Factors associated with diet barriers in patients with poorly controlled type 2 diabetes

Li Cheng¹, Doris Yin-ping Leung¹, Janet Wing-hung Sit¹, Xiao-mei Li², Yu-ning Wu³, Miao-yan Yang⁴, Cui-xia Gao⁵, Rong Hui⁶

¹The Nethersole School of Nursing, Faculty of Medicine, The Chinese University of Hong Kong, Ma Liu Shui, Shatin, New Territories, Hong Kong; ²The Department of Nursing, Faculty of Medicine, The Xi’an Jiaotong University; ³The Department of Endocrinology, The Ninth Affiliated Hospital of Xi’an Jiaotong University; ⁴The Department of Endocrinology, The Second Affiliated Hospital of Xi’an Jiaotong University; ⁵The Department of Endocrinology, Shaanxi Provincial People’s Hospital, Xi’an, People’s Republic of China

Background: The study was conducted to investigate the diet barriers perceived by patients with poorly controlled type 2 diabetes and examine the associations between diet barriers and sociodemographic characteristics, medical condition, and patient-centered variables.

Methods: Secondary subgroup analyses were conducted based on the responses of 246 adults with poorly controlled type 2 diabetes from a multicenter, cross-sectional study. Diet barriers were captured by the Diet Barriers subscale of the Personal Diabetes Questionnaire. Participants also completed validated measures of diet knowledge, empowerment level, and appraisal of diabetes. Multiple regression techniques were used for model building, with a hierarchical block design to determine the separate contribution of sociodemographic characteristics, medical condition, and patient-centered variables to diet barriers.

Results: Diet barriers were moderately evident (2.23±0.86) among Chinese patients with poorly controlled type 2 diabetes. The feeling of deprivation as a result of complying with a diet was the most recognized diet barrier (3.24±1.98), followed by “eating away from home” (2.79±1.82). Significantly higher levels of diet barriers were observed among those with lower levels of diet knowledge (β=−0.282, P<0.001) and empowerment (β=−0.190, P=0.015), and more negative appraisal (β=0.225, P=0.003).

Conclusion: Culturally tailored, patient-centered intervention programs that acknowledge individuals’ preferences and allow for flexibility in diet management should be launched. Interventions programs that could enhance diet knowledge, promote positive appraisal, and improve empowerment level might effectively address diet barriers perceived by patients with poorly controlled type 2 diabetes.

Keywords: diabetes, diet barriers, knowledge, appraisal, empowerment

Introduction

Despite the advances in treatment and self-management education, poor glycemic control is an evident issue among patients with type 2 diabetes.¹ A recent multinational, cross-sectional study estimated that nearly 60% of patients with type 2 diabetes suffered from poor glycemic control worldwide.² Mounting evidence demonstrates that such patients are at increased risk of developing irreversible micro- and macrovascular complications.²³ Optimization of glycemic control in this vulnerable population is a high priority for diabetes care.³

The poor glycemic control in patients with type 2 diabetes is due to multiple factors. As indicated by the Health Promotion Model and Patient Empowerment Model, perceived barriers are among the key factors that predict sustained behavioral change.⁴⁵ Diet barriers often lead to undesirable diet management (ie, behavioral dysregulation and lapse), which attributes mostly to poor glycemic control.⁶⁷ Recognizing and addressing diet barriers have been prioritized as a crucial step in providing patient-centered care to patients with poorly controlled diabetes.⁸⁻¹¹
Previous research indicated that patients with poorly controlled diabetes perceived more diet barriers compared with subjects with good glycemic control.12 Given the variance in experiences and concerns for different metabolic conditions, diet barriers perceived by patients with poor glycemic control might be different from those perceived by subjects with good glycemic control.13 Few studies have investigated the diet barriers perceived by underserved adults with type 2 diabetes and all glycemic control levels using validated instruments.7,14,15 None of these studies mentioned any attempt to report diet barriers perceived by patients with poor glycemic control via subgroup analysis. The needs and characteristics of patients with poorly controlled diabetes thereby remain unclear. Although diet barriers have been the focus of self-management research and clinical care efforts, the existing self-management interventions may not adequately address the concerns of patients with poor glycemic control.16

Building a culture of patient-centeredness requires identification of key factors that account for diet barriers.17 Consistent evidence showed that deficiencies in diet knowledge were associated with increased diet barriers.16 The Transactional Model of Stress and Coping and results from the recent Diabetes Attitudes Wishes and Needs Study 2 indicated that negative appraisal of diabetes consisted of barriers to adequate diet management.18,19 Previous reviews supported that the empowerment level predicts the extent of an individual’s active engagement in overcoming self-management barriers.20,21 Of note is that a paucity of published studies simultaneously examined the independent effects of sociodemographic characteristics, medical condition, and patient-centered variables on diet barriers among patients with poorly controlled type 2 diabetes. A comprehensive understanding of diet barriers would facilitate the conceptualization of a design for tailored, patient-centered intervention programs for patients with poor glycemic control.

Building on the available evidence, in this study, we aimed to 1) examine diet barriers specifically perceived by patients with poor glycemic control; and 2) explore the associations between diet barriers and sociodemographic characteristics, medical condition, and patient-centered variables.

Methods
Data presented here are secondary analyses from a multicenter, cross-sectional study with an overall goal to examine the psychometric properties of the Chinese version of the Personal Diabetes Questionnaire (PDQ).22 The study was carried out between February and October in 2012. Potential participants were recruited from four tertiary university-affiliated hospitals in Xi’an, People’s Republic of China. This study was approved by the Institutional Review Boards, including Xi’an Jiaotong University and each study site.

Participants
To be eligible, participants were adults with type 2 diabetes, with intact cognitive function with the Abbreviated Mental Test more than 7, had no psychiatric illness, and were able to provide written informed consent. Patients who had cancer or severe complications, end-stage illnesses, or were unwilling to participate in the study were excluded. In total, 361 eligible patients were approached; 346 of them gave their informed consent to participate in the study (response rate = 95%). This analysis only included subjects with poor glycemic control (n = 246), as defined by patients with glycated hemoglobin (HbA1c) values greater than 7.5% advocated by the International Diabetes Federation.1

Measures
Outcome variables: diet barriers
Perceived diet barriers were measured by the Diet Barriers subscale of the PDQ which was a seven-item, patient-centered, self-report questionnaire. Participants were asked questions such as “In the past three months have you had problems eating because you feel discouraged due to lack of results?” Each item was scored based on a six-Likert scale, with a possible range of 1 (never) to 6 (one or more times per day). Scores were calculated by averaging the participants’ response. A higher score indicates higher levels of perceived barriers in diet management.22 In the current study, the Chinese version of the Diet Barriers subscale of the PDQ demonstrated adequate internal consistency (Cronbach’s α = 0.705) and test–retest reliability (r = 0.990). The Diet Barriers subscale also displayed significant associations with HbA1c (r = 0.697, P < 0.001), supporting satisfactory criterion validity.

Independent variables
Sociodemographic data included sex, age, educational level, and monthly income level. Medical condition data included exposure to diabetes education talk (yes/no), diabetes duration, the number of complications, and insulin use (yes/no).

Patient-centered variables
Diet knowledge
Diet knowledge was measured by the Diet Knowledge subscale of the PDQ, using items such as “Use the information
about the number of calories in food to make decisions about what to eat." The participants responded to each item using a six-point Likert scale with a possible range of 1 to 6. A higher score indicated better knowledge in diet management. The Chinese version of the Diet Knowledge subscale demonstrated satisfactory internal consistency (Cronbach’s α=0.73) and significant association with HbA1c (r=−0.66, P<0.001).22

Appraisal of diabetes: Appraisal of Diabetes Scale
The Appraisal of Diabetes Scale (ADS) is a seven-item instrument designed to capture individuals’ appraisal of his or her diabetes.23 Responses for each item range from 1 to 5. The average mean rating of the scale is used, with a higher score indicating more negative appraisal of diabetes. The psychometric properties of the Chinese version of the ADS were established with acceptable internal consistency (Cronbach’s α=0.810) and excellent test–retest reliability (intraclass correlation coefficient =0.94).24 The significant correlation between ADS and HbA1c also supported the appropriate criterion validity (r=0.556, P<0.001).24

Empowerment level: Diabetes Empowerment Scale-Short Form
The eight-item Diabetes Empowerment Scale-Short Form (DES-SF) was used to measure the empowerment level of people with diabetes.25 A five-point Likert scale was employed and the scoring is performed by averaging participants’ response. A higher score is interpreted as a higher level of empowerment. The Chinese version of DES-SF demonstrated good internal consistency (Cronbach’s α=0.848) and test–retest reliability (r=0.817). In addition, the score of DES-SF was positively correlated with general self-efficacy (r=0.556, P<0.01), giving evidence of acceptable convergent validity.26

Procedure
Eligible patients were approached and provided with information sheets. After obtaining the consents, face-to-face structured interviews were conducted to collect participants’ information on sociodemographic characteristics and patient-centered variables by a trained research nurse. Data regarding medical condition were collected through the health system computerized medical records.

Statistical analysis
Data analysis was performed using IBM SPSS Statistics for Windows, Version 22.0: Armonk, New York, NY, USA. Sociodemographic characteristics, medical condition, and patient-centered variables of participants were reported as frequency (percentage) and mean ± standard deviation (SD) for categorical and continuous variables, respectively. Imputation was used to deal with the missing data: mean value substitution was used for continuous variables, and non-ignorable models were used for categorical missing values.27

Multiple regression techniques were used for model building, with a hierarchical block design to determine the separate contribution of sociodemographic characteristics, medical condition, and patient-centered variables to diet barriers. The first step of hierarchical regression included sociodemographic characteristics in the first block; this was followed by the addition of medical condition in the second block; and the third step added patient-centered variables into the third block. All statistical tests were two-sided and differences were accepted as significant at P<0.05.

Results
Characteristics of the study sample
Table 1 shows the sociodemographic characteristics, medical condition, and patient-centered variables of the participants. Overall, the mean age was 58.90±10.85 years; the mean diabetes duration was 9.68±6.22 years, and the mean HbA1c level was 10.47±2.29%. Patients with poor glycemic control had a low level of diet knowledge (2.33±0.85) and empowerment (2.72±0.84), and a high level of negative appraisal (3.04±0.75).

Table 2 displays the barriers perceived by patients with poor glycemic control. “Feeling deprived due to attempts to follow a diet” was the most highly endorsed diet barriers perceived by patients with poorly controlled type 2 diabetes (3.24±1.98), followed by “Eating away from home” (2.79±1.82).

Factors associated with diet barriers
Results of the hierarchical regression analyses are shown in Table 3. The final model (Model 3) was considered the best-competing model, as indicated by significantly increasing values of adjusted R². The inclusion of the three patient-centered variables increased the magnitude of variance explained by 23.1%. The results of Model 3 revealed that higher levels of diet barriers were associated with lower levels of diet knowledge (β=−0.282, 95% CI: [−0.341, −0.200], P<0.001) and empowerment (β=−0.190, 95% CI: [−0.317, −0.035], P=0.015), and more negative appraisal (β=0.225, 95% CI: [0.093, 0.443], P=0.003). In addition, male subjects and younger subjects were more likely to report increased diet...
barriers, as shown in the first and second steps of hierarchical regression analyses. However, after adding patient-centered variables into the model, neither sex nor age was significantly associated with the magnitude of diet barriers.

**Discussion**

Our findings suggested that diet barriers were moderately evident among patients with poor glycemic control. The feeling of deprivation due to complying with a diet was the most frequently cited diet barrier perceived by patients with poorly controlled type 2 diabetes. Subjects with lower levels of diet knowledge and empowerment and those with a more negative appraisal of diabetes were more likely to report higher levels of diet barriers.

From the patients' perspective, healthy eating is a complex and demanding decision-making process. Our study confirmed that patients with poor glycemic control faced an array of diet barriers, including psychological-dimension and situational-dimension barriers. In our study, “Feeling deprived due to attempts to follow a diet” was the frequently cited diet barrier, followed by “Eating away from home”. The feeling of food deprivation as an important diet barrier perceived by patients with poor glycemic control has been reported by other diabetes populations. The feeling of deprivation is often accompanied by the restrictive attitudes and loss of pleasure in eating and autonomy, which in turn led to increased susceptibility to disordered eating behaviors. One possible reason for the feeling of food deprivation is that diet recommendations are either too general, idealistic, or not culture-specific. With limited clear and practical dietary advice, patients are more likely to strictly and passively follow the instructions, thereby inducing the feeling of food deprivation. To decrease the levels of diet barriers perceived by patients with poor glycemic control, effective diet management intervention programs that provide concrete, practical, and culturally specific diet information (including portion control, meal planning, and food shopping) should be launched. Individuals’ preferences should be acknowledged, and flexibility in diet management should be allowed. A flexible restrained approach has been suggested as an advantageous approach to foster healthy eating habit in the long term.

All the patient-centered variables, including diet knowledge, diabetes appraisal, and empowerment, are significantly associated with diet barriers in the final hierarchical regression model.

### Table 1 Sociodemographics characteristics, medical condition, and patient-centered variables of patients with poor glycemic control (n=246)

| Variables | Poor glycemic control (n=246) |
|-----------|-------------------------------|
| **Sociodemographics characteristics** | |
| Male, n (%) | 141 (57.32) |
| Age, M (SD) | 58.90 (10.85) |
| Educational level, n (%) | |
| Primary school | 113 (45.93) |
| Senior high school | 77 (31.30) |
| College or above | 56 (22.77) |
| Monthly income, n (%) | |
| <1,000 RMB | 56 (22.76) |
| (1,000–3,000) RMB | 133 (54.07) |
| >3,000 RMB | 57 (23.17) |
| **Medical condition** | |
| Experience of diabetes education talk, n (%) | |
| Yes | 118 (47.97) |
| No | 128 (52.03) |
| Duration, M (SD) | 9.68 (6.22) |
| Numbers of complications, n (%) | |
| 0 | 11 (4.76) |
| 1–2 | 94 (38.21) |
| >2 | 141 (57.32) |
| Insulin use, n (%) | |
| Yes | 121 (49.19) |
| No | 125 (50.81) |
| **Patient-centered variables** | |
| Diet knowledge, M (SD) | 2.33 (0.85) |
| Appraisal of diabetes, M (SD) | 3.04 (0.75) |
| Empowerment, M (SD) | 2.72 (0.84) |

**Note:** Patients with poor glycemic control refers to patients with HbA1c more than 7.5%.

**Abbreviations:** SD, standard deviation; M, mean; HbA1c, glycated hemoglobin.

### Table 2 Diet barriers perceived by patients with poor glycemic control (n=246)

| Eating problems when | Mean ± SD |
|----------------------|-----------|
| … when feeling stressed, anxious, depressed, angry, or bored | 1.28±0.92 |
| … because of hunger or food cravings | 2.19±1.63 |
| … because family or friends tempt you or are not very supportive of your efforts to eat right | 2.01±1.21 |
| … when eating away from home (such as fast food, in restaurants, with relatives, or potluck meals) | 2.79±1.82 |
| … because you feel deprived due to trying to follow a diet | 3.24±1.98 |
| … because you feel discouraged due to lack of results (such as no weight loss, or high blood sugars) | 2.02±1.38 |
| … because you are too busy with family, work, or other responsibilities | 2.05±1.70 |
| Total | 2.23±0.86 |

**Abbreviation:** SD, standard deviation.
After standardizing the coefficients, we found the strongest association between diet knowledge and diet barriers, suggesting that knowledgeable individuals are more likely to perceive a lower level of diet barriers. This point of view is in agreement with results of previous reviews, which assert that subjects who lack diet knowledge perceived more diet barriers, thereby increasing the likelihood of poor adherence in diet management.16,30 Johnson and colleagues demonstrated that knowledgeable individuals were likely to gain awareness of their self-regulatory capacity to address diet barriers.32 Individuals with more diet knowledge are more competent in making informed decisions that are flexibly suited to their goals, priorities, and lifestyle.37 Patients with poorly controlled diabetes might particularly benefit from the development of intervention programs that can fill the gaps in knowledge required to achieve the goal of healthy eating. However, diet knowledge alone does not necessarily lead to decreased levels of perceived diet barriers.36 Future works should establish effective ways to facilitate the transferability of diet knowledge within individuals’ social and cultural networks.

Negative appraisal of diabetes is positively associated with perceived barriers in diet management. This finding is in agreement with results of previous research, which showed the deleterious effect of negative appraisal on self-management barriers.38–40 Several reasons may account for the relationship between diabetes appraisal and perceived barriers. Appraisal of diabetes affects the likelihood of adoption of a given behavior.41 The Transactional Model of Stress and Coping supported the declaration that patients with negative appraisal may use “avoidance or passive resignation” instead of problem-focused and meaning-focused methods as potential coping strategies.42,43 Patients with negative appraisal may consider diabetes as a condition that is beyond their own control and passively engage in problem-solving activities; these patients may perceive higher levels of diet barriers when complying with healthy eating recommendations.5,44 Moreover, negative appraisal of diabetes was evidenced by increased vulnerability to psychological distress.40,45 Psychological distress could cognitively distract patients and impede their autonomy and decision-making skills. Thus, psychological distress poses a great challenge in overcoming barriers.16,43,46 Hence, the negative appraisal is a medically meaningful component that would likely contribute to the diet barriers perceived by patients with poor glycemic control. The current findings suggest that an assessment of diabetes appraisal could provide valuable clues on the identification of individuals with increased levels of diet barriers. Intervention programs that promote a more positive and adaptive appraisal may decrease the diet barriers perceived by patients with poor glycemic control.

The association between the empowerment level and diet barriers indicates that diet barriers are disproportionally challenging for those with lower empowerment level. This finding corroborated the theoretical assertions in Patient Empowerment Model and Empowerment Process Model,
which state that empowerment as a psychological self-efficacy could determine the commitment and perseverance of self-management efforts in the presence of barriers.\textsuperscript{5,21} The negative association of diet barriers with empowerment has been detected in previous integrative literature reviews.\textsuperscript{5,21} Empowerment has been linked to active roles in decision making in diet management.\textsuperscript{49,50} Patients with a higher level of empowerment are more self-motivated to have a dynamic perception of diet knowledge and take meaningful behaviors accordingly.\textsuperscript{51–55} A patient-centered approach to enhance empowerment may potentially be effective in addressing diet barriers. However, assessment of the effectiveness of such intervention programs in patients with poor glycemic control is beyond the scope of the current study.

We found two variables are significantly associated with diet barriers in the first and second steps of the hierarchical regression analyses, namely, male and age. Male subjects and younger subjects were more likely to report more diet barriers. However, the relationships between sex, age and diet barriers became nonsignificant, when patient-centered variables were added into the model. One potential explanation for the loss of significant statistical association between being a male and diet barriers might be the sex differences in use of diabetes education.\textsuperscript{56} Studies in diverse populations showed that male patients reported a lower diabetes education attendance rate and exhibited a lower level of diet knowledge, compared with female subjects.\textsuperscript{57–61} Thus, sex may confound the effect of diet knowledge on predicting the levels of diet barriers. Moreover, younger patients were found to be more sensitive to diabetes-related stigma (such as blaming, shaming, negative stereotyping, discrimination, and lost opportunities), thereby leading to increased psychological burden and negative appraisal of diabetes.\textsuperscript{62,63} Such negative emotional and cognitive reactions may “wash out” the association between younger age and diet barriers.

**Limitations**

Our results should be interpreted within the context of our design and methods. First, this study is cross-sectional in nature. Therefore, firm conclusions cannot be made on the causal effects of sociodemographic characteristics, medical condition, and patient-centered variables on diet barriers. Population-based and longitudinal studies are needed to gain more insight into the associations indicated by the current study. Second, the diet knowledge, diabetes appraisal, empowerment level, and diet barriers were assessed using self-report instruments; thus, responses may be biased. Nevertheless, self-report is the only feasible and cost-effective method known for collecting such data.\textsuperscript{64} Finally, our study only recruited participants from tertiary university-affiliated hospitals, which place limits on the generalizability of our exploratory results. Nevertheless, in the People’s Republic of China, most of the patients will be followed up at the clinics after diagnosis. Due to the uneven development of hospital and primary care, patients with poor glycemic control have a tendency to consult health care professionals in tertiary hospitals. Further studies that recruit a larger sample size of patients with poorly controlled type 2 diabetes in the community are warranted.

**Implications**

Although causality cannot be obtained, the results of the investigation still have great potential to provide information for clinical practice. Diet barriers appeared to be challenging for patients with poor glycemic control. The exploration of the correlates confirms the significance of diet knowledge and emphasizes the roles of diabetes appraisal and empowerment in this vulnerable diabetes subgroup. The mechanisms underlying these associations are not clear and need to be elucidated in future studies.

Health care professionals need to consider subjects with low levels of diet knowledge, empowerment, and positive appraisal as an “at-risk” group among patients with poor glycemic control. It is imperative to evaluate these patient-centered variables as parts of routine practice to detect patients who need interventions. Culturally tailored intervention programs that aim to improve diet knowledge and facilitate knowledge transferability should be prioritized for patients with poor glycemic control. Further research is needed to develop effective intervention programs to promote positive appraisal and empowerment for individuals with poor glycemic control.

**Conclusion**

Diet barriers are moderately evident among Chinese patients with poorly controlled type 2 diabetes. Culturally tailored, patient-centered intervention programs that acknowledge individuals’ preferences and allow for flexibility in diet management should be launched. Intervention programs that enhance diet knowledge, promote positive appraisal, and improve empowerment level might effectively address diet barriers among patients with poorly controlled type 2 diabetes.

**Disclosure**

The authors report no conflicts of interest in this work.
References

1. International Diabetes Federation. IDF Diabetes Atlas. 6th ed. Brussels: International Diabetes Federation; 2013.
2. Litwak L, Goh S-Y, Hussein Z, Malek R, Prusty V, Khamseh ME. Prevalence of diabetes complications in people with type 2 diabetes mellitus and its association with baseline characteristics in the multinational A1chieve study. Diabetol Metab Syndr. 2013;5(1):57.
3. American Diabetes Association. Standards of medical care in diabetes – 2014. Diabetes Care. 2014;37(Suppl 1):14–80.
4. Harvey NJ, Lawson VL. The importance of health belief models in determining self-care behaviour in diabetes. Diabet Med. 2009;26(1):5–13.
5. Ho AYK, Berggren I, Dahlborg-Lychkage E. Diabetes empowerment related to Pender’s Health Promotion Model: a meta-synthesis. Nurs Heal Sci. 2010;12(2):259–267.
6. Lara J, McCrum LA, Mathers JC. Association of Mediterranean diet and other health behaviours with barriers to healthy eating and perceived health among British adults of retirement age. Maturitas. 2014;79(3):292–298.
7. Marcy TR, Britton ML, Harrison D. Identification of barriers to appropriate dietary behavior in low-income patients with type 2 diabetes mellitus. Diabetes Ther. 2011;2(1):9–19.
8. Esden JL, Nichols MR. Patient-centered group diabetes care: a practice innovation. Nurse Pract. 2013;38(4):42–48.
9. Barry MJ, Edgman-Levitan S. Shared decision making – the pinnacle of patient-centered care. N Engl J Med. 2012;366(9):780–781.
10. Inzucchi SE, Bergenstal RM, Buse JB, et al. Management of hyperglycemia in type 2 diabetes: a patient-centered approach: position statement of the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). Diabetes Care. 2012;35(6):1364–1379.
11. Koch L. Diabetes: efficacy of behavioral interventions in patients with poorly controlled diabetes mellitus. Nat Rev Endocrinol. 2011;7(12):691.
12. Khahtab M, Khader YS, Al-Khawaldeh A, Ajloumi K. Factors associated with poor glycemic control among patients with type 2 diabetes. J Diabetes Complications. 2010;24(2):84–89.
13. Stetson B, Schlundt D, Rothschild C, Floyd JE, Rogers W, Mokshagundam SP. Development and validation of The Personal Diabetes Questionnaire (PDQ): a measure of diabetes self-care behaviors, perceptions and barriers. Diabetes Res Clin Pract. 2011;91(3):321–332.
14. Knight H, Stetson B, Krishnasamy S, Mokshagundam SP. Diet self-management and readiness to change in underserved adults with type 2 diabetes. Prim Care Diabetes. 2015;9(3):219–225.
15. Thornton LE, Jeffery RW, Crawford DA. Barriers to avoiding fast-food eating in an environment supportive of unhealthy eating. Public Health Nutr. 2013;16(12):2015–2013.
16. Ahola AJ, Groop PH. Barriers to self-management of diabetes. Diabet Med. 2013;30(4):413–420.
17. Mc Sharry J, Bishop ML, Moss-Morris R, Kendrick T. “The chicken and egg thing”: cognitive representations and self-management of multimorbidity in people with diabetes and depression. Psychol Health. 2013;28(1):103–119.
18. Peyrot M, Burns KK, Davies M, et al. Diabetes Attitudes Wishes and Needs 2 (DAWN2): a multinational, multi-stakeholder study of psychosocial issues in diabetes and person-centred diabetes care. Diabetes Res Clin Pract. 2013;99(2):174–184.
19. Lazarus RS, Folkman S. Transactional theory and research on emotions and coping. Eur J Pers. 1987;1(3):141–169.
20. Cattaneo LB, Chapman AR. The process of empowerment: a model for use in research and practice. Am Psychol. 2010;65(7):646–659.
21. Strychar I, Elisha B, Schmitz N. Type 2 diabetes self-management: role of diet self-efficacy. Can J Diabetes. 2012;36(6):337–344.
22. Cheng L, Wu Y, Li X. The reliability and validity of Chinese version of the Personal Diabetes Questionnaire. Chin J Nurs. 2014;49:749–753.
23. Carey MP, Jorgensen RS, Weinstrom RS, et al. Reliability and validity of the appraisal of diabetes scale. J Behav Med. 1991;14(1):43–51.
24. Cheng L, Li X, Gao C, Hui R, Yang J, Wu Y. The reliability and validity of the Chinese version of the Appraisal of Diabetes Scale. Chin J Nurs Educ. 2013;10:485–488.
25. Anderson RM, Fitzgerald JT, Gruppen LD, Funnell MM, Oh MS. The Diabetes Empowerment Scale-Short Form (DES-SF). Diabetes Care. 2003;26(5):1635–1660.
26. Hu B, Lou Q, Tian Y, Zhang Q, Zhu J. Study on empowerment and its influencing factors among diabetes inpatients. Chin J Nurs. 2011;46:225–228.
27. Little RJ, Rubin L. Statistical Analysis with Missing Data. New York: John Wiley & Sons; 1987.
28. Glanz K, Rimer BK, Viswanath K. Health Behaviour and Health Education. New York: John Wiley & Sons; 2008.
29. Yannakoulia M. Eating behavior among type 2 diabetic patients: a poorly recognized aspect in a poorly controlled disease. Rev Diabet Stud. 2006;3(1):11–16.
30. Vihan S, Stuart NS, Fitzgerald JT, et al. Barriers to following dietary recommendations in type 2 diabetes. Diabet Med. 2005;22(1):32–38.
31. Cleveringa FGW, Minkman MH, Gorter KJ, Van Den Donk M, Rutten GEHM. Diabetes Care Protocol: effects on patient-important outcomes. A cluster randomized, non-inferiority trial in primary care. Diabetes Med. 2010;27(4):442–450.
32. Johnson F, Pratt M, Wardle J. Dietary restraint and self-regulation in eating behavior. Int J Obesity. 2012;36(5):665–674.
33. Quick VM, Byrd-Bredbenner C, Neumark-Sztainer D. Chronic illness and disordered eating: a discussion of the literature. Adv Nutr. 2013;4(3):277–286.
34. Penkofer S, Ferrans CE, Velsor-Friedrich B, Savoy S. The psychological impact of living with diabetes: women’s day-to-day experiences. Diabetes Educ. 2014;33(3):680–690.
35. Choi S, Song M, Chang SJ, Kim SA. Strategies for enhancing information, motivation, and skills for self-management behavior changes: a qualitative study of diabetes care for older adults in Korea. Patient Prefer Adherence. 2014;8:219–226.
36. Nam S, Chesa C, Stotts NA, Kroon L, Janson SL. Barriers to diabetes management: patient and provider factors. Diabetes Res Clin Pract. 2011;93(1):1–9.
37. Simall BS, Walker RJ, Hernandez-Tejada MA, Campbell JA, Davis KS, Egede LE. Associations between coping, diabetes knowledge, medication adherence and self-care behaviors in adults with type 2 diabetes. Gen Hosp Psychiatry. 2012;34(4):385–389.
38. Hara Y, Koyama S, Morinaga T, et al. The reliability and validity of the Japanese version of the Appraisal of Diabetes Scale for type 2 diabetes patients. Diabetes Res Clin Pract. 2011;91(1):40–46.
39. Holmes-Truscott E, Skinner TC, Pouwer F, Speight J. Negative appraisals of insulin therapy are common among adults with type 2 diabetes using insulin: results from diabetes MILES – Australia cross-sectional survey. Diabet Med. 2015;32(10):1297–1303. doi:10.1111/dme.12729.
40. Fisher EB, Thorpe TD, Devellis BM, Devellis RF. Healthy coping, negative emotions, and diabetes management: a systematic review and appraisal. Diabetes Educ. 2015;33(6):1080–1103.
41. Afkaihirt A. Role of illness and medication perceptions on adherence to medication in a group of Iranian patients with type 2 diabetes. J Diabetes. 2012;4(3):243–247.
42. Whitbread RR, Kreitzer M, Lauren Crain AL, Lewis BA, Hanson LR, Enstad CJ. Mindfulness-based stress reduction for family caregivers: a randomized controlled trial. Gerontologist. 2013;53(4):676–686.
43. Shah BM, Gupchup GV, Borrego ME, Raisch DW, Knapp KK. Depressive symptoms in patients with type 2 diabetes mellitus: do stress and coping matter? Stress Health. 2012;28(2):111–122.
44. Rustveld LO, Pavlik VN, Jibaja-Weiss ML, Kline KN, Gossey JT, Volk RJ. Adherence to diabetes self-care behaviors in English- and Spanish-speaking Hispanic men. Patient Prefer Adherence. 2009;3:123–130.
45. Hudson JL, Bundy C, Coventry PA, Dickens C. Exploring the relationship between cognitive illness representations and poor emotional health and their combined association with diabetes self-care: A systematic review with meta-analysis. J Psychosom Res. 2014;76(4):265–274.
46. Pandit AU, Bailey SC, Curtis LM, et al. Disease-related distress, self-care and clinical outcomes among low-income patients with diabetes. *J Epidemiol Community Health*. 2014;68(6):557–564.

47. Anderson RM, Funnell MM, Butler PM, Arnold MS, Fitzgerald JT, Feste CC. Patient empowerment: results of a randomized controlled trial. *Diabetes Care*. 1995;18(7):943–949.

48. Funnell MM, Anderson RM. Empowerment and self-management of diabetes. *Clini Diabetes*. 2004;22(3):123–127.

49. Sharp PB, Salyer J. Self-efficacy and barriers to healthy diet in cardiac rehabilitation participants and nonparticipants. *J Cardiovasc Nurs*. 2012;27(3):253–262.

50. Schulz PJ, Nakamoto K. Health literacy and patient empowerment in health communication: the importance of separating conjoined twins. *Patient Educ Couns*. 2013;90(1):4–11.

51. Du H, Everett B, Newton PJ, Salamonson Y, Davidson PM. Self-efficacy: a useful construct to promote physical activity in people with stable chronic heart failure. *J Clin Nurs*. 2012;21(3–4):301–310.

52. Pulvirenti M, Mcmillan J, Lawn S. Empowerment, patient centred care and self-management. *Heal Expect*. 2011;17(3):303–310.

53. Schmuhl H, Demska H, Lamprinos I, Dogac A, Ploessnig M, Hildebrand C. Concept of knowledge-based self-management pathways for the empowerment of diabetes patients. *Eur J Biomed Informatics*. 2014;10(2):12–16.

54. Tol A, Baghbanian A, Mohebbi B, et al. Empowerment assessment and influential factors among patients with type 2 diabetes. *J Diabetes Metab Disord*. 2013;12(1):6.

55. Zoffmann V, Kirkevold M. Realizing empowerment in difficult diabetes care: a guided self-determination intervention. *Qual Health Res*. 2012;22(1):103–118.

56. Burner E, Menchine M, Taylor E, Arora S. Gender differences in diabetes self-management: a mixed-methods analysis of a mobile health intervention for inner-city Latino patients. *J Diabetes Sci Technol*. 2013;7(1):111–118.

57. Pun SP, Coates V, Benzie IF. Barriers to the self-care of type 2 diabetes from both patients’ and providers’ perspectives: literature review. *J Nurs Healthc Chronic Illn*. 2009;1(1):4–19.

58. Lemes dos Santos PF, dos Santos PR, Ferrari GSL, Fonseca GAA, Ferrari CKB. Knowledge of diabetes mellitus: does gender make a difference? *Ospag Public Heal Res Perspect*. 2014;5:199–203.

59. Gucciardi E, Wang SCT, DeMelo M, Amaral L, Stewart DE. Characteristics of men and women with diabetes: observations during patients’ initial visit to a diabetes education centre. *Can Fam Physician*. 2008;54(2):219–227.

60. Gucciardi E, Demelo M, Booth G, Tomlinson G, Stewart DE. Individual and contextual factors associated with follow-up use of diabetes self-management education programmes: a multisite prospective analysis. *Diabet Med*. 2009;26(5):510–517.

61. Mathew R, Gucciardi E, De Melo M, Barata P. Self-management experiences among men and women with type 2 diabetes mellitus: a qualitative analysis. *BMC Fam Pract*. 2012;13:122.

62. Woodard LD, Landrum CR, Anspoker AB, Ramsey D, Naik AD. Interaction between functional health literacy, patient activation, and glycemic control. *Patient Prefer Adherence*. 2014;8:1019–1024.

63. Browne JL, Nefs G, Pouwer F, Speight J. Depression, anxiety and self-care behaviours of young adults with type 2 diabetes: results from the International Diabetes Management and Impact for Long-term Empowerment and Success (MILES) Study. *Diabet Med*. 2015;32(1):133–140.

64. Hankonen N, Kinnunen M, Absetz P, Jallinoja P. Why do people high in self-control eat more healthily? Social cognitions as mediators. *Ann Behav Med*. 2013;47(2):242–248.