 females (76.9%). Table 1 shows the participant characteristics. QOL scores were  $48.7 \pm 7.3$  according to PCS and  $47.8 \pm 7.7$  according to MCS.

At entry, high values of HbA1c ( $\geq 7\%$ ) were detected in 51% (60/117) of participants. Most had concomitant diseases (86.3%), which included hypercholesterolemia (55.6%), hypertension (51.3%), rheumatoid arthritis (22.2%), back pain (18.8%), heart disease (15.4%), osteoarthritis (12.0%), depression (6.8%), pulmonary diseases (4.3%), skin diseases (4.3%), and other medical conditions (9.4%). Complications of diabetes were present in 51.3% of participants, including 93 with diabetic neuropathy. The mean score for attitude (PAID, a cognitive factor) was  $41.9 \pm 15.0$  (cut-off value), and only 11 participants (9.4%) had a score  $\geq 60$ .

### Descriptive statistics and correlations

Parameters correlated significantly with PCS/MCS of QOL factors ( $P < 0.05$ , by Pearson’s test) were extracted and shown in Tables 2 and 3. PCS factors were correlated significantly with knowledge of normal blood glucose levels, self-efficacy, and self-management behavior (exercise) (Table 2). MCS factors were correlated significantly with age, HbA1c, neuropathy, knowledge of insulin, attitude, self-efficacy, self-management behavior (exercise) (Table 3).

### QOL model for participants with diabetes

Based on the proposed model in Fig. 1, we developed path diagrams for PCS and MCS. Then, we varied the relationships between the lower-value paths, and re-analyzed the models using the significant bivariate association tests. Finally, we obtained the revised models

**Table 1. Participant characteristics (n = 117)**

		Number (%)	Mean ± SD	Min	Max
<b>Attributes</b>					
Age	Male		65.4 ± 7.7	50	84
	Female		64.2 ± 10.0	39	87
Gender	Male	27 (23.1)			
	Female	90 (76.9)			
Duration of diabetes (years)			8.6 ± 9.5	0	52
<b>QOL</b>					
Physical Component Summary (PCS)			48.7 ± 7.3	25.7	61.4
Mental Component Summary (MCS)			47.8 ± 7.7	25.3	63.1
<b>Related factors</b>					
<b>Physical factors</b>					
HbA1c (%)			7.6 ± 2.0	4.6	14.0
Comorbidities	No	16 (13.7)			
	Yes	101 (86.3)			
Complications (multiple answers)	Nephropathy	8 (6.8)			
	Neuropathy	16 (13.7)			
	Retinopathy	39 (33.3)			
	Amputation	1 (0.9)			
	Previous foot ulcer	2 (1.7)			
	Neuropathy Symptom Score	Normal	24 (20.5)		
	Mild neuropathy	17 (14.5)			
	Moderate neuropathy	35 (29.9)			
	Severe neuropathy	41 (35.1)			
<b>Social factors</b>					
Number of family members				1	12
Support status	needs score (7–35)			7	35
	actual score (6–30)			6	30
Educational background	Illiterate	2 (1.7)			
	Primary	35 (29.9)			
	Secondary	57 (48.7)			
	College	19 (16.2)			
	Postgraduate	4 (3.4)			
Economic status	Poverty: total score (0–100)		62.1 ± 17.2	19	100
<b>Cognitive and behavioral factors</b>					
Knowledge: total score (correct answer rate)			63.2 ± 14.7	10	83.3
Attitude (PAID): total score (20–100)			41.9 ± 15.0	20	100
Self-efficacy: total score (8–80)			60.6 ± 16.3	8	80
Self-management behavior: exercise habits		93 (79.5)			
Self-management behavior: healthy diet		88 (75.2)			

PAID, Problem Area in Diabetes; QOL, quality of life.  
HbA1c refers to glycated hemoglobin.

shown in Figs. 2 and 3.

The most significant path influencing PCS was from self-efficacy to self-management behavior (exercise), with a path coefficient of 0.37. This was followed by paths from knowledge to self-efficacy, from HbA1c to self-management behavior (exercise), from self-management behavior (exercise) to PCS, from knowledge to PCS, and from HbA1c to PCS. In the MCS, the path from self-efficacy to self-management behavior (exercise) was most significant, with a path coefficient

of 0.37. This was followed by paths from HbA1c to self-management behavior (exercise), from neuropathy to MCS, from age to self-efficacy, from knowledge to MCS, from self-management behavior (exercise) to MCS, and from age to MCS. HbA1c and MCS did not show a high score (–0.09).

## DISCUSSION

In this study of factors affecting the QOL of participants with type 2 diabetes in the Philippines, a path analysis

**Table 2. Coefficients of correlation with Physical Component Summary (PCS) (only significant results are shown [P < 0.05])**

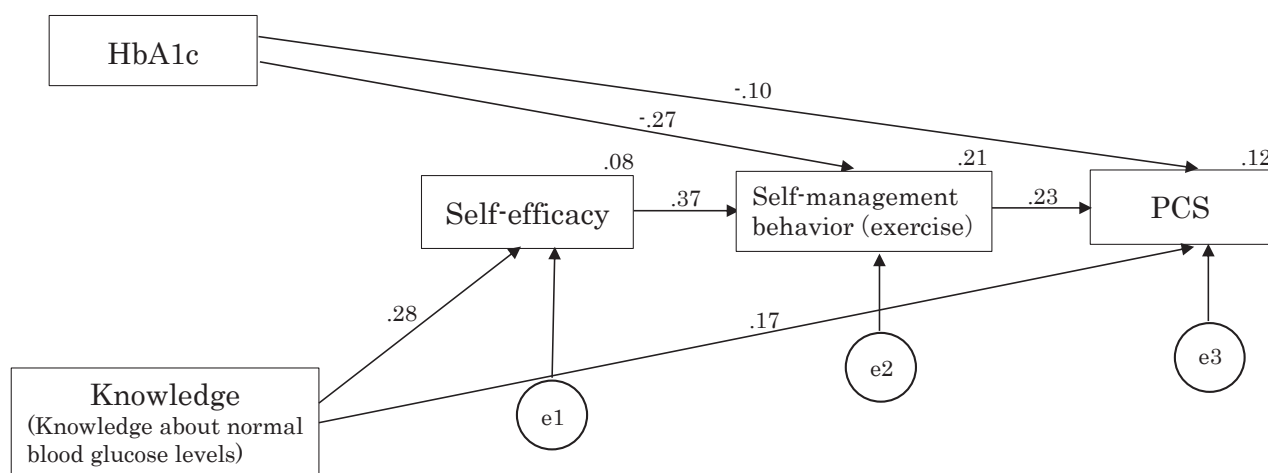
	HbA1c	Knowledge (about normal blood glucose levels)	Self-efficacy	Self-management behavior (exercise)
PCS	-0.193*	0.203*	0.220*	0.275**

Pearson's r, \* P < 0.05, \*\* P < 0.01  
 HbA1c refers to glycated hemoglobin.

**Table 3. Coefficients of correlation with Mental Component Summary (MCS) (only significant results are shown [P < 0.05])**

	Age	HbA1c	Neuropathy	Knowledge (about insulin)	Attitude (goals of diabetes treatment)	Self-efficacy	Self-management behavior (exercise)
MCS	0.238**	-0.211*	-0.285**	0.201*	-0.232*	0.243**	0.253**

Pearson's r, \*P < 0.05, \*\*P < 0.01  
 HbA1c refers to glycated hemoglobin.



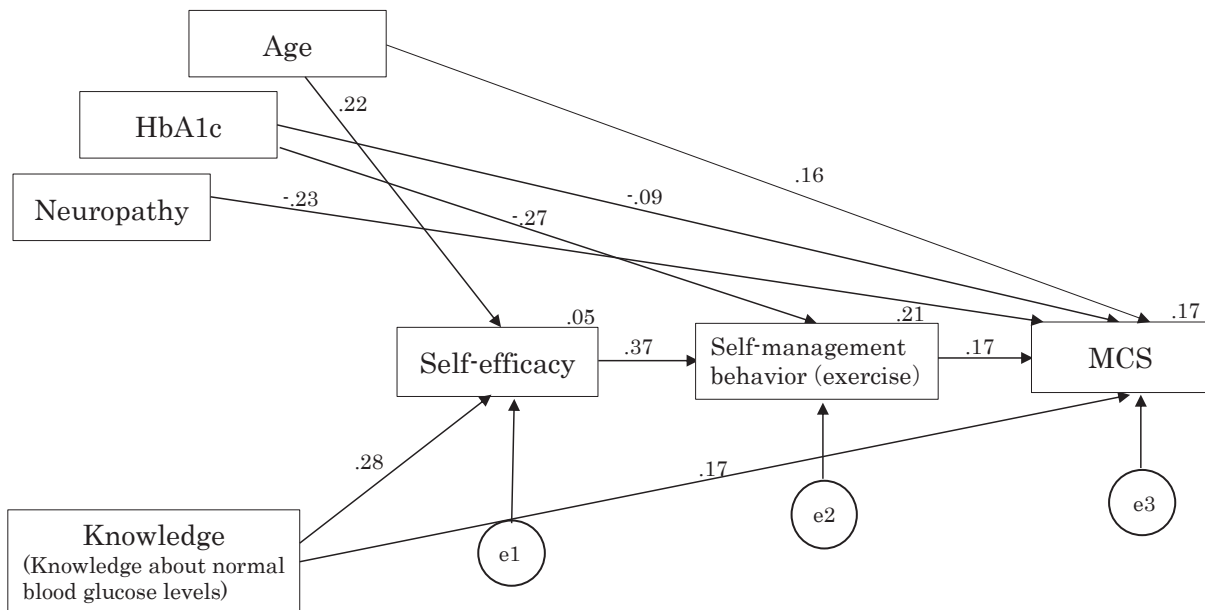
**Fig. 2.** An optimized structure of the conceptual model for the Physical Component Summary (PCS). ( $\chi^2(4) = 3.789, P = 0.435, GFI = 0.987, AGFI = 0.952, CFI = 1.000, RMSEA = 0.000$ ). \*P < 0.05. e1, error1; e2, error2; e3, error3. HbA1c refers to glycated hemoglobin. AGFI, adjusted goodness-of-fit index; CFI, comparative fit index; GFI, goodness-of-fit index; RMSEA, root mean square error of approximation.

was used to develop a model that included the relationship between awareness and behavioral factors such as knowledge, attitude, self-efficacy, and self-management behavior. We found that self-efficacy was the most important factor contributing to self-management behavior. Moreover, our results suggested that exercise-related self-management behavior directly increased QOL, more so than physical status factors such as HbA1c or neurological deficits. Finally, appropriate knowledge about insulin function and normal blood glucose levels also improved self-management behavior and QOL.

Bandura proposed the social learning theory, according to which self-efficacy influences behavior changes.<sup>13</sup> In short, self-efficacy is considered to be a requirement for performing exercise, and the results of the present study supported Bandura's theory. Although

we found that self-efficacy was the most important factor with respect to exercise-related self-management behavior, in general it is difficult to incorporate exercise into a daily life routine. Al-Khawaldeh et al. previously showed that with regard to self-management behaviors such as diet, exercise, foot care, and emotional management, confidence in the ability to exercise regularly is the lowest.<sup>27</sup> This could be due to the fact that in the Philippines, traffic conditions are not favorable, roads are not maintained, and the climate is hot,<sup>28, 29</sup> all of which contribute to making outdoor exercise difficult. Thus, healthcare professionals must provide care that improves self-efficacy with respect to exercise by guiding patients through exercise methods that align with regional cultures and climates.

Four factors are known to improve self-efficacy:



**Fig. 3.** An optimized structure of the conceptual model for the Mental Component Summary (MCS). ( $\chi^2(13) = 11.820$ ,  $P = 0.542$ , GFI = 0.971, AGFI = 0.938, CFI = 1.000, RMSEA = 0.000). \* $P < 0.05$ . e1, error1; e2, error2; e3, error3. HbA1c refers to glycated hemoglobin. AGFI, adjusted goodness-of-fit index; CFI, comparative fit index; GFI, goodness-of-fit index; RMSEA, root mean square error of approximation.

performance accomplishments, vicarious learning, verbal persuasion, and self-appraisal of emotional and physiological responses.<sup>30</sup> As it is said that many forms of exercise reduce stress directly by preventing bodily illness or by providing extra benefits for the mind,<sup>31</sup> exercise actually promotes self-appraisal of emotional and physiological responses. Moreover, patients can share their progress or tips for exercising, thus learning from each other. Patients may also experience performance accomplishments by incorporating indoor exercises learned from other patients, which ultimately leads to confidence in continuing to exercise.

According to the United States Centers for Disease Control (CDC), the advantages of exercising to improve QOL markedly exceed the associated risks, such as injury.<sup>32</sup> Exercise is known to reduce the risk of early death related to chronic diseases, irrespective of age, ethnicity, body type, and body frame. Routine exercise decreases the risks of various diseases and health conditions, and contributes to improvements in QOL.<sup>33</sup>

Furthermore, Mehta et al.<sup>34</sup> showed that accurate knowledge about diabetes enhanced self-efficacy in the management of diabetes. Future educational interventions on diabetes should place a greater emphasis on increasing knowledge regarding diabetes causes, comorbidities, and treatments. The present results revealed that proper knowledge of diabetes may also improve the QOL of diabetes participants, as evidenced by two positive correlations between the participants'

knowledge level about the normal range of blood glucose and their physical QOL, and between their levels of knowledge about the functions of insulin and their mental QOL. A low percentage of study participants had proper knowledge about diabetes: the rate of correct answers in the 30-question test was only 43%, while the rate for questions regarding the self-monitoring of diabetes was even lower (24%).<sup>35</sup> In this study, the rate of correct answers in the 30-question test was 63.2%, suggesting that the knowledge level of all participants was not high; however, this rate (63.2%) was higher than that reported previously,<sup>35</sup> possibly due to differences in the questions used in the two studies. Given that improving knowledge regarding diabetes had positive effects on self-management behavior, patients' overall understanding of diabetes needs to be improved. Public health education is effective in this regard, and should thus contribute to preventing diabetes and slowing its progression. However, in a previous study, only 12.2% of patients with type 2 diabetes attended educational seminars in the Philippines.<sup>33</sup> Factors such as low income and the lack of higher education may prevent patients from taking advantage of opportunities to obtain relevant knowledge and skills through public health education. Therefore, educational programs that take into account the social situation in the Philippines must be developed to improve patient QOL.

This study showed that PCS and MCS were not closely related to HbA1c, which is in contrast to previous

findings suggesting a relationship between HbA1c and QOL.<sup>36–38</sup> The clinic at which this study was conducted measures fasting blood glucose rather than HbA1c to assess glucose control during routine health check-ups. Therefore, one reason why HbA1c was not related to QOL in the present study was that participants did not routinely undergo HbA1c measurement and may not have correctly understood the importance of high HbA1c values. Even when HbA1c is high, if a participant does not understand the significance of a high value, a correlation with QOL may not be demonstrated. Thus, further education needs to be provided in order for participants with diabetes to understand HbA1c correctly.

This study also revealed some differences in the factors affecting PCS versus MCS. The causal model showed that MCS was correlated with age and neuropathy. Whereas we expected neuropathy to lower physical QOL, the participants actually felt that neuropathy lowered mental QOL, presumably related to the inconveniences in daily life caused by pain. Psychological factors, including anxiety and irritation, influence MCS. They are also strongly associated with depression. A correlation between depression and neurological symptoms was previously identified in people with type 2 diabetes.<sup>39</sup> Therefore, it is conceivable that neuropathy strongly correlates with MCS, since more severe neurological symptoms lead to a greater the risk of developing depression caused by low sleep quality secondary to marked pain, as well as cognitive impairment associated with depression. Age directly influenced both MCS and self-efficacy: older participants had higher MCS scores and self-efficacy. According to the developmental stages proposed by Erikson,<sup>40</sup> young people tend to have many problems with psychosocial development, including lack of confidence regarding intimacy and generativity, a significant role both at work and at home, and less confidence in incorporating self-management behaviors into their daily lives. Thus, the MCS of young people may be lower than that of older people. Regardless of their age, it is important to support people with diabetes in fulfilling their roles related to work, family, and social activities.

The results of the present study did not show any direct correlation with social factors, indicating that in a low-income area in the Philippines, the QOL of people with type 2 diabetes was not influenced by their socio-economic status. It appears that people in the Philippines attach importance to an understanding of their disease and to positively incorporate disease self-management into their daily lives, for instance as revealed in a developed country such as Australia. Our results suggested that medical professionals should not

only help people with diabetes to improve their HbA1c levels, but also use cognitive approaches to encourage behavior change. Increased self-efficacy in diabetes management may allow patients to take effective measures against the disease at a reduced cost.

## LIMITATIONS OF THIS STUDY

This study was conducted only in one area (municipality) of the Philippines, and the subject size was limited. Therefore, there might be some biases in the present study. In addition, some participants might have misunderstood the questions and responded incorrectly, because they had limited literacy. Accordingly, these points need to be verified through additional studies in some other areas of the Philippines.

*Acknowledgments:* This study was jointly funded and supported by the “Japanese Technical Cooperation with Grassroots Projects for Health Promotion” project of the Japan International Cooperation Agency (JICA), and “Human Development Projects” of the International Platform for Dryland Research and Education (IPDRE), Tottori University, Japan. The authors also acknowledge professors Seiji Kageyama and Youichi Kurozawa, Tottori University, Japan for their technical support and assistance with data collection and advice.

*The authors declare no conflicts of interest.*

## REFERENCES

- 1 Tazi Mezalek Z, Bono W. Challenges for lupus management in emerging countries. *Presse Med.* 2014;43:e209-e20. PMID: 24857588.
- 2 Trending Economics [Internet]. Trending Economics; 2018 [cited 2017 Nov 25]. Philippines GDP. Available from: <https://tradingeconomics.com/philippines/gdp>.
- 3 Philippine Food & Nutrition Research Institute. 8th National nutrition and health survey 2013 [Internet]. Manila: Republic of Philippines; [cited 2017 Oct 30]. Philippine Food & Nutrition Research Institute. Available from: <http://www.fnri.dost.gov.ph/index.php/nutrition-statistic/19-nutrition-statistic/118-8thnational-nutrition-survey>.
- 4 Philippine Statistics Authority. Filipino Families in the Poorest Decile Earn Six Thousand Pesos Monthly, on Average in 2012 (Results from the 2012 Family Income and Expenditure Survey) [Internet]. Quezon: Philippine Statistics Authority; 2013 [cited 2018 Oct 30]. Available from: <https://psa.gov.ph/content/filipino-families-poorest-decile-earn-six-thousand-pesos-monthly-average-2012-results-2012>.
- 5 Tan GH. Diabetes Care in the Philippines. *Ann Glob Health.* 2015;81:863-9. PMID: 27108153.
- 6 Obermann K, Jowett MR, Alcantara MO, Banzon EP, Bodart C. Social health insurance in a developing country: the case of Philippines. *Soc Sci Med.* 2006;62:3177-85. PMID: 16406248.
- 7 Colak TK, Acar G, Dereli EE, Özgül B, Demirbüken I, Alkaç C, et al. Association between the physical activity level and the quality of life of patients with type 2 diabetes mellitus. *J Phys Ther Sci.* 2016;28:142-7. PMID: 26957746.
- 8 Kapran RM. The significance of quality of life in health care. *Qual Life Res.* 2003;12:S3-S16. PMID: 12803306.



- 9 Kueh YC, Morris T, Borkoles E, Shee H. Modelling of diabetes knowledge, attitudes, self-management, and quality of life: a cross-sectional study with an Australian sample. *Health Qual Life Outcomes*. 2015;13:129. PMID: 26286395.
- 10 Muñoz DL, Gómez OL, Ballesteros LC. [Factors correlated with low-income diabetic patients' quality of life in Bogota]. *Rev Salud Publica (Bogota)*. 2014;16:246-59. PMID: 25383498. Spanish with English abstract.
- 11 Ku GM, Kegels G. Knowledge, attitudes and perceptions of people with type 2 diabetes as related to self-management practices: Results of a cross-sectional study conducted in Luzon, Philippines. *Chronic Illn*. 2015;11:93-107. PMID: 24907237.
- 12 Van Olmen J, Ku GM, Bermejo R., Kegels G, Hermann K, Van Damme V. The growing caseload of chronic life-long conditions calls for a move towards full self-management in low-income countries. *Global Health*. 2011;7:38. PMID: 21985187.
- 13 Bandura A. Self-efficacy: toward a unifying theory of behavior change. *Psychol Rev*. 1977; 84:191-215. PMID: 847061.
- 14 Bourbeau J, Nault D, Dang-Tan T. Self-management and behavior modification in COPD. *Patient Edu Couns*. 2004; 52: 271-7. PMID: 14998597.
- 15 American Diabetes Association. Standards of Medical Care in Diabetes-2013. *Diabetes Care*. 2013;36:S11-S66. PMID: 23264422.
- 16 Young MJ, Boulton AJ, Macleod AF, Williams DR, Sonksen PH. A multicentre study of the prevalence of diabetic peripheral neuropathy in the United Kingdom hospital clinic population. *Diabetologia*. 1993;36:150-4. PMID: 8458529.
- 17 Fitzgerald JT, Funnell MM, Hess GE, Barr PA, Anderson RM, Hiss RG, et al. The reliability and validity of a brief diabetes knowledge test. *Diabetes Care*. 1998;21:706-10. PMID: 9589228.
- 18 Mark S. Simple Poverty Scorecard Poverty-Assessment Tool Philippines [Internet]. Washington: Washington University; [cited 2017 Oct 01] Simple Poverty Scorecard® Poverty-Assessment Tool Philippines. Available from: [http://www.simplepovertyscorecard.com/PHL\\_2004\\_ENG.pdf](http://www.simplepovertyscorecard.com/PHL_2004_ENG.pdf)
- 19 Garcia AA, Villagomez ET, Brown SA, Kouzerkanani K, Hanes CL. The Starr Country Diabetes Education Study. *Diabetes Care*. 2001;24:16-21. DOI: 10.2337/diacare.24.1.16.
- 20 Welch GW, Jacobson AM, Polonsky WH. The problem areas in diabetes scale. An evaluation of its clinical utility. *Diabetes Care*. 1997;20:760-6. PMID: 9135939.
- 21 Turner-Bowker DM, Bayliss MS, Ware JE Jr, Kosinski M. Usefulness of the SF-8 Health Survey for comparing the impact of migraine and other conditions. *Qual Life Res*. 2003; 12:1003-12. PMID: 14651418.
- 22 Lorig K, Ritter PL, Villa FJ, Armas J. Community-based peer-led diabetes self-management: a randomized trial. *Diabetes Educ*. 2009;35:641-51. PMID: 19407333.
- 23 Marcus BH, Rossi JS, Selby VC, Niaura RS, Abrams DB. The stages and processes of exercise adoption and maintenance in a worksite sample. *Health Psychol*. 1992;11:386-95. PMID: 1286658.
- 24 Prochaska JO, DiClemente CC, Norcross JC. In search of how people change. Applications to addictive behaviors. *Am Psychol*. 1992;47:1102-14. PMID: 1329589.
- 25 Toyota H. Introduction to co-variance structural analysis – Structural formula Modeling. 1st ed. Tokyo; Asakura Shoten; 2007. p.1-245. Japanese.
- 26 Hu L, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Struct Equ Model*. 1999;6:1-55. DOI: 10.1080/10705519909540118.
- 27 Al- Khawaldeh OA, Al-Hassan MA, Froelicher ES. Self-efficacy, self-management, and glycemic control in adults with type 2 diabetes mellitus. *J Diabetes Complications*. 2012;26:10-16. PMID: 22226484.
- 28 Cinco TA, Hilario FD, de Guzman RG, Ares ED. Climate Trends and Projections in the Philippines. Proceedings of the 12th National Convention on Statistics (NCS). Philippines, 2013;1-20.
- 29 Southeast Asia [Internet]. Hong Kong: South China Morning Post; [update 2018 Aug 26, cited 2018 Dec 3]. Solutions to Manila's infamous traffic jams may be underground and on the water. Available from: <https://www.scmp.com/news/asia/southeast-asia/article/2161386/solutions-manilas-infamous-traffic-jams-may-be-underground>.
- 30 van de Laar KE, van der Bijl JJ. Strategies enhancing self-efficacy in diabetes education: a review. *Sch Inq Nurs Pract*. 2001;15:235-48. PMID: 11871582.
- 31 Harvard Health Publishing [Internet]. Boston: Harvard University; [update 2018 July 13, cited 2018 Oct 10]. Exercising to relax. Available from: <https://www.health.harvard.edu/staying-healthy/exercising-to-relax>.
- 32 Hsu YC, Tsai SF, Yu L, Chuang JI, Wu FS, Jen CJ, et al. Long-term moderate exercise accelerates the recovery of stress-evoked cardiovascular responses. *Stress*. 2016;19:125-32. PMID: 26473638.
- 33 Warburton DE, Nicol CW, Bredin SS. Health benefits of physical activity: the evidence. *CMAJ*. 2006;74:801-9. PMID: 16534088.
- 34 Mehta NV, Trivedi M, Maldonado LE, Saxena D, Humphries DL. Diabetes knowledge and self-efficacy among rural women in Gujarat, India. *Rural Remote Health*. 2016;16:3629. PMID: 26976745.
- 35 Ardeña GJ, Paz-Pacheco E, Jimeno CA, Lantion-Ang FL, Paterno E, Juban N. Knowledge, attitudes and practices of persons with type 2 diabetes in a rural community: phase I of the community-based Diabetes Self-Management Education (DSME) Program in San Juan, Batangas, Philippines. *Diabetes Res Clin Pract*. 2010;90:160-6. PMID: 20828851.
- 36 Carlson AE, Aronson BD, Unzen M, Lewis M, Benjamin GJ, Walls ML. Apathy and Type 2 Diabetes among American Indians: Exploring the Protective Effects of Traditional Cultural Involvement. *J Health Care Poor Underserved*. 2017;28:770-83. PMID: 28529223.
- 37 Gao J, Wang J, Zheng P, Haardörfer R, Kegler M, Zhu Y, et al. Effects of self-care, self-efficacy, social support on glucose control in adults with type2 diabetes. *BMC Fam Pract*. 2013;14:1-6. PMID: 23705978.
- 38 Sousa VD, Zauszniewski JA, Musil CM, Price Lea PJ, Davis SA. Relationships among self-care agency, self-efficacy, self-care, and glucose control. *Res Theory Nurs Pract*. 2005;19:217-30. PMID: 16144240.
- 39 Bartoli F, Carra G, Crocarno C, Carretta D, La Tegola D, Tabacchi T, et al. Association between depression and neuropathy in people with type 2 diabetes: a meta-analysis. *Int J Geriatr Psychiatry*. 2018;31:829-36. PMID: 26729627.
- 40 Erikson EH. The program of ego identity. *Journal of the American Psychoanalytic Association*. 1956;121-456. DOI: 10.1177/000306515600400104.