STUDIA UBB PSYCHOL.-PAED., LXVIII, 1, 2023, p. 5-27
(Recommended Citation)
DOI:10.24193/subbpsyped.2023.1.01

Motivation Profile and Wellbeing in Transylvanian Hungarians with Type 2 Diabetes

Kármen SULYOK[1], Kinga KÁLCZA-JÁNOSI[1*], Ibolya KOTTA[1]

ABSTRACT. Diabetes is a complex endocrine disease with a series of complications and it represents a significant public health concern globally and regionally in Romania. Specific aspects of motivation as well as mental wellbeing are considered to be related to diabetes management. When the psychological needs are supported, people experience better quality motivation, higher sense of wellbeing and tend to maintain desirable behaviors. Our objective was to examine the predictive role of motivation and wellbeing variables on glycemic control in patients diagnosed with type 2 diabetes in Transylvania, Romania. We also targeted other relevant factors (demographic parameters, clinical illness characteristics, diabetes-related knowledge) which influence optimal glycemic control. Participants (N=232) were Hungarian speaking adult patients from Transylvania, Romania, diagnosed with type 2 diabetes. Demographic and clinical data sets were collected. Participants completed a set of questionnaires developed to measure motivational dimensions, subjective wellbeing and diabetes-related knowledge. Targeted motivation variables were established based on Self-Determination Theory. The study followed an observational correlational design. Hierarchical multiple regression models were used to investigate the predictors of glycemic control. Results show that perceived competence and autonomous motivation have increased predictive power on optimal glycemic control, but the effect of motivation is partially mediated by wellbeing components. Illness related characteristics like vascular complications, comorbidities and illness duration proved to be essential predictors of glycemic control. Illness duration seemed to have a specific effect on glycemic control for patients living in Transylvania, longer duration predicts better glycemic control. Future research should examine the topic using an experimental design.

Keywords: type 2 diabetes, glycemic control, autonomy, competence, relatedness, wellbeing, illness characteristics, diabetes-related knowledge

[1] Babes-Bolyai University, Faculty of Psychology and Educational Sciences, Department of Applied Psychology, Cluj-Napoca, Romania
[*] Corresponding author. Address for correspondence: December 21, 1989 Boulevard no. 128, Cluj-Napoca, Romania; Tel.: +40264-445206; E-mail address: kinga.kalcza-janosi@ubbcluj.ro

Introduction

Diabetes is a complex endocrine disease with a series of complications, and it represents a significant public health concern globally and regionally in Transylvania, Romania. In a 2016 report the World Health Organization has estimated the number of diabetes patients would reach 425 million by 2017, with a global prevalence in the adult population rising to 8.5% (WHO, 2016). Negative effects of diabetes have been linked to poor glycemic control reflected in high glycosylated hemoglobin (HbA1c) levels, which are associated with substantial morbidity and mortality rates. Recent studies have shown a significant rise in the number of diabetic patients in Romania (Mota & Dinu, 2013; Roșu & Moța, 2018). Results of an extensive study published by the Romanian Society of Diabetes, Nutrition, and Metabolic Diseases stated that in 2014 there were nearly 2 million Romanian citizens suffering from diabetes mellitus (IDF Diabetes Atlas 9th Edition 2019, n.d.; Mota & Dinu, 2013).

According to the International Diabetes Federation (IDF) data, the age-standardized prevalence of diabetes in Romania was 8.4%, with approximately the same rates for men and women (International Diabetes Federation - The Programme, n.d.). However, the first large scale national study on the occurrence of diabetes in Romania (PREDATORR) recorded an elevated, 11.6% age- and sex-adjusted rate (Roșu & Moța, 2018), almost double compared to previous estimations (Mota & Dinu, 2013).

Complications related to diabetes can be prevented by appropriate treatment, lifestyle changes and regularly performed self-management tasks, such as maintaining a healthy diet, self-monitoring blood sugar levels, adjusting insulin doses and medication. Patient self-management was considered to be reflected in the level of glycemic control; a variable found to be associated with the harmful effects of the condition (Egwim, 2022). Good glycemic control was indicated by a HbA1c level lower than 7%, with values over being perceived as reflecting poor control ("Glycemic Targets: Standards of Medical Care in Diabetes—2018", 2017).

Although various factors have been described to predict poor glycemic control (Ross et al., 2011; Yasmin, Al-Zahraa, 2023), evidence is lacking on specific predictors and mediating factors associated with this variable among patients with type 2 diabetes in Romania.

Diabetes-Related Knowledge and Diabetes Management

The self-management of diabetes was described as one of the most complex challenges in the treatment of this chronic disease. Diabetes-related knowledge has been considered an important prerequisite in preventing disease related complications. Educated patients were found to manage the disease better than those unable to understand it and its symptoms (McPherson et al., 2008). Strine et al. (2005) reported that 50-80% of diabetes patients worldwide have significant knowledge gaps regarding their disease. Some evidence-based studies suggested that patients with diabetes complications often lack adequate knowledge about the nature of the disease, risk factors and associated complications (Menwer Alanazi et al., 2017; Sivaganom et al., 2002; Strine et al., 2005). Although there is significant literature on the detrimental effects of a lacking diabetes education, studies on the relationship between diabetes-related knowledge and complications of the disease have reported conflicting results (e.g. Menwer Alanazi et al., 2017; Ozcelik, 2010). Lack of awareness is considered to be a contributing factor in patients manifesting inappropriate attitudes towards diabetes care and treatment. Similarly, McPerson et al. (2008) and Ozcelik et al. (2010) have found a strong inverse correlation between diabetes-related knowledge and HbA1c values, which reflects a better glycemic control.

Diabetes-related knowledge is considered important, but there were also results demonstrating that it is not the best predictor of glycemic control; diabetes education programs have shown mixed results in effectiveness (Adarmouch et al. 2017; Dube et al., 2015).

Several studies presented a lack of association between diabetes knowledge and different aspects of glycemic control (Arora et al., 2011; Formosa, 2008; He & Wharrad, 2007), but managed to find correlations with other associated variables (e.g. disease duration) or demographic characteristics of patients (e.g. level of education) (Arora et al., 2011).

Basic Psychological Needs and Diabetes Management

Self-determination theory (SDT) (Deci & Ryan, 2000) is a macro-theory of human motivation which posits that people are innately oriented towards attaining their physical and mental wellbeing and are more prone to adopt behaviors conducive to this state when basic psychological needs for *autonomy, competence and relatedness* are socially accepted (Williams et al., 2009). According to SDT, motivation is a psychological energy directed at a particular goal. When the psychological needs are supported by the social surroundings, people experience better quality motivation, higher sense of wellbeing and are more likely to maintain desirable behaviors.

Because of the way it explores the autonomous and self-determined characteristics of individual behavior (Deci, & Ryan, 2004), the theory was considered an excellent model for understanding chronic disease management (Williams et al., 2004). SDT identifies several distinct types of motivation, each impacting learning, performance, personal experience and wellbeing (Ryan & Deci, 2000a). The theory has been applied to explore different health-related behaviors in 184 data sets from around the world (Ng et al. 2012), for example the motivational basis for committing to long-term prescription drug treatments (Williams et al., 2005). Based on previous empirical results there was a positive link between patient autonomy and health (Ng et al., 2012). A recent study conducted with cluster randomized control trial method revealed that autonomy support groups working within the SDT frame could help patients not only achieve a better glycemic control, but also maintain it for a longer period of time (Yun et al., 2020).

SDT posited the three basic psychological needs as universal, underlining that the satisfaction of each may differ from one culture to another (Deci & Ryan, 2000). Research data has since confirmed that these psychological needs are indeed universal (Chirkov et al., 2005) but self-determination was also linked to culture (Moneta, 2004).

Mental Wellbeing and Diabetes Management

The concept of mental wellbeing was developed in the context of positive psychology and represents a complex psychological construct influenced by positive psychological characteristics (e.g. optimism, positive affect) and related constructs. According to the WHO, mental health and wellbeing are treated as equivalent concepts (WHO, 2005). In mental health service, mental wellbeing has been used as an outcome measure.

In psychological research, wellbeing was described as comprising positive emotional states (feeling good) and good functioning (thoughts on good functioning), specifically having a command over resources or achieving a balance between resources and challenges. From a multi-disciplinary point of view, wellbeing has been presented as a concept focused on optimism which can be described as the balance point between the resources and the challenges of an individual (Wassel & Dodge, 2015). This balance might have an important influence on health-related behavior and specifically diabetes management.

Self-efficacy, optimism and resilience in diabetes patients have been correlated with numerous beneficial outcomes (Al-Khawaldeh et al., 2012; Celano et al., 2013; Roberston et al., 2012; Venkataraman et al., 2011). These positive constructs have been associated with superior medical outcomes, including better glucose control and lower mortality rates (Massey et al., 2017). Higher levels of overall wellbeing in patients with diabetes were correlated with better glucose control (Papanas et al., 2010). Also, better measures of emotional vitality and life satisfaction were associated with a more effective prevention of type 2 diabetes (Boehm et al., 2015).

Though the relationship between positive psychological constructs and health outcomes is not fully understood, most evidence that linked positive states to superior outcomes emphasized an increased adherence to health behaviors (Al-Khawaldeh et al., 2012; Roberston et al., 2012; Venkataraman et al., 2011).

Objectives

Our first objective is to examine the motivational profile of Hungarian speaking Romanian patients with type 2 diabetes living in Transylvania, within the theoretical framework of SDT. In addition, we aim to identify other variables (demographic parameters, clinical illness characteristics and diabetes-related knowledge) which could predict health maintaining behavior of patients with diabetes living in the socio-cultural background of Transylvania, Romania.
Our second major goal is to examine the role of mental wellbeing as a mediator in the relationship between motivation and glycemic control.

Materials and Methods

Participants

Patients were sampled from 9 public hospitals in Transylvania, Romania, using a systematic sampling method. The patients were recruited from four randomly chosen counties (62% from Harghita, 18% from Mures, 12% from Covasna and 8% from Satu Mare).

They were asked to complete paper-based questionnaires during a screening visit.

The initially selected 317 participants were included in the sample based on the following criteria: Hungarian speaking adults (over 18 years), diagnosed with type 2 diabetes according to the standards of the American Diabetes Association ("Classification and Diagnosis of Diabetes: Standards of Medical Care in Diabetes—2020," 2019).

In order to reach our targeted sample, the following exclusion criteria were applied: 1) recent history of hypoglycemic coma; 2) primary neurological condition as history of transient ischemic attacks, cerebrovascular stroke, epilepsy or psychiatric disease; 3) previous severe head injury; 4) any sensory or motor disorder that would preclude questionnaire completing; 5) regular treatment with any medications known to have psychoactive effects and 6) drug or alcohol abuse.

Based on our exclusion criteria, 278 subjects were found to be eligible. After completing the outlier identification (see section *Data processing and statistical analysis*) a number of 232 (N=232) participants were recruited.

Power and sample size

A priori power analysis was performed using G_Power3 for hierarchical linear regression (total number of predictors 11) with a p-value of 0.05 and statistical power of 0.95. Results showed that for a medium effect size (f^2 = 0.15) (Faul et al., 2009) the required sample size is n = 178. Recommended effect sizes used for this assessment were as follows: small (f^2= .02), medium (f^2= .15), and large (f^2= .35) The sample size of the study (n = 232) proved to be suitable for detecting medium effect sizes.

Ethics Statement

Our study used questionnaires to assess self-management behaviors, socio-demographic and clinical characteristics of patients. Data regarding biomedical parameters was extracted from the participants' medical records. All participants gave written informed consent after being provided a complete description of the study.

Methods and procedures were implemented as requested by the Guideline of the Code of Deontology for the Profession of Psychologist, elaborated by the Romanian College of Psychologists (COPSI).

Measurements

Demographics

Participants provided information about their sex, age, education, marital status and perceived economic status.

Clinical Assessment

Participants were asked to provide demographic data and medical history of diabetes. *Diabetes control* was measured using glycosylated hemoglobin (HbA1c) level measurements. Information regarding the last HbA1c value was collected from the medical records provided by the general practitioners with the patients' consent. The test indicates the level of glycemic control over a 3-month period. Poor diabetes control was defined by a HBA1c ≥ 7% according to the guidelines on glycemic targets for diabetes control ("Glycemic Targets: Standards of Medical Care in Diabetes—2018," 2017). Furthermore, we collected data about *treatment type* (insulin, oral medication or nothing) and *disease duration* (number of years since type2 diabetes was diagnosed). A *comorbidities/ complications* number was calculated based on the count of "Yes" answers given by participants on a list. List of comorbidities included: hypertension/heart diseases, dyslipidemia, liver disease, other chronic diseases, combination of aforementioned diseases and microvascular complications (retinopathy, neuropathy).

Instruments

In order to measure motivational dimensions, subjective wellbeing and diabetes-related knowledge, the following instruments were used:

To assess the motivational components of subjects we used the *Self-Determination Theory Questionnaire Packet for Diabetes* (Kálcza et al., 2016). The packet evaluates SDT constructs through 3 questionnaires.

Treatment Self-Regulation Questionnaire-Diabetes (TSRQ-D): assesses the individual differences specific to types of motivation or regulation (Autonomous Regulation Subscale and Controlled Regulation Subscale). Autonomous Regulation scores are represented by the average score given on autonomous items. Controlled Regulation scores are calculated from the average score of controlled items. Relative Autonomy Index (RAI) is calculated by subtracting the mean of Controlled Regulation scores from the mean of the Autonomous Regulation scores.

Perceived Competence for Diabetes Scale (PCDS) assesses feelings related to healthy behaviour, showing the degree to which patients feel they effectively manage diabetes in everyday life.

Modified Health Care Climate Questionnaire for Diabetes (mHCCQ-D) assesses how patients perceive their relationship with the medical staff and their perception over healthcare providers being autonomy supportive rather than controlling in consultations.

Patients evaluate on a 7-point Likert scale the degree to which the statements describe them, 1 meaning "strongly disagree" and 7 representing "strongly agree". For PCDS-HU and mHCCQ-D-HU questionnaires, scores range from 1 to 7, the final score is reached using averages. Because RAI-index is calculated by subtracting the average score of one 7-point Likert-type subscale from another, its range spreads from -6 to +6. Higher scores suggest a higher level on the measured dimensions.

The psychometric properties of the Hungarian scales used in our study were very good (TSRQ-D-HU Autonomous Regulation Subscale α = 0.82 and α = 0.92 at Controlled Regulation Subscale; PCDS-HU α = 0.87; mHCCQ-D-HU α = 0.85), they replicated those of the English version (Kálcza-Jánosi e.t al., 2017).

In order to evaluate the mental wellbeing of patients, we used The *Short Warwick Edinburgh Mental Well-being Scale (SWEMWBS)* (Stewart-Brown & Mohammed, 2001). The instrument presents a more restricted view of mental wellbeing than the original scale, with most items representing aspects of overall psychological and specifically eudaimonic wellbeing, and a few covering hedonic wellbeing or affect (Stewart-Brown et al., 2009). The scale has been validated for young people aged 15-21 (McKay & Andretta, 2017; Ringdal et al., 2018) and the general population (Ng Fat et al., 2017). The 7 items are positively worded with five response categories from 'none of the time' to 'all of the time'. Scores range from 7 to 35, higher scores indicate an elevated positive mental wellbeing. Previous research found the SWEMWBS to show adequate internal consistency (α = 0.83) (Rogers et al., 2018).

Participants also completed the *Diabetic Knowledge Questionnaire - 24 (DKQ-24)* (Garcia et al., 2001). The DKQ 24-item version was developed from the original DKQ-60. The instrument assesses knowledge about the causes, types, self-management competencies and complications of diabetes. When calculating the knowledge score, 1 point is given to a correct answer, while 0 indicates an incorrect one. Scores range from 0 to 24, higher scores indicate a more accurate knowledge regarding diabetes.

The Hungarian version of the DKQ-24 presented good reliability with a Cronbach alpha index of 0.74 (Kálcza-Jánosi, et al., 2013).

Data Processing and Statistical Analysis

The study followed an observational, correlational design. To establish the relationship between the aforementioned factors we performed calculations using SPSS (Statistical Package for the Social Sciences) version 23.0.

In the first stage the Z-score method of outlier detection was performed, every value too far from zero (between -3 and 3) was considered an outlier and was removed from the database. All data was presented as mean (M) and standard deviation (SD) for continuous variables and as frequency/percentage for categorical variables. A probability (p) value ≤0.05 was considered statistically significant.

Hierarchical multiple regression models were used to investigate the predictors of glycemic control. The variables for regression models were chosen on a theoretical and statistical basis.

Violations of the normality assumption were checked using Shapiro-Wilk's test. All continuous variables (except autonomous motivation index) were transformed by square-root transformation (moderately, positively skewed data and moderately, negatively skewed data). Categorical variables were introduced as dummy variables. The Durbin Watson statistic was used to test the autocorrelation in the residuals from the statistical regression analysis. Linearity, homoscedasticity and multicollinearity were checked for the assumption that they relate to how the data fits the multiple regression model.

For the model, first we have introduced our control variables: baseline patient factors, including demographics (age, sex, education, marital status, economic status). In the second step illness variables (diabetes duration, treatment, comorbid diseases, vascular complications, diabetes related knowledge) were added. In a third stage we introduced the targeted variables represented by motivational factors (climate, perceived competence and autonomous motivation related to diabetes management) and finally perceived wellbeing was included.

Mediation analyses were performed to test the mediating role of wellbeing in the association between autonomous motivation and glycemic control using the PROCESS macro (Model 4) for SPSS version 3.5 (Hayes, 2018). Additionally, the bootstrapping method (10,000 resamples, 95% confidence intervals (CI)) was conducted to check for the significance of the indirect effects. Significance level of $p < 0.05$ was used for all analyses.

Results

Preliminary analysis

There were 232 type 2 diabetes patients included in the study, the youngest being 41, the oldest 77 years old. The age range can be explained by the age-specific characteristics of type 2 diabetes. 46.6%) of participants presented a good diabetes control, having HbA1c levels < 7%. Sample characteristics are described in Table 1.

Table 1. *Baseline characteristics of the participants (N = 232)*

Diabetic patients (N = 232)	
Age, years	58.19(6.32)
Gender_Male (n, %)	123(53%)
Education, years	10.09(2.49)
Marital status (n, %)	
Married	212(91.4%)

Diabetic patients (N = 232)	
Single	5(2.2%)
Widowed/Divorced (n, %)	15(6.5%)
Perceived economic status (n, %)	
Poor	33(14.2%)
Moderate	182(78.4%)
Good	17(7.3%)
Treatment (n, %)	
Insulin	52(22.4%)
Oral medication	169(72.8%)
Nothing	11(4.7%)
Diabetes control, HbA1c	7.37(1.01)
Diabetes control_Good (HbA1c < 7%) (n, %)	108(46.6%)
Duration of diabetes, years	7.52(3.85%)
Comorbidity (n, %)	
No/unknown	91(39.2%)
Hypertension/Heart diseases	67(28.9%)
Dyslipidemia	32(13.8%)
Liver disease	6(2.6%)
Other chronic disease	9(3.9%)
Their combination	27(11.6%)
Microvascular complications (n, %)	63(27.2%)
Diabetes-related knowledge	15.40(3.56)
Climate	5.93(.99)
Autonomous motivation index	1.25(1.23)
Perceived competence	5.65(1.16)
Subjective well being	21.74(4.62)

Note: Values are mean±SD, unless indicated otherwise.

The majority of respondents (60.8%) reported having at least one additional diagnosed chronic illness, with hypertension being the most common condition.

Psychological predictors of glycemic control

The Pearson correlation values of assessed variables are presented in Table 2.

Table 2. *Correlation between glycemic control and the assessed variables*

	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Age	1								
2. Education_years	-.244**	1							
3. Diabetes_duration_years	.156*	.102	1						
4. Diabetes related knowledge	-.075	.369**	.124	1					
5. Climate	-.048	.047	-.087	.035	1				
6. Perceived competence	.025	-.032	-.140*	.058	.337**	1			
7. Autonomous motivation index	.055	.128	.070	.233**	-.121	.204**	1		
8. Subjective wellbeing	.019	.222**	.050	.114	.102	.169**	.158*	1	
9. Glycemic control (HbA1c)	-.001	-.139*	-.005	-.098	-.137*	-.274**	-.238**	-.494**	1

*Note: *p < .05. **p < .01.; categorical variables were not introduced in the correlation matrix*

Hierarchical multiple regression was carried out to determine the effect of demographic, clinical and psychological variables on glycemic control in type 2 diabetes patients (HbA1c) (see Table 3).

Table 3. *Multivariate linear regression models with glycemic control as dependent variable*

	Model 1			Model 2			Model 3			Model 4		
	B	SEB	*β*	*B*	SEB	*β*	*B*	SEB	*β*	*B*	SEB	*β*
Age	-.037	.029	-.084	-.037	.026	-.084	-.024	.025	-.055	-.011	.023	-.024
Gender_male (dummy variable)	-.040	.023	-.108	-.019	.021	-.051	-.027	.021	-.073	-.012	.019	-.034
Education	-.064	.031	-.135*	-.051	.029	-.107	-.054	.028	-.114	-.023	.026	-.048
Marital status_married (dummy variable)	.056	.041	.084	.042	.037	.064	.026	.036	.039	.020	.033	.031
Perceived economic status_good (dummy variable)	-.205	.045	-.288**	-.137	.041	-.193**	-.118	.040	-.166**	-.107	.036	-.151**
Diabetes duration				-.035	.015	-.148*	-.038	.014	-.160**	-.030	.013	-.129*
Diabetes treatment_ insulin (dummy variable)				.055	.026	.123*	.054	.025	.121*	.059	.022	.132**
Comorbid disease_ Hypertension/ Heart diseases (dummy variable)				.073	.025	.178**	.075	.024	.183**	.062	.022	.151**
Comorbid disease_Liver disease (dummy variable)				.042	.067	.036	.058	.064	.050	.093	.059	.080
Comorbid disease_ Dyslipidemia (dummy variable)				.081	.032	.150**	.088	.031	.163**	.085	.029	.158**

	Model 1			Model 2			Model 3			Model 4		
	B	SEB	*β*	*B*	SEB	*β*	*B*	SEB	*β*	*B*	SEB	*β*
Comorbid disease_Other chronic disease (dummy variable)				.070	.057	.073	.103	.055	.107	.117	.050	.122*
Comorbid disease_Their combination (dummy variable)				.164	.037	.283**	.160	.035	.277**	.135	.032	.234**
Vascular complications (dummy variable)				.131	.026	.315**	.121	.025	.291**	.100	.023	.239**
Diabetes related knowledge				-.012	.024	-.031	.012	.024	.031	.013	.022	.034
Climate							-.021	.050	-.025	-.005	.046	-.006
Perceived competence							-.152	.042	.212**	-.123	.039	-.171**
Autonomous motivation index							-.021	.009	-.139*	-.017	.008	-.114*
Subjective wellbeing										-.125	.019	-.341**
adj R^2	.098**			.310**			.377**			.478**		
F(*df*)	6.028(5,226)**			8.403(14,217)**			9.228(17,214)**			12.757(18,213)**		
Δ R^2	-			.234**			.071**			.096**		

*Note: *p < .05. **p < .01.; categorical variables were introduced in the model as dummy variables; dependent variable: glycemic control (HbA1c)*

The hierarchical multiple regression analysis resulted in a statistically significant model, the adjusted R^2 indicates that a small, 9.8%, percent of the variation in glycemic control could be explained by demographic variables. The model revealed that education and good economic status are negative significant predictors, *participants with a higher level of education and good economic status show better glycemic control*.

Clinical factors and diabetes variables introduced in the second phase of our analysis also contributed to a statistically significant model. Diabetes related variables were found to explain an additional 23.4% of the variation in glycemic control. Adjusted R^2 revealed that 31% of the variance in the glycemic control could be explained by the model, but education lost its predictive power. Results show that several illness characteristics and having comorbidities have predictive power over glycemic control. Diabetes duration, insulin treatment, hypertension and heart diseases, dyslipidemia and the combination of comorbid diseases as well as vascular complications are all statistically significant predictors. Other measured variables did not contribute to the multiple regression model. Results show that illness duration has a significant negative weight, indicating that *participants with longer illness duration* have lower levels of HbA1c and overall *better glycemic control*. This unexpected result is discussed in conclusions. Positive prediction power was found for the other significant clinical variables. *Comorbidities are associated with* higher HbA1c percentage, *poor glycemic control*. Our analysis indicates that *diabetes-related knowledge has no statistically significant predictive effect on glycemic control*.

Further results revealed that motivational variables have an increased predictive power on our dependent variable. Adjusted R^2 indicated that 37.7% of the variance in glycemic control could be explained by the model. Perceived competence and autonomous motivation were found to be statistically significant predictors. Data revealed that although climate variables explain an additional 7.1% of variation in glycemic control, this motivational factor has weak explanatory power. *Perceived competence and autonomous motivation* both present a significant negative weight, indicating that *participants with higher motivational factors* have lower HbA1c levels, *better glycemic control.*

Finally, the final model with the wellbeing factor included proved to be statistically significant, although the explanatory power is weak. Wellbeing explained an additional 9.6% of the variation in glycemic control**;** adjusted R^2 indicates that 47.8 % of the variance could be explained by the overall model. The wellbeing variable has a negative weight, suggesting that *participants with better mental wellbeing have a more optimal glycemic control*.

The mediating role of subjective wellbeing between SDT components and glycemic control

In the first mediation model we tested whether wellbeing (ME) mediates the relationship between autonomous motivation (PV) and glycemic control (DV). First, the predictive link between autonomous motivation (PV) and glycemic control (DV) was tested, omitting the mediator. We found that the total effect is significant, autonomous motivation (PV) significantly predicts glycemic control (DV) (F(1,230) = 13.84, p < .001, R^2 = .057, b = -.196, t(230)= -3.721, p <.001). Next, we found that autonomous motivation (PV) significantly predicts wellbeing (ME) (F(1,230)= 5.92, p = .016, R^2 = .025, b = .59, t(230)= 2.43, p = .016). The predictor and mediator together significantly predict glycemic control (F(1,230)= 42.44, p < .001, R^2 = .270). Regression between wellbeing (ME) and glycemic control (DV) was found to be significant, while controlling for autonomous motivation (b = -.103, t(229) = -8.189, p < .001). Finally, we found a significant predictive power of autonomous motivation (PV) upon glycemic control (DV) while controlling for the mediator (b = -.135, t(229)= -2.870, p = .005). The indirect effect of autonomous motivation on glycemic control was significant (Effect = -.06, 95% C.I. (-.112, -.015). The results confirmed that wellbeing partially mediates the effects of autonomous motivation on glycemic control.

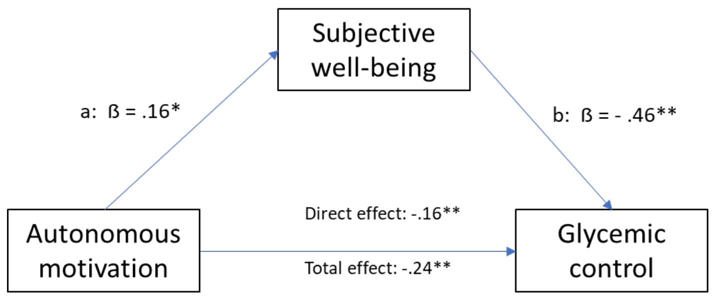

Figure 1. *Mediational model*

*Notes. Betas are standardized effect sizes * p ≤ .01; **p ≤ .001*

Discussion and Conclusion

Type 2 diabetes is a chronic disease which requires proper disease management, reflected in good glycemic control. Glycemic control is associated with several illness-related factors like diabetes duration, insulin treatment, comorbidities, vascular complications, but also with psychological factors (e.g. motivational components, wellbeing) and demographic variables.

Based on a multivariate linear regression analysis we can conclude that several of the aforementioned factors have good predictive value and are able to explain variations in glycemic control.

When analyzing the role of demographic variables in glycemic control, our results show that good economic status and higher education level predicts a better glycemic control. Age, gender or marital status presents no predictive value for this variable. This result is partially consistent with studies researching the predictive value of SES, race and gender on glycemic control (Assari et al., 2017; Rahman et al., 2020). Research completed in a developing country setting where socioeconomic status (SES) is associated with inequality in both prevalence and control of diabetes suggests that low SES predicts poor glycemic control through health-related behaviors, comorbid conditions, essential health service-related practices (Rahman et al., 2020). In another study, SES-variables show no predictive value, economic status is considered to be predictive for glycemic control when race by gender interaction is included (Assari et al., 2017). Although these studies suggest that gender might have a role in explaining the variance in glycemic control, this variable is mainly a covariate which has no significant independent predictive effect, as presented in our results.

Our data suggests that higher level of education predicts better glycemic control. Previous studies targeted at this demographic factor are inconsistent, and tend to variate depending on the socio-cultural characteristics of participants (Al-Rasheedi, 2014; Gebermariam et al., 2020). This leads us to presume that although higher education may predict better glycemic control in the region of Transylvania, Romania, this link may vary across socio-cultural contexts and therefore should be considered in future research related to glycemic control.

Illness-related clinical factors and comorbidities are predictive for 31% of variations in glycemic control. This effect is stronger for vascular complications and the combination of diseases, with these factors predicting a poorer glycemic control. Higher illness duration, however, leads to a more optimal glycemic control.

Data presenting the effects of higher illness duration on glycemic control is contradictory (Gebermariam et al., 2020; Saghir et al., 2019; Shita & Iyasu, 2022). The findings suggest that there is a significant difference between institutional healthcare and health management behavior of diabetes patients in different regions, leading to distinctive effects on glycemic control and prevention of complications.

While results regarding clinical factors of illness and comorbidities are overall supported by the current literature (Rahman et al., 2020; Shita & Iyasu, 2022), vascular complications and combinations of diseases are not specifically predictive on glycemic control.

Our results indicate that diabetes knowledge has no significant predictive effect for glycemic control. Although researchers emphasize the positive association between proper diabetes education and the patients' better glycemic control (McPerson et al., 2008; Ozcelik et al., 2010), in other studies diabetes knowledge is not a significant predictor for glycemic control (Adarmouch et al., 2017; Dube et al, 2015). Osborn et al. (2010) posit that diabetes knowledge is an independent, direct predictor of diabetes self-care and is related to glycemic control through self-care**.** This result might explain our data which indicates that diabetes knowledge has no direct linear influence on the outcomes in glycemic control. These findings suggest that there is a need for further research targeted on mediator and moderator factors influencing the role of diabetes knowledge in glycemic control.

In a more recent meta-analytic study Marciano et al., (2019) state that glycemic control is best predicted by performance-based and self-report health literacy. Diabetes knowledge is not a direct predictor of glycemic control. This reveals the need for studies which also consider the role of health literacy and its relationship to specific diabetes knowledge.

Analysis conducted on motivational aspects of SDT reveals those participants with a higher level of perceived competence and autonomous motivation, present better glycemic control. The result is in line with previous findings on patient autonomy and health (Ng et al., 2012; Williams et al., 2004; Williams et al., 2005; Yun et al., 2020), and suggests that competence and autonomy are components less anchored in the socio-cultural context of participants. Results also emphasize the importance of training and support groups focused on developing and maintaining the autonomous motivation of patients.

The wellbeing variable has a weak, but significant direct effect on glycemic control, thus better mental health is predictive for a more optimal glycemic control. Although the effect is weak, our result is consistent with previous studies, specifically that overall wellbeing and positive psychological constructs are correlated with better glucose control (Massey et al., 2010; Papanas et al., 2017). Additional analysis leads to the conclusion that subjective wellbeing has a partial mediating role on the relationship between autonomous motivation and glycemic control. Although the psychosocial factors related to health outcomes in patients with diabetes have been studied exhaustively, we are not aware of articles discussing the possible mediator role of wellbeing variables. This could be an important aspect to consider and could further allow a better matching of patients to compensatory interventions.

This study proposes several important conclusions. First, perceived competence and autonomous motivation are important in reaching an optimal glycemic control, but the effect of motivation is partially mediated by wellbeing components. Second, illness related characteristics like vascular complications, comorbidities and illness duration prove to be essential predictors of glycemic control. Third, illness duration seems to have a specific effect on glycemic control for patients living in Transylvania, Romania. Although diabetes-related knowledge (expected to increase over time) does not predict better glycemic control, results suggest that in time patients acquire experience in managing type 2 diabetes and those with longer illness duration have a more optimal glycemic control. Future research should address the interaction between demographic characteristics and illness duration in predicting diabetes management.

Limitations

The design of the study is cross-sectional, which limits our ability to clarify causal relationships between targeted variables. Further research should examine this topic with an experimental design.

The HbA1c extracted from medical records was collected from the last three months prior to the recruitment of the participants. Despite the fact that HbA1c is the standard measure for the diagnosis and monitoring of diabetes, HbA1c derived from multiple time points could better reflect the glycemic control than a single reading. The metabolic outcomes of diabetic patients could be improved by adequate motivation training and increased wellbeing, hence future research should address this subject using an experimental methodology in longitudinal studies.

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