Structural equation modeling of family support for the diet of male workers with type 2 diabetes

Original Article

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Structural equation modeling of family support for the diet of male workers with type 2 diabetes

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Abstract

Background: Dietary management is a fundamental part of the treatment of type 2 diabetes mellitus. However, lifestyle changes associated with dietary management are related with many factors, especially among male workers with type 2 diabetes mellitus, whose employment makes appropriate dietary management difficult. For lifestyle management support, it is important to base social support on the patient's needs and available resources. Family support is important in the dietary management of patients with type 2 diabetes. The family support needs to account for gender differences in patients' needs, which are influenced by traditional gender roles. We examined a structural model of support based on Norbeck's social support model and developed a family support model that worked effectively for the dietary self-management of male workers with type 2 diabetes mellitus.

Methods: A cross-sectional study was conducted using a self-administered questionnaire. We collected data from 92 Japanese male workers (mean age = 55.3 ± 9.5 years) with type 2 diabetes mellitus. Data were analyzed using descriptive statistics, correlation analysis, and structural equation modeling.

Results: The fit indices of the final model were goodness-of-fit index 0.964, adjusted goodness-of-fit index 0.916, comparative fit index 0.99, and root mean square error of approximation 0.042. The model consisted of six factors, indicating the structure by which family support influenced dietary self-management behavior. Of these, three factors ("preparations to minimize blood glucose fluctuations at work," "meals prepared with extra effort just for the patient," and "involvement based on an understanding of the combined difficulty of work and diet") were fed into the structural model.

Conclusions: A structural model of family support for dietary self-management among male workers with type 2 diabetes mellitus was developed. The model included family support for "preparations to minimize blood glucose fluctuations at work (meals at work)," "meals prepared with extra effort just for the patient (meals prepared with extra effort)," and "involvement based on an understanding of the combined difficulty of work and diet (understanding of the combined difficulty)", indicating that male workers with type 2 diabetes mellitus must receive these three types of support for good dietary self-management behavior.

KEY WORDS

diet therapy, structural equation modeling, social support, type 2 diabetes, male workers

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Introduction

In 2017, two-thirds of all people with diabetes (327 million people) globally were of working age[1]. For patients with type 2 diabetes mellitus (T2DM), the prevention of complications by maintaining good glycemic control is the cornerstone of treatment. Lifestyle management is a fundamental aspect of diabetes care. Lifestyle management includes diabetes self-management education (DSME), diabetes self-management support (DSMS), nutrition therapy, physical activity, smoking cessation counseling, and psychosocial care[2]. Dietary management is a necessary treatment for people with diabetes[3]. For patients in their prime working years, who account for the majority of people with T2DM, balancing work and medical care can be challenging and may affect adherence to dietary management[4-6]. Hence, support for workers with T2DM is required.

The importance of social context in diabetes management has been noted. The social context in diabetes management includes resources such as family, workmates, partners, and health care providers, and diabetes management takes place in the context of complex interpersonal relationships. Social relationships both influence and are influenced by diabetes across the lifespan[7]. Healthcare providers coordinate support, including recognizing the resources available to assist patients on an ongoing basis and making the best choices to meet their needs[8]. However, it is difficult to grasp when and what patients eat. Hence, dietary support is a challenging aspect of lifestyle management[9].

Social support improves self-management, which includes dietary management for people with diabetes[10]. Regarding social support for people with diabetes, Rosland et al.[11] reported that more than half of the adults with T2DM had family members or friends who were informal supporters and helped them manage their regularly. Support from family members living with T2DM is especially important in managing the patient's dietary management[12]. There are three types of social support: social embeddedness, which measures support indirectly by assuming it is there; perceived support, which is the subjectively perceived experience of the patient; and enacted support, which concerns the frequency of receiving supportive actions[13]. Cohen and Wills[14] described the buffering function of social support in the process of how stress affects health. First, when an event or potential stressor occurs, it affects an individual's assessment of how it is perceived. Second, when a stressor is perceived to be stressful and requires coping, social support promotes adaptive coping behaviors and reappraisal by the individual and inhibits maladaptive responses. What is envisioned in the former is primarily support networks or perceived support, while what is envisioned in the latter is both as well as enacted support. For medical professionals to coordinate support, they must understand its types and functions.

It was reported that support for patients' autonomy (autonomy support), where the support provider acknowledged the patient's perspective and affirmed their abilities, led to better diabetes self-management and glycemic control[15, 16]. Polonsky[17] describes the involvement of a diabetic patient's family members who constantly interfere excessively with the patient's eating behavior as the "diabetes police." In other words, he states that the family's well-intentioned support of the patient can unintentionally act negatively on the patient, putting the patient under constant strain and making the patient unwilling and fed up with disease management. He pointed to the importance of the perspective that family support is perceived as helpful by the patient. Self-management was reported to be influenced by gender[18, 19] and the support that patients requested from their families[20]. In addition, differences in the impact of traditional gender roles on support functioning were found; family support for male T2DM compared to female T2DM particularly affected dietary compliance[21]. Considering that males with diabetes have poorer dietary self-management than females[19] and that approximately 80% of working diabetics in Japan are men[22], the support for male patients is urgently needed. Family support for meals as perceived by working men with T2DM has been shown to have a factor structure that consists of support for meal management not only at home but also in the workplace[23]. In other words, family support for the diet of male workers with T2DM at home and at work should be considered.

Therefore, it is important for working men with T2DM to feel that they have family support to manage

their diet well. However, there have been no studies of male workers with T2DM from this perspective and no studies on effective family support for good dietary management have been identified. Accordingly, we thought it was necessary to focus on the function of family support and to find ways to assist patients and their families with improving dietary management. Therefore, in this study, we aimed to validate a structural model of support based on the social support model and clarify a structure of effective family support for the dietary management of male workers with T2DM. This model has the potential to provide a new nursing method for family support for male workers with T2DM and can be used in clinical practice.

Methods

This study was conducted to test a hypothetical model to determine the function of family support on dietary management in male workers with T2DM.

1. Participants and Procedure

The survey was conducted across 25 hospitals (with 20 or more beds) and clinics (without beds or with 19 or fewer beds) that provided metabolic/endocrinology services in Japan from August 2020 to August 2021. Inclusion and exclusion criteria for the participants were explained to the medical staff, who then referred patients for participation. Patients were eligible if they were men with T2DM, aged between 18 and 75 years, worked, and did not live alone. Patients were excluded if they had any of the following: serious medical complications (e.g., dialysis, blindness, paralysis, or cancer) that had a significant physical and mental impact on their functioning; cognitive dysfunction; difficulty answering a questionnaire; difficulties with communication; a diagnosis of diabetes within the past three months; or a change in diabetes treatment within the past four weeks.

A cross-sectional study was conducted using a self-administered questionnaire. First, the researchers asked the national network members commissioned by the Japan Academy of Diabetes Education and Nursing to list the study facilities. Next, the researchers requested the listed facilities to conduct the survey. The doctors or nurses at the facilities explained the purpose of the study to the patients verbally or in writing and requested their participation. The doctors or nurses then distributed a set of envelopes containing the questionnaires to those who cooperated, and requested their responses. The questionnaires were collected by the mail method. The participation in this study was considered consent by responding to the questionnaire.

The questionnaire was distributed to 295 men, and 123 were collected (41.7% response rate). After those with missing responses were excluded, 92 questionnaires were analyzed (valid response rate: 74.8%). It took approximately 15 minutes to complete the questionnaire. Permission was obtained from the developer for the use of the scale. This study was approved by the Institutional Review Board of the concerned university (No. 952-4). This study was conducted in accordance with the principles outlined in the Declaration of Helsinki and all its future amendments or comparable standards.

2. Measures

1) **Participant characteristics.** These included age, illness duration, hemoglobin A1c (HbA1c) level, diabetes treatment, diabetic complications, diseases other than diabetes, cohabitation status (family members who lived with the participant), marital status, occupation, meal preparation(s), patients with or without diabetes education, and families with or without diabetes education.

2) **Hypotheses among the factors.** In considering the hypotheses regarding the relationships among the factors (Figure 1), we referred to Norbeck's[24] model of social support. This model, which includes assessment, planning, intervention, and evaluation, is easily incorporated into nursing practice. The assessment included properties and social support. Characteristics determine the need for social support and the actual social support available. Situational characteristics are work, family expectations and demands, and illness and crises, which predict the intensity and duration of social support needed situationally. The amount of actual social support available or use of social support is considered in the amount of support.

3) **Properties of the situation.** The stress that the patient perceived was defined as properties of the situation. The Japanese version of the Perceived Stress Scale[25] was used. The scale consisted of 14 items and enquired regarding the frequency

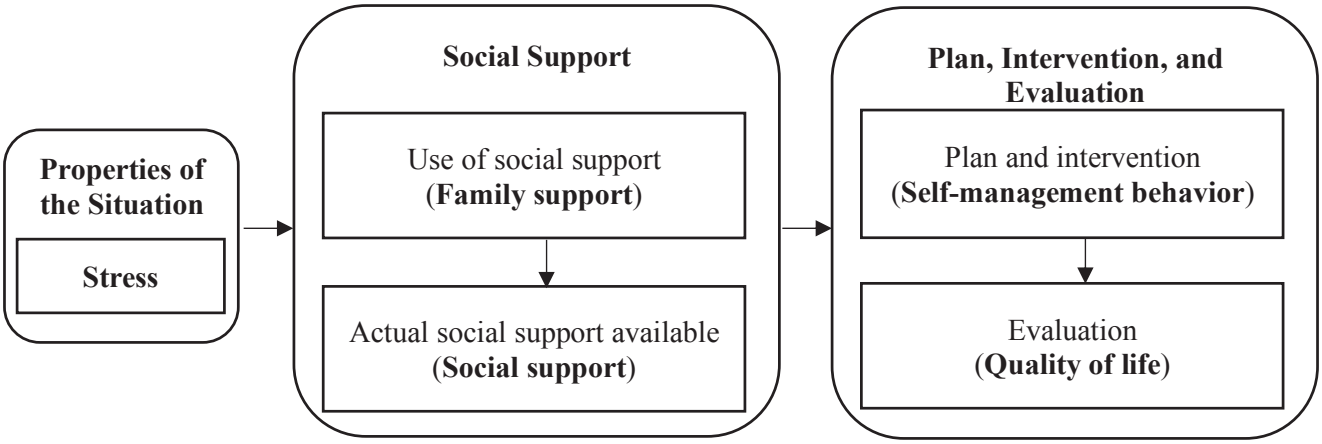


Figure 1 Hypothesis model.

of the condition experienced in the past month. Respondents rated their answers on a five-point Likert scale that ranged from 0 (never) to 4 (always). Stress was assessed by calculating the total score of each item. Cronbach's alpha of the scale in this study was .781.

4) **Social support.** The greater the perception of social support among people with T2DM, the better their treatment behaviors and quality of life (QoL)[26]. The use of social support (family support) and actual social support available (social support) were defined as social support.

Family support was measured by the Family Support Scale for Diet Therapy for Male Workers (FSS-DMW)[23]. The scale consisted of 31 items that enquired regarding the extent to which patients felt supported by their families. Respondents rated their answers on a five-point Likert scale that ranged from 1 (strongly disagree) to 5 (strongly agree). The FSS-DMW comprised six factors: involvement based on an understanding of the combined difficulty of work and diet (understanding of the combined difficulty), guidance to always follow dietary therapy (guidance), preparations to minimize blood glucose fluctuations at work (meals at work), efforts and ideas incorporated into every day diet (everyday diet), shared meals where everyone ate the same food (mealtime), and meals prepared with extra effort just for the patient (meals prepared with extra effort). The scores for each item were summed to calculate the scores for the total scale and each subscale. The total scale and subscale scores were used to evaluate the hypotheses. The higher the score for both the total and subscale scale scores, the higher the participant's perception of family support. Cronbach's alpha for the total score in this study was .968.

Social support was measured by the Japanese version of the Social Support Scale[27]. The scale consisted of 12 items and a higher score indicated higher social support. Respondents rated their answers on a seven-point Likert scale that ranged from 1 (strongly disagree) to 7 (strongly agree). Cronbach's alpha in this study was .942.

5) **Planning, intervention, and evaluation.** Good self-management behavior improves patients' QoL[26]. Patients' self-management behavior was defined as planning and intervention and the patient's QoL was defined as evaluation.

Self-management behavior was measured using the Japanese version of the Summary of Diabetes Self-Care Activities (J-SDSCA)[28]. The J-SDSCA measured self-care behaviors in patients with diabetes and consisted of 17 items concerned with dietary behaviors, motor exercise, self-monitoring of blood glucose levels, drug management (which included insulin injection therapy), foot care, and smoking. Participants indicated the frequency of engaging in specific behaviors on a scale from 0 to 7. In this study, only the dietary subscale was used. Cronbach's alpha for the dietary factors in this study was .779.

QoL was measured using the Japanese version of the Audit of Diabetes-Dependent Quality of Life for patients with diabetes[29]. This instrument contained two overview questions to measure (1) the patient's overall

QoL and (2) how the patient's QoL would change if they did not have diabetes. An additional 19 specific items measured the (a) impact on QoL (how each aspect of life would change if the patient did not have diabetes) and (b) the importance of a specific item (how important each of these 19 aspects of life was to the patient's QoL). A five-point Likert scale (range − 3 to 1) was used to measure the impact on QoL, and a four-point Likert scale (range 0 to 3) was used to measure the importance. Weighted impact scores for each domain were calculated by multiplying the two scales (range − 9 to +3; more negative scores indicated a greater negative impact of diabetes on QoL, while positive scores (only rarely seen) indicated a positive impact of diabetes on QoL). The average weighted impact score was calculated by summing the weighted impact scores for all the applicable domains and dividing them by the number of applicable domains for each respondent. Cronbach's alpha in this study was .826. An application for permission to use the scale was submitted and approval was obtained from Health Psychology Research Ltd (No. CB 1041).

3. Data Analysis

Descriptive statistics were computed for individual characteristics and observed variables. The reliability of each scale was calculated using Cronbach's alpha, and Spearman's correlation coefficient was used to analyze the correlation between the observed variables. Model validation was conducted using structural equation modeling. Initially, the number of samples required for the analysis was more than 50 when five variables were assumed[30], which were confirmed to be sufficient. The goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), comparative fit index (CFI), and root mean square error of approximation (RMSEA) were used to judge model fit. The criteria for goodness-of-fit were the GFI, AGFI, and CFI close to 1 with a small difference between the GFI and AGFI, and RMSEA less than .05[31]. The data were analyzed using SPSS Statistics version 25 (IBM Corp., Armonk, NY, USA) and SPSS Amos version 25 (IBM Corp., Armonk, NY, USA).

Results

1. Participants' Characteristics

The average age of the participants was 55.3 ± 9.5 years. The average disease duration was 10.8 ± 8.2 years and the HbA1c level was 7.2 ± 0.8 (levels of 6.5% or higher indicated that the person had diabetes). Approximately half of the respondents were in 20 managerial occupations (21.7%) or 18 professional/technical occupations (19.6%) (Table 1).

2. Correlations among the Observable Variables

Stress was significantly correlated with social support ($r = -.28$, $p < .05$). Family support was significantly correlated with social support ($r = .57$, $p < .01$) and dietary self-management behavior ($r = .48$, $p < .01$). Social support was significantly correlated with dietary self-management behavior ($r = .24$, $p < .05$). QoL was not correlated with any of the variables (Table 2).

3. Test of the Hypothesized Model

The hypothesized model was validated using structural equation modeling, with QoL as the outcome and the five observed variables to evaluate the hypothesized model. The hypothesized model was not identified, and the model was refined using the Wald test with reference to the modification index and GFI. The final model with dietary self-management behavior is shown in Figure 2. The path coefficients represented standardized estimates, all of which were significant. The decision variables were "understanding of the combined difficulty" (32%), "meals prepared with extra effort" (37%), "social support" (43%), and "dietary self-management behavior" (23%). The fit index for the final model was chi-square = 10.426, degrees of freedom = 9, $p = 0.317$, $\chi^2/\mathrm{df} = 1.158$, GFI = 0.964, AGFI = 0.916, CFI = 0.99, and RMSEA = 0.042. The values showed a high goodness-of-fit and were therefore judged to be the valid model.

In the adopted model, social support and "meals prepared with extra effort" influenced dietary self-management behavior. The path coefficients were both positive, which indicated that the greater the support received, the better the dietary self-management. In addition, the family support of in "meals at work" influenced the belief that they were supported by "meals prepared with extra effort" and it influenced their belief of "understanding of the combined difficulty." Furthermore, "understanding of the combined difficulty" increased social support and indirectly contributed to better dietary self-management behavior. In addition, stress had a negative effect on social support, and

Table 1 Participants' Characteristics.

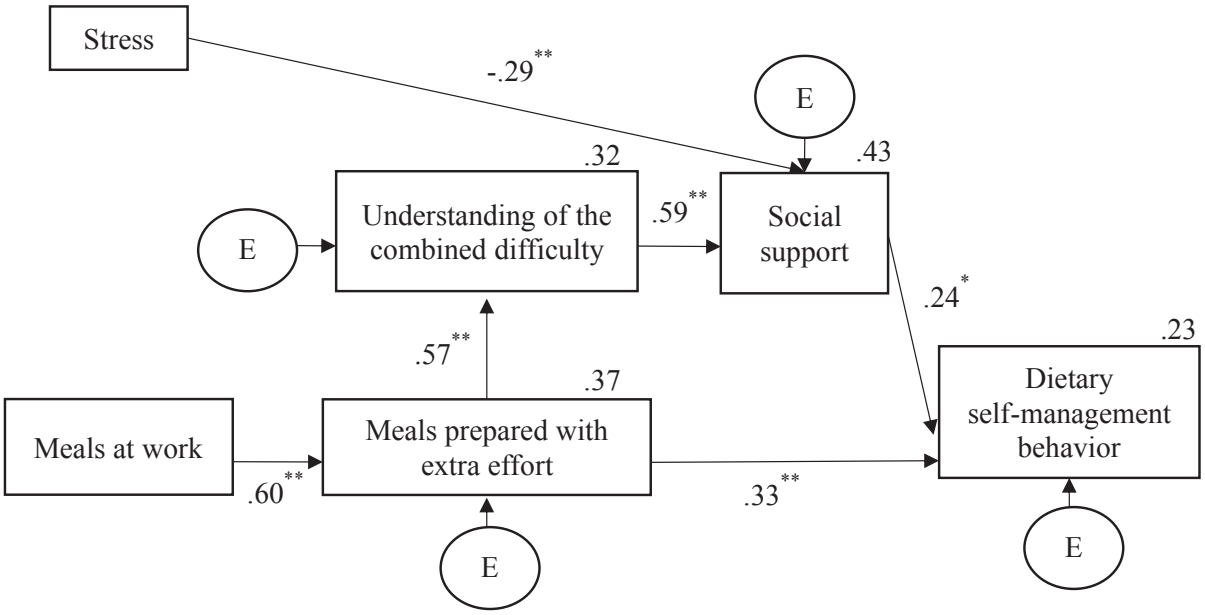
Characteristics		*n*	Mean ±*SD*
Age (years)		92	55.3 ± 9.5
Disease duration (years)		89	10.8 ± 8.2
HbA1c (%)		83	7.2 ± 0.8
		n	%
Treatment	Oral medication	82	89.1
	Injection medication	48	52.2
Diabetic complications	Yes	34	37.0
	No	47	51.1
	Unanswered	10	10.9
Disease(s) other than diabetes	Yes	36	39.1
	No	50	54.3
Cohabiting status	Spouse	74	80.4
	Child	47	51.1
	Grandchild	1	1.1
	Parent	32	34.8
	Other	3	3.3
Occupation	Managerial occupations	20	21.7
	Professional and technical workers	18	19.6
	Office workers	6	6.5
	Salespersons	1	1.1
	Service occupations	10	10.9
	Security personnel	0	0.0
	Agriculture, forestry, and fishery workers	6	6.5
	Production process workers	6	6.5
	Transportation and machine operators	6	6.5
	Construction and mining workers	4	4.3
	Workers engaged in transportation, cleaning, and packaging	4	4.3
	Other	8	8.7
Marital status	Married	75	81.5
	Single	16	17.4
Meal preparer(s)	Participant	9	9.8
	Spouse	66	71.7
	Other	11	12.0
	Unanswered	6	6.5
Diabetes education for the patients	Yes	74	80.4
	No	12	13.0
	Unanswered	6	6.5
Diabetes education for the families	Yes	35	38.0
	No	50	54.3
	Unanswered	7	7.6

Note. N = 92. SD = standard deviation

Table 2 Correlations among the Observed Variables.

Criterion scales	Stress	Family support	Social support	Dietary self-management behavior
Stress	1.00			
Family support	-0.12	1.00		
Social support	-0.28*	0.57**	1.00	
Dietary self-management behavior	-0.22	0.48**	0.24*	1.00
Quality of life	-0.15	-0.05	0.10	-0.06

Note. N = 81. Spearman's correlation coefficient
*p < .05. **p < .01.



N = 92. X^2 = 10.426; p = 0.317; goodness-of-fit index = 0.964; adjusted goodness-of-fit index = 0.916; comparative fit index = 0.99; root mean square error of approximation = 0.042. *p < .05. **p < .001.

Figure 2. Structural equation modeling of family support for the diet of male workers with Type 2 diabetes.

more stress was associated with lower social support. Furthermore, "meals prepared with extra effort" had a direct effect on better dietary self-management behavior.

Discussion

We were able to create a structural model using the hypothesis based on Norbeck's[24] theory of social support. This study showed that male workers with T2DM who received support from family members had better self-management. We were able to include many

of the factors selected in the hypothesis. For family support, we included "meals at work," "meals prepared with extra effort," and "understanding of the combined difficulty." Although QoL was not included in the final model, given that the participants in this study were employed, it is possible that the participants' social background status, such as work and relationships, did not affect the high or low QoL in these related domains. A significant challenge for workers with T2DM is to manage diabetes appropriately while working[32]. Workers with T2DM have been reported to experience a negative impact on self-management, as working has many effects on the patient's care environment, including high workload, poor job control, and the attitude of prioritizing work over diabetes[5]. This could affect the progression of future complications and other factors that reduce the quality of life, especially for patients in their prime working years. Nanayakkara et al.[33] reported that the difficulties of following dietary recommendations were associated with the suffering related to diabetes. Family members are among the leading sources of informal support for people with diabetes, and support from them plays an important role in ameliorating the distress associated with patient self-management[34]. This can affect the future progression of complications and other factors that can reduce QoL, especially for those in their prime working years. The results of the goodness-of-fit indices suggested that this study's model had a high explanatory power as a structure to explain family support for better dietary management among male workers with T2DM. This indicates the need to focus on family support for the dietary management of male workers with T2DM.

A significant challenge for workers with T2DM is to manage diabetes appropriately while working[32]. Workers with T2DM have been reported to experience a negative impact on self-management, as working has many effects on the patient's care environment, including high workload, poor job control, and the attitude of prioritizing work over diabetes[5]. Therefore, maintaining good self-management is crucial. In this study, patients who received behavioral support from their family members for meals at work and laborious meal preparation felt that their family members understood the combined difficulty of work and diet. The perception that they could receive support from others led to better self-management behavior. Furthermore, patients who received support from their families for meals at work and meals with extra effort just for them showed better dietary self-management behaviors. In addition, lower stress was associated with better dietary self-management behavior as they felt that they could receive more support from others.

Regarding the function of support, patients with diabetes tend to show better self-management behavior when they perceive family support positively. Conversely, a family's obstructive behaviors can be a barrier to self-management[35]. In this regard, we found that family support for male workers with T2DM, such as "meals at work," "meals prepared with extra effort," and "understanding of the combined difficulty," had an effective impact on self-management behaviors. Diabetes mellitus has many effects on a person's life and involves major lifestyle changes. Behavioral support from family members in the form of providing "meals at work" and "meals prepared with extra effort," had a direct impact on working patients' good dietary self-management behavior and could be very effective.

For clinical application, we propose the use of new family support content in helping male workers with T2DM achieve good dietary control. Kitagawa[36] reported the importance of receiving behavioral support from family members of working patients with T2DM. In this study, we found that family behavioral support for a working patient's diet is an effective way to improve the patient's dietary self-management behavior directly. The study also showed the importance of providing "meals at work," and "meals prepared with extra effort," and "understanding of the combined difficulty" as dietary management support for working male patients with T2DM. Therefore, health care providers need to help families provide support to their patients and help patients feel that they are supported by them.

Conclusion

Based on the results of this study, we were able to create a family support structure model for the diet of male workers with T2DM that satisfied the goodness-of-fit requirements. Among the factors, "meals at work," "meals prepared with extra effort," and "understanding

of the combined difficulty" were included. The model showed that patients who experienced the three abovementioned factors showed increased social support and better self-management. To improve dietary self-management behavior, it is emphasized that families of male workers with T2DM should focus on providing to feel being received support for patients "meals at work," "meals prepared with extra effort," and "understanding of the combined difficulty."

Limitation

The limitation of the study was that generalizability in populations with different distributions of occupations is unknown because administrative and professional occupations accounted for half of the total.

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就労男性 2 型糖尿病患者の食事に対する家族サポート構造モデル

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Abstract

背景： 2 型糖尿病患者にとって食事管理は治療の基本であるが，管理に伴うライフスタイルの変化は様々な要因が関係する。特に就労 2 型糖尿病患者は就労が影響し管理が困難な状況である。支援で代表的なソーシャルサポートは患者の利用できるサポート資源やニーズという患者視点に基づくことが重要である。中でも食事は家族サポートが重要である。家族サポートは伝統的な性役割の背景がニーズに影響するため性差を考慮する必要がある。本研究は Norbeck のソーシャルサポートモデルを基に家族サポートの構造モデルを検討し，就労男性 2 型糖尿病患者の食事自己管理に有効な家族サポートモデルを構築した。

方法： 自記式質問紙を用いた横断研究を行った。対象は日本の就労男性 2 型糖尿病患者 92 名（平均年齢 55.3 ± 9.5 歳）であった。記述統計，相関分析，構造方程式モデリングを用いて分析した。

結果： 最終的モデルは, goodness-of-fit index = 0.964, adjusted goodness-of-fit index = 0.916, comparative fit index = 0.99, root mean square error of approximation = 0.042 であった。モデルは 6 因子からなり，家族サポートが食事自己管理行動に影響を与える構造が示された。家族サポートは「仕事中の血糖変動を最小限にするための準備」,「患者のためだけにひと手間かけた食事」,「仕事と食事の両立の困難さを理解したうえでの関わり」の 3 因子が投入された。

結論： 就労男性 2 型糖尿病患者の食事自己管理に対する家族サポートの構造モデルが構築された。このモデルは，3 つの家族サポートを含んでおり，就労男性 2 型糖尿病患者が良好な食事自己管理行動をとるためには，この 3 種類のサポートを受ける必要があることを示していた。