

The role of behavioral characteristics in disease-management of insulin-treated type 2 diabetes mellitus patients

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PhD Thesis

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Szeged

2021

List of publications providing the basis of the thesis:

1. **Klinovszky, A.**, Kiss, I. M., Papp-Zipernovszky, O., Lengyel, Cs., Buzás, N. (2019). Associations of different adherences in patients with type 2 diabetes mellitus. *Patient Preference and Adherence*, 13(1), 395–407. **IF: 1.946, Q1**
2. **Klinovszky, A.**, Papp-Zipernovszky, O., Buzás, N. (2021). Building a House of Skills – A Study of Functional Health Literacy and Numeracy among Patients with Type 2 Diabetes in Hungary. *International Journal of Environmental Research and Public Health*, 18(4), 1–14. **IF: 3.390, Q2**
3. **Klinovszky, A.**, Papp-Zipernovszky, O., Sallay, V., Lengyel, Cs., Buzás, N. (2021). Behavioral characterization of patients with Type 2 Diabetes Mellitus (T2DM) for more effective therapy based on the qualitative research (**manuscript preparation in progress**)

List of publications related to the subject of the thesis:

1. Papp-Zipernovszky, O., **Klinovszky, A.**, Buzás, N. (2020). Illness knowledge of type 2 diabetes patients: the Hungarian validation of Diabetes Knowledge Test. *Orvosi Hetilap*, 162(22), 870–877. **IF: 0.540 Q4**
2. Sallay, V., **Klinovszky, A.**, Csuka, I. S., Buzás, N., Papp-Zipernovszky, O. Striving for autonomy in everyday diabetes self-management: A grounded theory study. *BMJ Open*, (**submitted**)

ABBREVIATIONS

HbA1c = hemoglobin A1C

BHLS = Brief Health Literacy Screen

COREQ = Consolidated Criteria for Reporting Qualitative Research

DNT-15 = Shortened version of Diabetes Numeracy Test

(F)HL = (Functional) Health Literacy

HSCO = Hungarian Central Statistical Office

MeSH = Medical Subject Heading

NVS = Newest Vital Sign

NEAK = Tasks of the National Health Insurance Fund of Hungary

OECD = Organisation for Economic Co-operation and Development

PIAAC = Programme for the International Assessment of Adult Competencies

PLS-SEM = Partial Least Squares Structural Equation Modeling

REALM = Rapid Estimate of Adult Literacy in Medicine

S-TOFHLA = Short Test of Functional Health Literacy

T2DM = Type 2 Diabetes Mellitus

WHO = World Health Organization

1. Introduction

Type 2 Diabetes Mellitus (T2DM) is a complex metabolic disorder characterized by hyperglycemia and absolute or relative insulin deficiency or lack of insulin action. This chronic disease consequently affects fat and protein metabolism and increases the potential for microvascular and macrovascular complications. The peculiarity of the disease is that it often develops unnoticed, over decades, in most cases it is asymptomatic or may be accompanied by mild symptoms, which patients tend to underestimate or ignore. In the background of its development, in addition to the genetic predisposition, the more determining factors are the so-called external, environmental factors such as unhealthy eating, obesity and a sedentary lifestyle. Once diagnosed, T2DM requires complex and individualized therapy. Therapy for T2DM requires regular medication and insulin dosing, but it is important to emphasize that neither medication nor insulin therapy alone can achieve the desired metabolic-enhancing effect if the therapy is not supplemented by appropriate lifestyle care (medical nutrition therapy and exercise) and regular blood glucose monitoring. It is thus outlined that adequate patient cooperation (adherence) is an essential aspect for ensuring the right metabolic situation and the success of therapies. Adherence means following the personalized recommendations given by the patient's doctor – in the field of medication, medical nutrition therapy and lifestyle. Since diabetes is a lifelong disease, the treatment of which is based on a person's self-care and self-management skills and abilities, the appropriate level of adherence is decisive for the development of the disease.

It is well known that in cases where the management of T2DM is ineffective and the optimal metabolic status cannot be maintained in the long term, there can be basically two main reasons behind it: one is due to the healthcare system (e.g.: misdiagnosis, lack of education, etc.), the other is due to inadequate self-management of the person with diabetes, often associated with a low level of adherence. It is not sufficient to examine a single aspect or phenomenon in isolation to state what may cause a lower level of adherence, where the boundary line is drawn beyond the responsible behavior of patients, what factors influence, facilitate and inhibit adherence to therapy and appropriate disease management of patients with diabetes.

The present doctoral dissertation aims to explore and summarize the dynamics of adherent behavior and its factors influencing disease management in insulin-treated T2DM patients. This is due to the fact that adequate knowledge, skills, psychological resources and self-management skills are a major factor in treating this increasingly intense and complex illness. Patients with

the right information and knowledge can participate as active decision-makers in the health issues related to them. However, based on scientific data, nearly 48% of those affected do not have the optimal metabolic levels needed to treat diabetes. In light of this, it becomes warranted to explore the complex factors that may play a central role in the successful treatment of DM as a multifactorial disease.

In diabetes care, patients are often forced as lay people to switch to insulin and to manage their own metabolic processes, often without prior medical knowledge. Inadequate levels of health literacy can impede patients' adherent behavior, proper interpretation and systematization of treatment-related health information and can have a significant impact on self-care and self-management competence and, consequently, the effectiveness of therapy. Patients who are characterized by higher levels of adherence, adequate health literacy, and psychological resources (e.g.: appropriate coping strategies), need health care less often on average, suffer less from complications from their illness, and spend less on medication and have a better quality of life. In addition, proper metabolic management also reduces the incidence of premature mortality.

The question therefore arises as to the extent to which successful treatment can be determined by the patient's health literacy and understanding of health, and where is the line at which psychological and behavioral factors can influence the therapeutic cooperation of patients, and the successful adaptation to complex treatment. To cover all these factors, we examined three areas in our research. The first study was a cross-sectional questionnaire study in which we hypothesized that multiple adherence types needed to be considered in the management of diabetes and examined the relationship between these different adherence types. In the second study, we sought to explore the level of health literacy and diabetes-specific numeracy skills of insulin-treated T2DM patients in light of their therapeutic efficacy. The third was a qualitative methodology study aimed at a complex interpretation and understanding of patients' views on treatment and pharmaceutical forms, their relationship to treatment, and the integration of these experiences into their daily lives.

2. Aims

In this dissertation the following aims were set:

Aim 1:

Mapping the adherent behavior of patients with T2DM by examining the association between the various types of adherence. (Approval no. 3715) (*Article 1*)

Aim 2:

Mapping the level of FHL among insulin-treated, T2DM patients. Furthermore, we examined the role and the impact of these special competencies and skills during self-care and disease management. (Approval no. 4639) (*Article 2*).

Aim 3:

Assessing patients' experiences comprehensively related to treatment and types of medication: to explore and understand patients' relationship to treatment, the integration of these experiences into their daily lives, and their expectations related to diabetes mellitus therapy.

We also examined the therapeutic behavior of the patients, the psychological aspects and experiences behind their behavior, attitudes toward treatments and technologies, and the impact of these factors on quality of life.

One of our goals was to analyse the interviews from the qualitative research in a complex manner and to identify the most common patient types and their characteristics based on our results.

In line with the behavioral responses and disease-related coping strategies of the patient types, we tried to formulate psychological intervention recommendations that could help DM patients to adapt more easily to therapies and which could be beneficial for future diabetes care programs. (Approval no. 4324) (*Article 3*).

3. Test sample and methods

3.1. Associations of different adherences in patients with type 2 diabetes mellitus

Participants

The cross-sectional survey was conducted at the Diabetes Unit, 1st Department of Internal Medicine, Szent-Györgyi Albert Health Centre, University of Szeged. It was conducted among patients diagnosed with T2DM, for whom switching to insulin or insulin intensification was recommended in order to maintain optimal carbohydrate metabolism. The final sample included data and results from 113 patients (38 men and 75 women). The average age of the participants was 60.56 years ($SD = 12.94$), who were diagnosed with T2DM for an average of 13 years ($SD = 8.230$).

Instruments and data collection

Sampling was done by convenience sampling with the help of an interviewer. To map the different types of adherence, we used the adherence questionnaire conceptualized by the research group, which measured medication adherence, adherent behavior of individuals related to medical nutrition therapy, exercise, and blood glucose measurement on a self-reported basis.

Data analysis

Statistical analysis of the data was performed using IBM SPSS for Windows 22 (IBM Corporation, Armonk, NY). In order to properly select the statistical tests, we also checked the fulfillment of normality divided into items, questionnaires and groups due to the large number of items. Since the Kolmogorov-Smirnov hypothesis testing method showed significant values and the conditions of the normal distribution were not met, we decided to use non-parametric tests for more precise calculations (e.g.: Spearman's rank correlation, multivariate regression analysis with standardized values, etc.).

3.2. Health literacy and diabetes-specific numeracy skills in the therapeutic effectiveness of insulin-treated T2DM patients

Participants

In the final sample, we recorded data from a total of 102 individuals with diabetes (41.2% male and 58.8% female) who had been diagnosed with T2DM for an average of 10.76 years ($SD = 6.702$). The average age was 64.75 years ($SD = 9.180$; minimum: 37, maximum: 85). The majority of participants had a vocational secondary education ($N = 58$). Subjects had received insulin therapy for an average of 6.59 years ($SD = 5.098$) and 45.1% were undergoing intensive insulin therapy. It is important to mention that 67.6% of the patients measured their blood glucose level more than twice a day, and 73.5% of them already had some complications related to diabetes at the time of the study.

Instruments and data collection

The health literacy tests used were the Brief Health Literacy Screen (BHLS) self-reported health literacy questionnaire, the Short Adult Functional Health Competence Questionnaire (S-TOFHLA) reading and comprehension tests, and the Shortened Version of the Diabetes Numeracy Test (DNT-15). The persons involved in the research were recruited through the diabetes associations in Csongrád-Csanád county. The sampling method of the cross-sectional survey was performed by convenience sampling. Exclusion criteria included stroke affecting cognitive function, or a previously acquired head injury, which had to be taken into account for a more precise definition of the results.

Data analysis

After recording the data in a database, identifying missing values and outliers, and testing for normality, we decided to use non-parametric tests. Descriptive statistics were used to calculate sample means and general statistical indicators. Internal consistency and reliability value of the measurements were tested by Cronbach's Alpha and Kuder-Richardson reliability coefficient. The correlation between the different variables was analyzed by Spearman's rank correlation. Mann-Whitney and Kruskal-Wallis tests were used to determine which groups could differ significantly. The significance level of the tests was checked using Bonferroni

correction. In addition, Structural Equation Modeling (SEM), including Partial Least Squares (PLS) path modeling, was used to model the measured variables.

3.3. Treatment attitudes of insulin-treated T2DM patients, integration of self-care into daily life and expectations related to diabetes therapies

Participants

A total of 50 (24 men and 26 women) insulin-treated T2DM patients were included in the qualitative research. The average age of the participants was 64.82 years ($SD = 9.735$), who had been diagnosed with T2DM for an average of 18.77 years ($SD = 12.303$), and 41 (82%) had one or more comorbidities. Regarding family status, more than half of the participants ($N = 30$) were married. Interviewees rated their own financial situation on an average of 5.98 on a scale of 1 to 10.

Instruments and data analysis

The sampling method of the qualitative study was realized by convenience sampling and snowball sampling. In the qualitative study, the method of interviewing was a semi-structured interview. The texts of the semi-structured interviews were analyzed using thematic analysis. Interviews were recorded with a voice recorder, with the consent of the patients, and transcribed by deleting personal data. Interviews lasted an average of 1 hour and 30 minutes. In order to make sure that the research is as accurate as possible, we followed the recommendations of the Consolidated Criteria for Reporting Qualitative Research (COREQ) checklist. The interview questions were organized into three main groups, focusing on the history of the disease, the current treatment regimen, and the ecological context of the treatment, i.e., the environmental (social and situational) parameters influencing the effectiveness of the treatment.

Data analysis

The thematic analysis of the typed text corpora was prepared based on the analyses of two researchers involved in the research and an independent coder outside the laboratory. To collect and manage data, we used The Qualitative Data Analysis & Research Software – ATLAS.ti 8 text analysis software. The internal consistency value of the analysis performed with the

qualitative technique was checked with Krippendorff's internal reliability value based on 10 interview texts containing the most marked response samples during the thematic analysis, which had an Alpha value = 0.920, which was a high reliability value.

4. Research results and formulation of theses

4.1. Associations of different adherences in patients with type 2 diabetes mellitus

Adherence to medication showed a weak, positive, significant correlation with adherence to glucose monitoring among T2DM patients ($r_{106} = 0.322, p < 0.001$); that is, the more adherent patients to drug treatment, the more likely they are to follow instructions on self-monitoring of blood glucose levels. However, adherence to medication showed a moderate-to-negative correlation with patients' medical nutrition therapy adherence ($r_{109} = -0.575, p < 0.001$). This finding suggests that the more patients adhere to taking antidiabetics regularly and properly, the less motivated they feel to adhere to carbohydrate intake and to meet the criteria for a proper diet. Furthermore, we found a moderate, significant, and inverse correlation between adherence to medication and adherence to physical exercise ($r_{108} = -0.496, p < 0.001$), suggesting that the more patients follow medication orders, the less they will adhere to physical exercise therapy. Adherence to medical nutritional therapy showed a correlation with adherence to blood glucose monitoring ($r_{105} = 0.414, p < 0.001$) as well as with adherence to physical exercise ($r_{109} = 0.279, p = 0.003$). Based on these findings, we can say that the subjects who attempted to integrate the diet prescribed for people with diabetes, were more likely to control their blood glucose levels, and found time to follow the prescribed physical exercise regimen.

In the light of the obtained results, the following thesis was formulated:

THESIS 1: Stronger adherent behavior related to medication is presumably one of the factors that can reduce long-term commitment to lifestyle therapies.

Thesis support:

The fact that the degree of adherence related to medication is negative shows a significant correlation with lifestyle variables, which can be substantiated in two basic ways. One is related to the operation of the health care system. In most post-communist countries, including Hungary, the traditional, paternalistic approach to patient co-operation in health care has long

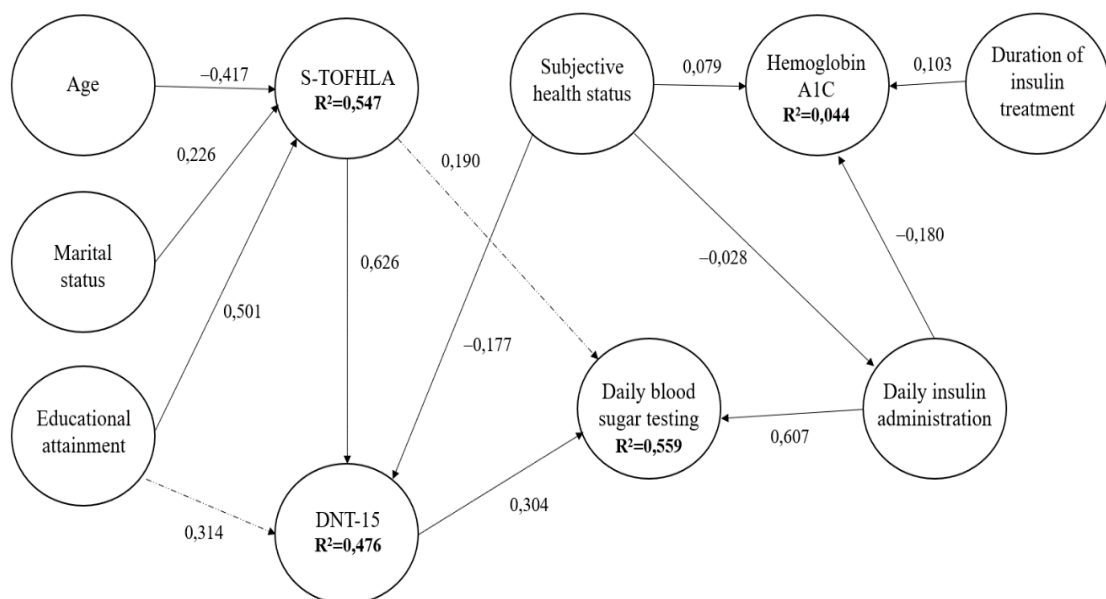
been the prevailing view, the essence of which is that the patient follows medical instructions as a passive participant and expects health improvement primarily from medical care/medicine. More specifically, physician-centered communication and decision-making dominance came to the fore. In the case of diabetes mellitus, the disease requires lifelong professional care, meaning that it cannot be cured after some progression, but can be treated with due care and effort. According to some research, successful treatment of diabetes depends more than 95% on the patient's self-care abilities and skills. On the other hand, this phenomenon also points out that lifestyle therapies require a dynamic approach, requiring the joint consideration of several influencing variables (e.g. sociodemographic parameters, psychological and behavioral characteristics, individual competencies, etc.). In summary, the fact that these complex therapies are mostly individualized also plays a role. Patients can truly experience the essence of personalized therapy only when they can actively participate in the decision-making processes that affect them within the medical communication and relationship. It is therefore of key importance that the physician involves the patient in the decision-making processes that affect him or her in addition to providing appropriate information, thus promoting the commitment and satisfaction of the patient towards therapies. Patients who are properly educated and adherent to several elements of complex therapy are aware that their body delays the release of insulin after a meal, which can cause a sudden spike in blood glucose levels; therefore, an adherent approach related to nutritional therapy becomes a key element. When studying the relationship of adherence to medical nutrition therapy with other adherences, we should also remember that all these processes are influenced by how well a particular patient is able to solve problematic situations, i.e. how resourceful they are, and how advanced their diabetes is.

4.2. Health literacy and diabetes-specific numeracy skills in the therapeutic effectiveness of insulin-treated T2DM patients

The variance-based PLS-SEM model included the variables S-TOFHLA and DNT-15 test scores, self-rated health status, three-month HbA1c blood glucose levels, duration of insulin therapy, and daily glucose monitoring and frequency of daily insulin administration, which are important in DM management. Regarding direct effects, based on the standardized path coefficients indicated on the arrows in Figure 1, the pairings between latent variables can account for both positive and negative effects. Based on the analysis, the results of S-TOFHLA

are more strongly influenced by patients' age ($\beta = -0.417$), marital status ($\beta = 0.226$) and educational attainment ($\beta = 0.501$). The S-TOFHLA which measures reading and comprehension competencies, effects the diabetes-specific numeracy DNT-15 test results ($\beta = 0.626$). In addition, the subjective health status of T2DM patients has a negative effect on the DNT-15 test scores ($\beta = -0.177$). Self-assessed health status also shows a positive impact on the outcome variable, i.e. the HbA1c level ($\beta = 0.079$), while it has an inverse effect on one of the self-management behaviors, namely, the frequency of daily insulin dosing ($\beta = -0.028$), which impacts HbA1c values ($\beta = -0.180$) and it is also conditioned by the duration of insulin treatment ($\beta = 0.103$). At the same time, regular blood glucose monitoring, which plays a key role in the treatment of T2DM, is affected by patients' DNT-15 scores ($\beta = 0.304$) and the frequency of daily insulin dosing ($\beta = 0.607$). The direct effect of subjective health status through the variable of daily insulin dosage frequency on the HbA1c level is positive and smaller ($-0.028 * (-0.180)$) than its indirect effect ($\beta = 0.079$). Among indirect effects, education level has a positive impact on DNT-15 scores (0.314), while S-TOFHLA has a positive impact on the frequency of daily blood glucose measurements (0.190) (Figure 1).

Figure 1 The role of functional health literacy and diabetes-numeracy in the PLS-SEM model of sociodemographic variables, subjective health status, HbA1c values, duration of insulin treatment and diabetes self-management behaviors



Based on our research results, the following theses were formulated:

THESIS 2: Adequate levels of functional health literacy (reading and comprehension competencies, diabetes-specific numeracy skills) make patients' behaviors related to self-care and self-management more effective (regular blood glucose monitoring and insulin administration).

Thesis support:

According to the literature, inadequate health literacy is more common among older patients, however, health professionals overestimate their patients' knowledge and skills related to health. Another factor underlying this phenomenon may be the compensatory behavior of patients, with which patients seek to mask the perceived deficiencies and the resulting shame from their physician. Others seek to compensate for the lack of recognized competence and knowledge through stricter adherence to lifestyle therapies. However, the skills mapped by objective measurement tools reflect a more realistic picture and point to areas where the application of knowledge in the treatment of DM and the promotion of a more effective disease management are hindered. Individuals who, on average, have higher levels of functional health literacy and diabetes-specific numeracy skills are more conscious, checking and correcting their own blood glucose levels multiple times. In addition, they are likely to have a higher level of education, which may be an advantage in situations where diabetes therapy requires quick, immediate problem resolution. The latter is also important because almost 50% of patients with inadequate functional health literacy and diabetes-specific numeracy skills are unable to detect preconditions associated with hypoglycemia in time and, according to scientific data, only 38% are able to deal with a pre-existing (mild or moderate) hypoglycemic crisis. Thus, it can be concluded that an adequate level of functional health literacy can make patients' self-care and self-management behaviors more effective by giving regular blood glucose monitoring and appropriate insulin dosing behaviors a greater role in health behaviors.

THESIS 3: Based on the lowest correct response rate in the DTN-15 test the self-management of insulin-treated type 2 diabetes patients is mostly influenced by carbohydrate counting as well as drug dosing difficulties. In order to increase the effectiveness of diabetes education, great emphasis should be placed on the above.

Thesis support:

Proper follow-up of medical nutrition therapy requires complex knowledge, and the purpose of dietary treatment needs to be articulated as accurately as possible, as the composition of the diet varies from individual to individual. The body weight, the energy content of the diet, the carbohydrate content of the nutrients should all be taken into account and the diurnal fluctuations in insulin sensitivity should be monitored. In addition, knowledge of the energy needs adapted to the patient's lifestyle and age is also important, the former due to energy consumption, in the latter case taking into account that the body's energy needs decrease with advancing age due to the loss of muscle mass. It is important to know the rate of absorption of foods, the effect of proteins, fibers, fats and carbohydrates on the glycemic index, i.e. the hypoglycemic effect of the food consumed. In addition, insulin-treated T2DM patients need to measure their blood glucose levels several times a day, evaluate the results obtained, and take advantage of their dietary options based on their knowledge. The latter can only be truly successful if they are familiar with the onset and duration of action of the insulin products prescribed to them and their specific characteristics, in order to be able to make the necessary adjustments in time (insulin dose adjustment, exercise or dietary adjustments). In addition to the results of international research, the above-mentioned problem was also supported by a study measuring diabetes knowledge conducted by our research group. Therefore, it is justified to revise the programs related to medical nutrition therapy, to expand knowledge, and to increase the patients' higher level knowledge about diet within patient education.

THESIS 4: Insulin-treated T2DM patients who score high on a test measuring reading and comprehension tasks also perform significantly better on a test measuring diabetes-specific numeracy skills.

Thesis support:

Research on health understanding in previous years focused mainly on the conceptualization of the phenomenon and the development of measurement instruments. Tests measuring disease-specific health literacy have also appeared in the last ten years, but these are currently available

in small numbers and seek to explore individual health-related competencies along very different aspects. Previous research using S-TOFHLA, Newest Vital Sign (NVS) and Rapid Estimate of Adult Literacy in Medicine (REALM) and DNT tests, which measure functional health literacy, have found that the skills and abilities measured in the tests show different results, especially in terms of age and education, however, there is a relationship between different skills. Based on this, it can be said that reading and comprehension skills, the proper filtering and processing of information play an important role in the communication process and learning. At the same time, if we take into account, within diabetes-specific numeracy skills, that not only the proper execution of computational tasks, but also the problem-solving ability of patients and certain aspects of critical thinking are included, it is outlined that the two areas are closely related. Thus, the study of health literacy should take into account that there are different types of functional health competencies that can interact. Furthermore, these different types of functional health literacy aspects can be developed by physicians and health professionals after timely recognition (e.g. through the use of modern technical tools, through verbal communication, patient education etc.) and communicated in everyday clinical practice to benefit therapeutic efficacy.

4.3. Treatment attitudes of insulin-treated T2DM patients, integration of self-care into daily life and expectations related to diabetes therapies

Based on the frequency indicators of the categories within the topics, it can be said that a significant proportion of diabetes patients (80%) try to incorporate the patient self-part into their personality through self-reinforcement and most of them experience treatments as a burden (80%). Emotional manifestations associated with illness and treatment are mostly negative, accompanied by perceived imbalances in private life, symptom formation, and increased need for control. In addition, it is important that the negative emotional manifestations in the texts of the interviews are mostly organized around dissatisfaction with therapy, the progressive nature of diabetes, and its care. It is also outlined that in insulin-treated T2DM patients there is a need not only to take individual parameters into account in the field of medical and lifestyle therapies, but also to adapt to psychological resources and personality traits. This statement is supported by our finding that a significant proportion of diabetes patients (76%) used personalization as a long-term coping option, while defense mechanisms were observed in those patients who avoided the use of active coping. It is hypothesized that the appropriate level of adherence may

often be hindered by the defense mechanisms observed in patients' reactions and behaviors, which are mostly responses to decreased control and anxiety due to lack of knowledge. Based on our results, it was also outlined that two different attitudes could be detected within the topic of insulin attitudes in the interviews: 'frightening' and 'saving' attitudes. 84% ($N = 42$) of the individuals in the sample perceived insulin and the associated mode of administration (pen and needle) as fear-provoking, while 70% ($N = 35$) of them gave the medication a 'rescuer' connotation. However, based on our results, 42% ($N = 21$) of participants are satisfied with their current means of insulin delivery, while 46% ($N = 23$) are primarily resentful of needle use. Openness to new insulin delivery technologies can be detected in only 20% ($N = 10$) of the patient sample.

In the light of the obtained results, the following theses were formulated:

THESIS 5: The therapeutic behavior of insulin-treated T2DM patients is determined by the patients' emotional manifestations and commitment to diabetes and treatment, and the effectiveness of the given coping methods for treatment-related difficulties.

Thesis support:

The emotional manifestations of diabetes patients have a kind of self-regulatory role. These processes are also important when it comes to illness, self and physical symptoms, as they affect physiological responses, patients' emotional engagement with diabetes therapy, and patients' open behavior. Personal factors that determine their behavior include long-term coping strategies. It can be said that diabetes patients try to cope with the difficulties and therapeutic expectations associated with the disease in many ways. Coping strategies are selected based on the controllability of stressful events and the psychological resources available to them. Some may experience the diagnosis of chronic disease and the introduction and adaptation of treatments as a kind of crisis, so that exiting the situation, adapting treatment guidelines to individual lifestyles, dietary requirements and insulin dosing experiments through parallel blood glucose monitoring may provide them with a single, yet accessible area of control. The latter behavior is characterized by the use of personalization as a coping strategy. In other diabetes patients, the frequent use of defense mechanisms has been observed, confirming the fact that in the future it would be important to map the types of coping methods during the psychological help of diabetes patients as well.

THESIS 6: In the disease-management of insulin-treated T2DM patients, attitudes related to insulin treatment, including their satisfaction with insulin delivery technology, determine their openness to future technologies.

Thesis support:

Assessing and understanding attitudes toward insulin in T2DM patients should be interpreted as a complex process. Individuals' attitudes toward insulin are mostly influenced by their previously formed beliefs about insulin therapy (e.g. insulin makes you fat, can cause infertility, injections are painful, etc.). It is common for patients to associate the introduction of insulin therapy with the severity of their diabetes. In addition, it is important to note that in the study of insulin and attitudes towards insulin intake, the role of negative emotions, views on loss of control, and bodily sensations (feelings) is also emphasized. These attitudes may later have an effect on attitudes and openness related to new insulin delivery technologies, which is also influenced by the integration of previous experiences and self-management habits into a successful lifestyle. Measurements of attitudes toward insulin treatment and current insulin delivery technologies have shown that the insulin-related fears and the anxiety of those patients, who experience the introduction of insulin as an impediment and intensification as a personal failure, affect the success of insulin treatment negatively. In addition, the availability of technologies (both physically and financially), their ease of use, their perceived usefulness and the minimum incidence of side effects can be important considerations.

5. Summary and utilization of results

Insulin-treated T2DM patients can be adherent in several ways, and patterns of relationships between different types of adherence can affect treatment attitudes and disease-management in an individual with diabetes. Because diabetes is a lifelong chronic disease that requires continuous self-monitoring and decision-making, the functional health literacy skills and knowledge that patients have in performing self-care tasks is of cardinal importance. In the complex therapy of T2DM, it is mostly necessary to increase the knowledge in the field of medical nutrition therapy (especially in the field of calorie and carbohydrate counting, insulin dosing based on current blood sugar levels, and drug dosing calculation tasks). At the same time, it is important to take into account the importance of the patient's knowledge of how their bodies function and the ability to make quick decisions. It can also be said that the patient's ability to adapt to the new lifestyle required to manage diabetes and the level of emotional commitment to self-care are decisive in their attitudes towards illness and treatment. Attitudes toward insulin and individual experience with insulin treatment are also decisive in how someone can cope with their illness over time. It is also an important observation that adequate levels of adherence in insulin-treated type 2 diabetes patients can often be hindered by the defense mechanisms observed in their reactions and behavior, which are mostly responses to decreased control and anxiety due to lack of knowledge. In addition, the extent to which their expectations regarding insulin therapy, confidence in the effectiveness of treatment, and the feelings and symptoms associated with it affect a patient's everyday well-being, coexistence with their illness, and quality of life is decisive. This is because the latter experiences may not only explain adaptation to therapy, but also predict openness to new insulin delivery technologies.

Overall, it can be stated that insulin-treated T2DM patients can be involved in therapy in two different ways and their commitment and adaptability to therapy can be increased. One can be achieved by taking into account different types of adherence, developing competencies related to health literacy, which we have formulated based on the results of our research. The other aspect focuses on psychological support, anxiety reduction, the importance of emotional engagement, the patient's psychological resources, and experience in treating illness, which can be used to benefit therapeutic efficacy by overwriting cognitive biases and misconceptions, reshaping coping strategies, and adapting individual behavioral characteristics.

Acknowledgement

I would like to express my sincere gratitude to my supervisors Dr Norbert Buzás and Dr Orsolya Papp-Zipernovszky for their continuous support, patience, motivation, and knowledge of my PhD work and related research. I am grateful to the Diabetes Unit, 1st Department of Internal Medicine, Szent-Györgyi Albert Health Centre, University of Szeged, for providing me with the opportunity to collect data during the research. I would like to thank Professor Dr Csaba Lengyel for the useful comments and professional suggestions, which improved the quality of my scientific work. I am grateful to the leaders and members of all the regional diabetes associations who contributed to the tests and questionnaires, as well as to the individuals who participated in the semi-structured interviews. During these interviews, people opened up to me and honestly shared with me their feelings, ideas, and experiences about their illness and treatment. I learned a lot from them.

Furthermore, I owe a special thanks to the EFOP-3.6.1-16-2016-00008 subproject and the ÚNKP-19-3 New National Excellence Program of the Ministry for Innovation and Technology for providing financial support for the research.

Last but not the least, I would like to thank my loving family, my friends for all the help, patience, emotional support, and encouragement I received from them during my PhD studies.