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UNDESRSTANDING THE FACTORS INFLUENCING DIABETES SELF-MANAGEMENT IN CHINESE PEOPLE WITH TYPE 2 DIABETES USING STRUCTURAL EQUATION MODELING

A dissertation submitted to the

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Abstract

Understanding the Factors Influencing Diabetes Self-management in Chinese People with Type 2 Diabetes Using Structural Equation Modeling

Background: It China, more than 20 million people were diagnosed with diabetes in 2000 and it was estimated there would be 42.3 million people with diabetes by 2030 (Wild, Roglic, Green, Sicree, & King, 2004). Diabetes mellitus self-management (DMSM) is considered the cornerstone for controlling diabetes and preventing diabetic complications. To develop effective interventions to promote DMSM in China, it is critical to identify the factors influencing DMSM relevant to this population. The purposes of this study were to test a hypothesized model describing the effects of individual and environmental factors on DMSM in patients with type 2 diabetes in China, and to test if the estimated effects are the same between two subgroups, patients treated with insulin vs. patients treated without insulin. The individual factors included diabetes knowledge, beliefs of treatment effectiveness, and diabetes self-efficacy. Environmental factors included social support from family members and provider-patient communication.

Methods: A cross-sectional survey research design was used in this study. The study was conducted at a major hospital in Beijing China. A convenience sample of 201 Chinese adult patients with type 2 diabetes mellitus who attended the outpatient department of the Endocrinology unit at the hospital from September 2004 to November 2004 was obtained for this study. Data were collected using a self-reported questionnaire. Structural equation modeling (SEM) analysis was conducted to test the hypothesized

model, and examine and explore the relationships between and among the individual and environmental factors and DMSM.

Findings: The initial hypothesized model did not fit the observed data. Based on statistical findings and theoretical soundness, the model was modified. The final model had a good fit to the data. The key findings were that belief in treatment effectiveness and diabetes self-efficacy were key proximal factors affecting DMSM. Knowledge and the environmental factors indirectly affected DMSM through belief in treatment effectiveness and self-efficacy. The findings based on the multi-group SEM analysis indicated that patient-provider communication was a more important factor affecting DMSM for the insulin-treated subgroup, while family support was more important for the non-insulin treated subgroup.

Conclusions: The good fit of the final model indicated that significant determinants of DMSM described in American studies were also important predictors of DMSM in Chinese with diabetes. The model illustrated that individual and environmental factors affected DMSM both directly and indirectly. Understanding the complex relationships between and among the individual and environmental factors and DMSM helps the practitioner to design intervention programs promoting DMSM using a more comprehensive approach. The practitioner should also be aware of the differences between the subgroups when developing intervention programs.

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CHAPTER ONE INTRODUCTION

Statement of Problem

Health Issue

Diabetes mellitus has become a major public health problem worldwide (King, Aubert, & Herman, 1998) and one of the most challenging health problems in the 21st century (International Diabetes Federation [IDF], 2005). More than 170 million people had diabetes mellitus worldwide in 2000 and it was projected that this number would double in 2030 (Wild, Roglic, Green, Sicree, & King, 2004). In 2002, about 18.2 million Americans had diabetes (6.3%) (National Institute of Disease and Digestive and Kidney Disease [NIDDK], 2004) compared to 16 million having diabetes in 1997 (Centers for Diabetes Control and Prevention [CDC], 1998).

In China, the prevalence of diabetes is increasing in conjunction with economic development. The prevalence of diabetes increased from 0.9% in 1980 to 1.3% in 1986 to 3.09% in 1994 among the population over 25 years of age (Pan, Yang, Li, & Liu, 1997). In China, more than 20 million people were diagnosed with diabetes in 2000, and it was estimated there would be 42.3 million people with diabetes in 2030 (Wild et al., 2004). King et al. (1998) projected that China would be one of the countries with highest increases in the prevalence of diabetes from 1995 to 2025.

Diabetes mellitus, as a chronic disease, significantly contributes to morbidity, mortality, disability, and health cost. People with diabetes mellitus suffer from many diabetes-related complications, such as cardiovascular diseases, kidney diseases, blindness, and lower-extremity amputations. For example, in United States in 2000, diabetes was the sixth leading cause of death and the leading cause of blindness in adults

aged 20-74 years. The direct and indirect cost of diabetes mellitus was $132 million in the U.S. in 2002 (National Institute of Health [NIH], 2004).

Few statistics about the mortality and morbidity resulted from diabetes have been reported in China. The health cost of diabetes has been reported. The annual health care expenditure related to diabetes in China was RMB 170 billion ($20 billion) (People's Daily, 1999).

Self-Management for Patients with Diabetes

Any individual having diabetes needs to incorporate a complicated set of regimens into their daily life (e.g. taking medication, diet, exercise, blood glucose monitoring, foot care). Diabetes, as a chronic disease, requires a high level of patient responsibility for day-to-day management. The term "self-management" or "self-care" has been widely used to describe the daily-based management of diabetes by patients themselves (Glasgow & Anderson, 1999). Self-management behaviors are the cornerstone of the glycemic control that is needed to prevent or lessen the severity of long-term diabetic complications.

Even though diabetes self-management is considered critical in diabetes control, few patients with diabetes perform diabetes self-management. The CDC (2000) reported that only 18.4% of patients with diabetes have glycosylated hemoglobin (HA1c) checked yearly and 39.6% of patients performed self-monitoring blood glucose once a day. Some adolescents with diabetes expressed that the diabetes self-care regimens were too complicated to achieve (Kyngas & Hentinen, 1995).

To improve health outcomes for people with diabetes, it is critical to identify factors influencing diabetes self-management. Understanding how these factors influence

self-management will provide the basis for developing effective interventions to enhance diabetes self-management behaviors in patients with diabetes.

Predictors of Self-Management

Many studies have been conducted regarding diabetes self-management and its determinants. Many researchers who have evaluated predictors of self-management have focused on individual factors, such as demographics, diabetes knowledge, attitudes, emotional well-being, and self-efficacy (Corbett, 1999; Glasgow, Toobert, & Gillette, 2001; Rubin, Peyrot, & Saudek, 1989). Thus, programs to change diabetes patients' self-management behaviors were mostly designed to improve individual knowledge and psychological factors (Chan & Molassiotis, 1999: Rubin, Peyrot, & Saudek, 1993).

Glasgow and Eakin (1998) concerned that studies in diabetes self-management had concentrated on individual factors affecting self-management, and less attention had been given to the larger environmental context that influences patients' diabetes self-management behaviors. Programs to change diabetes patients' self-management behaviors that were designed to affect individual factors often neglected the contextual circumstances of family, society, and health care system. Therefore, there is a need for a broader approach to understanding diabetes self-management. Some authors have called for research to explore not only the influence of individual factors on diabetes self-management but also the influence of environmental/external context on diabetes self-management (Fisher, Walker, Bostrom, Fischhoff, Haire-Joshu, & Johnson, 2002; Glasgow et al., 1999; Jack, Liburd, Vinicor, Brody, & Murry, 1999; Zgibor & Songer, 2001).

Glasgow and Eakin (1998) summarized factors determining diabetes self-management and categorized those factors into different levels of influences in a pyramid. From the top of the pyramid to the bottom, levels of influences on self-management include personal level, family – significant others level, health care system level, worksite-organization level, neighborhood – community level, and media – policy – culture level. Based on Glasgow and Eakin's (1998) perspective, both individual and environmental factors influencing diabetes self-management were included in the current study. For example, diabetes-specific knowledge, beliefs of the effectiveness of the treatment, and self-efficacy are at the personal level, social support is at the family level, and physician-patient communication is at the healthcare system level.

Knowledge is considered to be the basis of establishing self-management behavior in patients with diabetes (Coates & Boore, 1996; Corbett, 1999). Researchers have demonstrated that beliefs of the effectiveness of the treatment, self-efficacy, social support, and provider-patient communication were associated with diabetes self-management in Americans with diabetes (Foster, 1995; Hampson, Glasgow, & Gallant, 2003; Hurley & Shea, 1992; Piette, Schillinger, Potter, & Heisler, 2003). Diabetes characteristics are also associated with diabetes self-management and its influencing factors. For example, insulin-treated patients with type 2 diabetes were more likely to perform self-management behaviors than those with non-insulin treated type 2 diabetes (Ruggiero et al., 1997). Longer duration of diabetes has been associated with increased their knowledge of diabetes (Lukoschek, Fazzari, & Marantz, 2003; Via & Salyer, 1999).

Most of the studies on diabetes self-management and its predictors were conducted with U.S. populations. There is a shortage of diabetes self-management studies

among Chinese patients with diabetes living in mainland China. There are studies on the effects of interventions to increase knowledge of diabetes self-management in people living in Hong Kong and Taiwan (Chan & Molassiotis, 1999; Jiang et al., 1999), but no similar studies have been conducted in Mainland China. It is therefore important to examine if the same factors affecting self-management behaviors in the US, affects those with diabetes in China, since the prevalence of diabetes is rising in this population.

Purpose of the Study

The purpose of this study was two fold. The main purpose was to test a hypothesized model describing influences of both individual and environmental factors on diabetes mellitus self-management (DMSM) in Chinese adults with type 2 diabetes using structural equation modeling. The individual factors hypothesized to affect DMSM were diabetes knowledge, belief of the effectiveness of the treatment, and diabetes-specific self-efficacy. Environmental factors included social support and provider-patient communication. In addition, demographic variables and diabetes history were included. The second purpose was to test if the estimated effects of those variables on DMSM in the model are the same between two subgroups of patients with type 2 diabetes, patients treated with insulin vs. patients treated without insulin.

Theoretical Model

A model was developed based on the literature. It was hypothesized that, among individual factors, beliefs of treatment effectiveness and diabetes-specific self-efficacy would be the proximal factors influencing DMSM. It was also hypothesized that knowledge would both directly affect DMSM and indirectly affect DMSM through beliefs and self-efficacy. It was further hypothesized that provider-patient communication

and social support not only would directly affect DMSM but also indirectly affect DMSM through knowledge and social support respectively. Finally, it was hypothesized that duration of diabetes and education level would directly affect knowledge about diabetes (Figure 1-1).

In the model, education, duration of diabetes, social support, and provider-patient communication are exogenous variables and knowledge, beliefs, self-efficacy, and self-management are endogenous variables. The constructs depicted by ellipses are not directly measurable and the rectangles indicate variables that are directly measurable.

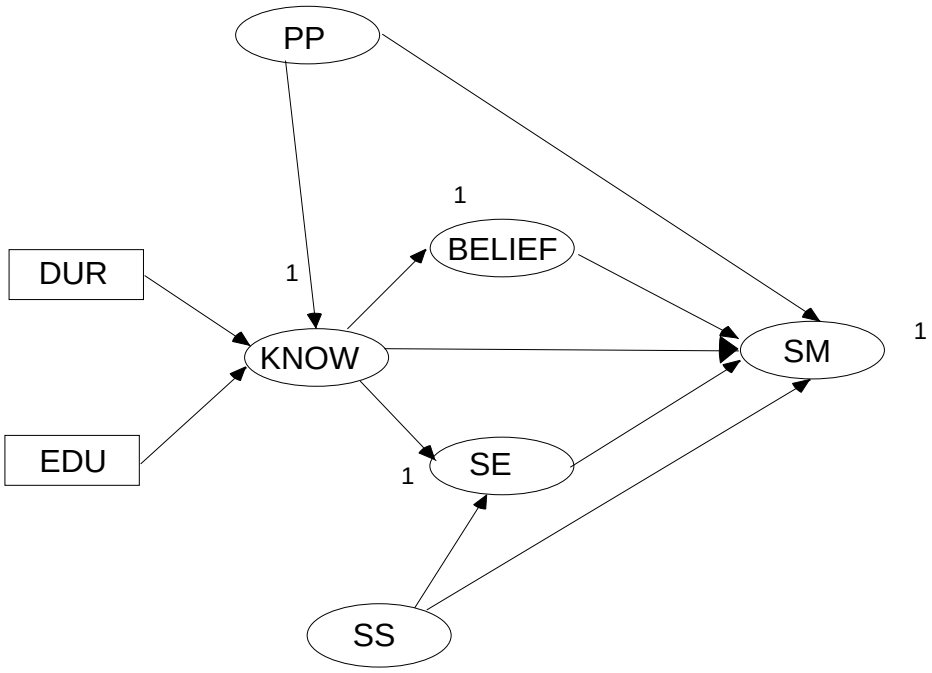

Figure 1-1. Hypothesized model: Direct and indirect effects of individual and environmental factors on diabetes self-management.

Notes: SM denotes self-management, SE denotes diabetes self-efficacy, BELIEF denotes belief of treatment effectiveness, SS denotes social support, PP denotes provider-patient communication, EDU denotes education level, and DUR denotes duration of diabetes

Significance for Nursing

In Western society, a large body of studies has been conducted to explore and identify factors significantly influencing diabetes self-management. There is a shortage of studies in this research field conducted among patients with diabetes in China, even though there is an increase of the prevalence of diabetes in China. It is not known if those influencing factors identified in studies which were mainly conducted with American

populations will predict diabetes self-management behaviors among patients with diabetes in China. Understanding the phenomena of diabetes self-management will optimize health outcome of patients with diabetes in China. Therefore, a well-designed study to investigate self-management and its determinants would have important implications for the care of patients with diabetes in China.

If the findings of this study demonstrate the causal relationships between multiple factors and diabetes self-management and identify those factors significant to predict self-management behaviors, it will support the need for more comprehensive approaches to promoting diabetes self-management. For example, intervention programs both enhancing knowledge and promoting social support and patient-provider communication may be more effective than interventions aimed primarily at increasing diabetes-related knowledge. Therefore, the long term goal of this study is to provide a basis for developing more effective interventions beyond increasing diabetes knowledge to improve diabetic patients' health outcomes and prevent diabetic complications.

In this study, the structural equation modeling technique was used to test the causal relationships between both individual and environmental factors and diabetes self-management. To date, most researchers examining the relationships between diabetes self-management and its determinants used correlation or multiple regression analysis. Correlation analysis only demonstrates that an association exists between two variables but it is difficult to infer if there is a cause-and-effect relationship. Multiple regression analysis can be used to provide explanations of possible cause-and-effect relationships among a set of variables. However, the direct and indirect causal effects cannot be established using multiple regression. Structural equation modeling has an advantage

over correlation and multiple regression analysis. The direct and indirect causal effects can be estimated and tested simultaneously using structural equation modeling. Therefore, structural equation modeling provides a better method to understand the underlying mechanism of the effects of multiple factors on diabetes self-management.

Definitions of Terms

Diabetes Mellitus Self-Management (DMSM)

Concepts

Before defining diabetes self-management, it is necessary to point out the shift from the concept of compliance/adherence to the concept of self-management over the past 20 years. Historically, compliance was used to describe the act of following a diabetes treatment regimens. Lutfey and Wishner (1999) suggested that compliance was not an appropriate term to describe how individuals with diabetes manage their disease and adherence should be used to replace compliance. According to Lutfey and Wishner (1999), unlike compliance, adherence captures the active and autonomous roles of patients in medical care.

However, Glasgow and Anderson (1999) have suggested that both "compliance" and "adherence" are inappropriate to evaluate patients' behavior for caring for themselves. Some researchers (Anderson & Funnell, 2000; Glasgow & Anderson, 1999) proposed that both compliance and adherence concepts were based on what the health professionals want, what they believe, and what they control.

Diabetes as a chronic disease requires a high level of patients' responsibilities for day-to-day management. From a chronic-care perspective, patients make important choices and have control (Anderson & Funnell, 2000). The concept of self-management

incorporates problem solving and decision making processes, and is broader than compliance/adherence to prescribed regimens (NIH, 2000). Therefore, the concept of self-management is considered a more accurate term to describe the behaviors that patients with diabetes undertake to manage their diabetes (Anderson & Funnell, 2000; Glasgow & Anderson, 1999; Glasgow, Wilson, & McCaul, 1985). "Self-management" or "self-care" is preferable to either "compliance" or "adherence". The term "self-management" has been used in diabetes care (Glasgow & Anderson, 1999). However, compliance and adherence can be seen in some diabetes care literature. The concept of self-management or self-care will be used interchangeably in this study.

Defining Diabetes Self-Management

Self-management has been defined as "a set of skilled behaviors engaged in to manage one's own disease" (Goodall & Halford, 1991). NIH (2000) presented a diabetes-specific self-management definition in terms of "client strategies and behaviors that contribute to blood glucose normalization, improved health, and prevention or reduction of complications."

Individuals with diabetes have to undertake a complicated set of behaviors to manage their diabetes on a daily basis. According to Hill-Briggs (2003), there are four components in diabetes self-management behaviors: 1) self-monitoring of blood glucose (SMBG), 2) diet, 3) exercise, and 4) medication. Schilling, Grey, and Knafl (2002) conducted a concept analysis of self-management of type 1 diabetes in children and adolescents. In the article, the authors summarized a list of behaviors supposed to be carried out by pediatric patients with type 1 diabetes, including insulin injection, blood

glucose monitoring, diet, exercise, managing acute diabetic complications, adjusting regimen (insulin, diet, and exercise), and foot care.

In the current study, diabetes self-management was operationally defined as a set of behaviors that patients with diabetes perform daily to achieve diabetes control. Those behaviors include regulating diet, engaging in exercise, taking medications (insulin or oral hypoglycemia agents), self-monitoring blood glucose levels, and maintaining foot care. Therefore diabetes self-management has five dimensions: diet, exercise, medication, glucose testing, and foot care (Figure 1-2).

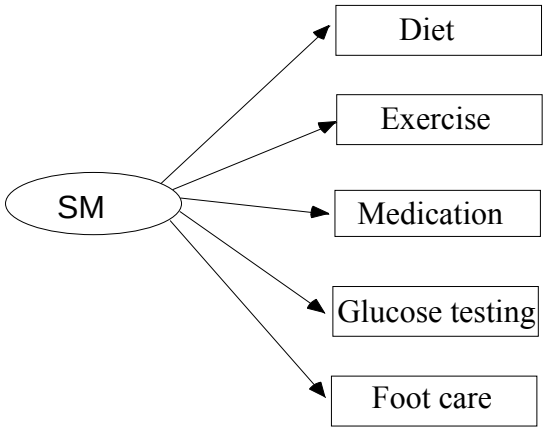

Figure 1-2. A measurement model of diabetes mellitus self-management

Knowledge

Even though the concept of diabetes knowledge has been used widely in diabetes research, the concept was seldom explicitly defined either conceptually or operationally. In the dictionary, knowledge is defined as "specific information about something" (Dictionary.com, 1994). Beeney, Dunn, and Welch (2003) understood diabetes knowledge as patients' general understanding of diabetes or the facts about their diabetes. In the current study, diabetes knowledge was operationally defined as patients'

understanding of information about physiological aspects of diabetes as a disease and principles of diabetes management with diabetic diet, exercise, medication, glucose self-monitoring, and foot care (Figure 1-3).

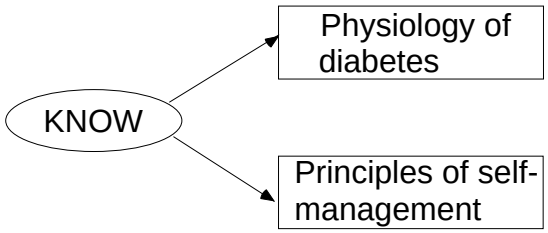

Figure 1-3. A measurement model of diabetes knowledge

Beliefs of the Effectiveness of the Treatment

Beliefs of treatment effectiveness have been conceptually defined as patients' beliefs about the efficacy of treatment regimen (Skinner, John, & Hampson, 2000). Skinner and Hampson (2001) identified two dimensions in beliefs of treatment effectiveness in diabetes care: to control diabetes and to prevent diabetic complications. In the current study, beliefs of the effectiveness of the treatment were operationally defined as patients' beliefs about the importance of diabetes self-management activities in controlling diabetes and preventing long-term diabetic complications (Figure 1-4). The Control subscale focuses on managing diabetes under good control, such as without hyper- or hypo-glycemia. The Prevention subscale emphasizes preventing future complications of diabetes, a major goal of controlling diabetes.

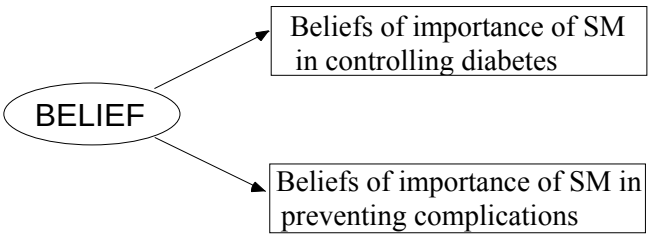

Figure 1-4. A measurement model of beliefs of treatment effectiveness

Self-Efficacy

Self-efficacy is conceptually defined as an individual's confidence to carry out a specific task or behavior (Bandura, 1997). In the current study, self-efficacy is specific to diabetes self-management behaviors. There are five dimensions of self-management behaviors. Correspondingly, there are five dimensions of diabetes-specific self-efficacy. Diabetes-specific self-efficacy in this study was operationally defined as judgment of the diabetes patients' own capability of carrying out diabetes self-management activities, including diabetes diet, exercise, taking medications, self-monitoring blood glucose levels, and foot care (Figure 1-5).

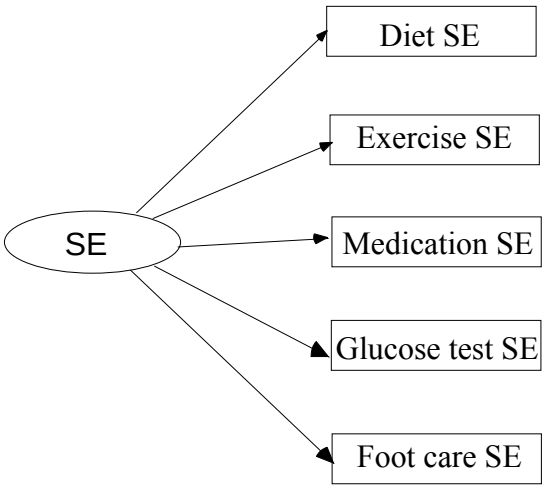

Figure 1-5. A measurement model of diabetes self-efficacy

Social Support

Based on Langford, Bowsher, Maloney, and Lillis (1997), social support can be understood as having four major attributes: emotional, instrumental, informational, and appraisal support. Emotional support involves the feeling of being cared for, being loved, and being trusted. Instrumental support refers to tangible goods or aids, such as financial assistance. Informational support refers to information provided to one for problem-solving. Appraisal support is defined in terms of information communicated relevant to one's self-evaluation.

In this study, social support from family members was emphasized. Toljamo and Hentinen (2001) indicated that the family is usually the source for emotional and instrumental support. Social support was operationally defined as patients' perception of support from their family members including feelings of being cared for by their family members, tangible aids in relation to diabetes management from family members, and

appraisal from family members on patients' diabetes-related self-management activities (Figure 1-6).

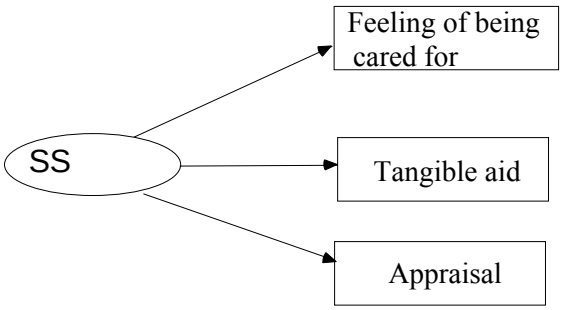

Figure 1-6. A measurement model of social support

Provider-Patient Communication

Communication has been defined as "transmitting information, thought, or feelings so that it is satisfactorily received or understood" (Merriam-Webster, 2004). Ong, de Haes, Hoos, and Lammes (1995) identified two dimensions of provider-patient communication and they are instrumental (task focused) behaviors and affective (socio-emotional) behaviors. Examples for instrumental communication include giving information, asking questions, and identifying treatment, and examples for affective communication are showing concern, being friendly, and providing encouragement.

In the description about interpersonal process of care by Stewart et al. (1999), the patient-physician interaction included three dimensions: communication, decision making, and interpersonal style. Communication includes general clarity, elicitation of and responsiveness to patient problems and concerns, explanations of condition and medical care, and empowerment and interpersonal style which includes friendliness, respectfulness, and emotional support.

There are no nurse practitioners in China. Physicians are the health-care providers who interact with diabetes patients at outpatient visits. Therefore, in this study provider-patient communication was operationally defined as patients' perception of physician's general clarity during their talking, physicians' explanation of diabetes and medical care, and physicians' carefully listening to and responsiveness to patient problems and concerns about diabetes management (Figure 1-7).

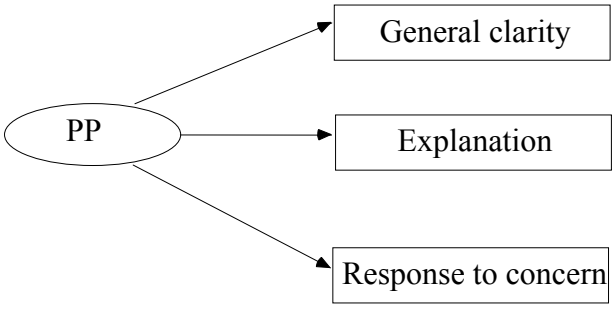

Figure 1-7. A measurement model of provider-patient communication

Education Level

Education level is operationally defined as the highest degree received by an individual from formal schools or institutes. The categories of the education level in China include 6-year primary school, 9-year middle school, high school graduate, some college or technical school, college graduate (bachelor's degree), and graduate degree.

Duration of Diabetes

Duration of diabetes was operationally defined as the number of years since the participant was diagnosed with type 2 diabetes.

Subgroups of Type 2 Diabetes

Two subgroup of type 2 diabetes were defined based on whether or not patients were prescribed insulin therapy. Patients with type 2 diabetes whose treatment plans did not include insulin therapy were placed in the non-insulin-treated subgroup and those whose treatment plans included insulin therapy were placed in the insulin-treated subgroup.

Research Questions

In this study, the target population was Chinese adult patients with type 2 diabetes attending the Endocrinology Outpatient Department of Peking Union Medical College Hospital (PUMCH) in Beijing, China. The research questions were: Among Chinese adult patients with type 2 diabetes attending the Endocrinology Outpatient Department of PUMCH:

1. Does the hypothesized model fit the observed data?
2. Does the belief of treatment effectiveness directly affect DMSM?
3. Does diabetes self-efficacy directly affect DMSM?
4. Does knowledge directly affect DMSM and indirectly affect DMSM through beliefs and self-efficacy?
5. Does social support directly affect DMSM and indirectly affect DMSM through self-efficacy?
6. Does provider-patient communication directly affect DMSM and indirectly affect DMSM through knowledge?
7. Do education level and duration of diabetes directly affect knowledge?

8. Do the estimates of the direct and indirect causal effects in the model differ between the two subgroups of patients with type 2 diabetes (insulin-treated vs. non insulin-treated)?

CHAPTER TWO LITERATURE REVIEW

Introduction

The research literature on diabetes self-management and its influencing factors is reviewed in this chapter. The review includes seven sections: 1) trends of diabetes in China; 2) diabetic complications and diabetes self-management; 3) the relation between knowledge, beliefs of treatment effectiveness, and self-management; 4) the relation between self-efficacy and diabetes self-management; 5) the relation between social support and diabetes self-management; 6) the relation between provider-patient communication and diabetes self-management; and 7) demographic and diabetes characteristics related to diabetes self-management.

Trends of Diabetes in China

Diabetes mellitus is a chronic disease caused by deficiency in production of insulin or ineffectiveness of the insulin produced by pancreases. Diabetes is usually classified into two major types: type 1 (insulin-dependent diabetes, IDDM) and type 2 (non-insulin-dependent diabetes, NIDDM). Type 2 diabetes affects about 85% to 95% of the people with diabetes in developed countries and an even higher percentage in developing countries (International Diabetes Federation [IDF], 2005).

In China, the prevalence of diabetes is increasing in conjunction with economic development. Pan, Yang, Li, and Liu (1997) conducted a national diabetes survey of 19 provinces, cities, and areas in China and reported that the prevalence of diabetes was 3.09% among the population over 25 years of age in 1994. The authors indicated that the prevalence of diabetes in China increased three times within 15 years among the

population aged over 25 years, from 0.9% in 1980 to 1.3% in 1986 to 3.09% in 1994 (Pan et al., 1997). King, Aubert, and Herman (1998) reported a similar trend of the increased prevalence of diabetes in China. They estimated and projected that the prevalence of diabetes was 2.0% in 1995, 2.2% in 2000, and would increase to 3.4% in 2025 among people aged over 20 years in China.

Gu et al. (2003) also conducted a national study investigating the prevalence of diabetes in 15,540 adults aged 35 to 74 years from 31 provinces in China. The authors reported that in China the prevalence of diabetes was 5.5% among the population aged 35 to 74 years in 2000 and three out of four individuals with diabetes were undiagnosed. In addition, the age-standardized prevalence of diabetes of the population aged 35 to 74 living in urban area (7.8%) was higher than that of those living in rural area (5.1%) (Gu et al., 2003).

Diabetes Mellitus Self-Management

People with diabetes mellitus are at risk of experiencing diabetes-related acute complications, such as hypoglyecemia and diabetic ketoacidosis, or chronic complications, such as cardiovascular diseases, kidney diseases, blindness, and lower-extremity amputations. In the U.S. in 2000, diabetes was the sixth leading cause of death, the leading cause of blindness in adults aged 20-74 years, and the leading cause of amputation of limbs. Individuals with diabetes accounted for more than 60 percent of nontraumatic lower-limb amputations (National Institute of Health [NIH], 2004). Even though similar statistics for China are unavailable, Hu and colleagues (1991) reported that the prevalence of retinopathy due to diabetes was 31% in 1986 in China.

To reduce diabetes-related mortality and morbidity, patients with diabetes need to normalize their blood glucose level to prevent or delay diabetic complications (Diabetes Control and Complications Trial [DCCT], 1993). In order to normalize blood glucose levels, individuals having diabetes need to incorporate a complicated set of regimens into their daily life (e.g. taking medication, diet, exercise, blood glucose monitoring, and foot care). Specifically, patients with diabetes might be prescribed no medication, oral hypoglycemia agents, or insulin injections to control their diabetes. Food can affect patients' blood glucose levels, so patients need to adjust what they eat, how much they eat, and when they eat. Exercise can help patients to lower their blood glucose levels and patients should exercise regularly. Patients should do a self-test of blood glucose level because it provides patients and their health providers with information about how well their diabetes is controlled. To prevent diabetic complications with feet, patients should examine their feet for blisters, cuts, and bruises every day.

Researchers have demonstrated that improving diabetes self-management can improve diabetic patients' health outcomes. For example, Clement (1995), based on an extensive literature review, concluded that interventions improving diabetes self-management behaviors were associated with reduced hospitalizations for diabetes-related problems. In the DCCT (1993), patients with type 1 diabetes who were involved in intensive intervention targeting diabetes self-management tasks were at reduced risk for developing diabetic complications. In another study, Williams, McGregor, Zeldman, Freedman, and Deci (2004) found that diabetes self-management behaviors predicted improvement in glycemic control. In addition, interventions improving self-management

also improved quality of life among patients with diabetes (Steed, Cooke, & Newman, 2003).

Even though diabetes self-management is considered critical in diabetes control, problems concerning diabetes self-management are common among individuals with diabetes. Toljamo and Hentinen (2001) reported that in their study 19% of patients with diabetes neglected self-care. Based on statistical data from 41 states in 1997, the CDC (2000) reported that only 18.4% of patients with diabetes have glycosylated hemoglobin (HA1c) checked yearly and 39.6% of patients performed self-monitoring blood glucose once a day. In addition, Xu, Deets, Whitmer, and Pan (2005) reported that only 33% of patients performed foot care and 13% of patients performed blood glucose self-testing in a sample of Chinese patients with diabetes in Beijing China.

To improve health outcomes for people with diabetes, it is critical to explore why some people adopt and maintain diabetes self-management behaviors but some do not. Identifying and understanding factors influencing diabetes self-management is helpful for developing effective interventions to promote diabetes self-management. The diabetes self-management literature is presented as follows.

Relationships between Knowledge, Beliefs, and Self-Management

Knowledge and Self-Management

Diabetes knowledge is an important concept in diabetes management. In the past decade, a number of research studies have been conducted investigating the relationships between diabetes knowledge and disease control (Corbett, 1999; Jiang et al., 1999; Mazzuca et al., 1986). Theoretically, if patients are to play an active role in managing their diseases, they must be knowledgeable of their condition and its management (Coates

& Boore, 1996; Corbett, 1999). Specifically, in order to manage diabetes, the individual must understand medication, diet, exercise, blood glucose self-monitoring, foot care, and how to adjust the regimen according to his/her illness situation (Coates & Boore, 1996). Therefore, the relationship between diabetes knowledge and diabetes control is that increased knowledge of diabetes is correlated to improved diabetes control and that a low level of diabetes knowledge is associated with poor control (Bradley, 1995; Coates & Boore, 1996).

Rubin, Peyrot, and Saudek (1989) conducted a one-group pretest-posttest study to investigate the effect of an education program on knowledge, self-care patterns and glycosylated hemoglobin (HbA_{1c}) levels. A total of 165 patients with diabetes completed the education program. Knowledge, self-care, and HbA_{1c} levels were measured at baseline, at the end of the program, and six month later. At the end of the education program, knowledge was improved ($p < .001$). Six months after the education program, comparing with the baseline data, improvements in self-care patterns and HbA_{1c} levels were observed. Performance of self-monitoring of blood glucose and exercise rose (both $p < .0001$), and HbA_{1c} levels ($p < .001$) improved.

Mazzuca et al. (1986) also reported statistically significant differences in self-care skills and behaviors between the participants who received a diabetes education intervention and those who did not receive the intervention. Patients in the experimental group had significantly greater decrease in fasting blood glucose and HbA_{1c} level than those in the control group.

However, Coates and Boore (1996) reported opposite results. Coates and Boore conducted a cross-sectional study to examine whether diabetes knowledge was associated

with diabetes control. Both diabetes knowledge and HbA_{1c} levels were measured in a sample of 275 people with diabetes. They found that knowledge only accounted for .106 of the variance in the HbA_{1c} measures. Coates and Boore (1996) concluded that there was no relationship between knowledge and diabetic control and that knowledge alone was insufficient to influence diabetic control.

Inconsistent results about the relationship between knowledge and diabetes control were also obtained in two studies with Chinese diabetics. A cross-sectional study investigated the relationship between diabetes knowledge and compliance among 52 Chinese individuals with type 2 diabetes (Chan & Molassiotis, 1999). The researchers found that there was no relationship between knowledge and compliance ($r = .24$, $p = .08$). In contrast, a total of 121 Chinese patients with type 2 diabetes who received advanced diabetes education significantly improved their diabetes self-care techniques and HbA_1 levels (Jiang et al., 1999).

Inconsistent results regarding the relationship between knowledge and diabetes control may be due to the lack of a clear definition of knowledge of diabetes and limitations in the measurement of knowledge (Bradley, 1995; Coates & Boore, 1996). Coates and Boore (1996) argued that the items in knowledge measurements used in some studies were not relevant to the outcome measured in the study.

Bradley (1995) had similar comments. Bradley stated that some aspects of knowledge could not be related to blood glucose control measured by HbA_{1c} levels. For example, knowledge about foot care would not affect HbA_{1c} levels. Bradley (1995) used the Diabetes Knowledge Scale developed by Dunn and colleagues (1984) as an example and pointed out that only some of the 15 items in the scale were relevant to the HbA_{1c}

level. Therefore, it is unlikely that all 15 items of the scale would be related to HbA_{1c} levels.

In summary, knowledge as a factor affecting diabetes self-management has been examined in many studies. However, the results did not consistently demonstrate that diabetes knowledge was predictive of diabetes self-management.

Beliefs of Treatment Effectiveness and Self-Management

The concept called "beliefs of treatment effectiveness," one of the constructs of the Personal Models, has had increased attention by researchers (Hampson, 1997; Skinner, Hampson, & Fife-Schaw, 2002). The Personal-Models approach emphasizes the importance of illness representation as the guide for subsequent disease-related behaviors such as self-management (Hampson, 1997). Other constructs of the Personal Models of illness are identity (disease label and associated knowledge), cause (personal responsibility for causing the disease), consequences (the effect of the disease), and timeline (beliefs about disease course) (Hampson, Glasgow, & Foster, 1995).

A number of researchers have examined the construct of beliefs of treatment effectiveness in relation to diabetes self-management both in older adults with diabetes and in adolescents with diabetes (Hampson et al, 1995, Skinner & Hampson, 2001; Skinner, John, & Hampton, 2000). For example, Hampson et al. (1995) conducted a longitudinal study among older adults with diabetes ($N = 78$) to examine the relationship between diabetes self-management and the variables in the Personal Models. The authors reported that the variables in the Personal Models were predictive of diabetes self-management behaviors after controlling for demographic and medical history variables. Among the predictors, beliefs of treatment effectiveness most strongly predicted diabetes

self-management, especially dietary intake at baseline (partial $r = .42$, $p < .001$) and at 4-month follow-up (partial $r = .35$, $p < .01$) and physical activity at baseline (partial $r = .36$, $p < .001$) (Hampson et al., 1995).

In addition, Skinner et al. (2000) and Skinner and Hampson (2001) also tested the Personal Models of diabetes and diabetes self-management in a sample of adolescents and reported similar results that beliefs of treatment effectiveness was a significant predictor of diabetes self-management. The variables in the Personal Models and diabetes self-management behaviors were measured in adolescents with diabetes ($N = 74$) at baseline and 1-year follow-up (Skinner & Hampson, 2001). They found that the variables in the Personal Models were correlated with self-management and greater beliefs about the effectiveness of treatment to control diabetes significantly predicted better self-management (dietary intake), accounting for 17% of the variance.

A larger study was conducted with a sample size of 2,056 adults with diabetes across America. Of the participants, 14% had type 1 diabetes, 56% had type 2 diabetes insulin-treated, and 30% had type 2 non-insulin-treated (Glasgow, Hampson, Strycker, & Ruggiero, 1997). The purpose of the study was to examine the variables of Personal Models and social-environmental barriers related to diabetes self-management. Belief about treatment effectiveness was the strongest predictor of diet intake (partial $r = .37$, $p = .00$), exercise (partial $r = .30$, $p = .00$), and glucose testing (partial $r = .26$, $p = .00$).

Another study conducted by Hampson (1997) compared the associations between the Personal Models and disease management across different diseases (diabetes and osteoarthritis). Beliefs about the disease and the consequences of the disease were most predictive of self-management in patients with osteoarthritis, while for patients with

diabetes, beliefs of treatment effectiveness to control disease were most predictive of diabetes self-management compared to other variables of Personal Models.

No study was found that included examination of the influence of beliefs in treatment effectiveness on diabetes self-management in a Chinese population. However, in Chinese culture, beliefs do affect behaviors. For example, beliefs about Chinese medicine and Western medicine influenced Chinese people's choice of illness management strategies (Zhang & Verhoef, 2002). Zhang and Verhoef (2002) examined illness management strategies in Canadian Chinese immigrants with arthritis and found that illness management strategies were influenced by beliefs about Western medicine and beliefs about Chinese medicine. Those who believed Western medicine to be stronger and to function faster than Chinese medicine would use Western medicine, while those who believed Chinese medicine and acupuncture to be miracle and to be a holistic approach towards health would use Chinese medicine.

Based on the literature reviewed above, the concept of beliefs of treatment effectiveness has consistently demonstrated strong predictive ability of diabetes self-management. In addition, across studies, belief of treatment effectiveness was the strongest predictor of diabetes self-management. Therefore, the concept of beliefs of treatment effectiveness was included in the current study to be examined its association with diabetes self-management.

Beliefs Mediating Knowledge and Self-Management

Both knowledge and beliefs of treatment effectiveness have been found to independently predict diabetes self-management (Hampson, Glasgow, & Foster, 1995; Jiang et al., 1999; Rubin et al., 1989; Skinner & Hampson, 2001). However, the

mediating effect of beliefs of treatment effectiveness on the relation between diabetes knowledge and self-management has not been reported. It was hypothesized that beliefs could be changed by improving knowledge (Bradley, 1995). For example, a belief that foot care is not necessary for diabetes control, may be changed when information is provided that foot care is associated with avoidance of foot lesions, and associated with the decreased risk of diabetic foot complications.

Sedlak, Doheny, and Jones (2000) conducted a study examining the effect of an osteoporosis education program on health beliefs and health behaviors based on the Health Beliefs Model. In the study, participants were provided information about the definition of osteoporosis, description of bone health, risk factors for osteoporosis, diagnostic screening for bone density, and treatment of osteoporosis. Participants also completed evaluation instruments of knowledge, health beliefs (susceptibility to and seriousness of developing osteoporosis, benefits and barriers of calcium intake and exercise), and osteoporosis preventative behaviors at baseline and 3 weeks after the end of the education program. The researchers found that participants' knowledge about osteoporosis and beliefs about the benefits of calcium intake significantly increased, and intake of caffeine significantly decreased at posttest.

Beliefs might be a mediator between knowledge and behaviors in other types of diseases, even though the effect of improving diabetes knowledge on beliefs of treatment effectiveness and then on diabetes self-management based on the Personal Models of diabetes has not been tested. Therefore, it was hypothesized that diabetes knowledge predicted beliefs of treatment effectiveness and then predicted diabetes self-management,

which meant that diabetes knowledge had an indirect influence on diabetes self-management through beliefs of treatment effectiveness (Figure 2-1).

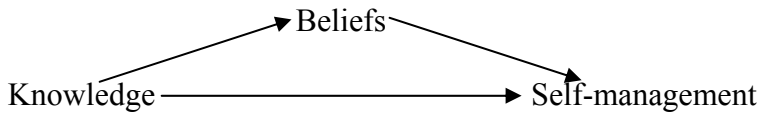

Figure 2-1. Relationship among knowledge, beliefs, and self-management: Direct effect of knowledge on self-management and beliefs mediating the effect of knowledge on self-management

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Relationships between Knowledge, Self-Efficacy, and Self-Management

Self-Efficacy and Self-Management

Self-efficacy, a construct of social cognitive theory, is defined as an individual's confidence in carrying out a specific task or behavior (Bandura, 1997). According to Bandura (1997), self-efficacy predicts task initiation and exertion. Some researchers found that self-efficacy was a significant predictor for different types of disease management behaviors. For example, Lev and colleagues (2001) suggested that enhanced self-efficacy might decrease symptom distress and increase quality of life in a group of patients with breast cancer. In another study, self-efficacy was a significant predictor of heart disease management behaviors in older women. These behaviors included using medicine, exercise, managing stress, following diet (Clark & Dodge, 1999).

Self-efficacy is also a significant predictor for diabetes self-management behaviors. In 1992, Hurley and Shea (1992) studied self-efficacy in 142 insulin-treated adults with diabetes and found that self-efficacy was associated with diabetes self-care (*r*

= .578, $p < .001$) and higher level of self-efficacy prior to discharge predicted better diabetes self-care behaviors a month later. Similar findings were found in adults with type 2 diabetes treated either by insulin or by oral agents ($N = 309$) (Aljasem, Peyrot, Wissow, & Rubin, 2001). Both bivariate and multivariate analyses demonstrated that self-efficacy was associated with self-care behaviors. Higher self-efficacy predicted more frequent blood glucose testing, less frequent skipping of medication and binge eating, and closer adherence to diet (Aljasem, Peyrot, Wissow, & Rubin, 2001).

In another study conducted in young adults with type 1 diabetes, self-efficacy was a better predictor of all aspects of self-care compared to self-esteem (Johnston-Brooks, Lewis, & Garg, 2002). The participants were measured on self-esteem, self-efficacy, and self-care behaviors at baseline, 3-month, and 6-month follow-ups. Based on the baseline data, greater self-efficacy significantly predicted better overall self-care behaviors and each aspect of diabetes self-care (exercise, diet, and blood testing). In the multiple regression equation, self-efficacy accounted for 35% of variance in overall self-care ($p < .0005$), 42% in diet self-care ($p < .0005$), 14% in exercise self-care ($p < .005$), and only 9% in blood testing self-care ($p < .005$).

However, when conducting a longitudinal analysis using baseline self-efficacy to predict 6-month follow-up self-care, the predictive ability of self-efficacy dropped significantly. Self-efficacy only significantly predicted diet self-care ($R^2 = .07$, $p < .005$) and exercise self-care ($R^2 = .06$, $p < .05$). A limitation of this study was the external validity. The participants in the study were homogeneous. The participants had a narrow age range (18 to 35 years), were mostly white, and had a higher social economic status

(85% completed some or all of college, with an average annual income between $24,999 and $34,999) (Johnston-Brooks et al., 2002).

Various researchers have examined the association between self-efficacy and self-care behaviors in different groups of the population. In a group of adolescents with diabetes, self-efficacy best predicted adherence compared to other dependent variables and accounted for 20% of the variance in self-reported adherence (Littlefield, Craven, Rodin, Daneman, Murray, & Rydall, 1992). Self-efficacy also significantly predicted adherence to diet, exercise, and blood testing at baseline and predicted diet and exercise adherence at 4-month follow-up in African American women with NIDDM (Skelly, Marshall, Haughey, Davis, & Dunford, 1995).

In summary, self-efficacy was a significant factor in predicting adherence/self-care behaviors in patients with diabetes even though the variance of self-care behaviors explained by self-efficacy varied based on different studies. Greater self-efficacy predicted better self-care behaviors.

Self-Efficacy Mediating Knowledge and Self-Management

According to Bandura (1997), self-efficacy is the bridge between knowing what to do and actually doing it. The effects of diabetes education programs on self-efficacy reported in the literature also indicated the relationship between knowledge and self-efficacy. For example, in the study by Holcomb et al. (1999), an education program on preventing NIDDM provided fifth-grade students with information about diabetes and the importance of diet and exercise in preventing NIDDM. At the end of the program, students who received the intervention significantly increased their diabetes knowledge and self-efficacy related to NIDDM prevention.

In another study, Rubin, Peyrot, and Saudek (1993) reported that a diabetes education program yielded the improvement of knowledge, self-esteem, self-efficacy, self-care behaviors, and HbA_{1c} level. Compared with baseline data, participants who received interventions improved their knowledge, self-esteem, self-efficacy, and performance of self-care behaviors, the level of anxiety, depression, and HbA_{1c} levels. However, the intervention was designed to emphasize coping skills in addition to improving knowledge. Therefore, the increased knowledge can not be considered the only predictor of the improved self-efficacy or level of self-care in this study.

The mediation effect of self-efficacy on the relationship between knowledge and behavior has been tested in other diseases. For example, a causal analysis of exercise and calcium intake behaviors for osteoporosis prevention among young women in Thailand demonstrated that self-efficacy mediated the relationship between knowledge and behaviors (exercise and calcium intake) (Piaseu, Schepp, & Belza, 2002). In the study, the experimental group was provided information about osteoporosis risk factors, consequences of disease, and strategies to prevent osteoporosis. The authors conducted a set of linear regression analyses and found that knowledge predicted calcium intake and exercise directly and indirectly predicted behaviors when mediated by self-efficacy.

In summary, self-efficacy was a significant predictor of adherence/self-care behaviors in patients with diabetes. Greater self-efficacy predicted better self-care behaviors. In addition, self-efficacy might mediate the effect of knowledge on self-management. Therefore, it was hypothesized that diabetes self-efficacy had direct influence on diabetes self-management and also mediated the influence of diabetes knowledge on diabetes self-management (Figure 2-2).

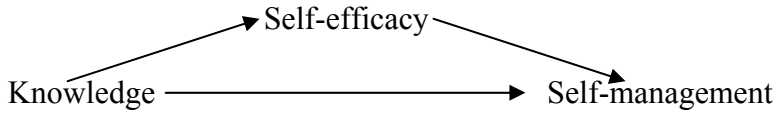

Figure 2-2. Relationships among knowledge, self-efficacy, and self-management: Direct effect of knowledge on self-management and self-efficacy mediating the effect of knowledge on self-management

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Relationships between Social Support and Self-Management

Social Support and Self-Management

Social support is an important consideration for patients managing a chronic disease. A review of the literature on the influence of social support on chronic illness self-management revealed a positive relationship between social support and chronic illnesses self-management, particularly for diabetes self-management (Gallant, 2003). Among 13 articles reviewed, six of them showed that higher levels of support were related to better self-management behaviors. Among these six studies, five studies focused on diabetes (Gallant, 2003).

A study of women with gestational diabetes demonstrated that social support was a significant predictor of diet and medication compliance (Ruggiero, Spirito, Bond, Coustan, & McGarvey, 1990). This finding is in agreement with the results of Garay-Sevilla et al.'s (1995) study, in which social support significantly predicted adherence to treatment in a sample of 200 patients with type 1 diabetes. Participants who received support from family and friends had higher level of diabetes self-care behaviors (Toljamo

& Hentinen, 2001; Wang & Fenske, 1996) and patients who did not receive support had poorer self-care (Toljamo & Hentinen, 2001).

Schafer, McCaul, and Glasgow (1986) conducted a longitudinal study to examine the relationships between supportive and non-supportive family behaviors and adherence to diabetes regimens in patients with type 1 diabetes. The participants and their family members were measured on family support and self-care activities at baseline and 6-month follow-up. During the 6-month interval, the participants were required to complete 1 week of diabetes self-care self-monitoring and 24-h dietary recalls. They found that non-supportive family interactions prospectively predicted poorer adherence. Participants' age ranged from 12 to 64 years old. The correlation between family support and adherence only occurred in adult patients and not in the adolescents.

Glasgow and Toobert (1988) replicated the previous study in patients with type 2 diabetes. They obtained similar results that family support was the strongest and most consistent predictor of adherence in patients with type 2 diabetes aged over 40 years. Glasgow and Toobert (1988) also reported that regimen-specific family support more strongly predicted the respective areas of regimen adherence/self-care behavior than overall supportive or non-supportive support. For example, exercise-specific support account for 34% variance of exercise adherence, while general positive family support only accounted for 11% variance of exercise adherence (Glasgow & Toobert, 1988).

In contrast, Gleeson-Kreig, Bernal, & Wooley (2002) found no strong relationship between social support and diabetes self-management. Gleeson et al. (2002) defined social support in terms of the structure of the support, functional type of support, and nature of the support, which were measured by support network size, types of support

needed, and satisfaction with support. The reliability and validity of the instrument was not reported. Diabetes self-management was assessed by measuring diabetes self-efficacy. Self-management and self-efficacy are different concepts. Even though other researchers found that diabetes self-management is associated with diabetes self-efficacy, it is questionable whether the measurement of self-efficacy can be used to assess the relationships of self-management with other variables. By doing this, the authors were examining the relationships between social support and self-efficacy rather than the relationships between social support and self-management.

The relationships between social support and self-management have been examined in samples of Americans with diabetes. However, no study could be found conducted in samples of Chinese with diabetes. In China, the family is the basic social unit in which persons learn the appropriate ways of behavior (Wong & Pang, 2000). A significantly positive relationship between family support and self-care behavior was obtained in Chinese patients with chronic obstructive pulmonary (COPD) disease (r = .252, p = .012) and the authors concluded that patients with COPD having a higher level of family support would be more likely to perform self-care behaviors (Jiang, Chaiwan, Panuthai, Cheng, Yin, Li, 2002).

Self-Efficacy Mediating Social Support and Self-Management

Social support directly affects diabetes self-management. Williams and Bond (2002) reported that social support indirectly affected diabetes self-management through self-efficacy. In addition, Gallant (2003) articulated that there might be an indirect influence of social support on diabetes self-management through self-efficacy.

The hypothesis that self-efficacy mediates the effects of social support on diabetes self-care was tested in a group of people with diabetes aged 18 and over ($N = 94$) (Williams & Bond, 2002). In the study, Williams and Bond found that there were significant positive relationships between self-efficacy and self-care behaviors and family support were also associated with exercise and diet self-care. A series of three multiple regression analyses were conducted to test the hypothesis described as above, the results demonstrated that the relationships between social support and exercise and diet self-care behaviors were mediated by self-efficacy. But this relationship was not true for blood glucose testing behavior. One of the strengths of this study is that the authors used two different instruments measuring self-care behaviors which increased accuracy and reliability of self-care assessment.

Self-efficacy as mediator of the relationship between family support and preventive behaviors was also found in patients with osteoporosis (Ievers-Landis, Burant, Drotar, Morgan, Trapl, & Kwoh, 2003). In this study, Ievers-Landis et al. developed and tested a model. One of the hypotheses in the model was that the influence of family support on osteoporosis preventive behaviors was mediated by self-efficacy in a group of preadolescent females. Three hundred fifty four preadolescent girls aged between 8 and 11 years participated in the study. Knowledge, self-efficacy, family support, friend support, and osteoporosis preventive behaviors (weight-bearing exercise and calcium intake) were measured. In the data analysis, it was observed that there was a significant drop in the effect of family support on both preventive behaviors upon inclusion of self-efficacy in the model, which means that self-efficacy mediated the relationship between family support and osteoporosis preventive behaviors.

In summary, social support has been identified as a significant factor influencing chronic illness self-management, especially diabetes self-management. Based on the literature reviewed, social support may influence diabetes self-management directly or indirectly through self-efficacy (Figure 2-3).

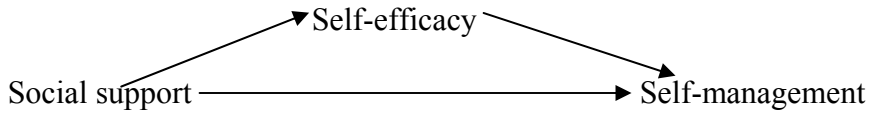

Figure 2-3. Relationships among social support, self-efficacy, and self-management: Direct and indirect effect of social support on self-management and self-efficacy mediating the effect of social support on self-management

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Relationships between Provider-Patient Communication and Self-Management

Provider-Patient Communication and Self-Management

The communication style between health care providers and patients is considered crucial in disease management. The influence of doctor-patient communication style on patients' health outcomes has obtained a great deal of attention in health care research. Ong, de Haes, Hoos, and Lammes (1995) and Stewart (1995) suggested that physician-patient communication had an important influence on patient health outcomes and patient health outcomes improved with good physician-patient communication. Patient health outcomes measured in these studies included satisfaction, compliance/adherence to treatment, understanding, quality of life, anxiety, blood hypertension, patient perception of symptoms, psychologic distress, and glycsylated hemoglobin.

Three purposes related to provider-patient communication were identified and are: 1) exchanging information, 2) finding common ground regarding treatment, and 3) making treatment-related decision (Brown, Stewart, & Ryan, 2003; Ong et al., 1995). A major purpose of medical communication is to exchange information between the provider and the patient. Communication includes the exchange of information from patient to physician about medical history and from physician to patient about the disease management plan (Ong et al., 1995; Stewart, 1995). For the doctor, the exchange of the information is the basis of understanding the health problem of the patient; and for the patient, the exchange of the information is the basis of understanding the treatment plan and the instruction from the doctor. Therefore, clear information exchange is the first step for correct diagnosis, treatment, and higher patient adherence to treatment (Brown et al., 2003; Ong et al., 1995).

The second purpose of communication is to find common ground pertaining to treatment between the provider and the patient in order to enhance patients' adherence to the treatment. This statement was tested in a study assessing the influence of agreement between patients with type 2 diabetes and their physicians on patient outcomes (Heisler, Vijan, Anderson, Ubel, Bernstein, & Hofer, 2003). In the study, 127 patients with type 2 diabetes and their physicians were surveyed about the top 3 diabetes treatment goals and corresponding strategies. The patient self care behaviors were measured. Agreement between patients and physicians on the top 3 goals were normalizing blood glucose levels, losing weight, and becoming more physical fit. Agreement on strategies were taking medications and exercising. Using multivariable regression analysis, it was shown that patients who had higher agreement with their physicians on treatment goals had higher

level of diabetes self-management than those who had less agreement with their physicians after controlling confounding variable such as diabetes duration (β coefficient = .68, p = .004) (Heisler et al., 2003).

The third purpose of provider-patient communication is to offer the patient the choice of participation in treatment-related decision making (Brown, et al., 2003; Ong et al., 1995). Increased patient participation in medical decision is associated with improved adherence self-care (Golin, DiMatteo, & Gelberg, 1996; van dam, van der Horst, van den Borne, Ryckman, & Crebolder, 2003). However, researchers have reported that not all patients preferred to participate in decision making and the patient may actively seek information about treatment options but may still feel that the physician should make the medical decision (Golin et al., 1996; Ong et al., 1995). Compared to physician communication effectiveness, patient participation in decision making is relatively less important in predicting diabetes self-management (Heisler, Bouknight, Haywrd, Smith, & Kerr, 2002).

Heisler et al. (2002) compared the relative importance of physician communication and participatory decision making in predicting diabetes self-management among 2,000 veterans. They found that provider communication was significantly related to diabetes self-management (R^2 = .21, p < .001). In the linear regression model, participatory decision making was a significant predictor of self-management. However, when adding physician communication into the model, decision making was no longer significantly associated with self-management. It means that physician communication was more important in predicting diabetes self-management than participatory decision making. The strength of this study lies in the large sample size.

However, the study population was mainly composed of male and elderly patients. This limits external validity and generalizations of results to female or younger populations.

Piette and colleagues (2003) also found that both general provider-patient communication and diabetes-specific communication were independently associated with diabetes self-management behaviors (foot care, medication adherence, diet, and exercise) after controlling for some confounders. Again, the strength of this study is its large sample size (N = 1,015) and its ethnical diversity (White, African American, Hispanic, and other ethnicity). However, there is similar limitation as the previous study in that a major portion of population was male (95%) and elderly patients.

There is a shortage of studies examining the relationship between provider-patient communication and self-management in patients with diabetes in China. However, in one study, researchers found that Chinese people also value physicians' communication style. For example, some Chinese immigrants in Canada indicated that they would discontinue medication because of the physicians' blunt explanation (Zhang & Verhoef, 2002).

Knowledge Mediating Communication and Self-Management

As discussed above, one of the major purposes of provider-patient communication is to exchange information between patients and their providers. During the medical encounter, providers usually offer patients information about their disease and treatments. Providers' communication style with patients is associated with patients' understanding of information. Good communication is related to better understanding (Ong et al., 1995).

Heisler et al. (2002) also reported that patient understanding of self-care behaviors might be a mediator for the influence of physician communication on diabetes self-management. For example, when adding patient understanding into the regression model, the predictive ability of physician communication to self-management dropped but still remained significant. The authors concluded that patient understanding may mediate the effect of physician communication on diabetes self-management. Facilitating information exchange is a critical pathway for diabetes self-management.

Furthermore, provider-patient communication is associated with not only patients' understanding of information but also patients' recall of information (Ong et al., 1995). Patients often have difficulty in recalling all the information that the provider gives and the percentage recall of information varies. Provider-patient communication style was associated with recall of information given by providers (Ong et al., 1995).

In summary, large scale research has demonstrated that provider-patient communication is associated with diabetes self-management. Also provider-patient communication was consistently associated with patients' understanding of medical information and recall of information. Understanding of self-care behaviors might mediate the relationship between provider-patient communication and self-management in patients with diabetes. Even though no research could be found on assessing if knowledge mediates the effect of communication on self-management, based on the studies reviewed here, it was hypothesized that provider-patient communication influences diabetes self-management both directly and indirectly through increasing patients' knowledge of diabetes (Figure 2-4).

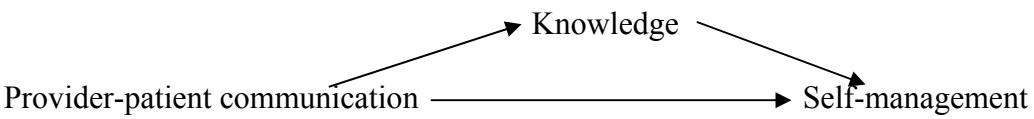

Figure 2-4. Relationships among knowledge, provider-patient communication, and self-management: Direct effect of provider-patient communication on self-management and knowledge mediating the effect of provider-patient communication on self-management

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Demographic Variables and Diabetes History

Few studies were found investigating the associations between diabetes self-management and demographic or diabetes characteristics. Ruggiero and colleagues (1997) found important differences for self-management levels (diet, exercise, and self-testing) across diabetes types or sociodemographic groups in a large-scale study on the self-reported frequency of recommended self-management plans. Participants in that study included three subgroups: insulin-dependent diabetes, non-insulin dependent diabetes (NIDDM) using insulin, and NIDDM not using insulin. Among these three subgroups, patients with NIDDM using insulin had the highest level of self-management compared with the other two groups and those with NIDDM without insulin-treated had the lowest level of self-management. Employment status and the type of insurance coverage were associated with the level of diabetes self-management (Ruggiero et al., 1997). Employed individuals had lower levels of diet and blood glucose testing self-management than retired individuals or homemakers. Patients with Medicaid/Medicare health coverage reported more often performing diet and blood glucose testing self-management than those with other types of insurance coverage, such as private insurance or without insurance coverage.

The influence of demographic variables on diabetes self-management was also reported by other researchers. For example, Karter, Ferrara, Darbinian, Ackerson, and Selby (2000) reported that patients treated by insulin will more likely to perform blood glucose self-monitoring. In addition, people with diabetes with the highest co-payment rates tested their blood glucose levels at a lower frequency than did those with no co-payments (Karter et al., 2000; Simmons, Peng, Ara, & Gatland, 1999).

Additional demographic characteristics related to factors influencing diabetes self-management included for example, duration of diabetes which was positively associated with patients' understanding of diabetes discussed above (Via & Salyer, 1999). Patients' education level was also associated with understanding of health information (Lukoschek, Fazzari, & Marantz, 2003).

The studies reviewed above indicated that types of diabetes, types of treatment, employment status, and health coverage were all associated with diabetes self-management. Also patients' education and duration of disease directly influence diabetes knowledge. In the current study, not all of these demographic variables were included for several reasons. First, adult patients with type 2 diabetes were the study population. Type of diabetes was not considered a factor in this study. Secondly, in China, the prevalence of type 2 diabetes is concentrated in individuals over the age of 55 years (Pan et al., 1996; Pan, Yan, Li, & Liu, 1997). In Beijing China, people usually retire at 55 years of age, and have health insurance. In a preliminary study conducted in Beijing China among patients with diabetes (Xu, Deets, Whitmer, & Pan, 2005), more than 80% participants were over 55 years old and around 95% of the study participants reported having health insurance. It was considered that there was no variance with employment status and health coverage

among the participants of this study, thus employment status and health coverage were not included in this study.

Based on the above discussion, for this study, the subgroups of diabetes (type 2 diabetes treated with insulin or without insulin), education, and duration of diabetes were the potential factors influencing diabetes self-management and its determinants in patients with type 2 diabetes. These three variables were included in the study (Figure 2-5).

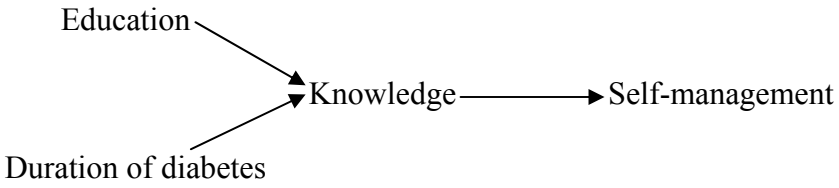

Figure 2-5. Demographic and diabetes characteristics and self-management

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Summary

Diabetes mellitus is a major health problem worldwide. To prevent diabetic complications and optimize the health outcome of patients with diabetes, individuals having diabetes have to incorporate a set of self-care regimens into their daily lives. To develop effective interventions to promote diabetes self-management behaviors, it is critical to identify the factors influencing self-management.

A large body of studies has been conducted examining diabetes self-management and its predictors in Americans with diabetes. Multiple factors have been identified including both individual and environmental factors, such as demographic variables, diabetes knowledge, beliefs of treatment effectiveness, diabetes self-efficacy,

social support, provider-patient communication. Most of the studies involved either only individual factors or only environmental factors and few studies included both individual and environmental factors. Since individuals' behavior does not happen in vacuum, the influence of the environmental context on behaviors should not be neglected.

In addition, there is an increased prevalence of diabetes in China. To improve health care for patients with diabetes in China, understanding diabetes self-management and its predictors are needed. However, few studies examining diabetes self-management and its determinants were found about patients with diabetes in China. Therefore, it is necessary to examine if the predictors of diabetes self-management identified in the Western culture also predict diabetes self-management in patients with diabetes in China.

Furthermore, most of the studies reviewed in this chapter examined the relationships between diabetes self-management and its influencing factors by using simple correlation analysis or multiple regression method. Thus, only the direct effects of factors on self-management could be examined while the indirect effects are unknown. In this study, to more clearly examine diabetes self-management and its determinants, both the direct and indirect effects of individual and environmental factors on diabetes self-management in patients with diabetes in Beijing China were explored.

CHAPTER THREE METHODOLOGY

This study was conducted in two phases. First, a pilot study was conducted to test the reliability and validity of the instruments in a group of patients with type 2 diabetes in Beijing China. After verifying the instruments' reliability and validity, the main study was conducted to test the hypothesized model by examining the overall model fit and the relationships between variables. This chapter presents the specific research plan involved in the conduct of the pilot and main studies. Included in this chapter are the following: descriptions of the research design, identification of the target population, the sampling plan, selection of reliable and valid instruments to measure the study variables, procedures for the data collection and data analysis, and procedures for the protection of human participants.

Study Setting

The study was conducted at the Outpatient Department of the Endocrinology Unit of Peking Union Medical College Hospital (PUMCH) in Beijing China. The PUMCH is one of the largest hospitals in China and is located in the center of Beijing China. The hospital provides both inpatient and outpatient services. This study focused on patients with type 2 diabetes who attended the outpatient department.

Sample

The study population was adult patients with type 2 diabetes who attended the outpatient department of the Endocrinology unit at PUMCH in Beijing China during the time the study was conducted. To participate in this study, patients had to meet inclusion and exclusion criteria. The inclusion criteria were: 1) a diagnosis of type 2 diabetes

mellitus; 2) Chinese aged 21 or over; 3) diagnosed type 2 diabetes mellitus for duration of greater than 1 year; 4) able to understand Chinese; and 5) willing to participate in the study. Patients diagnosed with type 1 diabetes mellitus or having acute diabetes-related complications were excluded from this study. Also, to allow for experience with self-management, patients who had been diagnosed within the past year were excluded.

Measurements

Data were collected using a self-reported questionnaire made up of six instruments plus demographic information and diabetes history questions. The variables included diabetes self-management, diabetes knowledge, beliefs of treatment effectiveness, diabetes self-efficacy, social support from family members, provider-patient communication, education level, duration of diabetes, and subgroup of treatment (Appendix A). Each instrument is described in the following section.

Diabetes Self-Management

Diabetes self-management was operationally defined as a set of behaviors that patients with diabetes perform daily to achieve diabetes control. Those behaviors include regulating diet, engaging in exercise, taking medications (insulin or oral hypoglycemia agents), self-monitoring blood/urine glucose levels, and taking care of feet. The measure of diabetes self-management used in this study was developed based on the Summary of Diabetes Self-Care Activities (SDSCA) (Toobert, Hampson, & Glasgow, 2000).

The SDSCA scale has been used widely and its reliability and validity had been tested in American population. Toobert et al. (2000) assessed the internal consistency using inter-item correlations in adult patients with diabetes. The inter-item correlations were acceptable for general diet (.57 to .71), exercise (.47 to .80), blood-glucose testing

(.69 to .75). The inter-item correlations were not satisfactory for specific diet (.07 to .23). The validity of the SDSCA scale was assessed by correlating with other criterion measures (Toobert et al., 2000).

The diabetes self-management questionnaire for this study included five aspects of the diabetes regimen based on the operational definition. They were diet, exercise, glucose testing, medication, and foot care. Considering the low internal consistency of the specific diet items and the difference of diet habits between Chinese and Americans, the items for specific diet were excluded. Therefore, the questionnaire included 10 items, items 1 and 2 for medication, 3 and 4 for general diet, 5 and 6 for exercise, 7 and 8 for glucose testing, and items 9 to 10 for foot care. In the questionnaire, patients were asked about how many days they performed the self-care activities during the last 7 days. An example of the questionnaire is "How many of the last seven days have you followed a diabetic diet?" The summed number of days was calculated. A higher score indicated a higher level of self-care performance.

Diabetes Knowledge

Diabetes knowledge was operationally defined as the patients' understanding of information about physiological aspects of diabetes as a disease and principles of diabetes management. The measurement of diabetes knowledge used in the study was adapted from the Diabetes Knowledge (DKN) Scales (Beeney, Dunn, & Welch, 2003), the Patient Information Test (Garrard et al., 1987), and the Diabetes Knowledge Evaluation developed by the American Association of Clinical Endocrinologists and the American College of Endocrinology (2002).

The reliability and validity of the DKN scales have been tested. The Cronbach's alpha was .91 in a sample of type 1 and type 2 diabetes patients (Beeney et al, 2003). The content validity of the DKN scales has been evaluated by a panel of diabetes health professionals. The different DKN scores in different subgroups of patients with diabetes indicated that the DKN scales had the satisfied construct validity. For example, it was assumed that patients with type 1 diabetes and insulin-treated type 2 diabetes had higher DKN scores and the study results confirmed the assumption (Beeney et al., 2003). The Cronbach's alpha was .88 for the Patient Knowledge Test scale. The psychometric properties of the Diabetes Knowledge Evaluation scale were not found.

Based on the operational definition of diabetes knowledge in this study and consideration of Chinese culture, the original English version scales were modified. For example, because the diet habits are different between Chinese and Americans, some items regarding to food exchange list were not used. An item in the DKN-A was "Butter is mainly either protein, carbohydrate, fat, or mineral". Chinese people usually do not eat butter and this item was not used. The wording of some items was also changed to comply with a Chinese communication style.

The diabetes knowledge questionnaire used in this study consisted of 14 items. Each item had four choices and the last choice was "I don't know". A score of 1 was given for a correct answer and 0 for incorrect or unknown answer. The score ranged from 0 to 15. A higher score indicated a higher level of diabetes knowledge.

Beliefs of Treatment Effectiveness

Beliefs of the effectiveness of the treatment were operationally defined as patients' beliefs about the importance of diabetes mellitus self-management activities in

controlling diabetes and preventing long-term diabetes complications. The beliefs of treatment effectiveness variable was measured using the items adapted from the Personal Models of Diabetes Questionnaire developed by Hampson, Glasgow, and Toobert (2003) and the Perceived Treatment Effectiveness Scale developed by Skinner, Hampson, and Fife-Schaw (2002).

The reliability of the Personal Models of Diabetes Questionnaire has been reported as satisfactory (Cronbach's alpha = .74) (Hampson, Glasgow, & Toobert, 2003). Skinner et al. (2002) indicated that the internal consistency of the Perceived Treatment Effectiveness Scale had satisfied internal consistency. Cronbach's alpha was .74 for effectiveness to control diabetes (8 items) and .82 for effectiveness to prevent compilations (10 items).

The instrument that measured beliefs of treatment effectiveness in this study consisted of 9 items. The first four items measured the belief that diabetes self-management activities (diet, exercise, medications/insulin, and self-monitoring blood level) were important in controlling diabetes. The remaining 5 items of the questionnaire measured the belief that diabetes self-management activities (diet, exercise, medications/insulin, self-monitoring blood level, and foot care) were important in preventing diabetes complications. Taking care of feet was considered more relevant to prevent diabetes-related foot complication such as amputation of limbs rather than to control diabetes directly. Thus, the item of foot care was only included in the second part of the instrument.

The instrument had a 5-point Likert scale from 1 (not important) to 5 (extremely important). The score ranged from 9 to 45. Higher scores indicated greater perceived

belief that diabetes self-management could control diabetes and prevent diabetic complications.

Diabetes Self-Efficacy

Diabetes self-efficacy was operationally defined as judgment of the diabetes patients' own capability to carry out diabetes self-management activities. The method for measuring diabetes self-efficacy in this study was adapted from the Self-Efficacy Scale for patients with type 2 diabetes (SE-Type 2 scale) developed by van der Bijl, van Poelgeest, and Shortridge-Baggett (1999). The reliability and validity of the Self-Efficacy Scale were tested by van der Bijl et al. (1999). They found that the internal consistency cronbach's alpha was .81 and four factors were extracted and explained 55% of the variance.

For this study, some items of the original SE-Type 2 scale were removed based on theoretical consideration. For example, the items regarding low or high blood sugar management were removed because this aspect was not included in the operational definition, and other changes were made with wording to reflect the different culture. For example, one item is "I think I am able to follow my diet when I am at a reception/party." Dining together with friends is a more common activity for Chinese people rather than attending a reception or party. Therefore, the item was changed to "I think I am able to follow my diet when I dine together with my friends."

For this study, the modified instrument consisted of 7 items covering five aspects: diet (items 2 and 3), exercise (items 5 and 6), glucose testing (item 1), medication (item 7) and foot care (item 4). It had a 5-point Likert-scale, from 1 (no, definitely not) to 5 (yes,

definitely). The score ranged from 7 to 35. Higher scores indicated higher self-efficacy in performing self-care activities.

Social Support from Family Members

Social support from family members was measured based on the family and friends support subscale of the Chronic Illness Resources Survey (Glasgow, Strycker, Toobert, & Eakin, 2000) and the Diabetes Family Behavior Checklist (DFBC) (Schafer, McCaul, & Glasgow, 1986). Glasgow et al. (2000) found the Chronic Illness Resources Survey to be reliable and valid and the Cronbach's alpha was .75 for the family and friends support subscale. The DFBC was developed for patients with type 1 diabetes. However, the reliability and validity of the DFBC in adult patients with diabetes (19 to 64 years old) has been reported and the average Cronbach's alpha for the positive items for adults was .73 (Schafer et al., 1986). The convergent validity was assessed by Schafer et al. (1986) and they reported that the DFBC scores for adults were related to their family members' scores.

The instrument used in this study included 7 items taken from these 2 scales. The items measured the extent to which individuals perceive that they receive emotional support (items 1 and 2), tangible aids (items 3, 4, 6, 7), and appraisal (item 5) from their family members in the prior 3 months. All the items reflect positive family support. It was a 5-point Likert scale from 1 (not at all) to 5 (a great deal). The score ranged from 7 to 35. Higher scores indicated more support from family members perceived by individuals.

Provider-Patient Communication

The provider-patient communication was measured based on the communication subscale of the Interpersonal Processes of Care (IPC) (Stewart et al., 1999) and the doctor support subscale of the Chronic Illness Resources Survey (CIRS) (Glasgow et al., 2000). For the IPC, the reported cronbach's alphas were .70 for the general clarity subscale, .86 for responsiveness, and .74 to .93 for explanation subscales (Stewart et al., 1999). Glasgow et al. (2000) reported that the Cronbach's alpha for the doctor support subscale in the CIRS was .91.

The instrument used in this study consisted of 7 items taken from these 2 scales. Patients were asked the extent to which they perceived that their doctors talked clearly (items 1 and 2), explained medical care (items 5, 6, 7), and responded to patients' concerns (items 3 and 4). It was a 5-point Likert scale from 1 (not at all) to 5 (a great deal). The score range of the questionnaire was from 7 to 35. Higher scores indicated better communication between patients and their doctors.

Demographic Information and Diabetic History

Demographics of the participants were collected, including age, gender, marital status, education level, employment, household income, types of insurance, and with whom living. Marital status was measured in four categories including never married, married, separated/divorced, and widowed. The participants were asked the highest degree received by an individual from formal schools or institutes to measure their education level, including 6-year primary school, 9-year middle school, high school graduate, some college or technical school, college graduate (bachelor's degree), and graduate degree. Household income was measured as the family's monthly salary from

all sources, including less than 1,000 yuan ($120), 1,000 to 1,999 yuan ($121 to $240), 2,000 to 3,999 yuan ($241 to $480), 4,000 to 5,999 yuan ($481 to $720), 6,000 to 8,000 yuan ($721 to $960), and over 8,000 yuan ($961). Employment was measured as 5 categories including no work, full-time, part-time, retired, and others. Type of health insurance was measured as 3 categories most popular in China, including governmental health insurance, through employer, and no insurance. Participants were also asked with whom they were living, which was measured as 6 categories including living by self, living with parents, with spouse and children, with parents, spouse, and children, with children, and with others.

Diabetes history included duration of diabetes and types of diabetes treatment (insulin-treated and non-insulin-treated) were also collected. The participants were asked how many years they had been diagnosed with type 2 diabetes and if they were using insulin to control their diabetes.

Pilot Study

Design

A cross-sectional research design was used in the pilot study. The purpose of the pilot study was to test the reliability and validity of the instruments. Since these instruments had not been used with a Chinese population, it was important to evaluate the validity and reliability of the instruments. The instruments also had been modified from the original format. Therefore, prior to conducting the main study, it was important to test the reliability and validity of the instruments. In addition, the pilot study was used to estimate the time to complete the survey and examine the process for recruiting participants.

Sample Selection

The sample for the pilot study was a convenience sample of Chinese adult patients with type 2 diabetes mellitus who attended the outpatient department of the Endocrinology unit at PUMCH from September 5th 2004 to September 11th 2004. Patients who met the inclusion and exclusion criteria were invited to participate in the study.

A power analysis for the pilot study was conducted based on the technique introduced by Cohen (1992). For a significance test of a sample correlation *r* with a power as .80 at alpha as .05, when the population correlation ρ is large (.50), the necessary sample size would be 28 (Cohen, 1992). It was estimated that the internal consistency (inter-item correlations) of the questionnaire and the subscales would be higher than .50, which was considered a large correlation. Based on this expectation and the power analysis, a sample size of 30 was chosen for the pilot study.

Data Collection

Recruitment

There were two ways to approach potential participants. At the outpatient department, each Tuesday afternoon was open particularly for patients with diabetes and the investigator approached patients waiting to see a doctor. Other time during weekdays the outpatient was open for any patients with endocrinology disorders and the investigator worked with a doctor whose patients mainly were diabetics. The doctor was informed about the study inclusion and exclusion criteria. When the doctor saw a patient and considered the patient met the criteria, she introduced the patient to the investigator and the investigator approached the patient. To maintain confidentiality, the doctor did not know who volunteered to participate in the study.

Data Collection

The investigator collected data using pencil-paper measures. The participants who met the criteria were invited to take part in the study. The purpose of study, the potential risks and benefits, and their rights to refuse and discontinue participating in the study were explained to the participants. Once they volunteered to take part in the study, patients received a survey to complete. Upon completion, they returned the survey directly to the investigator. Some participants were not able to read the survey by themselves because they did not bring their reading glasses. In those cases, the investigator read the survey to the participants and wrote down the answers for them. The investigator was accessible for questions while their answering the questionnaire.

Data Management

The completed questionnaires were put in an envelope which was accessible only to the investigator. The investigator coded the questionnaire and set up a SPSS 12.0 (Statistical Package for the Social Sciences) file named as pilot study data. Each completed questionnaire was given a study ID. The data collected in the pilot study were entered into the SPSS file which was used to conduct data analysis for the pilot study. The pilot study data set had no missing data.

Data Analysis

Reliability

The Cronbach's alpha was calculated to assess the internal consistency reliability. There are widely-accepted cut-off values for the alpha. Burns and Grove (1997) considered the alpha of .70 the lowest acceptable for a well-developed instrument but acceptable for a newly developed instrument and the Cronbach's alpha could be as low

as .60 for an instrument developed for research purposes. DeVills (1991) indicated that a Cronbach's alpha below .60 for a research scale is unacceptable, between .60 and.65 undesirable, between .65 and .70 minimally acceptable, between .70 and .80 respectable, between .80 and .90 very good, and greater than .90 as excellent. By convention, the alpha should be .70 or higher. In this study, the Cronbach's alpha of .70 was used to evaluate the reliability of the instruments.

Content validity

Four experts with health professional experience on diabetes were invited to evaluate the content validity in terms of representativeness and clarity respectively based on a 4-point scale: 4 as represent and clear, 3 as represent and clear with minor revisions, 2 as represent and clear with major revisions, and 1 as not represent and not clear (Rubio, Berg-Weger, Tebb, Lee, & Rauch, 2003) (Appendix B). Two experts were Chinese scholars in the U.S. and other two experts were Chinese doctors in Beijing China. The content validity indexes (CVI) were calculated for items and the instruments as well. A CVI of .80 was recommended for new measurement tools. Changes were made on those items with CVI lower than .80 based on the experts' comments.

Construct validity

A confirmatory factor analysis (CFA) was conducted to evaluate the construct validity of the instruments measuring diabetes self-management, beliefs, self-efficacy, social support, and provider-patient communication. Using CFA, the researcher determined if the number of factors and the loadings of indicators on the factors conform to what was expected. The variance explained by the factors was also reported. Generally,

the minimum acceptable cut-off is .30 for the factor loadings and the factors extracted should account for at least 70% of the total variance (Mertler & Vannatta, 2001).

For the diabetes knowledge scale, its construct validity was tested using the known-group method because it was hard to divide knowledge into subscales. It was assumed that patients' education level was associated with diabetes knowledge and patients with higher degree would have higher scores on diabetes knowledge test compared to those with lower degree. A one-way ANOVA was used to test the mean differences between patients with higher degree and patients with lower degree.

After testing the reliability and validity of the instruments, the results were evaluated and the instruments were revised as necessary based on results. Then the data collection started for the main study to test the hypothesized model by examining the model fit and parameter estimates.

Main Study

Design

A cross-sectional survey research design was used in the main study. A cross-sectional design involves the measurement of all variables for all cases within a narrow time span. The cross-sectional survey research design was used to examine the effects of diabetes knowledge, beliefs of treatment effectiveness, self-efficacy, social support from family members, provider-patient communication, and demographic and clinical variables on diabetes self-management in patients with type 2 diabetes in Beijing China.

Sample Selection

The sample was a convenience sample of Chinese adult patients with type 2 diabetes mellitus who attended the outpatient department of the Endocrinology unit at

PUMCH from September 14th 2004 to November 2nd 2004. Patients who met the inclusion and exclusion criteria and had not participated in the pilot study were invited to participate in the main study.

The sample size for the main study was decided based on the ratio of the number of participants to the number of model parameters rather than based on a traditional power analysis. More complicated models with more parameters need larger samples (Kline, 1998). Kline indicated that a desirable ratio of participants to parameters should be 20:1 but a 10:1 ratio would be more realistic. There are 19 parameters in the hypothesized model of this study, including 11 coefficients and 8 variances. Thus, based on the 10:1 ratio, a sample size of 190 was required for the main study. To plan for potential missing data, a sample size of 200 was chosen for the main study.

Patients visiting the outpatient department were based on 'walk-in' rather than appointments and neither doctors nor nurses knew who was coming for a doctor visit. There was no database available documenting outpatients' information. The head nurse of the outpatient department estimated that patient visits at the outpatient department averaged 750 diabetic patient-times per week. Most patients were living in Beijing and some of them came from other cities in China. Ten percent of the patients were diagnosed with type 1 diabetes. Some patients visited the doctor once a month for follow-up. Therefore, when these two factors were accounted for, it was estimated that the number of patients for the 6 weeks of data collection in the main study was 3500.

To separate the sample for the pilot study from that of the main study, each patient who was approached for the main study was asked if he/she had been asked to answer the survey on diabetes self-management behaviors before they were invited to

participate in the main study. As a further measure, the demographic information of the sample in the main study was also compared to that of the sample in the pilot study. There was no complete matched sample between the pilot and main studies in terms of demographic information.

Data Collection

The process of data collection in the main study was identical to that in the pilot study. To avoid repeating the identical information, the details for the process of data collection in the main study was referred to the section of data collection in the pilot study.

Data Management

The process of data management in the main study was similar to the process in the pilot study. The completed questionnaires in the main study were put in separated envelopes from the pilot study. The envelopes were accessible only by the investigator. The investigator coded the questionnaire and set up a SPSS 12.0 file named as main study data. Each completed survey was given a study ID. The data collected in the main study were entered into the SPSS file which was used to conduct data analysis for the main study.

Data Analysis

In the main study, structural equation modeling (SEM) was used to answer the research questions. The SEM is a technique combining multiple regression and factor analysis. The SEM allows researchers to estimate the direct and indirect relationships

between one or more independent variables and one or more dependent variables simultaneously (Ullman, 2001).

Missing Values

Missing data were handled prior to conducting the main analysis. The variables with missing data less than 2.5% were estimated using mean replacement. For those variables with missing data greater than 2.5%, the pattern of the missing was tested to see if the data were missing completely at random (MCAR) or missing at random (MAR). If the missing data in a variable are unrelated to the value of any other variables, they are considered MCAR. If the missing data do not meet the requirement of MCAR, but are unrelated to the value of a variable after controlling for another variable, the data are considered missing at random (MAR) (Howell, 1998).

To do so, those variables with missing data were recoded as dummy variables. For example, cases with no missing data on one variable were recoded as "0" and those with missing data on the same variable were recoded as "1." Then a *t*-test was run to determine if there were significant mean differences in other continuous variables between the group with missing data and the group without missing data. A chi-square test was run to determine if the distributions of other categorical variables were significantly different between the two groups.

If the data were determined MCAR, a regression approach was used to impute the missing values for the variables with missing date greater than 2.5%. If the data were determined not MCAR, the correlations between variables with missing data and those variables showing significant differences were examined. If the correlations were small, a regression approached was still used to impute the missing values. If the correlations

were big, two data analyses would be conducted, one for the data set with missing values deleted and one for the data set with missing values imputed. If the results from the two data analyses were not substantially different, either result would be used to report and interpret, otherwise the issue of missing values would be discussed as a study limitation.

Structural Equation Modeling

In the SEM analysis, all the eight research questions were answered by testing the model and modifying the model. There are six major steps in SEM analysis (Hair, Anderson, Tatham, & Black, 1998): 1) specifying the model; 2) examining assumptions for the SEM; 3) assessing the identification of the structural model; 4) choosing input matrix type; 5) evaluating goodness-of-fit and coefficients between variables; and 6) modifying the model. The student version of the AMOS 5.0 was used to run the SEM.

The first step was completed through the construction of the model and the relationships between variables were specified (Figure 1-1). After model specification, the next step was to test the assumptions underlying the SEM. Data were tested for multivariate normality and outliers.

At the third step, the degrees of freedom were calculated to assess the identification of the model. The degrees of freedom could be obtained by calculating data points minus parameters to be estimated. The data points in this study were: 8(8+1)/2 = 36 (8 refers to the number of variables in the model). There were 19 parameters to be estimated in the model including 11 coefficients and 8 variances (including errors and exogenous variables). Thus, the degrees of freedom for this study were 17 greater than zero which means the model was overidentified.

The fourth step was to select the type of input matrix. Usually either a correlation or a variance-covariance matrix can be used as data input for SEM. For this study, the variance-covariance matrix was used because SEM was originally formulated upon the use of the covariance matrix and covariance matrix is preferred for theory testing (Hair, Anderson, Tatham, & Black, 1998).

At the fifth step, the goodness-of-fit of the model was examined to answer research question one. The indices for the goodness of fit provided information to evaluate if the relationships in the proposed model fit the observed data. Because there is no single index considered the best index of overall fit (Hoyle & Panter, 1995), multiple indices were used for evaluating this structural equation model.

The model fit is usually evaluated upon three characteristics (Hoyler & Panter, 1995; Schumaker & Lomax, 2004): 1) Absolute fit measures concerning the degree to which the estimated covariance matrix matches the observed matrix; 2) Incremental fit concerning the degree to which the proposed model is superior to the null model; 3) Parsimonious fit concerning the number of estimated parameters to achieve a certain level of model fit. The chi-square statistic tests (desired value > .05), the goodness-of-fit index (GFI) (desired value > .90), and the root-mean-square error of approximation (RMSEA) (desired value < .08) are absolute fit indices. The adjusted goodness-of-fit (AGFI) (desired value > .90) and the normed fit index (NFI) (desired value > .90) are incremental fit indices. The Akaike information criterion (AIC) (smaller, better) and parsimonious goodness-of-fit index (PGFI) (higher, better) are parsimonious fit indices. Therefore, these model fit indices were used to evaluate if the hypothesized model fit the observed data.

At the sixth step, the process of model modification was completed based on outputs of the SEM analysis and theoretical reasonability. Following an examination of the goodness of fit indices, the data analysis included an examination of the significance of each causal path to answer research questions two to seven. The process involved an examination of keeping a significant path, or removing a non-significant path, or adding a new path. Adding or dropping a path was based on not only statistical significance but also theoretical reasonability. For example, if adding a path was indicated in the modification indices and also able to be explained from theoretical perspectives or consistent with the literature, the path was added, otherwise the path was not added.

In addition, the standardized residual covariance matrix provided additional information. For this study, residuals were examined to help determine the portion of the variance that was not accounted for. The desired values for standardized residual covariance matrix should be lower than 2.58 (Hair, Anderson, Tatham, & Black, 1998).

The model was modified integrating all considerations described as above. Then the modified model was estimated again to assess whether the model fit became better or not.

A multi-group SEM analysis was used to answer research question eight. The goodness-of-fit indices were used to examine whether the modified model generally fit both patients with type 2 diabetes with insulin-treated and patients with type 2 diabetes without insulin-treated. The estimated parameters were compared to examine if the causal relationships among variables were identical across the two groups.

Protection of Human Participants

There were no known risks to the participants in this study. There was no direct benefit to the participants in this study. Long term benefits may occur to other patients with diabetes in China because of what was learned from this study. The participants did not receive payment for participation in this study. Each participant was informed that his/her name would not be recorded thus his/her identity would remain confidential.

It was an anonymous survey, thus, a signed informed consent was not obtained. At the beginning of the survey, statements on the purpose of the study, potential risks and benefits, the rights to refuse or discontinue participating in the study was provided (Appendix A). A statement, "By completing this survey I indicate my consent to participate in this study" was also presented at the beginning of the survey. All participants indicated consent to participate when they answered the survey.

The Institute Review Boards (IRB) at the University of Cincinnati (UC) reviewed the study proposal. There was no organization in Beijing, China functioning similar to the Institute Review Boards in the US. Permission was sought from the PUMCH and the investigator was permitted by the vice president of the hospital to collect data at the outpatient department of the Endocrinology unit at the PUMCH. A permission letter was provided by the PUMCH and submitted to the IRB at UC.

CHAPTER FOUR RESULTS

In this chapter, the results of the study are presented. This chapter is organized around the following two sections: 1) findings of the pilot study, in which descriptive data of the participants and psychometric properties of the instruments are presented; and 2) findings of the main study are presented to answer the eight research questions.

Findings of the Pilot Study

Before the main study, a pilot study was conducted. The purpose of the pilot study was to test the reliability and validity of the instruments with a Chinese population. The reliability, content validity, and construct validity of the instruments were tested.

Participants

A total of 30 patients with type 2 diabetes were enrolled in the pilot study. They had mean age of 62 years and the age range was from 41 to 84. Sixteen were men (53.3%) and 14 were women (46.7%). The mean duration of diabetes was 10 years. Most of the participants (46.7%) had high school or higher degree. About half of them used insulin to control their diabetes.

Content Validity

Items of the instruments measuring belief of treatment effectiveness (BTE), diabetes self-efficacy (DSE), and provider-patient communication (PPC) had the content validity index (CVI) scores higher than .80 for both representativeness and clarity. Some items of diabetes self-management, diabetes knowledge, and social support scales had the CVI scores lower than .80 for either representativeness or clarity. Those items were

revised based on psychometric properties and experts' suggestions and discussed as follows.

Diabetes Self-Management

Among the 10 questionnaire items, one item (item 4) had a CVI score for representativeness lower than .80 and five items (items 4, 5, 6, 7, 8) had CIV scores for clarity lower than .80. In item 4, participants were asked on how many days of the last 7 days they ate their meals at the same time each day. Based on an expert's comments, "the same time each day" was not defined clearly and nobody really ate meals at the exactly same time every day. This item was considered not important or representative of this population. This item was removed in the main study.

An expert suggested that "exercise" was defined clearly in item 6 but not in item 5 and these two questions seem to be repeated. To address this, items 5 and 6 were combined in the main study and the question became "on how many of the last 7 days, did you participate in around 20 to 30 minutes of exercise, for example, walking, Tai Qi, climbing mountains, or dancing, etc."

For items 7 and 8, participants were asked about how often they self-tested blood/urine sugar. An expert suggested that self-testing blood or urine sugar should be asked separately in different items. Participants in the pilot study indicated that they either self-tested or went to hospital to check their blood sugar instead of testing their urine for sugar level. In the main study, the urine testing was removed from the items.

Diabetes Knowledge

For this measurement, the CVI scores for representativeness were higher than 0.80 for all items. Item 3 had a CVI score for clarity lower than .80. In the original question, participants were asked what normal range for blood sugar was. The experts suggested that the question be clarified about fasting blood sugar or postprandial blood sugar. For the main study, the item was changed to "what is the normal range for fasting blood sugar?" Even though item 7 had satisfied CVI scores, an expert suggested that the food choices be changed considering Chinese people's food preferences. Therefore, the food choices were changed to apple, pumpkin, kelp, and tofu.

Beliefs of Treatment Effectiveness

All items of the instrument measuring beliefs of treatment effectiveness had CVI scores for both representativeness and clarity higher than .80. No further revision was necessary.

Diabetes Self-Efficacy

All items of the instrument measuring diabetes self-efficacy had CVI scores for both representativeness and clarity higher than .80. However, it was suggested to change the statement style of the items measuring diabetes self-efficacy. In the original items, "I" was used as the subject and the sentence was affirmative. The statement style was changed, in which "you" was used as the subject and the affirmative statement was changed to a question; for example, "do you think you can follow diabetic diet at most of time?" instead of "I think I can follow diabetic diet at most of time."

Social Support from Family Members

All items of the instrument measuring social support had CVI scores higher than .80 for representativeness and clarity except item 7, which had a CVI for representativeness lower than .80. The participants in the pilot study also expressed that they did not need their family members to help them massage their feet. Therefore in the main study, the item 7 was removed.

Provider-Patient Communication

All items had CVI scores higher than .80 for both representativeness and clarity. No further revision was conducted.

Overall, most of the items on measures had CVI scores .80 or higher. Those with CVI scores lower than .80 were omitted or modified based on experts' comments. In addition, a few items were changed based on feedback from the participants in the pilot study.

Reliability

Once the content validity of the instruments had been evaluated, the instruments were tested for reliability. The data for the same 30 participants were used. The Cronbach's alpha for the instruments varied from .62 to .87. The Cronbach's alpha for the diabetes self-management scale was .68 which was lower than .70 but the value was marginal. The Cronbach's alpha was .62 for the instrument measuring diabetes knowledge. Other instruments had alpha values higher than .70 (Table 4-1).

Table 4-1

Cronbach's Alphas for the Instruments ($N = 30$)

Instruments	# of items	Cronbach's alpha
Diabetes self-management	8	.68
Diabetes knowledge	14	.62
Belief	9	.81
Diabetes self-efficacy	7	.87
Social support	6	.86
Provider-patient communication	7	.74

Construct Validity

Confirmatory factor analysis was conducted to test the construct validity for the instruments measuring diabetes self-management, belief of treatment effectiveness, diabetes self-efficacy, social support, and provider-patient communication. The known-groups method was used to test the construct validity of the diabetes knowledge scale.

Diabetes Self-Management

Because some participants either used oral hypoglycemia or insulin to control their diabetes and some used both, the mean of the first two items was calculated as a new variable measuring self-management on medication taking. After removing the item 4, eight items were included in the factor analysis. The 8 items loaded on 5 factors. The 5 factors totally explained about 90.9% variance of the 8 items. Except the factor loadings of items 3 and 9 were lower than .30, other factor loadings were higher than .30 (Table 4-2).

Table 4-2

Diabetes Self Management – Factor Loadings and Explained Variances

Item/Variance	Factors				
	Blood test	Medication	Exercise	Foot Care	Diet
% of Var.	22.39	21.82	20.63	13.18	12.94
Item 8	.939				
Item 7	.933				
Mean of item 1 and 2		.904			
Item 6			.905		
Item 5			.815		
Item 10				.954	
Item 9				.151	
Item 3		.810			.126

Diabetes Knowledge

The correlation table has shown that there was a significant correlation between diabetes knowledge and participants' education level ($r = .494$, $p < .01$). Participants with higher education level had higher scores on diabetes knowledge.

For further analysis, participants were divided into two groups based on their education level. Out of 30 participants, 19 participants had a high school degree and lower and 11 had technical school and higher degree. The mean of diabetes knowledge in the group with lower degree was 8.68 and that in the group with higher degree was 11.09. A one-way ANOVA was used to test if the means of diabetes knowledge were significantly different between these two groups. The mean of diabetes knowledge in the group with higher degree were significantly higher than that in the group with lower degree ($F = 8.01$, $p < .01$). Therefore, knowledge scores in patients with diabetes at

different education level indicated that the knowledge measurement had the satisfied construct validity.

Belief of Treatment Effectiveness

The 9 items loaded on two factors as expected. Most of the factor loadings were higher than .30 except the loading of item 7 on the second factor which was .281 but it is a marginal value. The 2 factors together explained about 61.6% variances of the 9 items (Table 4-3).

Table 4-3

Belief of Treatment Effectiveness – Factor Loadings and Explained Variances

Items/Variance	Factors	
	Controlling diabetes	Preventing complications
% of Var.	31.43	30.12
Item 3	.772	
Item 1	.771	
Item 2	.567	
Item 4	.557	
Item 5		.469
Item 6		.842
Item 9		.751
Item 8		.751
Item 7		.281

Diabetes Self-Efficacy

The 7 items loaded on 5 factors exactly as expected. All factor loadings were higher than .30. The 5 factors explained about 97.9% variances of the items (Table 4-4).

Table 4-4

Diabetes Self-Efficacy – Factor Loadings and Explained Variances

Item/Variance	Factors				
	Exercise	Diet	Blood test	Medication	Foot care
% of Var.	29.19	24.29	15.18	14.92	14.38
Item 5	.943				
Item 6	.902				
Item 3		.849			
Item 2		.793			
Item 1			.932		
Item 7				.894	
Item 4					.867

Social Support

Six items were included in the factor analysis after removing the item 7. The 6 items loaded on the 3 factors as expected and all the factor loadings were higher than .30. The 3 factors totally explained about 78.5% variance of the items (Table 4-5).

Table 4-5

Social Support Measurement – Factor Loadings and Explained Variances

Item/Variance	Factors		
	Appraisal	Emotional	Tangible aid
% of Var.	33.12	24.59	20.81
Item 5	.918		
Item 2		.755	
Item 1		.578	
Item 6			.383
Item 4			.357
Item 3			.353

Provider-Patient Communication

The 7 items loaded on 3 factors as expected. The 3 factors totally explained about 79.3% variance of the items. The factor loading for the item 5 (.217) were lower than .30 and all other loadings were higher than .30 (Table 4-6).

Table 4-6

Provider Patient Measurement – Factor Loadings and Explained Variances

Item/Variance	Factors		
	Response	Clarity	Explanation
% of Var.	33.12	24.59	20.81
Item 3	.898		
Item 4	.894		
Item 2		.769	
Item 1		.620	
Item 7			.933
Item 6			.419
Item 5			.217

Summary

The reliability and validity of the six instruments were examined. Based on the CVI scores and experts and participants' comments, the instruments were revised to improve the representativeness and clarity of the items. Construct validity was examined by conducting factor analysis and factors were extracted as expected. Most of items had factor loadings higher than .30 and only few had loadings lower than .30. For the reliability, the Cronbach's alpha varied from .62 to .87. Considering the first time of testing the instruments in a Chinese population, the findings were acceptable and the revised instruments were used for the main study (Appendix C).

Findings of Main Study

Once the reliability and validity of the instruments were tested and established in the pilot study, the revised instruments were used in the main study. The purpose of the main study was to test a hypothesized model using structural equation modeling (SEM). There were some missing data in the main study. After cleaning missing data, further data analysis was conducted to answer the research questions.

Participants

A total of 240 patients with type 2 diabetes who visited the PUMCH during September 2004 to November 2004 were approached, who met the inclusion and exclusion criteria. Among these 240 patients, 201 of them volunteered to participate in the study, and answered and returned the survey (84% response rate).

Demographic Characteristics

The participants had a mean age 61 years with an age range from 24 to 83. One hundred and two were men (50.7%) and 99 were women (49.3%). Seventy one participants (35%) had middle school or lower degree and 130 (65%) had high school or higher degree. About 78% of participants were retired. Among these 201 participants, about 75% of them had a family income between RMB 1,000 and RMB 4,000 per month ($120 to $480 per month). Eighty five percent of participants had insurance either through the Chinese governmental health insurance plan or through their employers. About 79.6% of participants were living with their spouses and children (Table 4-7).

Table 4-7

Demographic Characteristics of the Participants

Demographic characteristics	Participants	
	Number	Percent
Age		
24 – 40	11	5.5%
41 – 50	24	11.9%
51 – 60	52	25.9%
60 – 70	76	37.8%
71 – 83	38	18.9%
Gender		
Male	102	50.7%
Female	99	49.3%
Education Level		
6th grade	16	8.0%
9th grade	55	27.4%
12th grade	40	19.9%
Technical school	2	1.0%
Associate degree	33	16.4%
College graduate or higher	55	27.4%
Employment		
No work	2	1.0%
Full time	34	16.9%
Part time	3	1.5%
Retired	157	78.1%
Others	5	2.5%
Income		
Less than $120	32	15.9%
$121 to $240	102	50.7%
$241 to $480	48	23.9%
$481 to $720	8	4.0%
$721 to $960	3	1.5%
Over $961	8	4.0%
Health insurance		
Governmental health plan	136	67.7%
Through employer	36	17.9%
No insurance, pay from salary	29	14.4%

Table 4-7 (continued)

Demographic Characteristics	Participants	
	Number	Percent
With whom living		
By self	17	8.5%
Parents	4	2.0%
Spouse and children	158	78.5%
Parents, spouse, and children	2	1.0%
Children	16	8.0%
Others	4	2.0%

Disease Characteristics

The mean duration of diabetes was 10 years. Most of participants used oral hypoglycemia agents to control their diabetes. Very few of them used diet control. About 16.4% of participants used insulin alone to control diabetes and about 20.9% of participants used both oral agents and insulin (Table 4-8).

Because the major group used oral agents, participants were divided into two groups for further analysis. The subgroup with insulin-treated included those who used insulin alone or both insulin and oral agents and the subgroup with non-insulin-treated included those who used oral agents alone or only controlled their diet.

Table 4-8

Disease Characteristics of the Participants

Disease characteristics	Participants	
	Number	Percent
Treatment group		
Diet control only	3	1.5%
Oral hypoglycemia agents	123	61.2%
Insulin	33	16.4%
Oral hypoglycemia agents and insulin	42	20.9%

Diabetes Self-Management Level of the Participants

In terms of diabetes self-management, most participants reported that they followed their prescription of oral hypoglycemia agents or insulin injection (89.1%) and controlled their diet (71.6%) every day in the past week of the data collection date. In addition, 152 participants reported that they exercised at least 5 days per week, and among of them about 126 participants reported exercising every day. However, a lower percentage of participants reported that they performed blood glucose self-testing and foot care by themselves (Figure 4-1).

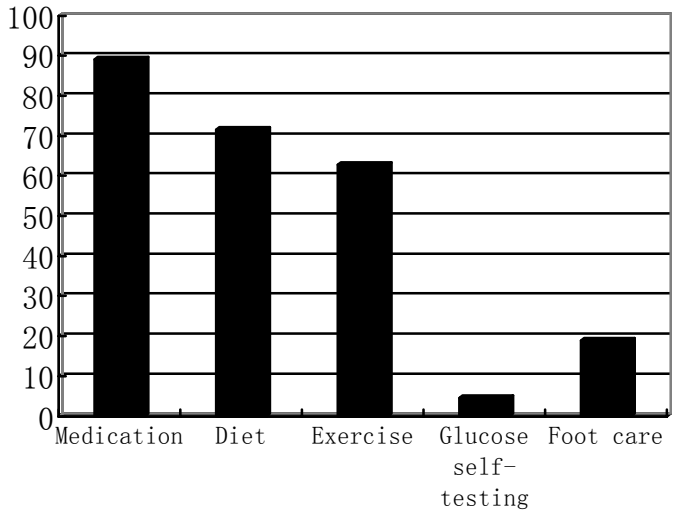

Figure 4-1. Diabetes Self-Management Level of the Participants

Cleaning Missing Data

The rate of missing data ranged from .5% to 6.0%, with an average of 3.2% for missing data. Four items of the diabetes knowledge scale, items 7, 10, 11, 13, and all items of belief, self-efficacy, social support, and provider-patient communications scales

had missing data higher 2.5%. All other items in the survey had missing data less than 2.5% which were estimated using the mean replacement.

For those variables with missing data greater than 2.5%, tests were conducted to determine if there were significant differences in other variables between the group with missing data and the group without missing data for one variable by using either *t*-test or chi-square method. The findings showed there were significant differences in education level, income level, and age between groups with or without missing data for all the items of the belief scale, the self-efficacy sale, and 2 items of the social support and provider-patient communication scales. However, significant differences were not found in income level and age between groups with or without missing for the items after controlling education level. Therefore, the data were considered missing at random (MAR) rather than missing completely at random (MCAR).

Although MAR, all missing data were less than 6% and there were small correlations between missing patterns and other variables. Missing data imputations were conducted to maintain the adequacy of the sample size, and therefore, the statistical power. The multiple regression approach was used for data imputation by using non-missing data to predict missing data.

Study Variables

Descriptive Data of the Study Variables

In this study, the summed raw scores for each instrument rather than factor scores were used because the items of each instrument were considered equally significant to the instrument. The mean and standard deviation (*SD*) of the study variables are reported in Table 4-9.

Assumptions

The assumption of the SEM, outliers and normality of the study variables were examined. There were no outliers. For normality, a common rule-of-thumb test is that skewness and kurtosis should be within -2 and +2 range when the data are normally distributed, but sometimes -3 and +3 is used. The values of skewness and kurtosis for almost all study variables were within -2 and +2 range. Even though the kurtosis for duration of diabetes was greater than +2, the skewness of that was within the range. The kurtosis for the multivariate (4.272) was a little bit higher.

Correlations between the Study Variables

Correlations between study variables were examined. Pearson correlations were calculated between interval variables and spearman correlations were calculated between ordinal and interval variables. The correlations between these variables are presented in the table as follows (Table 4-9).

Table 4-9

Study Variables – Correlations, Mean, and *SD*

	1	2	3	4	5	6	7	8
1. Education	—	-.066	.111	.109	.514**	.170*	.148*	.022
2. Duration		—	-.098	-.066	.021	-.001	.164*	.227**
3. Provider-patient			—	.262**	.173*	.328**	.273**	.179*
4. Social Support				—	.130	.387**	.370**	.281**
5. Knowledge					—	.340**	.197**	.109
6. Belief						—	.346**	.333**
7. Self-efficacy							—	.497**
8. Self-management								—
Mean of variables	3.74	10.47	25.95	20.18	8.32	32.6	29.28	32.74
SD of variables	1.81	7.97	4.63	5.35	2.31	5.70	4.43	9.08

*$p < .05$ **$p < .01$(2-tailed)

Structural Equation Modeling

To answer the research questions, the SEM was conducted to test the hypothesized model. In this study, the asymptotically distribution-free estimation was used rather than maximum likelihood to deal with nonnormality even though no significant problems with normality were identified. The results for the research questions were reported one by one in details as follows.

Research question one: Does the hypothesized model fit the observed data?

The test of the hypothesized model resulted in the following fit indices: χ^2 (17, N = 201) = 77.1, p = .000, goodness-of-fit index (GFI) = .933, root-mean-square error of approximation (RMSEA) = .133, normed fit index (NFI) = .543, adjusted GFI (AGFI) = .857, parsimonious GFI (PGFI) = .348, Akaike information criterion (AIC) = 115.10. The fit indices did not indicate a good fit of the model. Chi-square statistic tests, GFI, RMSEA were used to evaluate the degree to which the estimated matrix matched the observed matrix and non-significant chi-square, GFI over .90, and RMSEA less than .80 were desired. In the findings of the study, except GFI value was over .90, the other two indices did not reach the desired value. AGFI and NFI were used to evaluate the degree to which the proposed model was superior to the null model and both indices were lower than the desired value (> .90). AIC and PGFI were used to evaluate if the model was parsimonious.

Besides evaluating the model fit indices, the coefficients of paths in the hypothesized model were examined. Some coefficients were significant and some were not (Figure 4-2). Specifically, the paths from education to knowledge, from knowledge to beliefs and self-efficacy, from social support to self-efficacy, and from self-efficacy to self-management were significant and other paths were not significant.

Based on discussion as above, the hypothesized model derived based on studies with Americans with diabetes did not fit the data observed in a Chinese population with diabetes. A modification with the model was necessary based on both statistical findings and theoretical reasonability. The potential relationships between those variables were explored in this Chinese population with type 2 diabetes.

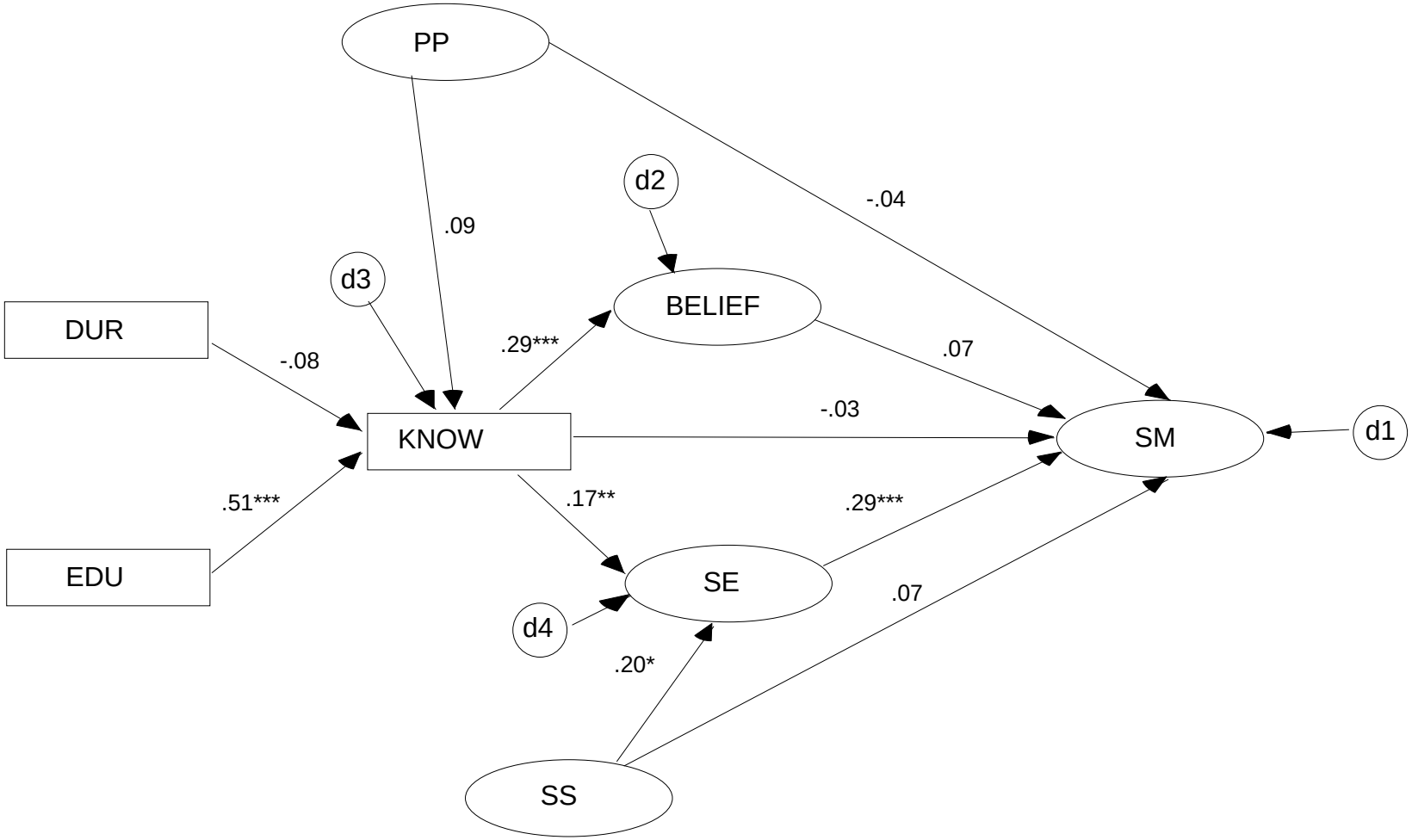

Figure 4-2. Hypothesized model with standardized estimates

* $p < .05$ ** $p < .01$ ***$p < .001$ (2-tailed)

First, based on the modification indices in the output, several paths were added, such as the path from duration to self-efficacy, duration to self-management, social support to beliefs, provider-patient to beliefs, and provider-patient to self-efficacy. From a theoretical perspective, these paths were reasonable to be added to the model. For example, better diabetes self-care communication between the provider and the patient might increase the patient's belief in the effectiveness of the self-care regimens and help the patient build up confidence in carrying out self-care activities. Patients with longer duration of diabetes might be better adapted to diabetes than those with less duration of diabetes. Thus patients with longer duration may have greater confidence in carrying out self-care activities and better adapt self-care activities into their daily life.

Based on the modification indices, two correlations were added into the model, including the correlations between provider communication and social support, and between two errors for self-efficacy and beliefs (d2 and d4). The standardized residual covariance matrix also showed that the residuals were 4.371 between provider communication and social support, and 2.660 between d2 and d4 respectively, both greater than 2.58. It was reasonable to add the correlation between provider communication and social support from a theoretical perspective as well. In China, patients with diabetes are usually accompanied by their family members when they visit a doctor. Family members may obtain information about diabetes and self-care regimens from communication between the patient and the doctor, which might be related to family member support of patients' self-care activities. Vice versa, patients receiving support from family members might be encouraged to discuss their self-care activities with a doctor. For the correlation between d2 and d4, even though no literature was found

supporting the correlation between self-efficacy and beliefs of treatment effectiveness, the researcher was interested in exploring the relationships between self-efficacy and beliefs and added the path in the model.

Furthermore, three paths with non-significant coefficients were dropped, including the paths from duration to knowledge, knowledge to self-management, social support to self-management, and provider communication to self-management. Dropping the paths was theoretically supportable. For example, knowledge about self-management was necessary but not enough to result in self-management behaviors, which was consistent with the literature. Removing the paths from social support and provider communication to self-management indicated that social support and provider communication can influence self-management indirectly.

Therefore, considering the statistical outputs and theoretical perspectives, some paths were added in the model and some paths were dropped. The modified model was tested again. The model fit was improved, χ^2 (14, N = 201) = 12.644, p = .555, GFI = .989, NFI = .925, AGFI = .972, RMSEA = .000, PGFI = .385, AIC = 56.644. The chi-square became non-significant, RMSEA less than .080, GFI, NFI, and AGFI all greater than .90, and AIC decreased significantly. These statistic tests indicated that the revised model had a better fit to the observed data. The coefficients between variables were also improved and all paths in the final model were significant (Figure 4-3).

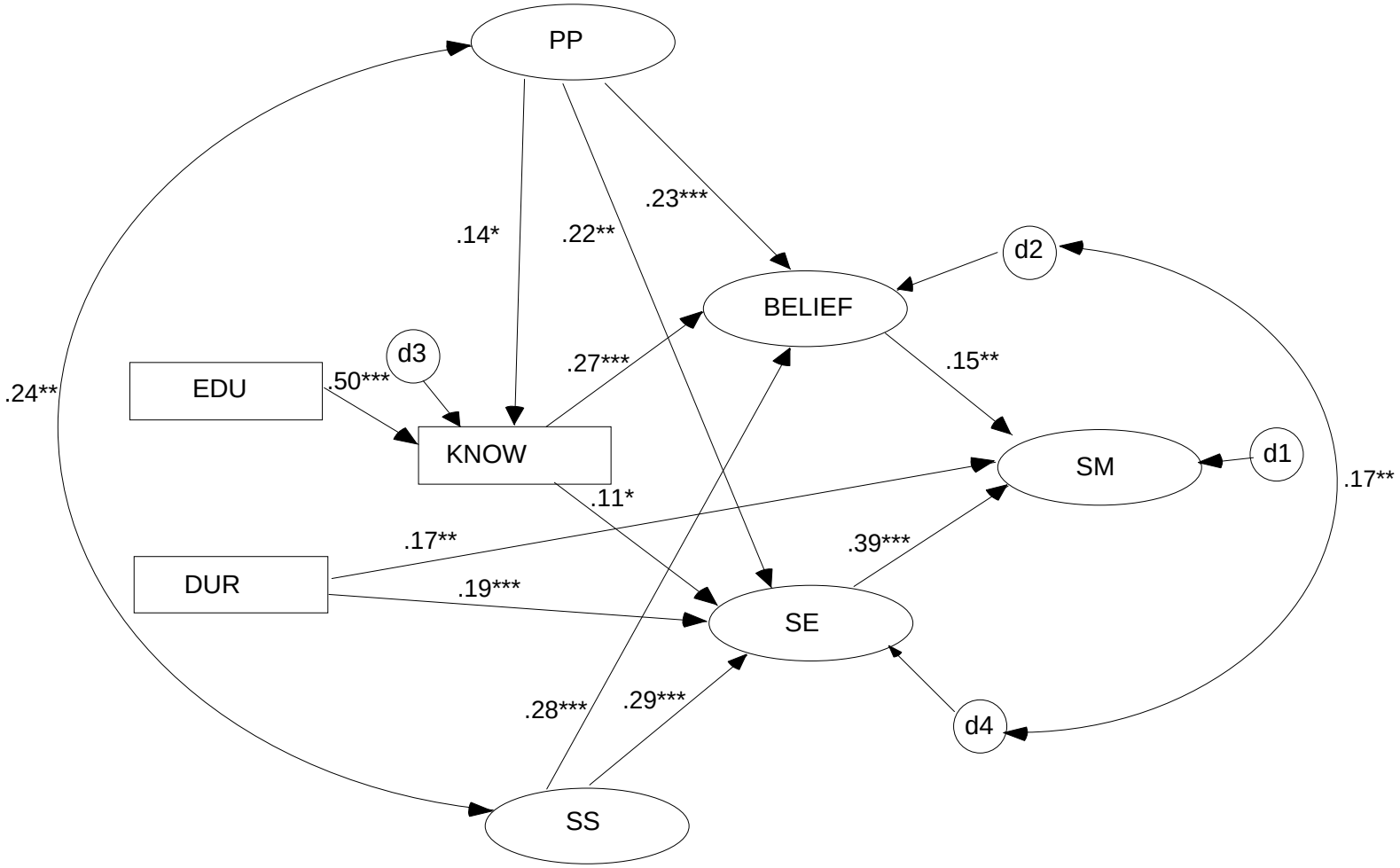

Figure 4-3. Final model with standardized estimates

Notes: * $p < .05$ ** $p < .01$ *** $p < .001$ (2-tailed)

Research question two: Does the belief of treatment effectiveness directly affect diabetes mellitus self-management (DMSM)?

Beliefs of treatment effectiveness directly affected the DMSM. Participants who believed in the effectiveness of treatment were more likely to perform DMSM. However, the standardized coefficient between beliefs and DMSM was small to median ($\beta = .15$, $p < .01$). The coefficient at .1 is considered small, .3 median, and .5 large (Figure 4-3).

Research question three: Does diabetes self-efficacy directly affect DMSM?

Diabetes self-efficacy significantly affected DMSM directly as expected. Patients with higher confidence in their capabilities to carry out activities had higher level of DMSM. The standardized coefficient between self-efficacy and DMSM was median to large ($\beta = .39$, $p < .001$) (Figure 4-3).

Research question four: Does knowledge directly and indirectly affect DMSM through beliefs and self-efficacy?

In the final model, the direct path from knowledge to self-management was removed because the path was not significant in the initial model fit test. However, the paths from knowledge to beliefs and self-efficacy were significant. The standardized coefficients for knowledge and beliefs was small to median ($\beta = .27$, $p < .001$) and for knowledge and self-efficacy was small ($\beta = .11$, $p < .05$) (Figure 4-3). Therefore, knowledge did not affect DMSM directly; instead, knowledge affected DMSM indirectly through beliefs and self-efficacy. This finding indicated that participants having knowledge about diabetes and self-management did not necessarily perform DMSM except through their beliefs or self-efficacy.

Research question five: Does social support directly and indirectly affect DMSM through self-efficacy?

Based on SEM testing, the non-significant path from social support to self-management was removed and a path from social support to beliefs was added in the final model. Therefore, social support from family members did not directly affect DMSM in Chinese patients with type 2 diabetes but significantly affected patients' self-efficacy ($\beta = .29$, $p < .001$) and beliefs ($\beta = .28$, $p < .001$), which in turn, affected DMSM.

Research question six: Does provider-patient communication directly and indirectly affect DMSM through knowledge?

In the final model, provider-patient communication did not directly affect patients' performance of DMSM. Two paths from provider communication to beliefs and self-efficacy were added in the final model. The standardized coefficient between communication and knowledge was small ($\beta = .11$, $p < .05$). The coefficients between communication and beliefs ($\beta = .23$, $p < .001$) and between communication and self-efficacy ($\beta = .22$, $p < .01$) were small to median. Therefore, provider communication indirectly affected diabetes self-management through knowledge about diabetes, beliefs of treatment effectiveness and diabetes self-efficacy.

Research question seven: Do education level and duration of diabetes directly affect knowledge?

Education level was significantly associated with patients' diabetes knowledge ($\beta = .50$, $p < .001$). However, duration of diabetes did not directly affect knowledge which indicated that longer duration of diabetes was not necessarily associated with higher level of diabetes knowledge. Furthermore, duration of diabetes not only directly

affected DMSM but also indirectly affected DMSM through self-efficacy. The coefficients both for duration and DMSM ($\beta = .17$, $p < .01$) and for duration and self-efficacy ($\beta = .19$, $p < .001$) were small to median.

Research question eight: Are the estimates of the direct and indirect causal effects in the model the same across different subgroups of patients with type 2 diabetes (type 2 diabetes with insulin-treated vs. type 2 diabetes without insulin-treated)?

The participants were divided into two groups, one group treated with insulin and another group treated without insulin. In this study, seventy five participants used insulin and 126 did not use insulin to control their type 2 diabetes. Based on the results of *t*-tests and chi-square tests, there were no significant differences in age, education level, and gender but there was a significant difference in duration of diabetes between the two subgroups. The participants using insulin had longer duration of diabetes (15 years ± 9.1) than those not using insulin (7.8 years ± 5.7), t (199) = - 6.954, $p = .000$.

The final model was tested to check if the model fit for both groups. The test resulted in the following statistical values: χ^2 (28, $N = 201$) = 27.69, $p = .481$, GFI = .982, NFI = .889, AGFI = .955, RMSEA = .000. All model fit indices researched desired values except for NFI. These statistic tests indicated that the final model generally fit for both groups.

As the figure 4-4 shows, most estimates of the direct and indirect casual relationships were consistent between the two groups. For example, self-efficacy directly influenced DMSM for both groups; both social support and provider-patient communication indirectly influenced DMSM through beliefs of treatment effectiveness and diabetes self-efficacy. Patients' educational level was significantly associated with

diabetes knowledge for both groups. In addition, knowledge indirectly affected DMSM through belief and duration of diabetes indirectly affected DMSM through self-efficacy for both groups.

However, some estimates for the direct and indirect casual effects of the model were different between the two groups. For example, the standardized coefficient for the association between belief of treatment effectiveness and DMSM was significant in the group treated with insulin ($\beta = .24$, $p < .01$) but the association was non-significant in the group treated without insulin ($\beta = .06$, $p > .05$). The coefficient was significant for the association between knowledge and self-efficacy for the group treated without insulin ($\beta = .17$, $p < .05$) but not for the group treated with insulin ($\beta = .01$, $p > .05$).

Most interestingly, provider-patient communication was a more important predictor than social support in the subgroup using insulin and social support was a more important predictor for the subgroup not using insulin. Specifically, provider communication significantly affected knowledge in the subgroup using insulin ($\beta = .24$, $p < .001$) but it was not true for the other group ($\beta = .10$, $p > .05$). Provider communication was a better predictor of self-efficacy in the subgroup using insulin ($\beta = .35$, $p < .01$) than in the subgroup not using insulin ($\beta = .18$, $p < .05$). Social support did not significantly affect self-efficacy in the subgroup using insulin ($\beta = .09$, $p > .05$) but significantly affected self-efficacy in the subgroup not using insulin ($\beta = .38$, $p < .001$) (Figure 4-4).

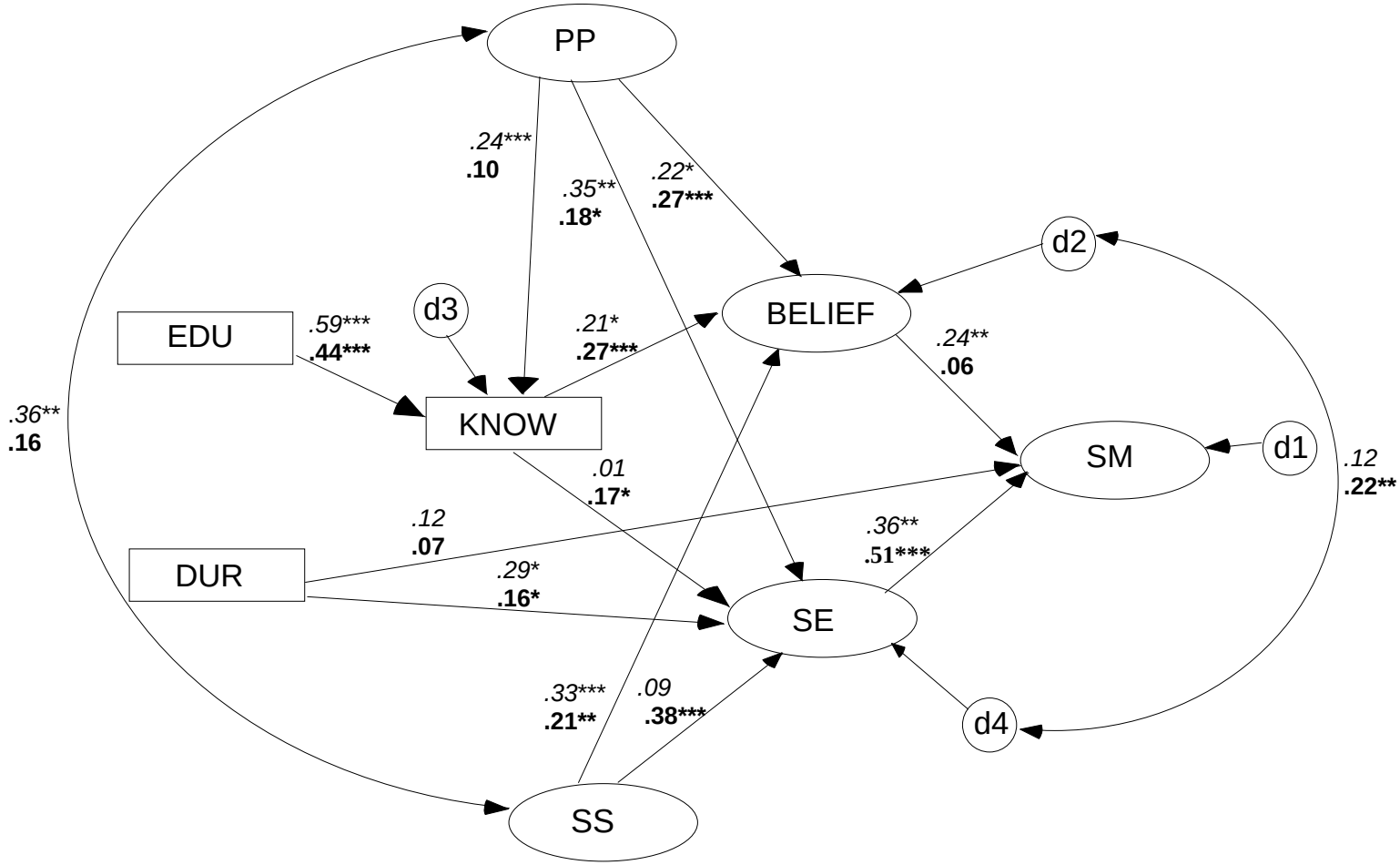

Figure 4-4. Multi-group model with standardized estimates

Notes: 1. * $p < .05$ ** $p < .01$ *** $p < .001$ (2-tailed)
2. The upper italic values represent the coefficients for the group using insulin and the lower bold values represent coefficients for the group not using insulin

Summary

In summary, the instruments measuring the study variables were tested for the reliability and validity in a group of Chinese patients with type 2 diabetes in a pilot study. Changes were made to all of the instruments based on psychometric properties. The findings of reliability and validity were acceptable and the revised instruments were used in the main study.

The findings of the main study showed that the initially hypothesized model did not fit the observed data well. The hypothesized model was modified based on both statistical results and theoretical perspectives. After modification based on the SEM testing, all model fit indices were improved indicating the revised model fit the observed data well. Besides evaluating the model fit, the coefficients between variables were examined. Some paths with significant coefficients were kept in the final model and some paths with non-significant coefficients were removed from the model. The findings were: 1) belief of treatment effectiveness and diabetes self-efficacy directly affected DMSM; 2) diabetes knowledge and social support indirectly affected DMSM through belief and self-efficacy; 3) provider-patient communication indirectly affected DMSM through knowledge, belief, and self-efficacy; 4) patients' educational level directly affected diabetes knowledge; 5) duration of diabetes not only directly affected DMSM but also indirectly affected DMSM through self-efficacy; 6) provider-patient communication were associated with social support; 7) some estimates of the model were different between the group treated with insulin and the group treated without insulin.

CHAPTER FIVE DISCUSSION

The purpose of this study was to test a hypothesized model estimating the influences of both individual and environmental factors on diabetes mellitus self-management (DMSM) in adult patients with type 2 diabetes in Beijing China. The individual factors included diabetes-related knowledge, beliefs of treatment effectiveness, and diabetes self-efficacy. The environmental factors included social support from family members and provider-patient communication. Education level, duration of diabetes, and type of treatment regimen were also included in the study. Structural equation modeling (SEM) was used to test the hypothesized model. The direct and indirect effects of these influencing factors on DMSM were explored.

In this chapter, a discussion of the study findings and the previous research literature is presented. This chapter is organized around the following four sections: 1) a discussion of the study findings along with research questions; 2) implications to nursing research and practice; 3) limitations of the study; 4) recommendations for future research.

Discussion of the Study Findings

Study Participants

The participants in this study consisted of adults, more than half aged 60 and over. Almost half (50.7%) reported a monthly family income at the rank between RMB 1,000 and 2,000 ($120 – $ 240), which was lower than the average monthly family income of RMB 2,800 ($338) for Beijing residents in 2004 (Lu, 2005). Most of participants reported having health insurance (85%).

The participants in the main study reported more likely performing medication self-management (89.1%), diet control (71.6%), and exercise (62.7%) every day. However, participants reported a lower frequency of performing foot care self management and blood glucose self-testing than the other diabetes self-management behaviors observed in this study. Only 18.9% of study participants performed foot care activities, and 4.5% performed blood glucose self-testing every day, much less frequently than the 39.6% of Americans with diabetes who perform daily blood glucose self-testing (CDC, 2000). These percentages indicated that problems concerning diabetes self-management were common in this group of participants.

Research Question One

Research question one: Does the hypothesized model fit the observed data? Based on the results of goodness-of-fit indices, the initially hypothesized model did not have a good fit to the observed data. Almost none of model fit indices reached the desired values and some paths between variables were not statistically significant. The model was modified by removing non-significant paths and adding several paths that were theoretically reasonable. The modified model was then tested. All indices for goodness-of-fit of the modified model were improved and reached the desired values, and the paths were significant. Therefore, the modified model represented a good model fit to the observed data. Figure 5-1 illustrates the modifications with the hypothesized model. The most important modifications were that the direct paths from knowledge, social support, and provider-patient communication to diabetes self-management were removed. Instead, the mediation effects of individual factors on the relationships between the environmental factors and self-management were identified. Specifically, knowledge, beliefs, and self-

efficacy respectively mediated the effects of social support and provider communication on diabetes self-management.

There were two possible explanations for the satisfactory model fit of the modified model to the observed data. First, the SEM analysis has the advantage of being able to identify not only direct effects of both individual and environmental factors on diabetes self-management but indirect effects as well. The hypothesized model was developed based on previous literature, in which the relationships between these variables and self-management were often examined using correlation analysis or multiple regression that could not detect any indirect effects between variables. Both direct and indirect relationships were probably the underlying mechanism of how these individual and environmental factors affected diabetes self-management.

Second, the hypothesized relationships in the initial model based on studies conducted in Americans with diabetes did not completely transfer to Chinese patients with diabetes presumably because cultural differences. In China, the use of complimentary and alternative medicine is common. Some patients use western therapies and may pursue Chinese traditional medicine treatment at the same time. The Chinese mindset is more intuitive and experience oriented (Hong, 2005). Chinese patients with diabetes may incorporate their own intuition and experience into the diabetes self-management instructions provided by health practitioners. For example, even though Chinese patients consider physicians an authority, if they disagree with their physicians' opinions based on their own experience, they may not follow the physicians' instructions. Therefore, the ritual and belief system in the Chinese culture may affect their diabetes self-management for Chinese patients with diabetes.

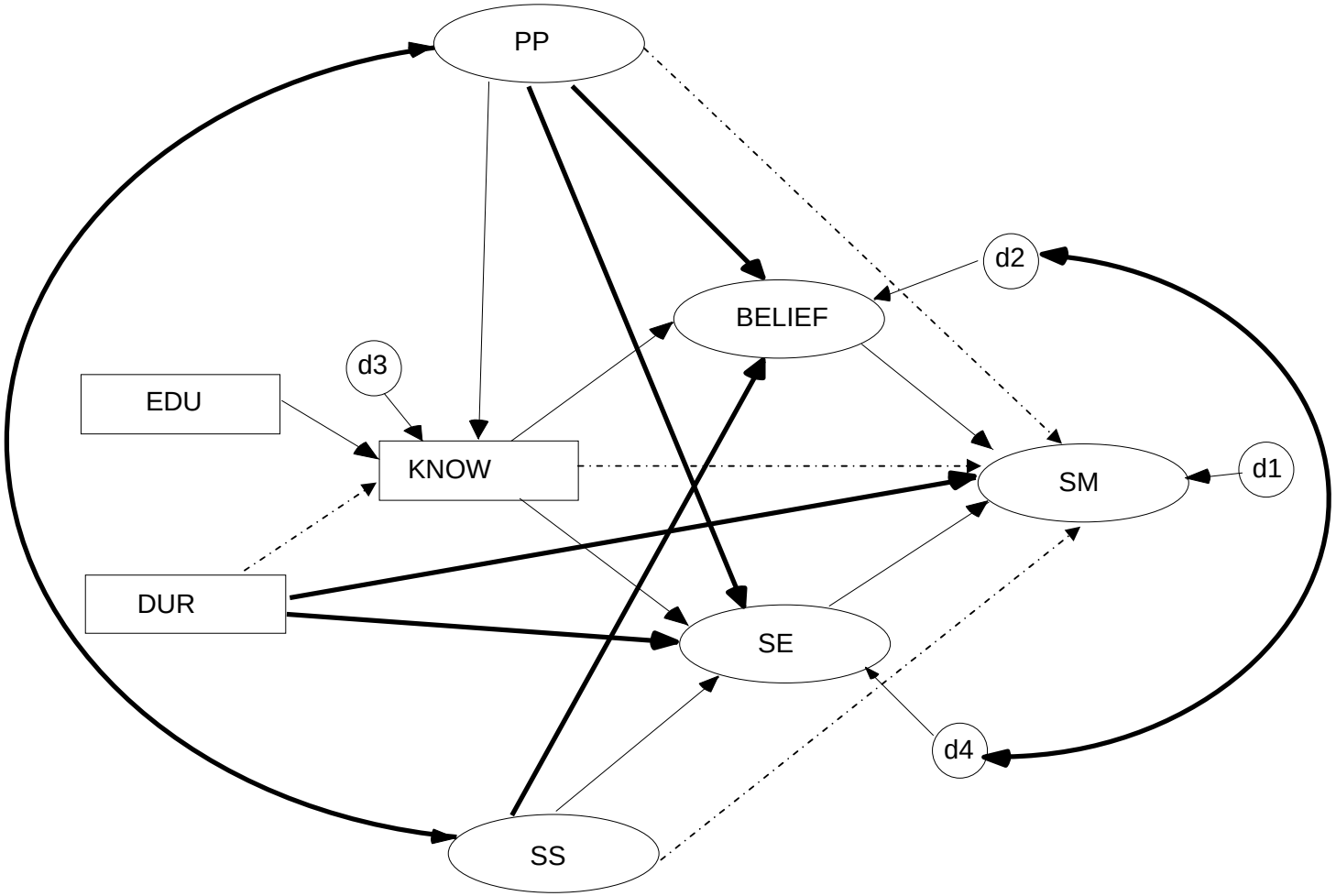

Figure 5-1: Modifications with the hypothesized model

Notes: The dotted line represents paths removed from the hypothesized. The **bond** line represents paths added in the final model.

Research Question Two

Research question two: Does the belief of treatment effectiveness directly affect DMSM? Beliefs of treatment effectiveness directly affected diabetes self-management in this Chinese sample. Specifically, participants with type 2 diabetes who had a stronger belief in the effectiveness of treatment to control diabetes and prevent diabetes complications were more likely to perform DMSM than those who had a weaker belief in treatment effectiveness. The findings were consistent with the results of the previous studies (Hampson, Glasgow, & Foster, 1995; Skinner et al., 2000; Skinner & Hampson, 2001).

However, in this study the relationship between beliefs of treatment effectiveness and DMSM was small to median ($\beta = .15, p < .01$), even though beliefs of treatment effectiveness has been reported as the most predictive construct compared to other constructs in the personal models of diabetes (Glasgow, Hampson, Strycker, & Ruggiero, 1997; Hampson, et al., 1995; Hampson, Glasgow, & Toobert, 1990). One possible explanation is that many Chinese people usually believe the effectiveness of both Western medicine and Chinese medicine, but on different aspects. For example, Chinese people believe that western medicine acts quickly, but they usually consider Chinese medicine better for adjusting the state of bodily equilibrium. Chinese patients with diabetes may use Western medicine methods to control their diabetes, and at the same time also pursue illness management strategies based on Chinese medicine traditions. This may dilute the influence of beliefs in the effectiveness of Western medicine based treatment on DMSM. Therefore, self-efficacy may be a more important factor affecting DMSM than beliefs of treatment effectives in this group of Chinese participants.

Research Question Three

Research question three: Does diabetes self-efficacy directly affect DMSM? The findings of this study add support to the growing evidence that self-efficacy is a significant predictor of DMSM. A key finding was that the coefficient for the path from self-efficacy to self-management had the highest value ($\beta = .39, p < .001$) compared to paths from other variables to self-management, which indicated that diabetes self-efficacy was the best predictor of DMSM among these individual and environmental factors.

Self-efficacy better predicted DMSM than beliefs of treatment effectiveness did in this sample. One possible explanation is that the construct of beliefs of treatment effectiveness has different predictive ability for different aspects of DMSM. Hampson et al. (1995) reported that belief of treatment effectiveness was most significantly related to dietary intake (partial $r = .42$) compared to physical activity (partial $r = .36$) and glucose testing (partial $r = .12$). In the current study, belief of treatment effectiveness was examined in relation to the overall DMSM rather than the individual aspects. The predictive ability of beliefs of treatment effectiveness for the overall DMSM level might be different for each aspect of the DMSM.

The findings of this study also added new evidence that the error (unaccounted variances) of diabetes self-efficacy was correlated with the error of beliefs of treatment effectiveness. Similar results were not found in the literature. Some researchers have reported that the variable of perceived benefits from the Health Belief Model or the Health Promotion Model mediated the association between self-efficacy and health behaviors (Shin, Yun, Pender, & Jang, 2005; Von, Ebert, Ngamvitroj, Park, & Kang, 2004). Even though the correlated errors were not found in other empirical research, the correlation could be explainable. Both self-efficacy and beliefs of treatment effectiveness are considered psychosocial factors. Self-efficacy is a type of belief in someone's

capabilities to carry out activities and beliefs of treatment effectiveness is a type of belief in the efficacy of those activities. These two types of beliefs might be correlated. However, further empirical studies are needed to explore and verify the correlation.

Research Question Four

Research question four: Does knowledge directly affect DMSM and indirectly affect DMSM through beliefs and self-efficacy? An important finding of this study was that the direct path from knowledge to DMSM hypothesized in the original model was not significant and the path was removed in the modified model. The finding provided evidence to the debate whether knowledge is sufficient to change behaviors. The results indicate that knowledge alone does not change behavior, which is consistent with previous studies (Chan & Molassiotis, 1999; Coates and Boore, 1996; Piaseu, Schepp, & Belza, 2002; Tankova, Dakovska, & Koev, 2001). Knowledge affected DMSM indirectly through beliefs of treatment effectiveness and diabetes self-efficacy.

The literature has shown both that knowledge is necessary but not sufficient to influence diabetes self-care behaviors and there are other factors linking between knowledge and outcomes (Coates & Boore., 1996). Chan and Molassiotis (1999) suggested that, in order to promote diabetes self-management, providing adequate knowledge is important, but individuals' beliefs and other psychosocial factors also are involved in self-management. In this study, beliefs of treatment effectiveness and self-efficacy were links between knowledge and DMSM, which means, in order to promote patients' DMSM, educational interventions should be designed to improve knowledge and enhance beliefs of treatment effectiveness and self-efficacy.

Research Question Five

Research question five: Does social support directly affect DMSM and indirectly affect DMSM through self-efficacy? Based on the simple correlation analysis, social support from family members was significantly associated with DMSM. However, in the SEM analysis, social support did not directly affect DMSM, and self-efficacy and beliefs of treatment effectiveness mediated the association between social support and DMSM in Chinese adult patients with type 2 diabetes.

These findings confirm the results reported by Duncan and McAuley (1993), who found that social support failed to affect exercise adherence directly but was able to affect exercise adherence indirectly through self-efficacy. Social support is a source of efficacy information (Bandura, 1997) and the social environment in which individuals live might facilitate or limit people's self-efficacy (Holloway & Watson, 2002). Therefore, in this study, social support from family members was one resource for building diabetes self-efficacy. In a cohesive and supportive family, the patient with diabetes may have an opportunity to express their feelings and concerns and feel being cared for by family members, which can increase their hope and confidence in managing diabetes.

The finding of beliefs of treatment effectiveness as a mediator between social support and DMSM supported the findings of some empirical studies (Skinner & Hampson, 1998; Skinner, John, & Hampson, 2000). Supportive families may encourage the adoption of patients' representations of their disease including disease-related beliefs (Skinner et al, 2000). In this study, an important dimension of social support was measured on tangible aids. Examples of tangible aids include family members reminding patients to take their medications, preparing a healthy diet, and encouraging them to engage in physical activity. The emphasis of family members on medication-taking, diet,

and exercise might influence participants' beliefs about the importance of these regimens on controlling diabetes and then influence their self-management behaviors.

Research Question Six

Research question six: Does provider-patient communication directly affect DMSM and indirectly affect DMSM through knowledge? Based on the simple correlation analysis, provider-patient communication was significantly associated with DMSM. But based on the SEM analysis, provider-patient communication failed to affect DMSM directly but was able to affect DMSM indirectly through diabetes-related knowledge, beliefs of treatment effectiveness, and self-efficacy. The findings of this study add support to the growing evidence showing the importance of provider-patient communication for promoting diabetes self-management behaviors (Heisler, Bouknight, Hayward, Smith, & Kerr, 2002; Heisler, Vijan, Anderson, Ubel, Bernstein, & Hofer, 2003; Kaplan, Greenfield, & Ware, 1989).

Kaplan et al. (1998) reported that the interaction between providers and patients reinforced patients' confidence and therefore influenced health outcomes. To facilitate patients' adoption of diabetes self-management, concordance between providers' beliefs and patients' beliefs about their illnesses and treatments must be reached. Higher degree of agreement between the physician and the patient resulted in higher level of DMSM (Heisler et al., 2003).

Chinese patients usually rely on the physician's suggestions on how to treat the disease. However, if patients disagree with the physician, they may not perform what they were instructed (University of Michigan Health System, 2005). In China, patients demonstrate more respect to the elderly physician because they consider the elderly physician has more experience and is more credible. Therefore, better provider-patient communication may help build up a trust relationship between the patient and the

physician and lead to common ground pertaining to the effectiveness of diabetes self-management between the provider and the patient in order to promote patients' DMSM ultimately.

In this study, a correlation between provider-patient communication and social support was added in the final model. In China, many patients are accompanied by their family members during their outpatient visit. By their presence, family members may obtain diabetes-related information from the communication between patients and their physicians, and would provide support to patients. Vice versa, family members' presence during the outpatient visit may assist the patient in communicating with the physician more effectively. However, further empirical studies are needed to elaborate the relationships between provider-patient communication and social support from family members.

Research Question Seven

Research question seven: Do education level and duration of diabetes directly affect knowledge? Education level directly affected knowledge. Participants having higher education degree had higher level of diabetes-related knowledge, which is consistent with previous research (Lukoschek, Fazzari, & Marantz, 2003). Patients with less educational level are more likely to have limited ability to understand health information (Lukoschek et al., 2003), which is a barrier for patients to obtain necessary knowledge about diabetes and self-management.

There was no relationship between duration and knowledge, which is inconsistent with previous research (Via & Salyer, 1999). In the study by Via and Salyer (1999), the variable of duration of diabetes was measured by either less than one year or more than one year. However, in the current study, only patients diagnosed with type 2 diabetes more than one year were included. Patients may try to obtain diabetes-related knowledge

within the first year since diagnosis and there is no obvious variation of knowledge after one year diagnosis, which might be the reason that duration of diabetes was not associated with level of diabetes-related knowledge in this study.

The findings that duration of diabetes not only directly affected DMSM but also indirectly affected DMSM through self-efficacy are similar to two other studies conducted in Taiwan (Chang, Chiou, Lin, Lin, & Tai, 2005) and in Korea (Shin, Yun, Pender, & Jang, 2005) who reported that prior experience with exercise may directly influence commitment to a plan for exercise and also indirectly influence commitment through exercise self-efficacy in a group of Korean adults with chronic diseases. One possible interpretation of the findings is that patients diagnosed with diabetes took years to accept their diagnoses and treatment regimens and patients with longer duration of diabetes may have better adaptation to the disease, less resistance to integrating the new lifestyle into their daily lives. In addition, patients with longer duration of diabetes had more experience with self-management regimens and previous successful experiences are considered major influential sources of self-efficacy (Bandura, 1997).

Research Question Eight

Research question eight: Do the estimates of the direct and indirect causal effects in the model are same across different subgroups of patients with type 2 diabetes (type 2 diabetes with insulin-treated vs. type 2 diabetes without insulin-treated)? Based on the multi-group SEM analysis, some path coefficients were identified differently between these two groups, which indicated that the relationships between some influencing factors and DMSM were not the same between the insulin-treated subgroup and the non-insulin-treated subgroup. Specifically, beliefs of treatment effectiveness was a better predictor of DMSM compared to self-efficacy in the insulin-treated subgroup, however self-efficacy was a stronger predictor of DMSM than beliefs of treatment effectiveness in the non-

insulin-treated subgroup. More interestingly, provider-patient communication was a more important factor influencing participants' knowledge and self-efficacy for the insulin-treated subgroup. However social support was a more important factor influencing diabetes self-management through self-efficacy for the non-insulin-treated subgroup.

Patients using insulin need a stricter and more complex regimen to control their diabetes. They need to inject insulin by themselves and check blood sugar more often. Patients using insulin may consider their diabetes more serious than those not using insulin (Hampson, Glasgow, & Toobert, 1990). Patients using insulin probably need more instructions from providers to manage their diabetes compared to those not using insulin. Therefore, for the subgroup using insulin, the communication between the provider and the patient may play a more important role in building their knowledge base, beliefs about treatment, and confidence in the management of their diabetes compared to family support. Non-insulin-treated patients may obtain knowledge from other sources. For example, some non-insulin-treated participants of this study indicated that they obtained diabetes-related knowledge mainly from books.

Patients using insulin may feel more stressful/depressed (Surwit, van Tilburg, Parekh, Lane, & Feinglos, 2005) than those not using insulin. According to Bandura (1997), one influence on an individual's self-efficacy is his/her physiological and affective states. Perceptions of disease severity or stressfulness may have a negative effect on self-efficacy. The negative effects of affective states can be lessened by mastery experiences (Bandura, 1997). Therefore, for patients using insulin, longer duration of diabetes with more experiences may be important for building self-efficacy.

Conclusion

The original hypothesized model did not fit the data well. However, the initial findings helped to guide the next step in SEM which was to modify the model. All of the

individual and environmental factors were retained in the final model but non-significant paths were dropped and new paths were added based on the findings and the theoretical soundness of the modifications. The final model was a good fit.

The key findings of the study were that beliefs of treatment effectiveness and diabetes self-efficacy were key proximal factors affecting DMSM. Knowledge and the environmental factors indirectly affected DMSM through beliefs of treatment effectiveness and self-efficacy. Some demographic and diabetes history variables also influenced on DMSM. The findings based on the multi-group SEM analysis indicated that provider communication was a more important factor affecting DMSM for the insulin-treated subgroup, while family support was more important for the non-insulin treated subgroup.

The results of this study contribute additional evidence on how individual and environmental factors affect DMSM both directly and indirectly. Rather than simple linear relationships, individual and environmental factors are intertwined and together influence DMSM. Some of the relationships between variables in this study were consistent with previous studies and theories. Some relationships may need to be tested and elaborated in the future. In conclusion, significant determinants of DMSM described in studies with Americans with diabetes are also important predictors of DMSM in Chinese with diabetes. The final model illustrated the potential underlying mechanism of how these factors influence DMSM in the context of the Chinese culture.

Implications to Nursing Practice

The findings of this study provided evidence to better understand diabetes self-management and its influencing factors. From the results of the study, some implications arise.

It is evident that knowledge does not affect diabetes self-management directly. This explains why traditional educational programs focusing on teaching patients about diabetes processes, treatment, and self-care regimens do not necessarily change diabetes patients' lifestyles and self-management behaviors. Knowledge about diabetes and self-care is only the basis for patients to play an active role in the management of their diabetes. Beliefs and self-efficacy are the crucial link between knowledge and DMSM. Therefore, to promote diabetes self-management in patients with diabetes, more intensive educational programs are needed to improve patients' knowledge which may enhance patients' beliefs about the effectiveness of the treatment and self-efficacy and then promote DMSM.

The model tested in this study provided a theoretical basis to understand how individual and environmental factors influence diabetes self-management in Chinese population with type 2 diabetes. The model illustrated factors that directly and indirectly affected DMSM. Rather than simple linear relationships, individual and environmental factors are intertwined to influence diabetes self-management. This implies that there is a need to involve both individual and environmental factors when developing interventions to promote diabetes self-management behaviors. Behavior change programs might be designed toward a more comprehensive approach. A more effective DMSM intervention may be one that is designed to provide knowledge about the disease and diabetes self-management skills, involve family members while delivering educational information to patients with diabetes, and enhance patients' communication skills with their providers.

In this study, patients' educational level, duration of diabetes, and type of treatment influenced DMSM either directly or indirectly. These findings may help nurses and other health care providers identify the characteristics that are most likely influencing DMSM. Providers may need to pay more attention to patients with lower education and

less duration of diabetes. Patients with lower educational level may have difficulty in mastering necessary knowledge or skills to manage their diabetes and health providers may need to spend a longer time with these patients. Providers need to be aware that patients with less duration of diabetes may be having a hard time adapting to diabetes self-management behaviors and have less confidence in their ability to carry out self-management activities. When providing interventions to promote diabetes self-management in patients with type 2 diabetes, patients may need to be dichotomized into two subgroups as insulin-treated or non-insulin-treated. The differences between the subgroups should be addressed in intervention programs. For example, improving the communication between the physician and the patient should be emphasized in the intervention to the insulin-treated subgroup, and enhancing social support from family members should be emphasized in the intervention to the subgroup not using insulin.

To date, this is the first study testing the relationships between DMSM and its determinants in Chinese adults with type 2 diabetes. The findings provide nurses and other health providers in China information that can help direct the development of interventions aimed at improvement of diabetes self-management in Chinese individuals with diabetes.

Limitations of the Study

Although the findings provide important insights about the relationships between DMSM and individual and environmental factors, several limitations should be noted. First, a cross-sectional design was used to describe the relationship between variables. The fundamental characteristic of cross-sectional design is that all data are collected at one time period, thereby limiting the ability to identify cause-and-effect relationships between variables. Even though the SEM statistical technique has an advantage over

other traditional methods for testing the causal relationships between variables, there are limitations in inferring causality.

Second, the results of the study are related to the chosen target sample only. The choice of a population of adult patients with type 2 diabetes seeking care at a hospital of an urban area in China limited the generalizability of the findings to this population. In addition, a convenience sampling method limited the generalizability of the study.

Third, the data of this study were collected using a self-reported questionnaire. Participants may underestimate or overestimate their self-management behaviors, which may have affected the findings.

Another limitation was that the sample size was relatively small for the multi-group SEM analysis. A sample size of 201 was used in the single-group SEM analysis to estimate 19 parameters in the initial model, which was acceptable. However, the sample size of 201 was relatively small in multi-group SEM analysis. Despite this shortcoming, the differences of the estimated parameters in the final model were identified between the two subgroups.

Recommendations for Future Research

The current study represents a step forward in examining the direct and indirect effects of both individual and environmental factors on diabetes self-management in Chinese patients with diabetes. Further improvement in this research field may contribute to the improvement of diabetes self-management and health outcomes in patients with diabetes. Several directions for future research are recommended.

A multi-methods approach to measuring diabetes self-management is suggested. For example, triangulating self-reported questionnaire and a daily diary may provide more accurate information about patients' self-management activates.

Replication of this study with other population may yield additional information

about the model. This study was conducted at a major hospital of an urban area in China. Replication of the study with diabetes patients from other local hospitals, other cities, or rural areas in China is recommended to validate the findings. Even though the influencing factors in the model were selected based on studies with American diabetes samples, the factors were examined individually and independently in relation to diabetes self-management in most of these studies. Therefore, studies testing the model in American diabetes samples and comparing the results to the findings of the current study will provide valuable insights about diabetes self-management and its influencing factors in different cultural contexts. In addition, studies testing the model in patients with other chronic diseases are recommended.

Third, research is needed to involve more environmental factors affecting diabetes self-management. In this study, both individual and environmental factors were examined in relation to diabetes self-management. Environmental factors were social support and provider-patient communication. In light of levels of influences on diabetes self-management summarized by Glasgow and Eakin (1998), social support is at family level and provider-patient communication at health system level. Glasgow and Eakin (1998) indicated that studies are needed that include other levels of environmental influences, such as worksite/school, neighborhood/community, and cultural/policy/media factors. Therefore, studies examining these factors in relation to diabetes self-management are recommended.

Finally, experimental studies based on the results of the current study are recommended. Based on the findings of this study, multiple levels of factors directly and indirectly influence diabetes self-management. Studies are needed to evaluate the effectiveness of intervention programs integrating all these factors. In addition, experimental studies have stronger power to identify the cause-and-effect relationships

between influencing factors and diabetes self-management.

Summary

This study added support to the growing evidence that individual and environmental factors affect diabetes self-management directly and indirectly. The final model fit lends validity to the importance of those factors for DMSM in Chinese participants with type 2 diabetes. Replication of this study with other populations is needed to confirm the results. In order to promote diabetes self-management, there is a need for more comprehensive interventions involving both individual and environmental factors beyond enhancing diabetes knowledge. The differences between the subgroups may need to be addressed in intervention programs.

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Appendix A: Questionnaire in the Pilot Study

This study is going to find out what factors influence how you care for your diabetes. You will be one of approximately 30 participants taking part in this study. Around 15 minutes of your time will be needed to take part in this study. There are no known risks or discomforts to you in this study. You will receive no direct benefit from your participation in this study, but your participation may help nurses and doctors better understand the factors influencing your caring for your diabetes.

The data from the study may be published; however, you cannot be identified by name because your name is not recorded. Taking part is voluntary and you may discontinue participation AT ANY TIME, without penalty or loss of benefits to which you are otherwise entitled. Yin Xu is the primary investigator of this study**.** If you have any other questions about this study, you may call Yin Xu at 13693123402, or email Yin Xu at xyi@ucmail.uc.edu. If you have any questions about your rights as a participant, you may email Dr. Margaret Miller, Chair of the Institutional Review Board—Social and Behavioral Sciences, at Margaret.Miller@UC.Edu.

Directions: The following questions are about your general information, what you do to take care of your diabetes, and what factors influence how you care for yourself. Please choose only one answer for each question. If you agree to take part in this study, answer the questions and return the questionnaire to me. Thank you for your taking part in the study.

By completing this survey I indicate my consent to participate in this study.

Section I：

On how many of the last seven days,	0	1	2	3	4	5	6	7
1. Did you follow the prescription of oral hypoglycemic agents?								
2. Did you follow the prescription of insulin injections?								
3. Have you followed a diabetic diet?								
4. Have you eaten your meals at the same time each day?								
5. Did you participate in at least 30 minutes of exercise?								
6. Did you participate in a specific exercise session (such as walking, Tai Qi, climbing mountains, dancing) other than what you do around the house or as part of your work?								
7. Did you test your blood/urine sugar?								
8. Did you test your blood/urine sugar the number of times recommended by your doctor?								
9. Did you check your feet?								
10. Did you dry between your toes after washing?								

Section II: There is only one correct answer for each question. If you know the answer, circle the letter in front of it. If you don't know the answer, circle the letter in front of "I don't know".

1. The usual cause of type 2 diabetes is:
   a) Eating too much sugar and other sweet foods
   b) Lack effective insulin in the body
   c) Failure of the kidneys to control sugar in the urine
   d) I don't know

2. In untreated diabetes the blood sugar is usually:
   a) Normal
   b) Increased
   c) Decreased
   d) I don't know

3. The NORMAL range for blood glucose is
   a) 2.8 mmol/l
   b) 6.1 mmol/l
   c) 7.0 mmol/l
   d) I don't know

4. Which of the following health problems is usually **NOT** complication of diabetes
   a) Kidney disease
   b) Eye problems
   c) Lung problems
   d) All the above
   e) I don't know

5. Which of the following is true?
   a) It does not matter if my diabetes is not fully controlled, as long as I do not have a coma
   b) It is best to show some sugar in the urine in order to avoid hypoglycemia
   c) Poor control of diabetes could result in a greater chance of complications later
   d) I don't know

6. The key to the control of diabetes is:
   a) The balance between regular amounts of insulin/tablets, food and exercise
   b) The maintenance of a low level of sugar in the urine in order to prevent hypoglycemia
   c) A high-protein, high fiber diet
   d) I don't know

7. People with diabetes should:
   a) Have their food cooked separately from that of the family
   b) Eat the same foods as the same time each day
   c) Vary their diet by substituting different foods correctly from the diet exchange list
   d) I don't know

8. In general, fit patients with diabetes should exercise for
   a) 1 hour once a week
   b) 20 to 30 minutes 3 to 5 times a week
   c) 1 hour every day
   d) I don't know

9. The general effect of exercise is to:
   a) Lower the blood sugar level
   b) Raise the blood sugar level
   c) Increase sugar in the urine
   d) I don't know

10. Rice is mainly:
   a) Protein
   b) Carbohydrate
   c) Fat
   d) I don't know

11. You can eat as much as you like of which of the following foods:
   a) Apples
   b) Celery
   c) Meat
   d) I don't know

12. Self-monitoring of blood glucose is:
   a) The key to determining the right amount of medication
   b) Important to see the effect of diabetes control such as diet and exercise
   c) Both a and b
   d) I don't know

13. People with diabetes should take good care of their feet because:
   a) After a long period of time, injecting insulin into the legs may cause swelling of the feet
   b) Flat feet are commonly associated with diabetes
   c) Older people with diabetes may have poor circulation of the blood in this area
   d) I don't know

14. The action of diabetes pills:
   a) Lower blood sugar
   b) Increase insulin secretion
   c) Increase insulin sensitivity
   d) All above
   e) I don't know

Section III: Please circle the answer that best describes how you feel:

	Not Important	Slightly Important	Fairly Important	Very Important	Extremely important
1. How important do you believe that diabetic diet is for controlling blood glucose level?					
2. How important do you believe exercise is for controlling blood glucose level?					
3. How important do you believe taking oral medications or injecting insulin is for controlling blood glucose level?					
4. How important do you believe self-monitoring blood or urine glucose is for controlling blood glucose level?					
5. How important do you believe diabetic diet is for preventing diabetic complications?					
6. How important do you believe exercise is for preventing diabetic complications?					
7. How important do you believe taking medications or injecting insulin is for preventing diabetic complications?					
8. How important do you believe self-monitoring blood or urine glucose is for preventing diabetic complications?					
9. How important do you believe checking your foot is for preventing diabetic complications?					

Section IV: Please answer each question by checking the answer that best describes how you feel:

	Yes Definitely	Probably Yes	Maybe Yes Maybe No	Probably No	Definitely Not
1. I think I am able to check my blood/urine glucose					
2. I think I am able to follow my diabetic diet most of the time					
3. I think I am able to follow my diabetic diet when I dine out together with my friends					
4. I think I am able to examine my feet for lesion					
5. I think I am able to get sufficient physical activities, for example, taking a walk, Tai Qi, or climbing mountains					
6. I think I am able to take extra exercise, when the doctor advises me to do so					
7. I think I am able to take my medicine or inject the insulin as prescribed					

Section V: Please answer each question by checking the answer that best indicates your experience over the past 3 months

Over the past 3 months,	Never	Rarely	Sometimes	Often	Always
1. **How often did** your family listen carefully to what you have to say about your diabetes?					
2. **How often did** your family encourage you to participate in exercise?					
3. **How often did** your family buy food or cook food for you that was especially recommended for your diabetes?					
4. **How often did** your family select food choices required by diabetic diet when you ate with them?					
5. **How often did** your family praise you for sticking to following diabetic diet, exercising, and self-monitoring blood/urine glucose?					
6. **How often did** your family help you remember to take your oral medicine or inject insulin?					
7. **How often did** your family help you to check your feet?					

Section VI: Please answer each question by checking the answer that best indicates your experience over the past 3 months

Over the past 3 months,	Never	Rarely	Sometimes	Often	Always
1. **How often did** your doctor use medical words that you did not understand?					
2. **How often did** you have trouble understanding your doctor because he/she spoke too fast?					
3. **How often did** your doctor listen carefully to what you had to say about your diabetes?					
4**. How often did** your doctor answer your questions and address your concerns about diabetes management during office visits?					
5. **How often did** your doctor thoroughly explain why a test was being done and what were the results of tests you had done (e.g. HbA1c, cholesterol, other laboratory tests)?					
6. **How often did** your doctor explain what you need to do to take care of your diabetes?					
7. **How often did** your doctor explain to you how to take the medicine (oral agents or insulin) (when, how much, and for how long)?					

Please put " √ " at the line next to your answer that best describes your situation:

1. Age: __ __ years old

2. Sex: Male___ Female___

3. What is your marital status?

___Never married

___Married

___Separated/Divorced

___Widowed

4. How many years of formal schooling have you completed?

___6-year primary school

___9-year middle school

___High school graduate

___Some college or technical school

___College graduate (bachelor's degree)

___Graduate degree

5. Which of the categories best describes your family's monthly salary from all sources?

___ Less than 1,000 yuan
___ 1,000 yuan to 2,000 yuan
___ 2,000 yuan to 4,000 yuan
___ 4,000 yuan to 6,000 yuan
___ 6,000 yuan to 8,000 yuan
___ 8,000 yuan and over

6. How many years have you been diagnosed as type 2 diabetes? _____ (Please put years)

7. Are you using insulin to control your diabetes? Yes ___ No ___

8. Do you smoke? Yes___ No___

9. Who pays for you medical care expenses (you can select one or more from the following)?

___China Governmental Health Plan

___Through an employer – the employer pays all or part of medical expenses

___No insurance and have to pay from my salary

Appendix B: Content Validity Evaluation

Instruction: please rate each item as follows:

- How representative the items are of the content domain of concepts on a scale of 1-4.
- How clear you think each item is on a scale of 1-4.
- Space is provided for you to comment on the item or to suggest revisions.

Theoretical definition *Diabetes self-management* - a set of behaviors that patients with diabetes performs daily to achieve diabetes control, including regulating diet, engaging in exercise, taking medications (insulin or oral hypoglycemia agents), self-monitoring blood/urine glucose levels, and maintaining foot care.	Representativeness 1 = item is *not representative* 2 = item needs *major revisions* to be representative 3 = item needs *minor revisions* to be representative 4 = item is *representative*	Clarity 1 = item is *not clear* 2 = item needs *major revisions* to be clear 3 = item needs *minor revisions* to be clear 4 = item is *clear*
Items 1. 在过去的 7 天里, 有几天您是遵从处方服用口服药的?	1 2 3 4	1 2 3 4
2. 在过去的 7 天里, 有几天您是遵从胰岛素处方使用胰岛素的?	1 2 3 4	1 2 3 4
3. 在过去的 7 天里, 有几天您是遵从您的糖尿病饮食要求进食的?	1 2 3 4	1 2 3 4
4. 在过去的 7 天里, 有几天您是每天都是在同一时间吃饭的?	1 2 3 4	1 2 3 4
5. 在过去的 7 天里, 有几天您每天参加至少半小时的体育活动?	1 2 3 4	1 2 3 4
6. 在过去的 7 天里, 有几天您除了家务或工作以外还参加某一专门的体育锻炼, 比如散步、打太极拳、爬山、跳舞?	1 2 3 4	1 2 3 4
7. 在过去的 7 天里, 有几天您测量您的血糖或尿糖?	1 2 3 4	1 2 3 4
8. 在过去的 7 天里, 有几天您遵从医生所建议的血糖或尿糖检测次数测量您的血糖或尿糖?	1 2 3 4	1 2 3 4
9. 在过去的 7 天里, 有几天您检查您的脚?	1 2 3 4	1 2 3 4
10. 在过去的 7 天里, 有几天您曾在洗脚后擦干脚趾缝?	1 2 3 4	1 2 3 4

Theoretical definition *Diabetes knowledge* - patients' understanding of information about physiological aspects of diabetes as a disease and principles of diabetes management with diabetic diet, exercise, medication, glucose self-monitoring, and foot care	Representativeness 1 = item is *not representative* 2 = item needs *major revisions* to be representative 3 = item needs *minor revisions* to be representative 4 = item is *representative*	Clarity 1 = item is *not clear* 2 = item needs *major revisions* to be clear 3 = item needs *minor revisions* to be clear 4 = item is *clear*
Items 1. II 型糖尿病通常的病因是： a) 吃过多的糖和其它甜的食物 b) 身体中缺乏有效的胰岛素 c) 肾脏无法控制尿中的糖 d) 我不知道	1 2 3 4	1 2 3 4
2. 对于未被治疗的糖尿病，血糖将会： a) 正常 b) 升高 c) 降低 d) 我不知道	1 2 3 4	1 2 3 4
3. 正常的血糖范围是： a) 4 – 8 mmol/l b) 7 -15 mmol/l c) 2 -10 mmol/l d) 我不知道	1 2 3 4	1 2 3 4
4. 以下的健康问题中，哪个通常不是糖尿病并发症： a) 肾脏疾病 b) 眼睛疾病 c) 肺部疾病 d) 我不知道	1 2 3 4	1 2 3 4
5. 以下哪句话是正确的： a) 只要我没有糖尿病昏迷，我的糖尿病是否被完全控制并不重要 b) 最好是让尿中显示有糖，以避免低血糖发生 c) 若糖尿病不能很好地控制，将会导致糖尿病病发症有较高的发生机会 d) 我不知道	1 2 3 4	1 2 3 4

Theoretical definition *Diabetes knowledge* - patients' understanding of information about physiological aspects of diabetes as a disease and principles of diabetes management with diabetic diet, exercise, medication, glucose self-monitoring, and foot care	Representativeness 1 = item is *not representative* 2 = item needs *major revisions* to be representative 3 = item needs *minor revisions* to be representative 4 = item is *representative*	Clarity 1 = item is *not clear* 2 = item needs *major revisions* to be clear 3 = item needs *minor revisions* to be clear 4 = item is *clear*
6. 控制糖尿病的关键是： a) 规律定量地用药、饮食、及体育锻炼之间达到平衡 b) 保持一个低的尿糖水平以避免低血糖 c) 高蛋白高纤维饮食 d) 我不知道	1 2 3 4	1 2 3 4
7. 糖尿病患者应该： a) 将自己的食物与家里的食物分开烹饪 b) 每天在同一时间吃同样的食物 c) 根据食品交换表，正确地选择不同的替代食物以变化饮食 d) 我不知道	1 2 3 4	1 2 3 4
8. 通常来说，体形适当的糖尿病病人应该锻炼： a) 每星期一个小时 b) 每星期 3 次，每次 20 至 30 分钟 c) 每天一个小时 d) 我不知道	1 2 3 4	1 2 3 4
9. 体育锻炼的效果通常是： a) 降低血糖水平 b) 升高血糖水平 c) 升高尿糖水平 d) 我不知道	1 2 3 4	1 2 3 4
10. 米饭主要是： a) 蛋白质 b) 碳水化合物 c) 脂肪 d) 我不知道	1 2 3 4	1 2 3 4

Theoretical definition *Diabetes knowledge* - patients' understanding of information about physiological aspects of diabetes as a disease and principles of diabetes management with diabetic diet, exercise, medication, glucose self-monitoring, and foot care	Representativeness 1 = item is *not representative* 2 = item needs *major revisions* to be representative 3 = item needs *minor revisions* to be representative 4 = item is *representative*	Clarity 1 = item is *not clear* 2 = item needs *major revisions* to be clear 3 = item needs *minor revisions* to be clear 4 = item is *clear*
11. 以下食物中，您可以不限量吃的是： a) 苹果 b) 芹菜 c) 肉类 d) 我不知道	1 2 3 4	1 2 3 4
12. 自我监测血糖： a) 是判断用药量是否正确的关键 b) 对观测糖尿病控制(如饮食和体育锻炼)的效果很重要 c) 以上两条都对 d) 我不知道	1 2 3 4	1 2 3 4
13. 糖尿病患者应该照顾好自己的脚，这是因为： a) 长期地在腿上进行胰岛素注射会导致脚的肿胀 b) 糖尿病患者常会并发平足 c) 患糖尿病的中老年患者的脚部的的血液循环可能会不好 d) 我不知道	1 2 3 4	1 2 3 4
14. 治疗糖尿病的药物的作用是： a) 降低血糖 b) 升高血糖 c) 中和胰岛素 d) 我不知道	1 2 3 4	1 2 3 4

Theoretical definition *Beliefs of treatment effectiveness* - patients' beliefs about the importance of diabetes mellitus self-management activities in controlling glucose level and preventing long-term diabetic complications	Representativeness 1 = item is *not representative* 2 = item needs *major revisions* to be representative 3 = item needs *minor revisions* to be representative 4 = item is *representative*	Clarity 1 = item is *not clear* 2 = item needs *major revisions* to be clear 3 = item needs *minor revisions* to be clear 4 = item is *clear*
Items 1. 您认为糖尿病饮食对控制血糖水平有多重要？ ● 不重要 ● 有点重要 ● 挺重要 ● 非常重要 ● 极其重要	1 2 3 4	1 2 3 4
2. 您认为体育锻炼对控制血糖水平有多重要？	1 2 3 4	1 2 3 4
3. 您认为服用降糖药或注射胰岛素对控制血糖水平有多重要？	1 2 3 4	1 2 3 4
4. 您认为自我监测血糖或尿糖对控制血糖水平有多重要？	1 2 3 4	1 2 3 4
5. 您认为糖尿病饮食对于防止糖尿病并发症有多重要？	1 2 3 4	1 2 3 4
6. 您认为体育锻炼对于防止糖尿病并发症有多重要？	1 2 3 4	1 2 3 4
7. 您认为服用降糖药或注射胰岛素对于防止糖尿病并发症有多重要？	1 2 3 4	1 2 3 4
8. 您认为自我监测血糖或尿糖对于防止糖尿病并发症有多重要？	1 2 3 4	1 2 3 4
9. 您认为检查您的脚对于防止糖尿病并发症有多重要？	1 2 3 4	1 2 3 4

Theoretical definition *Diabetes self-efficacy* - judgment of the diabetes patients' own capability to carry out diabetes self-management activities, including diabetes diet, exercise, taking medications, self-monitoring blood/urine glucose levels, and foot care	Representativeness 1 = item is *not representative* 2 = item needs *major revisions* to be representative 3 = item needs *minor revisions* to be representative 4 = item is *representative*	Clarity 1 = item is *not clear* 2 = item needs *major revisions* to be clear 3 = item needs *minor revisions* to be clear 4 = item is *clear*
Items 1. 我想我能够检查我的血糖或者尿糖 ● 肯定可以 ● 可能可以 ● 不确定 ● 可能不行 ● 肯定不行	1 2 3 4	1 2 3 4
2. 我想我能够在大部分的时候遵从我的糖尿病饮食	1 2 3 4	1 2 3 4
3. 我想我能够在与朋友聚餐时遵从我的糖尿病饮食	1 2 3 4	1 2 3 4
4. 我想我能够检查我的脚上是否有伤口	1 2 3 4	1 2 3 4
5. 我想我能够进行充分的锻炼，如散步，打太极拳，爬山	1 2 3 4	1 2 3 4
6. 当医生建议我进行额外的体育锻炼时，我想我可以做到	1 2 3 4	1 2 3 4
7. 我想我能够按照处方服用口服药或注射胰岛素	1 2 3 4	1 2 3 4

Theoretical definition *Social support* - patients' perception of support from their family members including feelings of being loved by their family members; tangible aids related to diabetes management from family members, and appraisal from family members on their diabetes-related self-management activities	Representativeness 1 = item is *not representative* 2 = item needs *major revisions* to be representative 3 = item needs *minor revisions* to be representative 4 = item is *representative*	Clarity 1 = item is *not clear* 2 = item needs *major revisions* to be clear 3 = item needs *minor revisions* to be clear 4 = item is *clear*
Items 1. 有多频繁您的家人仔细听您讲述有关您的糖尿病的事情？ ● 没有 ● 很少 ● 有时 ● 经常 ● 总是	1 2 3 4	1 2 3 4
2. 有多频繁您的家人鼓励您参加体育锻炼？	1 2 3 4	1 2 3 4
3. 有多频繁您的家人给您买或做些为您的糖尿病特别推荐的食物？	1 2 3 4	1 2 3 4
4. 当您与家人吃饭时，有多频繁您的家人挑选一些符合糖尿病饮食要求的食品？	1 2 3 4	1 2 3 4
5. 有多频繁您的家人在您坚持进食糖尿病饮食、参加锻炼、自我监测血糖或尿糖时表扬您？	1 2 3 4	1 2 3 4
6. 有多频繁您的家人帮您记着吃药或注射胰岛素？	1 2 3 4	1 2 3 4
7. 有多频繁您的家人帮您检查脚？	1 2 3 4	1 2 3 4

Theoretical definition *Provider-patient communication* - patients' perception of physician's general clarity during their talking, physicians' explanation of diabetes and medical care, and physicians' carefully listening to and responsiveness to patient problems and concerns about diabetes management	Representativeness 1 = item is *not representative* 2 = item needs *major revisions* to be representative 3 = item needs *minor revisions* to be representative 4 = item is *representative*	Clarity 1 = item is *not clear* 2 = item needs *major revisions* to be clear 3 = item needs *minor revisions* to be clear 4 = item is *clear*
Items 1. 有多频繁您的医生使用的医学术语是您不理解的？ ● 没有 ● 很少 ● 有时 ● 经常 ● 总是	1 2 3 4	1 2 3 4
2. 有多频繁您因为医生讲话太快而不理解医生的讲话内容？	1 2 3 4	1 2 3 4
3. 有多频繁您的医生仔细地听您讲述有关您的糖尿病的情况？	1 2 3 4	1 2 3 4
4. 在你看病时，有多频繁您的医生回答您的问题和回应您对糖尿病处理的关心？	1 2 3 4	1 2 3 4
5. 有多频繁医生向您仔细地解释，为什么要做某项检查和检查的结果是什么 (比如检查糖化血红蛋白、血脂、或其它的实验室检查) ？	1 2 3 4	1 2 3 4
6. 有多频繁您的医生向您解释您需要做些什么来照料您的糖尿病？	1 2 3 4	1 2 3 4
7. 有多频繁您的医生向您解释如何服药 (口服药或胰岛素) (比如说用药时间、药量、和用多长时间的药) ？	1 2 3 4	1 2 3 4

Appendix C: Revised Questionnaire in the Main Study

This study is going to find out what factors influence how you care for your diabetes. You will be one of approximately 200 participants taking part in this study. Around 15 minutes of your time will be needed to take part in this study. There are no known risks or discomforts to you in this study. You will receive no direct benefit from your participation in this study, but your participation may help nurses and doctors better understand the factors influencing your caring for your diabetes.

The data from the study may be published; however, you cannot be identified by name because your name is not recorded. Taking part is voluntary and you may discontinue participation AT ANY TIME, without penalty or loss of benefits to which you are otherwise entitled. Yin Xu is the primary investigator of this study**.** If you have any other questions about this study, you may call Yin Xu at 13693123402, or email Yin Xu at xyi@ucmail.uc.edu. If you have any questions about your rights as a participant, you may email Dr. Margaret Miller, Chair of the Institutional Review Board—Social and Behavioral Sciences, at Margaret.Miller@UC.Edu.

Directions: The following questions are about your general information, what you do to take care of your diabetes, and what factors influence how you care for yourself. Please choose only one answer for each question. If you agree to take part in this study, answer the questions and return the questionnaire to me. Thank you for your taking part in the study.

By completing this survey I indicate my consent to participate in this study.

Section I：

On how many of the last seven days**,**	0	1	2	3	4	5	6	7
1. Did you follow the prescription of oral hypoglycemic agents?								
2. Did you follow the prescription of insulin injections?								
3. Have you followed a diabetic diet?								
4. Did you participate in physical exercise at least 30 minutes of exercise? (such as walking, Tai Qi, climbing mountains, dancing) other than what you do around the house or as part of your work?								
5. Did you test your blood sugar?								
6. Did you test your blood/urine sugar the number of times recommended by your doctor?								
7. Did you check your feet?								
8. Did you dry between your toes after washing?								

Section II: There is only one correct answer for each question. If you know the answer, circle the letter in front of it. If you don't know the answer, circle the letter in front of "I don't know".

1. The usual cause of type 2 diabetes is:
    c) Eating too much sugar and other sweet foods
    d) Lack effective insulin in the body
    e) Failure of the kidneys to control sugar in the urine
    f) I don't know

2. In untreated diabetes the blood sugar is usually:
    a) Normal
    b) Increased
    e) Decreased
    f) I don't know

3. The NORMAL range for **fasting blood glucose** is
    a) 2.8 mmol/l
    b) 6.1 mmol/l
    c) 7.0 mmol/l
    d) I don't know

4. Which of the following health problems is usually **NOT** complication of diabetes
    a) Kidney disease
    b) Eye problems
    c) Lung problems
    d) All the above
    e) I don't know

5. Which of the following is true?
    a) It does not matter if my diabetes is not fully controlled, as long as I do not have a coma
    b) It is best to show some sugar in the urine in order to avoid hypoglycemia
    c) Poor control of diabetes could result in a greater chance of complications later
    d) I don't know

6. The key to the control of diabetes is:
    a) The balance between regular amounts of insulin/tablets, food and exercise
    b) The maintenance of a low level of sugar in the urine in order to prevent hypoglycemia
    c) A high-protein, high fiber diet
    d) I don't know

7. People with diabetes should:
    a) Have their food cooked separately from that of the family
    b) Eat the same foods as the same time each day
    c) Vary their diet by substituting different foods correctly from the diet exchange list
    d) I don't know

8. In general, fit patients with diabetes should exercise for
   a) 1 hour once a week
   b) 20 to 30 minutes 3 to 5 times a week
   e) 1 hour every day
   f) I don't know

9. The general effect of exercise is to:
   a) Lower the blood sugar level
   b) Raise the blood sugar level
   c) Increase sugar in the urine
   d) I don't know

10. Rice is mainly:
   a) Protein
   b) Carbohydrate
   e) Fat
   f) I don't know

11. You can eat as much as you like of which of the following foods:
   a) Apples
   b) Pumpkin
   c) Kelp
   d) Tofu
   e) I don't know

12. Self-monitoring of blood glucose is:
   a) The key to determining the right amount of medication
   b) Important to see the effect of diabetes control such as diet and exercise
   c) Both a and b
   d) I don't know

13. People with diabetes should take good care of their feet because:
   a) After a long period of time, injecting insulin into the legs may cause swelling of the feet
   b) Flat feet are commonly associated with diabetes
   c) Older people with diabetes may have poor circulation of the blood in this area
   d) I don't know

14. The action of diabetes pills:
   a) Lower blood sugar
   b) Increase insulin secretion
   f) Increase insulin sensitivity
   g) All above
   h) I don't know

Section III: Please circle the answer that best describes how you feel:

	Not Important	Slightly Important	Fairly Important	Very Important	Extremely important
1. How important do you believe that diabetic diet is for controlling blood glucose level?					
2. How important do you believe exercise is for controlling blood glucose level?					
3. How important do you believe taking oral medications or injecting insulin is for controlling blood glucose level?					
4. How important do you believe self-monitoring blood or urine glucose is for controlling blood glucose level?					
5. How important do you believe diabetic diet is for preventing diabetic complications?					
6. How important do you believe exercise is for preventing diabetic complications?					
7. How important do you believe taking medications or injecting insulin is for preventing diabetic complications?					
8. How important do you believe self-monitoring blood or urine glucose is for preventing diabetic complications?					
9. How important do you believe checking your foot is for preventing diabetic complications?					

Section IV: Please answer each question by checking the answer that best describes how you feel:

	Yes Definitely	Probably Yes	Maybe Yes Maybe No	Probably No	Definitely Not
1. **Do you think you** are able to check my blood glucose?					
2. **Do you think you** are able to follow my diabetic diet most of the time?					
3. **Do you think you** are able to follow my diabetic diet when I dine out together with my friends?					
4. **Do you think you** are able to examine my feet for lesion?					
5. **Do you think you** are able to get sufficient physical activities, for example, taking a walk, Tai Qi, or climbing mountains?					
6. **Do you think you** are able to take extra exercise, when the doctor advises me to do so?					
7. **Do you think you** are able to take my medicine or inject the insulin as prescribed?					

Section V: Please answer each question by checking the answer that best indicates your experience over the past 3 months

Over the past 3 months, **how often did**	Never	Rarely	Sometimes	Often	Always
1. your family listen carefully to what you have to say about your diabetes?					
2. your family encourage you to participate in exercise?					
3. your family buy food or cook food for you that was especially recommended for your diabetes?					
4. your family select food choices required by diabetic diet when you ate with them?					
5. your family praise you for sticking to following diabetic diet, exercising, and self-monitoring blood/urine glucose?					
6. your family help you remember to take your oral medicine or inject insulin?					

Section VI: Please answer each question by checking the answer that best indicates your experience over the past 3 months

Over the past 3 months, **how often did**	Never	Rarely	Sometimes	Often	Always
1. your doctor use medical words that you did not understand?					
2. you have trouble understanding your doctor because he/she spoke too fast?					
3. your doctor listen carefully to what you had to say about your diabetes?					
4**.** your doctor answer your questions and address your concerns about diabetes management during office visits?					
5. your doctor thoroughly explain why a test was being done and what were the results of tests you had done (e.g. HbA1c, cholesterol, other laboratory tests)?					
6. your doctor explain what you need to do to take care of your diabetes?					
7. your doctor explain to you how to take the medicine (oral agents or insulin) (when, how much, and for how long)?					

Please put " √ " at the line next to your answer that best describes your situation:

2. Age: __ __ years old

2. Sex: Male___ Female___

3. What is your marital status?

___Never married

___Married

___Separated/Divorced

___Widowed

4. How many years of formal schooling have you completed?

___6-year primary school

___9-year middle school

___High school graduate

___Some college or technical school

___College graduate (bachelor's degree)

___Graduate degree

5. Which of the categories best describes your family's monthly salary from all sources?

___ Less than 1,000 yuan
___1,000 yuan to 2,000 yuan
___ 2,000 yuan to 4,000 yuan
___ 4,000 yuan to 6,000 yuan
___ 6,000 yuan to 8,000 yuan
___ 8,000 yuan and over

6. Employment status:

___ Unemployed
___ Full-time employed
___ Part-time employed
___ Retired
___ Others

7. With whom you are living:

___ By myself
___ With parents
___ With spouse and children
___ Parents, spouse, and children
___ Children
___ Others

8. How many years have you been diagnosed as type 2 diabetes? _____ (Please put years)

9. Are you using insulin to control your diabetes? Yes ___ No ___

10. Do you smoke? Yes___ No___

11. Who pays for you medical care expenses (you can select one or more from the following)?

___China Governmental Health Plan

___Through an employer – the employer pays all or part of medical expenses

___No insurance and have to pay from my salary