ORIGINAL ARTICLE

Structural model of self-care agency in patients with diabetes: A path analysis of the Instrument of Diabetes Self-Care Agency and body self-awareness

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Abstract

Aim: The aim of this study was to examine a causal model of self-care agency by exploring the relationship between the structure of "body self-awareness" and the structure of the Instrument of Diabetes Self-Care Agency (IDSCA).

Methods: The participants were 353 patients with diabetes. The internal consistency of the six items for body self-awareness was examined by calculating the factor structure using principal factor analysis and Cronbach's alpha. In order to examine the relationship between the seven factors in the IDSCA, a path analysis was conducted.

Results: With regard to the factor structure, the factor loading of these five items was 0.511–0.743 ($\alpha = 0.739$). In the path analysis, "body self-awareness" was influenced by the "ability to acquire knowledge" and had a direct effect (0.33) on the "motivation to self-manage", while "motivation to self-manage" had an effect (–0.32) on the "ability to self-manage". The Goodness-of-Fit Index was 0.974.

Conclusion: "Body self-awareness" plays a part in the self-care operation process and serves as an intermediary factor to enable the performance of self-care operations by making the most use of self-care agency. Moreover, striking a proper balance between self-management that is focused on the treatment of diabetes and a person's ability for self-management of diabetes was found to be important.

Key words: body self-awareness, causal model, path analysis, patients with type 1 and type 2 diabetes mellitus, self-care agency.

INTRODUCTION

The number of patients with diabetes is increasing, with >346 million people estimated to have diabetes globally (Shrivastava, Shrivastava, & Ramasamy, 2013), and this number is expected to rise to 592 million by 2035 (Guariguata *et al.*, 2014). Addressing the continued needs and demands of individuals with diabetes is one of the biggest challenges that modern healthcare professionals face (Shrivastava *et al.*; Wagner *et al.*, 2001). In a review of the standards of diabetes self-management education, the American Diabetes Association found that there was a fourfold increase in complications among patients with diabetes who had not received formal self-care practice education (Mensing *et al.*, 2007; Shrivastava *et al.*). When patients with diabetes

participate in their care, they often see a dramatic impact on the progression and development of their disease (Shrivastava *et al.*; UK Prospective Diabetes Study Group, 1998).

Although a meta-analysis of self-management education for adults with type 2 diabetes revealed improved glycemic control and glycosylated hemoglobin levels at the initial follow-up (Norris, Lau, Smith, Schmid, & Engelgau, 2002; Shrivastava *et al.*, 2013; Williams, Freedman, & Deci, 1998), the observed benefits declined from 1–3 months after the end of the intervention. This suggests that continuing education is necessary (Shrivastava *et al.*; Williams *et al.*). In order for patients to obtain the full benefits of diabetes education, the knowledge they acquire must be transferred into self-care activities. Patients with diabetes are expected to follow a complex set of behavioral actions to manage their disease on a daily basis; for example, diet therapy, such as controlling calorie and sodium intake, or exercise therapy, such as walking. These actions must be in line with their lifestyle. The majority of patients with diabetes can significantly reduce the chances of developing long-term complications by improving their self-care activities (Shrivastava *et al.*). Lifestyle and self-care strategies are essential for preventing the complications of diabetes mellitus because these both require comprehensive educational intervention and determine the evolution of the disease (Caro-Bautista, Martin-Santos, & Morales-Asencio, 2014).

Nursing care is provided for patients with health-derived or health-related self-care deficits (Orem, 2001). Self-care agency is defined as the human capability to carry out specific kinds of actions. The development of self-care agency is dependent on learning, life experiences, and adequate instruction, which should be adjusted to each individual's time constraints, abilities, and willingness to learn (Orem). The relationship between therapeutic self-care demands as actions to be taken and self-care agency as the power to take necessary actions is clear (Orem).

Orem's (2001 concept of self-care agency includes the ability to respond to specific events and to understand the characteristics of these events, as well as the meaning of these events, the ability to see the need to change or regulate the actions observed, the ability to acquire knowledge of appropriate courses of action for regulation, the ability to decide what to do, and the ability to act to achieve the desired change or regulation.

To date, research on the effects and evaluation of diabetes education has proposed various methods of measuring the psychosocial factors that are related to

patient self-care behavior and self-efficacy (Fitzgerald *et al.*, 1996; Jansà *et al.*, 2013; Resnick, Luisi, Vogel, & Junaleepa, 2004; Spencer *et al.*, 2011; Toobert, Hampson, & Glasgow, 2000; Weinger, Butler, Welch, & La Greca, 2005; Williams *et al.*, 1998). One study identified a number of validated tools for assessing the four diabetes education outcomes of knowledge and understanding, self-determination, self-management, and psychological adjustment. However, only three tools, one for assessing self-management (Summary of Diabetes Self-Care Activities Measure) and two for assessing psychological adjustment (Problem Areas in Diabetes Questionnaire and Appraisal of Diabetes Scale), met all of the study's assessment criteria (validity, reliability, responsiveness, burden, feasibility, and acceptability) (Eigenmann, Colagiuri, Skinner, & Trevena, 2009). No single instrument achieves all of the validity and reliability requirements for identifying self-care behaviors or barriers; therefore, further studies need to be conducted in order to provide patients, clinicians, and researchers with valid and reliable instruments that are theoretically grounded and methodologically solid (Caro-Bautista *et al.*, 2014). In addition, although instruments have been developed to measure self-care agency in patients with chronic diseases (Dolovich *et al.*, 2004; Honjo, 2001; Riesch & Hauck, 1988; Sousa *et al.*, 2010), none of these instruments can fully assess self-care agency in patients with diabetes.

Therefore, the Instrument of Diabetes Self-Care Agency (IDSCA) for patients with diabetes was developed as a measure of the effects of nursing that can be used in nursing practice. The first stage in developing the IDSCA involved extracting the self-care agency factors of patients with diabetes from a previous study (Shimizu, Kuroda, Uchiumi, & Masaki, 2005) by using a qualitative approach. The extracted factors were "basic knowledge regarding diabetes and self-management", "ability to cope with stress", "ability to make the most of the support available", "monitoring ability", "application ability", "adjustment ability", "ability to understand one's own body", "motivation to self-manage", and "ability for self-realization despite suffering from diabetes" (Shimizu *et al.*, 2009).

The second and third stages involved creating eight factors and 77 measurement items using these extracted factors, whereas the fourth and fifth stages consisted of examining the content validity and feasibility as well as the reliability and validity of the measurement items (Shimizu *et al.*, 2011). As a result, the eight factors and 77 items were refined into seven factors ("ability to self-manage", "motivation to self-manage", "monitoring

Table 1 Excerpts of the tool/question items in the Instrument of Diabetes Self-care Agency that was developed in a previous study (Shimizu *et al.*, 2011)

Factor	Item
1: Ability to self-manage (12 items; α = 0.859)	You feel that self-management is fun and joyful
	Based on previous experience, you have become confident in your self-management ability
	Self-management has become second nature to you
2: Motivation to self-manage (eight items; α = 0.828)	You are interested in diabetes
	You have reasons that motivate you to self-manage
	Self-management leads you to achieve the life you want
3: Monitoring ability (six items; α = 0.818)	You judge your physical condition, diet, and exercise by checking your blood sugar levels
	You can predict whether you have low blood sugar. (If you do not take medicine, such as insulin, please choose "0.")
	You can predict whether you have high blood sugar
4: Application or adjustment ability (nine items; α = 0.891)	You can create a clear picture of your daily routine (e.g. activities) in your mind
	You try to match your self-management to your lifestyle
	You can adjust your self-management to fit any situation (e.g. when you are busy, when there is a special occasion, or when you have a party)
5: Ability to acquire knowledge (seven items; α = 0.752)	You know the complications of diabetes
	You know that illnesses, such as a cold, can influence your blood sugar levels
	You know about the relationship between blood sugar levels and eating
6: Ability to make the most of the support available (five items; α = 0.844)	You have someone to turn to when you need help with managing your health
	You have someone to help you with things that are related to your health that you cannot do
	You have someone to talk to about your worries and questions
7: Ability to cope with stress (seven items; α = 0.759)	You always feel tense about properly controlling your diabetes
	You cannot sleep at night when you think about diabetes
	You often feel depressed
Items that were not obtained in the factor analysis	
"Body self-awareness" (six items)	You consider self-management to be essential
	You always listen to your own body to find out what it needs
	You know what symptoms mean when they occur
	You feel that diabetes is something that will only happen to others (invalid result in the subsequent factor analysis)
	You feel the importance and risks of diabetes acutely
	There is something you are being careful about in order to improve the condition of your body

IDSCA has seven factors and 54 items, with α = 0.936. IDSCA, Instrument of Diabetes Self-care Agency.

ability", "application or adjustment ability", "ability to acquire knowledge", "ability to make the most of the support available", and "ability to cope with stress") and 54 items. However, the provisional factor, "ability to understand one's own body/body self-awareness", was not initially extracted.

"Body self-awareness" is a patient's ability to understand what state his or her own body is in and is an important factor of self-care agency in patients with diabetes with few subjective symptoms and a difficulty in recognizing his or her own physical condition. The

importance of nursing assistance to support self-care also has been demonstrated (Shimizu *et al.*, 2011). The reason that "body self-awareness" was not extracted as a factor was because no hypothesis was formed in the exploratory factor analysis. It is not related to its low importance in measuring self-care. The diversity and complexity of body self-awareness and the limitations to its quantification when exploring the factor structure that was created from the observed data were for other reasons (Kano, 2002; Shimizu *et al.*, 2011).

Benner (1989 stated the following about "bodily intentionality": it is common to find a change in posture and embodiment as the person finds new ways of living as a result of a major life change. The body has a capacity to respond and react to meaningful situations and this is based on cultural context. If a person is able to pay firm attention to the condition of their body, they are better able to adjust their actions in social situations and lifestyle accordingly.

Among Orem's (2001 capabilities and dispositions that form the basis for self-care agency, health is composed of body self-awareness factors, such as a willingness to engage in self-care by looking at one's self, concern about health, and enduring habits and interests to which one's attention is drawn by using sensations and perception. This suggests that body self-awareness has a diverse and complex involvement in the components of self-care agency. The IDSCA was developed as an instrument to encompass the entire structure of self-care agency, but it cannot elucidate the causal relationship between many variables in a short amount of time. The data often do not match up, even if a causal model is created based on findings and data from previous studies (Kano, 2002).

The aim of this study therefore was to examine a causal model of self-care agency as a whole by exploring the relationship between the structure of "body self-awareness", which was not extracted as component factor of self-care agency in a previous study, and the structure of self-care agency (IDSCA), which was elucidated in a previous study.

METHODS

Participants and data collection

The participants comprised outpatients with diabetes or inpatients. They were capable of verbal communication and of using the instrument. The participants had not been diagnosed with a mental illness and their doctors did not state that they should not participate. Patients who were mentally unstable, those with strong physical pain, and those in need of special care other than self-care education were excluded.

The data were collected from April 2009 to January 2010. Before collecting the data, written and verbal explanations were given to the data-collectors (22 certified diabetes nurses), those in charge of the cooperating facilities (22 facilities), and the participants regarding the purpose and content of the study, that the participants' free will would be respected when they consented

to cooperate or if they dropped out halfway through, and that the participants' privacy would be protected. Ethical considerations were addressed by confirming that the participants had signed a consent form for participation.

Instrument

The seven factors and 54 items in the IDSCA had been developed in a previous study (Shimizu *et al.*, 2011) and the six items that had been aggregated in a qualitative study (Shimizu *et al.*, 2009) and that composed "body self-awareness", which was not extracted as an exploratory factor, were used. The internal consistency of the seven factors was maintained (Table 1).

Statistical analysis

The statistical analysis was carried out by using SPSS AMOS v. 22 (IBM Corporation, Armonk, NY, USA). First, the internal consistency of the six items for body self-awareness, which was not extracted as a factor, were examined by calculating the factor structure with a principal factor analysis and Cronbach's alpha.

Next, in order to examine the relationship between the seven factors in the IDSCA, a path analysis was conducted with data from several models, using the "structural diagram of self-care agency factors" (Shimizu *et al.*, 2005, 2009, 2011), which was obtained from the results of a qualitative study (Shimizu *et al.*, 2005), as a model. A path analysis is a statistical analysis that is conducted by assuming several causal models between the variables and applying a multiple regression analysis and covariance structure analysis. The compliance of the path analysis model also was examined.

The purpose of a path analysis is to elucidate the causal relationship between the observed variables without introducing latent variables. A path analysis can be solved with a traditional method in which path coefficients are found by conducting a multiple regression analysis of each dependent variable and with structural equation modeling (SEM), which analyses all causal relationships simultaneously (Kano, 2002; Kano & Azuma, 2003). Structural equation modeling takes factor analysis one step further by relating the constructs to each other and to the covariates in a system of linear regressions, thereby purging the "structural regressions" of the biasing effects of measurement errors. In this way, SEM encompasses two ideas: latent variables and a joint analysis of systems of equations. In the present study, the notion was followed that the latent variable

is more powerful and generalizable than a joint analysis (Muth'en, 2002).

RESULTS

Of the 470 questionnaires that were distributed, 368 questionnaires were returned, and of these, 353 were usable. The participants were aged 19–88 years (mean age: 59.4 ± 13.2 years); 197 (53.5%) were men and 160 (43.5%) were women. The duration of diabetes morbidity ranged from 1 month to 50 years (mean: 12.0 ± 9.7 years). Thirty-eight participants (10.3%) had type 1 diabetes and 326 (88.6%) had type 2 diabetes; 189 (51.4%) used hypoglycemic agents, 215 (58.4%) were receiving insulin therapy, and 15 (4.1%) required assistance in their daily life (Table 2).

Factor structure of "body self-awareness"

Among the factors of self-care agency, the six items for "body self-awareness", a factor that was obtained in a qualitative analysis (Shimizu *et al.*, 2009) but not in an exploratory factor analysis (Shimizu *et al.*, 2011), underwent principal factor analysis and promax rotation. A single-factor structure was considered to be valid, based on changes in Eigenvalues. The cumulative contribution ratio of a single factor was 33.02. The commonality of the item, "You feel like diabetes is something that will only happen to others", after factor extraction was 0.092 and the factor loading was 0.304. As a result of these low values, this item was excluded and a second principal factor analysis and promax rotation were carried out with the remaining five items. The cumulative contribution ratio of the five items in this single factor was 37.88. The factor loading of these five items was 0.511–0.743 and the Cronbach's alpha was 0.739.

Causal relationship between the seven Instrument of Diabetes Self-Care Agency factors and "body self-awareness"

A path analysis was conducted with data from several models by using the "structural diagram of self-care agency factors" (Shimizu *et al.*, 2005, 2009, 2011) that were obtained from the results of a qualitative study as the model for the relationship diagram between the seven factors that were obtained by an exploratory factor analysis and the five items for body self-awareness, which was confirmed as a single structural factor. A

Table 2 Participants' characteristics

Characteristic	N = 368	%
Age (years)		
≤29	3	0.8
30–39	29	7.9
40–49	46	12.5
50–59	92	25.0
60–69	104	28.3
70–79	73	19.8
≥80	18	4.9
Unknown	3	0.8
Mean (SD): 59.4 ± 13.2		
Sex		
Male	197	53.7
Female	160	43.5
Unknown	11	3.0
Diabetes type		
1	38	10.3
2	326	88.6
Other	3	0.8
Unknown	1	0.3
Morbidity (years)		
<5	93	25.3
5–10	81	22.0
10–15	70	19.0
15–20	44	12.0
≥20	78	21.2
Unknown	2	0.5
Mean (SD): 12.0 ± 9.7		
HbA1c (%)		
≤6.0	45	12.2
6.1–7.0	107	29.1
7.1–8.0	85	23.1
8.1–9.0	50	13.6
9.1–10.0	33	9.0
≥10.1	45	12.2
Unknown	3	0.8
Mean (SD): 7.9 ± 2.5		
Hospital admission		
Inpatient	107	29.1
Outpatient	261	70.9
Oral hypoglycemic drugs		
No	178	48.4
Yes	189	51.4
Unknown	1	0.3
Insulin self-injection		
No	151	41.0
Yes	215	58.4
Unknown	2	0.5
ADL support		
No	352	95.7
Yes	15	4.1
Unknown	1	0.3

ADL, activities of daily living; SD, standard deviation.

significant difference in all the factors was confirmed when the significance of the individual path coefficients was tested by using a *t*-test (Fig 1). The value was a path coefficient, which is a standardized partial regression coefficient.

Relationship between "body self-awareness", "ability to acquire knowledge", "monitoring ability", and "application or adjustment ability"

The direct effect of the "ability to acquire knowledge" was 0.33 on "body self-awareness", 0.55 on "monitoring ability", and 0.15 on "application or adjustment ability". The "ability to acquire knowledge" had the strongest positive relationship with "monitoring ability", followed by a moderately positive relationship with "body self-awareness" and a weak positive relationship with "application or adjustment ability".

The direct effect of "monitoring ability" on "application or adjustment ability" was 0.21. These results do not indicate that the "ability to acquire knowledge" has a weak relationship with "application or adjustment ability", but rather that "monitoring ability" changes greatly depending on the "ability to acquire knowledge", which indirectly affects "application or adjustment ability" via "monitoring ability".

At the same time, "body self-awareness" was directly affected somewhat positively by the "ability to acquire knowledge" and indirectly affected by "monitoring ability". Moreover, "body self-awareness" was influenced by the "ability to acquire knowledge" and

"monitoring ability" had a strong positive direct effect (0.55) on "application or adjustment ability".

"Body self-awareness" and the "ability to self-manage" and "motivation to self-manage"

The factors that had a direct effect on the "ability to self-manage" were "body self-awareness" (0.44), "application or adjustment ability" (0.44), and the "ability to cope with stress" (0.37). Moreover, the "ability to self-manage" was found to have a strong positive direct effect (0.50) on the "motivation to self-manage". That is, the "ability to self-manage" influenced the "motivation to self-manage" by indirectly affecting "body self-awareness", "application or adjustment ability", and the "ability to cope with stress". "Body self-awareness" had a somewhat positive direct effect (0.33) on the "motivation to self-manage", whereas the "motivation to self-manage" had a somewhat negative effect (–0.32) on the "ability to self-manage".

The "ability to make the most of the support available" had a weak positive direct effect (0.24) on the "ability to cope with stress", as well as weak positive direct effects (0.10–0.16) on "body self-awareness", "monitoring ability", "application or adjustment ability", and the "motivation to self-manage". The "ability to cope with stress" had a somewhat direct effect (0.37) on the "ability to self-manage" alone.
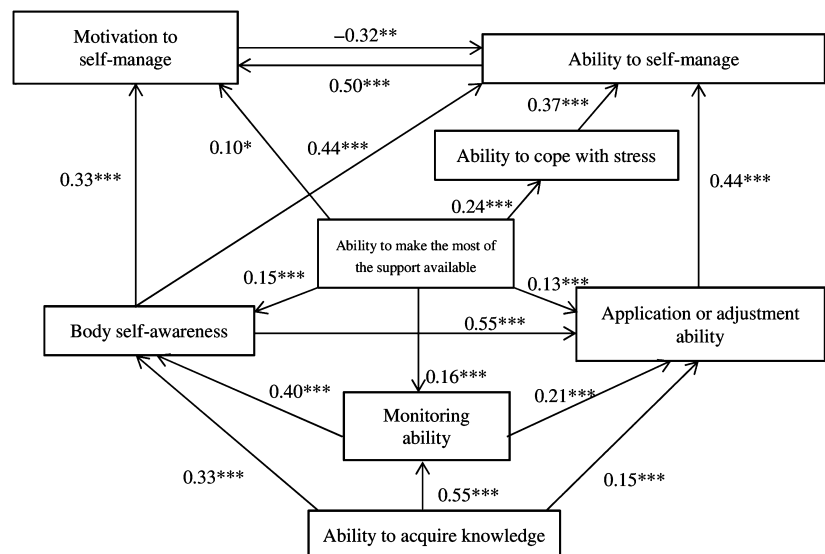

Figure 1 Self-care agency structural model: structural equation modeling of Instrument of Diabetes Self-Care Agency and body self-awareness. A path analysis was conducted to show the relationship between the seven factors that were obtained by the exploratory factor analysis and the five items for body self-awareness, which were combined into the single structural factor, "body self-awareness". The numbers represent the path coefficients, which were tested by using a *t*-test. *$P < 0.02$, **$P < 0.01$ and ***$P < 0.001$. AGFI, Adjusted Goodness-of-Fit Index; GFI, Goodness-of-Fit Index.

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Model's goodness-of-fit

The path analysis model fit very well, with a Goodness-of-Fit Index of 0.974 and an Adjusted Goodness-of-Fit Index of 0.914.

DISCUSSION

The IDSCA was developed as an instrument to measure self-care agency in patients with diabetes, which is a factor that nurses focus on when providing diabetes care (Shimizu *et al.*, 2009). In an exploratory factor analysis in a previous study, one of the factors that was defined in the concept of self-care agency, the "ability to understand one's own body = body self-awareness", was distributed among the other factors and did not become a structural factor (Shimizu *et al.*, 2011). A covariance structure analysis with a causal model in the present study revealed that the structural model of self-care agency had very similar causal relationships to the model that was hypothesized.

In the authors' hypothesis (Shimizu *et al.*, 2005, 2009, 2011), self-care agency was composed of nine factors, based on the results of a qualitative analysis (Shimizu *et al.*). With "basic knowledge regarding diabetes and self-management" as the base point, this self-care agency structure will continue to be developed in one direction to establish self-management methods by enhancing patients' "application or adjustment ability". It also will be developed in another direction to enhance the "ability to understand one's own body" and "motivation to self-manage". "Monitoring ability", which is necessary to enhance abilities in both directions, is key to both types of enhancement and has been shown to enhance the "ability for self-realization despite suffering from diabetes" by comprehensively utilizing these abilities. Furthermore, the "ability to cope with stress" and the "ability to make the most of the support available", which help to maintain emotional stability, are abilities that are involved in the whole process.

The results of this study revealed that "body self-awareness" influences the "ability to acquire knowledge" and "monitoring ability" and that these two abilities have a strong indirect effect on "application or adjustment ability", which leads to the "ability to self-manage".

Self-monitoring in type 2 diabetes is composed of three attributes: awareness of, interpretation of, and response to the particular disease manifestations of a patient with diabetes (Song & Lipman, 2008). In addition, as suggested by Orem (2001, the broad structure of the concept of self-care agency is understood with respect to operations that are specific to the phases of deliberate action; namely, estimative operations, transitional operations of reflection, critical judgment, decision-making, and production operations. The nature of human capabilities that enable self-care behavior is intermediate between the human functioning and the dispositions that are described in Backscheider's list and estimative, transitional, and production self-care operations. Ten power components that are necessary to engage in self-care operations in concrete situations were formulated and expressed as a single series and not in relation to the estimative, transitional, and productive operations (Orem).

The results of this study suggest that "body self-awareness" plays a part in the self-care operation process and that it serves as an intermediary factor that enables the performance of self-care operations by making the most use of self-care agency.

Many patients cannot put their knowledge into practice despite their utmost effort to learn self-management. Possessing the "ability to acquire knowledge" is not the only important part of the structural model of self-care agency. Increasing one's motivation and interest in self-management by making full use of one's body self-awareness and monitoring ability and making adjustments according to one's condition and lifestyle are also important in applying one's acquired knowledge in self-care activities.

Another important finding was that "body self-awareness" transforms "application or adjustment ability" into the "ability to self-manage". However, if "body self-awareness" influences the "motivation to self-manage" too strongly, it has a negative effect on the "ability to self-manage". Meanwhile, the "ability to cope with stress" also influences the "ability to self-manage" and shows the strongest relationship with the "ability to make the most of the support available".

Knowledge, attitude, and practice gaps exist among patients with type 2 diabetes, and although theoretical knowledge of how type 2 diabetes should be managed is available, the attitudes of patients and healthcare professionals can influence the practical implementation of life-enhancing changes for living with diabetes on a daily basis (Serrano-Gil & Jacob, 2010). Clinical assessments of the capacity of patients with chronic conditions should be expanded to include both autonomous decision-making and autonomous execution of the agreed-on treatment plans (Naik, Dyer, Kunik, & McCullough, 2009). The published literature emphasizes the role of self-care and empowerment in patients

who must alter their lifestyle to control their disease (Caro-Bautista *et al.*, 2014; Lauder, 2001). Excessive motivity from a very strong motivation and interest in the self-management of diabetes can be a hindrance to one's ability to enjoy self-management.

STUDY LIMITATION

Although background variables, such as age, sex, condition, and treatment, can affect self-care agency, the influence of background variables was not investigated in the present study. This is a topic that the authors hope to explore in a future study on the structure of the self-care agency of patients with diabetes.

PRACTICE IMPLICATIONS

In the structural model of self-care agency, it is important to strike a proper balance between self-management that is focused on the treatment of diabetes and one's ability to self-managediabetes. Moreover, carrying out self-management requires the ability to cope with stress while receiving support. Self-management education for patients with diabetes therefore needs to support patients in acquiring these self-care abilities.

CONCLUSION

It was found that "body self-awareness" plays a role in the self-care operation process and serves as an intermediary factor that enables the performance of self-care operations by making the most use of self-care agency. Increasing motivation and interest in self-management by making full use of body self-awareness and monitoring ability and by making adjustments according to one's condition and lifestyle are also important in using one's acquired knowledge of self-care activities. Moreover, striking a proper balance between self-management that is focused on the treatment of diabetes and one's ability to self-managediabetes was found to be important.

ACKNOWLEDGMENTS

CONFLICTS OF INTEREST

The authors have no conflicting interest to declare.

AUTHOR CONTRIBUTIONS

All the authors contributed to the conception and design of this study; Y. S., K. U., K. A., K. K., N. M., N. S., and H. M. made substantial contributions to the acquisition of the data; N. S. and H. I. made substantial contributions to the analysis and interpretation of the data; S. W. carried out the statistical analysis and drafted the manuscript; and Y. S. critically reviewed the manuscript and supervised the whole study process. All the authors read and approved the final manuscript.

REFERENCES

Benner, P. (1989). *The primacy of caring: Stress and coping in health and illness* (. Menlo Park, CA: Addison Wesley.

Caro-Bautista, J., Martin-Santos, F. J. & Morales-Asencio, J. M. (2014). Systematic review of the psychometric properties and theoretical grounding of instruments evaluating self-care in people with type 2 diabetes mellitus. *Journal of Advanced Nursing*, 70, 1209–1227.

Dolovich, L. R., Nair, K. M., Ciliska, D. K., Lee, H. N., Birch, S., Gafni, A., et al. (2004). The Diabetes Continuity of Care Scale: The development and initial evaluation of a questionnaire that measures continuity of care from the patient perspective. *Health and Social Care in the Community*, 12, 475–487.

Eigenmann, C. A., Colagiuri, R., Skinner, T. C. & Trevena, L. (2009). Are current psychometric tools suitable for measuring outcomes of diabetes education? *Diabetic Medicine*, 26, 425–436.

Fitzgerald, J. T., Davis, W. K., Connell, C. M., Hess, G. E., Funnell, M. M. & Hiss, R. G. (1996). Development and validation of the Diabetes Care Profile. *Evaluation & the Health Professions*, 19, 208–230.

Guariguata, L., Whiting, D. R., Hambleton, I., Beagley, J., Linnenkamp, U. & Shaw, J. E. (2014). IDF Diabetes Atlas: Global estimates of diabetes prevalence for 2013 and projections for 2035. *Diabetes Research and Clinical Practice*, 103, 137–149.

Honjo, K. (2001). Revision of the Self-Care Agency Questionnaire for patients with chronic illness. *Japan Journal of Nursing Science*, 21, 29–39.

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Jansà, M., Vidal, M., Giménez, M., Conget, I., Galindo, M., Roca, D., et al. (2013). Psychometric analysis of the Spanish and Catalan versions of the Diabetes Self-Care Inventory–revised version questionnaire. *Patient Preference and Adherence*, 7, 997–1005.

Kano, Y. (2002). Does structural equation modeling outperform traditional factor analysis, analysis of variance and path analysis? *The Japanese Journal of Behaviormetrics*, 29, 138–159.

Kano, Y. & Azuma, Y. (2003). Use of SEM programs to precisely measure scale reliability. In: H. Yanai, A. Okada, K. Shigemasu, Y. Kano & J. J. Meulman (Eds), *New developments in psychometrics* (141–148). Tokyo: Springer-Verlag.

Lauder, W. (2001). The utility of self-care theory as a theoretical basis for self-neglect. *Journal of Advanced Nursing*, 34, 545–551.

Mensing, C., Boucher, J., Cypress, M., Weinger, K., Mulcahy, K., Barta, P., et al. (2007). National standards for diabetes self-management education. *Diabetes Care*, 30(Suppl. 1), S96–S103.

Muth'en, B. (2002). Beyond SEM: General latent variable modeling. *Behaviormetrika*, 29, 81–117.

Naik, A. D., Dyer, C. B., Kunik, M. E. & McCullough, L. B. (2009). Patient autonomy for the management of chronic conditions: A two-component re-conceptualization. *The American Journal of Bioethics*, 9, 23–30.

Norris, S. L., Lau, J., Smith, S. J., Schmid, C. H. & Engelgau, M. M. (2002). Self-management education for adults with type-2 diabetes: A meta-analysis of the effect on glycemic control. *Diabetes Care*, 25, 1159–1171.

Orem, D. E. (2001). *Nursing: concept of practice* (6th edn. St. Louis, MO: Mosby.

Resnick, B., Luisi, D., Vogel, A. & Junaleepa, P. (2004). Reliability and validity of the self-efficacy for exercise and outcome expectations for exercise scales with minority older adults. *Journal of Nursing Measurement*, 12, 235–248.

Riesch, S. K. & Hauck, M. R. (1988). The exercise of self-care agency: An analysis of construct and discriminant validity. *Research in Nursing & Health*, 11, 245–255.

Serrano-Gil, M. & Jacob, S. (2010). Engaging and empowering patients to manage their type 2 diabetes, Part I: A knowledge, attitude and practice gap? *Advances in Therapy*, 27, 321–333.

Shimizu, Y., Kuroda, K., Uchiumi, K., Asou, K., Murakado, N. & Masaki, H. (2009). The development of an instrument to assess diabetes self-care agency – the revision of the instrument on the basis of the results.

Journal of Japan Academy of Diabetes Education and Nursing, 13, 146–157.

Shimizu, Y., Kuroda, K., Uchiumi, K. & Masaki, H. (2005). Extraction of self-care agency elements for patients with diabetes – toward development of nursing effect measurement tools. *Journal of Japan Academy of Nursing Science*, 11, 23–30.

Shimizu, Y., Uchiumi, K., Asou, K., Murakado, N., Kuroda, K., Seto, N., et al. (2011). The reliability and validity of the Instrument of Diabetes Self-Care Agency (IDSCA). *Journal of Japan Academy of Diabetes Education and Nursing*, 15, 118–127.

Shrivastava, S. R., Shrivastava, P. S. & Ramasamy, R. (2013). Role of self-care in management of diabetes mellitus. *Journal of Diabetes & Metabolic Disorders*, 12, 14.

Song, M. & Lipman, T. H. (2008). Concept analysis: Self-monitoring in type 2 diabetes mellitus. *International Journal of Nursing Studies*, 45, 1700–1710.

Sousa, V. D., Zauszniewski, J. A., Bergquist-Beringer, S., Musil, C. M., Neese, J. B. & Jaber, A. F. (2010). Reliability, validity and factor structure of the Appraisal of Self-Care Agency Scale-Revised (ASAS-R). *Journal of Evaluation in Clinical Practice*, 16, 1031–1040.

Spencer, M. S., Rosland, A. M., Kieffer, E. C., Sinco, B. R., Valerio, M., Palmisano, G., et al. (2011). Effectiveness of a community health worker intervention among African American and Latino adults with type 2 diabetes: A randomized controlled trial. *American Journal of Public Health*, 101, 2253–2260.

Toobert, D. J., Hampson, S. E. & Glasgow, R. E. (2000). The summary of diabetes self-care activities measure: Results from 7 studies and a revised scale. *Diabetes Care*, 23, 943–950.

UK Prospective Diabetes Study Group. (1998). Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). *The Lancet*, 352, 837–853.

Wagner, E. H., Austin, B. T., Davis, C., Hindmarsh, M., Schaefer, J. & Bonomi, A. (2001). Improving chronic illness care: Translating evidence into action. *Health Affairs (Millwood)*, 20, 64–78.

Weinger, K., Butler, H. A., Welch, G. W. & La Greca, A. M. (2005). Measuring diabetes self-care: A psychometric analysis of the Self-Care Inventory–Revised with adults. *Diabetes Care*, 28, 1346–1352.

Williams, G. C., Freedman, Z. R. & Deci, E. L. (1998). Supporting autonomy to motivate patients with diabetes for glucose control. *Diabetes Care*, 21, 1644–1651.