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(Degree)
博士（保健学）

(Date of Degree)
2008-03-25

(Date of Publication)
2011-12-19

(Resource Type)
doctoral thesis

(Report Number)
甲4228

(URL)
https://hdl.handle.net/20.500.14094/D1004228

Kobe J. Med. Sci., Vol. 54, No. 2, pp. E82-E96, 2008

Gender Differences of Dietary Self-Management Behavior Affecting Control Indices in Type II Diabetes

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Received 11 November 2007/ Accepted 17 December 2007

Key words: dietary self-management behavior, patient education, dietary intake, control index, type 2 diabetics.

【Aim】To establish effective dietary self-management behavior for type II male and female diabetics, by focusing on how dietary intake and dietary self-management affect control indices of type II diabetics. 【Methods】The study group comprised 170 type II diabetics, 93 men (mean age, 63.1±8.8 years old) and 77 women (mean age 63.4±10.2 years old). The final analyses of data collected from subjects comprised three control indices of type II diabetics, several factors related to control indices, and several items on a dietary self-management behavior questionnaire. Multiple regression analyses used control indices as dependent variables, and related factors as independent variables. Multiple regression analyses were also used for the relationships between dietary intakes as dependent variables and dietary self-management factors as independent variables. 【Results】Males showed a significant correlation between total energy intake per standard body weight per day and body mass index, and a significantly positive correlation between body mass index and waist circumference. Carbohydrate intake was significantly related to HbA_{1c}. Other results showed characteristic relationships between various questionnaire items and "total energy intake, lipids intake, and carbohydrate intake", respectively. Females showed significant correlation between carbohydrate intake and both body mass index and waist circumference, as well as characteristic correlations between various questionnaire items and both reductions and increases in carbohydrate intake. 【Conclusion】Our study discloses significant differences in dietary self-management behavior between males and females with type Ⅱ diabetes. We anticipate that educational support using findings of our study can make a significant contribution to improvement in control indices of type II diabetics.

The management of blood glucose levels and body weight of type II diabetics are extremely important for the prevention of complications (1, 2, 6). Dietary and exercise therapies are therefore recommended as basic treatment (18, 19). There are many factors, however, such as personal intrinsic factors (e.g. irritation, sensation of hunger, and negative

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emotions), environmental temptations and personal relationship issues, which may interfere with diet therapy. This means that there are many situations in which diabetics may eat more than their diet therapy allows, thus leading to patients' overeating (12, 28).

We previously reported that many diabetics use various devices to manage their dietary intake, as well as make various efforts at interfering with factors working against their dietary regimens in order to avoid hyperphagia (24). However, there are type II diabetics who showed excessive dietary intake levels before the onset of diabetes (7, 22). In such cases, it is believed that the management of blood glucose levels and body weight following the commencement of treatment is not easy. To provide appropriate support for dietary self–management behavior, there is the need for 1) precise evaluation of the strategies used to coordinate the actual dietary intake of the patients, as well as their behavior to cope with factors interfering with their dietary regimens, and 2) clarification of which environmental and behavioral factors are related to a decrease or increase in dietary intake. In addition, it is important to establish precise and concrete behaviors for recommendation or correction.

Current questionnaires related to evaluating actions for general treatment (8, 11, 26) and to dietary intake (5, 29) of type II diabetics have been developed mainly by European and American researchers. In addition, National Standards for Diabetes Self-Management Education were recently developed by the American Association of Diabetes Education (1, 18, 21) to evaluate behavior by using seven core standards, which cover eating habits, the effects of intervention and evaluation using outcome criteria. The measurements used for eating habits described in these papers are obtained from patients' replies to questions about food choices and knowledge of dietary intake adjustments. However, the strategies or behaviors which patients use to decrease their dietary intake, as well as their behavior to cope with factors interfering with dietary regimens, could not be evaluated. We therefore developed a dietary self-management behavior questionnaire covering the two areas of behaviors to comply with dietary regimens and behavior to cope with factors interfering with such regimens (24).

This study was conducted in order to establish an effective and concrete dietary self-management behavior for improvement in the control indices of type II diabetics. For this purpose, we used the questionnaire developed by us to focus on dietary intake affecting control indices of male and female type II diabetics and dietary self-management behavior related to dietary intake.

MATERIALS AND METHODS

1. Subjects

The study population comprised 201 patients with type II-diabetes who visited the outpatient clinic of the Department of Internal Medicine at Kobe University Hospital between November 2004 and July 2006. The eligibility criteria were: administration of the same therapy for the previous 6 months**;** no serious complications or conditions for which physical activity was contraindicated and/or restriction of protein intake was advised**;** no cognitive or psychiatric disorders. The period of investigation was from September 2006 to June 2007.

2. Methods of investigation

1) Control indices of type II diabetics

(a) Clinical blood data (HbA_{1c}、T-cholesterol、HDL-cholesterol) was obtained from the clinical records, and the mean values for the previous six months were used. It is well known that, with a meal, plasma triglycerides concentration increases significantly without significant changes in plasma total cholesterol and HDL-cholesterol (4). Since blood samples

obtained from diabetics were not always fasting samples, we analyzed data of total cholesterol and HDL-cholesterol.

(b) Physique including body composition. Body height, body weight and waist circumference were measured. BodyPlanner EX/P (DF-830WM; Yamato Scale Co., Ltd., Akashi, Japan) was used for the calculations of % body fat, % body muscle, area of visceral fat, and body mass index (BMI) (25).

2) Factors related to control indices of diabetes

(a) Mean daily dietary intake calculated from intakes for the previous one year (total energy, proteins, lipids, carbohydrates). Dietary intake was assessed through an individual interview using the validated Japanese 122-item food frequency questionnaire (FFQ) (5). The FFQ consists of a list of 122 food items with full-scale photographs, and pages where the patients can indicate the frequency and the amount of their food intake. The mean quantity of daily food intake was calculated based on the food intake per year. Furthermore, to ensure the accuracy of the data, the patients were asked to provide detailed information on the cooking method (i.e. raw, boiled, baked, or fried), the additional usage of seasoning (for example, sauce or dressing) just before eating a dish, and the disposal of leftovers. Dietary intake was reconfirmed by showing the patients "full-scale photographs of meal" and "various sizes of the real dishes (for example, rice bowl, big bowl, plate, and glass)".

(b) Mean daily physical activity calculated for approximately 1 month (exercise, steps, activity time). Lifecorder EX (Suzuken Co., Ltd., Nagoya, Japan), a portable pedometer with an acceleration measurement device, was used to calculate physical activity. Daily activity time (minutes/day), which is equivalent to more than 1.5 times of the metabolic rate, is also displayed (13).

(c) Resting energy expenditure was measured with the Metavine-S (Vine Co., Ltd., Tokyo, Japan) (23).

(d) Pharmacotherapeutic data were obtained from the clinical records of the subjects.

3) Dietary self-management behavior related to dietary intake

The appendix (see last page) shows the overall structure and all items of the Dietary Self-management Behavior Questionnaire (DSBQ) which was developed by us (24). The responses to the questionnaire were collected by mail.

The DSBQ consists of two areas: A) Following instructions of dietary regimen (50 items including 7 factors), and B) Coping behavior regarding factors interfering with dietary regimen (39 items including 9 factors). The first area of the DSBQ contains questions for three categories related to how well the patients can integrate the nutritional guidelines into their daily activities, which yield data on adherence to the dietary regimen. These three categories are: 1) General regularity of eating habits, 2) Following instructions for appropriate calorie intake (Cronbach's $\alpha = 0.66$~0.81), and 3) Strategies for cooking tasty and healthy meals ($\alpha = 0.77$, 0.79). The second area of the DSBQ contains questions for three categories regarding coping with factors interfering with the dietary regimen. Temporary deviations from the dietary known to be instigated by intrapersonal as well as environmental and/or interpersonal determinants, were identified with the modified Marlatt's model of relapse (12). These three categories are: 1) Avoidance of factors interfering with dietary regimen ($\alpha = 0.83$~0.70), 2) Temporarily deviant behavior ($\alpha = 0.55$, 0.72), and 3) Correcting temporarily deviant behavior ($\alpha = 0.66$, 0.70). Responses to the items of this scale were rated on a 5-point Likert scale (0 = never, 1 = occasionally, 2 = sometimes, 3 = usually and 4 = always). This means that the higher the subscale score is, the higher the frequency is of the patient engaging in self-management behavior.

3. Ethical concerns

The Ethics Committee of Kobe University approved the protocol for this study. Diabetics were selected based on the information provided by the hospital's physicians. Data were collected from patients who had given their written consent to participate in this study. Individual findings, such as the quantity of dietary intake, physical activity level and body composition, were reported to the respective subjects.

4. Method of analysis

First, univariate analyses were conducted for the selection of preliminary variables. Pearson's correlation coefficient was used to extract the control (objective) indices from blood and physique data, including body composition. Second, the relationships between the control indices thus extracted and the factors related to control indices, such as dietary intake, physical activity, resting energy expenditure and pharmacotherapy, were examined using Pearson's correlation coefficient or Spearman rank correlation coefficient. Variables showing $p<0.1$ in the univariate analyses were then used for the multiple regression analyses, with the extracted control indices as dependent variables and factors related to control indices as independent variables. Additionally, the relationships between dietary intake/day related to control indices and factors of dietary self-management behavior were similarly investigated by using correlation coefficients and multiple regression analysis.

A difference of $p<0.05$ were considered statistically significant. SPSS 15.0 for Windows was used for all statistical analyses.

RESULTS

1. Background of subjects

Valid responses were obtained from 170 (84.6%, comprising 93 males, and 77 female) of the 201 diabetics. The values were expressed as mean±SD. The age of males and females were 63.1±8.8 years old and 63.4±10.2 years old, respectively. The mean HbA_{1c} level of males and females for the preceding six months was 7.1±1.0% and 7.1±0.9%, respectively. The mean daily dietary intake was 1950.4±484.3 kcal for males and 1632.7±543.1 kcal for females. The background of the subjects is shown in Table I.

2. Correlation among control indices of type II diabetics

To select variables which were used as outcome indices for type II diabetics, physique including body composition, comprising body height (m), weight (kg), waist circumference (cm), estimated visceral fat area (VFA; cm^2), body fat rate (%), body muscle rate (%) and clinical blood data, that is, HbA_{1c} (%), total cholesterol (mg/dl), and HDL-cholesterol (mg/dl) were examined with Pearson's correlation coefficient. Results are shown in Table II.

The indices of physique including body composition proved to be mutually interrelated. It is generally accepted that that obese type II diabetics need to lose weight, particularly since it has been pointed out that visceral fat is related to insulin resistance and glycemic level (9, 10). BMI and waist circumference, which are simple and easy to use in clinical practice, were therefore adopted as outcome indices. HbA_{1c} and serum total cholesterol were used as independent variables of the control indices, because they showed almost no relationship with other indices.

3. Factors related to control indices of type II diabetics

Table III shows correlations among items, i.e. the adopted control indices, quantity of energy expended (physical activity), quantity of energy obtained from dietary intake (dietary intake), and details of pharmacotherapy, which are useful for quantitative evaluations of diabetics behaviors. Furthermore, multiple regression analyses were performed using control indices as dependent variables and factors related to control indices as independent variables.

Table I. Patients' background number n = 170 （males: 93, females: 77）

Parameter	Mean	SD	Mean	SD
Age	63.1	8.8	63.4	10.2
Glycemic control (HbA1c %)（average of the during for 6 monthes）	7.1	1.0	7.1	0.9
HDL cholesterol (mmol/l)（average of the during for 6 monthes）	53.2	14.8	65.3	14.5
Total-cholesterol (mmol/l)（average of the during for 6 monthes）	198.4	25.1	206.6	27.5
Walking volume (average number of steps/day)	8927.2	4448.3	7354.3	3015.4
Dietary energy intake (kcal/day)	1950.4	484.3	1632.7	543.1
Body Mass Index (kg/m^2)	23.7	3.5	23.3	4.2
Waist circumference (cm)	87.6	8.6	86.8	12.0
Parameter	Number	(%)	Number	(%)
Employment status				
Employed	51	(54.8)	17	(22.1)
Unemployed	41	(44.1)	58	(75.4)
Unknown	1	(1.1)	2	(2.6)
Living situation				
Living with another	80	(86.0)	47	(61)
Living alone	13	(14.0)	29	(37.7)
Duration of diabetes				
＜3 years	12	(12.8)	10	(13.0)
＜10 years	31	(33.4)	20	(26.0)
≧10 years	49	(52.7)	46	(59.8)
Unknown	1	(1.0)	1	(1.3)
Contents Type of the treatment				
Insulin injection	23	(23.2)	19	(24.7)
Insulinotropic agent (SU, BG, Rapid short-duration)	58	(62.4)	41	(53.2)
Insulin sensitizer	44	(47.3)	36	(46.8)
α-glucosidase inhibitors	34	(36.6)	26	(33.8)
Only dietary therapy/physical exercise	10	(10.8)	10	(13.0)
Prevalence of complications prevalence	41	(44.1)	30	(38.2)
Diabetic neuropathy	6	(6.5)	6	(7.8)
Diabetic retinopathy	18	(19.4)	22	(28.6)
Diabetic nephropathy (proteinuria)	20	(21.5)	8	(10.1)
Myocardial infarction/Angina pectoris	18	(19.4)	4	(5.1)
Cerebrovascular diseases	3	(3.2)	2	(2.6)
Diabetic foot (ulcer)	1	(1.1)	1	(1.3)

As the main findings for males in Figure 1 show, the factors which remained significant ($p<0.05$) when BMI was used as the dependent variable, were positive value for total energy intake per standard body weight per day (kcal/kgSBW; standardized partial regression coefficient: $\beta s = 0.40$), negative value for mean daily quantity of physical activity (steps/day; $\beta s = -0.39$) and resting energy expenditure ($\beta s = -0.23$). When waist circumference was used as the dependent variable, significant factors were positive value for total energy intake per day (kcal/day; $\beta s = 0.37$), negative value for mean daily quantity of physical activity (activity time/day; $\beta s = -0.33$) and resting energy expenditure ($\beta s = -0.28$). When HbA_{1c} was used, they were positive value for carbohydrate intake per day (g/kgSBW; $\beta s = 0.25$) and use of insulin injection ($\beta s = 0.35$).

Table II. Relationship of the control indices of type II diabetics.:Pearson's correlation coefficient.

	Physique including body composition						Clinical blood data	
		2)	3)	4)	5)	6)	1)	2)
Males								
Physique including body composition								
1) Body weight (kg)								
2) Vsceral fat area(cm^2)	0.70**							
3) Body Mass Index	0.91**	0.78**						
4) Body fat percentage(%)	0.80**	0.77**	0.88**					
5) Body muscle percentage(%)	-0.58**	-0.67**	-0.73**	-0.89**				
6) Waist circumference (cm)	0.73**	0.89**	0.76**	0.71**	-0.59**			
Clinical blood data								
1) Glycemic control (HbA_{1c} %)	0.12	-0.03	0.03	0.01	0.07	0.03		
2) HDL cholesterol (mmol/l)	-0.33**	-0.17	-0.25*	-0.23**	0.12	-0.26*	-0.10	
3) Total cholesterol (mmol/l)	0.02	0.13	0.12	0.01	-0.04	0.10	0.04	0.59**
Females								
Physique including body composition								
1) Body weight (kg)								
2) Visceral fat area(cm^2)	0.80**							
3) Body Mass Index	0.90**	0.81**						
4) Body fat percentage(%)	0.67**	0.87**	0.82**					
5) Body muscle percentage(%)	-0.50**	-0.71**	-0.68**	-0.94**				
6) Waist circumference (cm)	0.88**	0.93**	0.88**	0.84**	-0.67**			
Clinical blood data								
1) Glycemic control (HbA_{1c} %)	0.20	0.17	0.25*	0.18	-0.16	0.22*		
2) HDL cholesterol (mmol/l)	-0.32**	-0.27**	-0.29**	-0.20	0.15	-0.31**	-0.11	
3) Total-cholesterol (mmol/l)	0.07	0.07	0.06	0.10	-0.09	0.05	0.19	0.46**

"Data are expressed as Pearson's correlation coefficient (r)
*p<0.05; **p<0.01.

Table III. Relationship between control indices and factors related to control indices.

		Males n=93				Females n=77			
		BMI	waist (cm)	HbA_{1c} (%)	T-cho (mmol/dl)	BMI	waist (cm)	HbA_{1c} (%)	T-cho (mmol/dl)
Energy expenditure									
Walking, steps/day	r	-0.30**	-0.35**	-0.18†	0.05	-0.20†	-0.38**	0.03	0.06
Physical activity time (min/day)	r	-0.30**	-0.35**	-0.18†	0.06	-0.24*	-0.43**	-0.00	0.10
Resting energy expenditure/kg	r	-0.33**	-0.41**	0.06	-0.20	-0.51**	-0.35**	-0.04	-0.28*
Dietary intake									
Total energy intake (kcal/day)	r	0.35**	0.32**	0.17†	0.03	0.21†	0.20†	0.10	0.11
Total energy intake (kcal/kgSBW)	r	0.37**	0.30**	0.21*	0.00	0.23*	0.19†	0.05	0.16
Proteins intake (g/kgSBW)	r	0.20†	0.09	0.12	-0.06	0.19†	0.12	0.07	0.17
Lipids intake (g/kgSBW)	r	0.34**	0.24	0.18†	-0.12	0.22†	0.17	0.06	0.16
Carbohydrates (g/kgSBW)	r	0.33**	0.23*	0.28**	0.05	0.25*	0.27*	0.07	0.11
Lipids intake/Total intake (%)	r	0.07	0.03	0.01	-0.18†	0.16	0.09	0.09	0.16
Type of pharmacotherapy									
Insulin injection	rs	0.06	0.08	0.32**	-0.22*	0.03	0.09	0.41**	0.16
Insulinotropic agent	rs	-0.08	-0.08	0.04	0.16†	-0.11	-0.06	0.08	-0.28*
Insulin sensitizer	rs	0.17	0.12	0.31**	0.01	0.30**	0.26*	0.11	-0.02
α-glucosidase inhibitors	rs	-0.13	-0.09	0.11	-0.12	0.04	0.08	0.06	0.09

"Data are expressed as Pearson's correlation coefficient (r) or Spearman rank correlation coefficient (rs)
*p<0.05; **p<0.01; †p<0.1
‡ Reference category.
SBW: Standard body weight"

Table.IV. Relationship of dietary intake related to control indices and items of the Dietary Self-management Behavior Questionnaire

Dietary self-management behavior factors		Males n=93 Total energy intake kcal/day	Total energy intake kcal/kgSBW	Lipids intake g/kgSBW	Carbohydrates Intake g/kgSBW	Females n=77 Carbohydrates intake g/kgSBW
A) Following instructions of dietary regimen.						
1) General regularity of eating habits.						
・Frecuency of meals per day.	rs	0.06	0.03	0.21*	- 0.06	0.24*
・Frecuency of breakfast per week.	rs	0.00	0.01	0.01	0.08	0.13
・Time of breakfast.	rs	0.26*	0.22*	0.09	0.20†	0.06
・Time of lunch.	rs	0.33**	0.29**	0.28**	0.19†	- 0.03
・Time of dinner.	rs	0.12	0.11	0.22**	- 0.04	0.17†
・The time needed to finish dinner.	rs	0.07	0.04	0.04	0.02	- 0.04
・Frequency of snacking between meals.	rs	0.11	0.10	0.17†	0.29**	0.32**
Frequency of alcohol consumption.	rs	0.21†	0.16†	0.16†	- 0.09	0.11
2)Following instructions for appropriate calorie intake.						
Avoidance of excessive food intake.	r	- 0.32**	- 0.31**	- 0.22*	- 0.30**	- 0.14
Reduction of calories from lipids-containing foods.	r	- 0.22*	- 0.21*	- 0.25*	- 0.13	- 0.24*
Enhancement of satisfaction during meals.	r	- 0.26*	- 0.24*	- 0.14	- 0.20†	- 0.05
Reducing the use of the high-calorie seasoning.	r	- 0.04	- 0.03	- 0.03	- 0.04	- 0.26*
Reducing high-calorie drinks.	r	0.08	- 0.12	- 0.22*	- 0.17†	- 0.30**
3) Strategies for cooking tasty and healthy meals.						
Eating tasty food while maintaining nutritional balance.	r	- 0.28**	- 0.27**	- 0.26*	- 0.16	- 0.16†
Reducing the amount of cooking salt.	r	- 0.15	- 0.12	- 0.19†	- 0.05	- 0.44***
B) Coping behavior regarding factors interfering with dietary regimens.						
1) Avoidance of factors interfering with dietary regimens.						
Making every effort to manage without eating.	r	- 0.26*	- 0.20†	- 0.06	- 0.22*	- 0.15
Making every effort to avoid temptations from the surrounding environment.	r	- 0.14	- 0.06	0.05	- 0.02	0.05
Making every effort to control one's appetite.	r	- 0.15	- 0.10	- 0.07	- 0.06	- 0.04
Making every effort to eat low calorie foods when dining ou	r	- 0.17†	- 0.14	- 0.10	- 0.07	- 0.29*
Making every effort to obtain understanding and cooperation from others when dining out.	r	- 0.31**	- 0.28**	- 0.11	- 0.14	- 0.23*
2) Temporarily deviant behavior.						
Allowing one's own value system to take priority even if it means eating inappropriate food .	r	0.13	0.12	0.10	0.21*	0.39**
Eating without paying attention and/or unintentionally.	r	- 0.02	- 0.02	0.05	0.20†	0.36**
3) Correcting temporarily deviant behavior.						
Taking care not to repeat overeating during subsequent meal	r	- 0.13	- 0.10	- 0.12	- 0.09	- 0.22*
Taking care to regulates caloric intake, intentionally.	r	0.05	- 0.05	- 0.06	- 0.02	- 0.10

Data are expressed as Pearson's correlation coefficient (r) or Spearman rank correlation coefficient (rs) *p<0.05; **p<0.01; †p<0.1

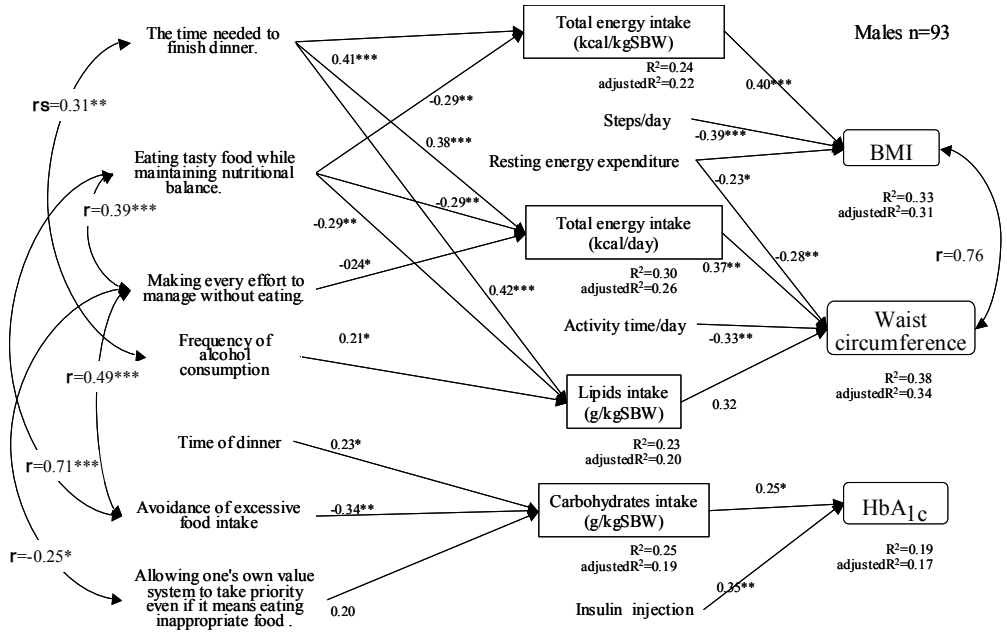

Figure1. Diagrammatic representation of multiple regression analyses. Relationships among dietary self-management behaviors, factors related to control indices and control indices of type 2 males diabetics.

: Standardized partial regression coefficient

: Coefficient

R^2 : Coefficient of determination

Females n=77

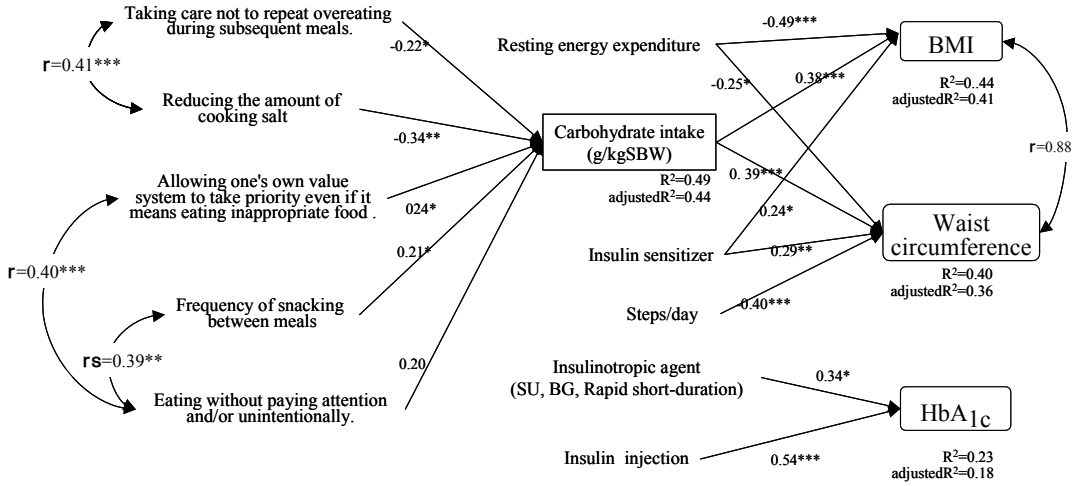

Figure2. Diagrammatic representation of multiple regression analyses. Relationships among dietary self-management behaviors,.factors related to control indices and control indices of type 2 females diabetics.

: Standardized partial regression coefficient

: Coefficient

R^2 : Coefficient of determination

The main findings for females in Figure 2 show that, when BMI was used as the dependent variables, significant factors were positive value for carbohydrate intake per day (g/kgSBW; βs = 0.38) and insulin sensitizer (βs = 0.24), and negative value for resting energy expenditure (βs = -0.49). And also, when waist circumference was used as the dependent variables, significant factors were positive value for carbohydrate intake per day (g/kgSBW; βs = 0.39) and insulin sensitizer (βs = 0.29), and negative value for mean daily quantity of physical activity (steps/day; βs = -0.40) and resting energy expenditure (βs = -0.25). When HbA_{1c} was used, they were positive value for use of insulin (βs =0.54) and/or use of insulinotropic agent (βs =0.34), but HbA_{1c} and dietary intake did not correlate.

4. Dietary self-management behavior related to dietary intake affecting control indices

The correlation between dietary intakes affecting control indices of type II diabetics and dietary self-management behavior is shown in Table IV. Figures 1 and 2 show the results of the multiple regression analyses using factors showing $p<0.1$ in the univariate analysis, with the dietary intakes affecting control indices as dependent variables and the dietary self-management behavior factors as independent variables.

For males, as the main findings in Figure 1 show, the behavioral factor "Eating tasty food while maintaining nutritional balance" (βs = -0.29, -0.29, -0.29) remained significant in the multiple regression as an independent variable for total energy intake (kcal/day and kcal/kgSBW) and lipids intake per day (g/kgSBW). When total energy intake (kcal/day) was used as the dependent variable, the significant factor "Making every effort to manage without eating." (βs = -0.24) remained. The behavioral factor "The time needed to finish dinner" (βs = 0.41, 0.38, 0.42) correlated with an increase in total energy intake (kcal/kgSBW, g/kgSBW) and lipids intake per day (g/kgSBW). In addition, "Frequency of alcohol consumption" and lipids intake (g/kgSBW) were related (βs = 0.21), as were "The time needed to finish dinner" and "Frequency of alcohol consumption" (rs = 0.31). When carbohydrates intake (g/kgSBW) was used as the dependent variable in another analysis, the significant factors were "Avoidance of excessive food intake" (βs = -0.34), "Time of dinner"(βs = 0.23) and " Allowing one's own value system to take priority even if it means eating inappropriate food" (βs = 0.20). "Eating tasty food while maintaining nutritional balance", "Making every effort to manage without eating" and "Avoidance of excessive food intake" proved to be mutually inter correlated (r=0.39, 0.49, 0.71).

For females, as the main findings in Figure 2 show, when carbohydrates intake (g/kgSBW) was used as the dependent variable, significant factors were " Reducing the amount of cooking salt" (βs = -0.34), "Taking care not to repeat overeating during subsequent meals"(βs = -0.22), "Allowing one's own value system to take priority even if it means eating inappropriate food" (βs = 0.24), "Frequency of snacking between meals" (βs = 0.21) and "Eating without paying attention and/or unintentionally"(βs = 0.20). "Reducing the amount of cooking salt" and "Taking care not to repeat overeating during subsequent meals" affected a reduction in carbohydrates intake (g/kgSBW), and these two factors correlated (r = 0.41). "Allowing one's own value system to take priority even if it means eating inappropriate food", "Frequency of snacking between meals", and "Eating without paying attention and/or unintentionally" affected the increase of carbohydrates intake (g/kgSBW), and these three factors correlated (rs = 0.39, r = 0.40).

DISCUSSION

Clarification of what kind of dietary self-management behavior is related to improvement in control indices for type II diabetics, and establishment of specific strategies for recommendation or correction, are considered important for such self-management. Hence, we developed the DSBQ, used in this study, for a quantitative evaluation of the implementation of dietary self-management behavior (24). Questionnaire items, including factors related to control indices of diabetes mellitus, can be utilized for the establishment of concrete dietary self-management behavior for recommendation or correction.

1. Dietary intake related to control indices of type II diabetes mellitus

Total energy intake (kcal/day or kcal/kg/SBW) by males correlated positively with both BMI and waist circumference. Similarly, the greater the carbohydrate intake (g/kg/SBW), the higher the HbA_{1c} level became. In females, too, the greater the carbohydrate intake (g/kg/SBW), the higher BMI and the larger the waist circumference became. These results show a passive correlation between total intake and BMI (7) as well as the influence of the total amount of carbohydrate intake on blood glucose level (2). The risk of reducing only carbohydrate intake has been pointed out from the viewpoint of onset of coronary heart disease (14, 15). Thus, to improve control indices of type II diabetics, carbohydrate intake and control of a well-balanced total dietary intake need to be taken into consideration (2).

2. Dietary self-management behavior related to dietary intake affecting control indices

Our findings showed that for male patients, total amount of intake and lipids and/or carbohydrates intakes become less when behavior patterns such as paying attention to "Avoiding excessive food intake", "Eating tasty food while maintaining nutritional balance" and "Making every effort to manage without eating" are implemented habitually. In addition, mutually positive correlations were recognized in the behaviors which were related to a decrease in dietary intake. Thus, it can be confidently expected that the recommendation of these behaviors to male diabetics will lead to a decrease of dietary intake and effective control of diabetes mellitus.

On the other hand, the behaviors related to an increase in total energy intake were late-night dinner, extended time for dinner, and higher frequency of alcohol consumption. In addition, there was a positive correlation between time needed to finish dinner and frequency of alcohol consumption. Thus, the extended time for dinner, which was related to an increase in total energy intake and lipids intake, may have a close relationship to the time required for alcohol consumption in addition to the frequency. Furthermore, the finding that the higher the frequency of alcohol consumption was, the higher the lipids intake was suggests that an increase in lipids intake may be accounted for by a dish eaten with alcohol. In addition, the alcohol drinking habit causes not only an increased energy intake due to alcohol itself but also deviation from a strict dietary regimen, and the risk of further increases in alcohol intake (2). Moreover, since alcohol consumption reduces basal metabolism, the necessity of recommending abstention from alcohol has been pointed out for patients for whom it is difficult to reduce the alcohol intake (3).

For males, then, the need for time management, such as starting time of dinner and the time needed to finish dinner, is clearly indicated, as well as control of the energy intake associated with alcohol consumption and its frequency.

For females, the parameters of "Taking care not to repeat overeating during subsequent meals" and "Reducing the amount of cooking salt" are related to a decrease in carbohydrate intake, and these behaviors correlate with each other. It has been pointed out that the restriction of salt in cooking is important not only for the prevention of complications such as hypertension, but also for the suppression of appetite (20). Moreover, and especially for

females, “Reducing the amount of cooking salt may be more effective for reducing dietary intake than simply emphasizing the need to reduce such intake. Similarly, “Taking care not to repeat overeating during subsequent meals” aims to reduce next dietary intake after excess intake by controlling patient’s mind. It is clear that medical workers should recommend this type of behavior to their patients to produce a reduction in dietary intake.

On the other hand, behaviors such as “Frequent snacking between meals, “Allowing one's own value system to take priority even if it means eating inappropriate food, and “Eating without paying attention and/or unintentionally, produced an increase in carbohydrates intake. Moreover, these behaviors were mutually interrelated. The parameter of “eating food without paying attention and/or unintentionally” implies eating without realizing it “when irritated or eating favorite food which is in front of the patient without paying attention and/or unintentionally”. Dietary restrictions may provide a strong provocation for these behaviors (16,17). Van de Laar et al. emphasized that “emotional eating”, which was seen as a normal reaction by both genders to emotional distress such as hunger and irritation, will not change even if dietary therapy for diabetics is continued, and reported that dietary intake, especially in females, increases as a result of this "emotional eating" (27). Furthermore, the relationship between "emotional eating" and “frequency of binge eating” has been pointed out in the case of females with high BMI (16, 17). Our study results partly supported these previous findings. The encouragement of behavior parameters described above, which focuses on behaviors leading to an increase of dietary intake, is important for the dietary support of female diabetics.

CONCLUSION

Characteristic findings showing gender differences were identified for dietary self-management behaviors that affect control indices (waist circumference, BMI, HbA_{1c}) of type II diabetes mellitus. We anticipate that educational support using the findings, including gender differences, obtained in this study will prove useful for the improvement in control indices of diabetes mellitus. However, the longitudinal study of how the practice of recommended dietary self-management behavior actually affects control indices of type II diabetes mellitus remains to be elucidated.

ACKNOWLEDGMENTS

This work was supported by a grant from the 21st Century Center of Excellence Program, “Center of Excellence for Signal Transduction Disease: Diabetes Mellitus as a Model,” and provided by the Ministry of Education, Culture, Sports, Science and Technology of Japan.

The authors are grateful to the patients who participated in the study and to the staff members of the outpatient clinic of Kobe University Hospital.

Appendix : Table of items in dietary self-management behaviors questionnaire

A) Following instructions of dietary regimen.	**50 items.**
1) General regularity of eating habits.	**(13 items)**
・ Frecuency of meals per day	3-point ordinal scale
・ Frecuency of breakfast per week	5-point ordinal scale
・ Time of breakfast.	5-point ordinal scale
・ Time of lunch.	5-point ordinal scale
・ Time of dinner.	6-point ordinal scale
・ The time needed to finish dinner	8-point ordinal scale
・ Frequency of snacking between meals	8-point ordinal scale
・ Time of snacking	nominal scale
・ Cause of snacking between meals	nominal scale
・ Frequency of dining out	7-point ordinal scale
・ Frequency of work-related dining out	7-point ordinal scale
・ Frequency of alcohol consumption	7-point ordinal scale
・ Frequency of smoking	7-point ordinal scale
2) Following instructions for appropriate calorie intake.	**(24 items, 5 factors)**
Factor 1 : Avoidance of excessive food intake.	**(9 items) α=0.81**
・ I use 50g-100g servings of meat or fish for a single meal. ・ I can estimate the weight (in grams) and the calorie content (number of units) of a serving just by looking. ・ I use food products with calorie content labels and carefully check the amount of calories. ・ I limit the amount of intake of cakes or sweets (for those who never eat sweets, please circle "Always"). ・ If a serving (slice) of fish is large, I eat only half. ・ When I have too much food (bought or made), I store it in one-meal servings in the refrigerator. ・ I eat rice by measuring it in one-meal servings. ・ I limit the amount of fruit intake to 1 unit (80kcal) per day. ・ I avoid eating pickles or appetizers (e.g.Tsukudani) because they make me want to eat more rice.	5-point Likert scale
Factor 2 : Reduction of calories from lipids-containing foods	**(4 items) α=0.73**
・ When cooking fried food, I reduce the amount of cooking oil by using a non-stick pan (e.g. teflon-) ・ I eat meat with as less fat as possible. ・ I eat more vegetable fat than animal fat. ・ I eat boiled meat dishes that reduce the fat content (e.g. Shabu-shabu)	5-point Likert scale
Factor 3 : Enhancement of satisfaction during meals	**(5 items) α=0.76**
・ I chew my food carefully before swallowing. ・ I savor the food before swallowing. ・ I prepare dishes to make them more attractive and appealing to the eye. ・ I prepare a variety of dishes but all with low calorie content. ・ I eat large amounts of low-calorie dishes(e.g. salads) to make me feel full.	5-point Likert scale
Factor 4 : Reducing the use of the high-calorie seasoning	**(3 items) α=0.68**
・ I avoid using mirin (sweetened sake) when cooking. ・ I avoid using sugar when cooking. ・ I use artificial sweeteners with less calorie content (e.g. Sugar Cut or Marvie).	5-point Likert scale
Factor 5 : Reducing high-calorie drinks	**(3 items) α=0.66**
・ I use artificial sweetener (low calorie content) in coffee or tea. (For those who do not usesweeteners of any sort, please circle "Always"). ・ I do not add milk to coffee or tea. ・ I avoid sweet drinks.	5-point Likert scale
3) Strategies for cooking tasty and healthy meals	**(13 items, 2 factors)**
Factor 1 : Eating tasty food while maintaining nutritional balance	**(8 items) α=0.79**
・ I eat a lot of vegetables. ・ I eat one fish dish or meat dish with some vegetarian dishes. ・ To reduce the amount of salt and sugar when cooking, I use natural seasoning (e.g. stock made from seaweed and dried fish) ・ I use vinegar as well as citric juices to reduce salt content. ・ I eat small amounts of a variety of foods. ・ To satisy the 60% daily requirement of carbohydrates for energy production, I eat other sources of carbohydrates besides rice, such as potatoes and lotus root. ・ I use spices when cooking to reduce salt content. ・ I make soup with many different kinds of vegetables.	5-point Likert scale
Factor 2 : Reducing the amount of cooking salt	**(5 items) α=0.77**
・ I avoid dishes that have too much flavoring/strong flavor. ・ I minimize the use of sauces, salad dressings, salad oil, etc. ・ I cook dishes with plain flavors. ・ I avoid eating broth from noodle dishes. ・ I avoid eating soup or broth such as miso soup.	5-point Likert scale

B) Coping behavior regarding factors interfering with dietary regimens.	39 items.
1) Avoidance of factors interfering with dietary regimens.	**(26 items, 5 factors)**
Factor 1: Making every effort to manage without eating.	**(8 items) α=0.83**
・Even when I'm hungry I try not to eat. ・Even when I'm stressed, I am conscious of my calorie intake when eating. ・Even when I'm stressed and feel a strong urge to eat, I try not to. ・When I happen to have sweets, I ask close friends or acquaintances to eat ~~it~~ them. ・I try to make excuses such "My taste has changed" to help me avoid eating sweets. ・When I feel like eating, I consciously remind myself of the complications that can arise from diabetes to disocurage myself from eating. ・I make a shopping list before I go shopping for food. ・To reduce my stomach size and thus curb my appetite, I try to reduce my overall food intake.	5-point Likert scale
Factor 2 : Making every effort to avoid temptations from the surrounding environment	**(6 items) α=0.76**
・I avoid places where other people are eating.. ・I avoid eat together with big eaters (especially younger genelation) ・I try to eat alone. ・I try not to eat out. ・I avoid drinking/eating parties. ・I interpret hunger as a sign that my blood sugar level is near normal to motivate myself not to eat.	5-point Likert scale
Factor 3 : Making every effort to control one's appetite	**(5 items) α=0.68**
・I avoid going shopping on an empty stomach. ・When I'm stressed, I try to divert my attention from thinking about eating . ・When I'm hungry, I drink water or tea. ・When I'm hungry, I eat low-calorie food. ・Planning ahead and choosing a specific dinner time per month for eating, rather than eating anytime	5-point Likert scale
Factor 4 : Making every effort to eat low calorie ~~foods~~ when dining out	**(4 items) α=0.81**
・I try to mainly eat low-calorie food (such as vegetables, non-meat and non-dairy products). ・I order dishes with many vegetables. ・Different from other persons, I order low-calorie food, for avoiding overrating. ・I count calories and decide the amount of food intake before meals.	5-point Likert scale
Factor 5 : Making every effort to obtain understanding and cooperation from others when dining out.	**(3 items) α=0.70**
・I try to dine out with people who take care not to overeat~~.~~ ・To avoid eating too much, I eat out with close friends or family who don't mind eating food I leave on my ・When I get invitations to go drinking, I use my illness as an excuse to refuse.	5-point Likert scale
2) Temporarily deviant behavior.	**(8 items, 2 factors)**
Factor 1 : Allowing one's own value system to take priority even if it means eating inappropriate food .	**(5 items) α=0.72**
・When eating out, I don't think about the diet I should be following. ・In certain socially obligatory situations, I do what is expected of me and eat like everyone else. ・Once I start to eat, I feel the urge to finish up everything and I eat it completely. ・Because I think it's wasteful to leave food on my plate, I finish off everything even if it's too much or I am ・When there's an occasion where~~,~~ cakes, pastries and other sweets are with tea, I accept.	5-point Likert scale
Factor 2 : Eating without paying attention and/or unintentionally.	**(3 items) α=0.55**
・When I feel stressed, I tend to eat without being aware of it, nor am I conscious of what and how much I eat. ・When I am extremely hungry, I eat food that makes me feel full. ・If it looks appetizing, I eat it.	5-point Likert scale
3) Correcting temporarily deviant behavior.	**(5 items, 2 factors)**
Factor 1 : Taking care not to repeat overeating during subsequent meals.	**(2 items) α=0.70**
・In situtations when if I overeat, I try to avoid doing it again. ・I try to reduce my intake during the next meal.	5-point Likert scale
Factor 2 : Taking care to regulate caloric intake, intentionally.	**(3 items) α=0.66**
・When I find myself overeating, I increase the amount of exercise afterwards. ・I strictly regulate caloric balance by exercise and food intake for a certain period (for one week around the tenth of the month). ・When I expect to eat a lot (at parties, get-togethers, etc.), I try to reduce my food intake before and after.	5-point Likert scale

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