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ORIGINAL RESEARCH

Comparison of Diabetes-Dependent Quality of Life (ADDQoL) in Patients with T2DM in Poland, The Czech Republic, and Slovakia

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Introduction: The purpose of the paper was to perform a comparative analysis of the impact of T2DM on QoL, including specific ADDQoL domains and associations between QoL, selected socio-demographic factors (including gender, age, education, residence, marital status, professional activity) or clinical parameters (HbA1c levels, fasting blood glucose, BMI, duration of DM, complications, treatment used), in adult diabetic patients from Poland, the Czech Republic and Slovakia. The study group included 608 patients diagnosed with T2DM. There were 214 patients from Poland, 196 from the Czech Republic and 198 from Slovakia.
Results: Overall, respondents from all three countries rated their QoL as good or very good. The mean scores for the item "If I did not have diabetes, my quality of life would be" were slightly higher for Poles than for Slovaks and Czechs. In the ADDQoL results, the weighted impact scores were negative for all domains. The lowest scores in all three countries were found for "freedom to eat,, for all patients; the highest for "living conditions". For Polish patients, the linear regression model demonstrated the following significant AWI predictors: pre-university education and past smoking. For Czech patients, the linear regression model demonstrated that none of the characteristics analyzed were significant independent predictors of AWI. In the For Slovak patients, the linear regression model demonstrated the following significant AWI predictors: higher education and concurrent heart failure.
Conclusion: In summary, our findings demonstrate that T2DM has a negative impact on all aspects of patients' QoL, which is the strongest in terms of the freedom to eat and dietary habits, regardless of the country. Education, past smoking, and concurrent heart failure were the only independent predictors of QoL in our study. This suggests a need for further research that would include more variables and a larger number of patients.
Keywords: diabetes mellitus, quality of life

Global epidemiological data indicate a rapid increase in the incidence of diabetes mellitus (DM). Currently, DM is among the most common causes of death worldwide. The condition is a serious public health concern. According to the literature data, there were 463 million patients with DM in 2019, and by 2045 this number is expected to have grown to 700 million.[1] DM prevalence differs between continents, depending on the presence of risk factors and some genetic differences associated with its incidence. Until recently, type 2 diabetes mellitus (T2DM) was considered a condition characteristic for residents of highly developed and wealthy countries, although at present the number of T2DM cases is also growing in developing countries.[2]

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The WHO defines quality of life (QoL) as an individual's perception of their position in life in the context of the culture and value systems in which they live, and in relation to their goals, expectations, standards, and concerns. Therefore, it is a broad concept, involving complex relationships between physical health, psychological status, personal beliefs, social relationships, and many associated characteristics of one's environment.[3]

Traditionally, the impact of chronic illness had been measured by morbidity and mortality. However, researchers have begun to appreciate health-related quality of life (HRQoL) as a valid and important outcome of medical interventions. In diabetic patients, QoL measurement can predict an individual's capacity for dealing with the illness and maintaining long-term health and wellbeing.[4]

Long-term T2DM management usually requires diet and lifestyle changes and strict adherence to treatment, all of which may affect QoL. When QoL and/or satisfaction with treatment are disturbed by the therapeutic regime, this can adversely affect the patient's perception of their QoL and increase the risk of complications. Insulin therapy and the associated complications are also linked to poorer QoL.[5,6] A literature review shows that DM has a negative impact on the patient's physical and psychological wellbeing, as well as their social functioning, and thus leads to a deterioration in QoL both in patients with T1DM[7,8] and in those with T2DM.[9–13]

As few papers exist that compare QoL between neighboring countries, the authors decided to investigate the issue in three neighboring European countries: Poland, the Czech Republic, and Slovakia.

Based on data provided by the Polish National Health Fund and the Diabetes-Coalition organization, there are about 3.5 million people with DM in Poland, which constitutes 9% of the entire population. T2DM has been diagnosed in 2 million people, or 6% of the population. Considering that 6% of the Polish population has T2DM,[14] with a maximum error of 3% and a confidence level of 90%, the minimum sample size can be estimated at 163 patients. For the Czech Republic, with a population of 10,650,000, a structure ratio of 7.38%,[15] confidence of 95%, and an error of estimation of 4%, the minimum size would be 164 patients. And for Slovakia, with a population of 5,450,000, a structure ratio of 5.85%,[16] confidence of 95%, and an error of estimation of 4%, the minimum size would be 132 patients.

Ultimately, 214 people from Poland, 196 from the Czech Republic and 198 from Slovakia were qualified for the research after excluding incorrectly completed questionnaires. Therefore, our sample size was sufficient for analysis.

Purpose

The purpose of the paper was to perform a comparative analysis of the impact of T2DM on QoL, including specific ADDQoL domains and associations between QoL, selected socio-demographic factors (including gender, age, education, residence, marital status, professional activity) or clinical parameters (HbA1c levels, fasting blood glucose, BMI, duration of DM, complications, treatment used), in adult diabetic patients from Poland, the Czech Republic and Slovakia.

The study was approved by the Bioethics Committee of the Beskidy Regional Chamber of Physicians in Bielsko-Biała, Poland, on 11 February 2016 (approval no. 2016/02/11/1), and the Bioethics Committee of the Wrocław Medical University (no. 621/2017). All participants were informed about the content of the study and gave their informed consent to participate in it. The study protocol was prepared in accordance with the Helsinki Declaration.

Material

A total of 660 patients were examined, 608 remained after excluding incorrectly completed questionnaires.

There were 214 patients from Poland (out of 240 examined), including 100 women and 114 men aged 61.53±7.76 years; 196 from the Czech Republic (out of 210 examined), including 82 women and 114 men aged 59.16±7 years; and 198 from Slovakia (out of 210 examined), including 96 women and 102 men aged 58.8±7.02 years.

All participants had been diagnosed with T2DM. In Poland, the study was performed at the Diabetes Clinic of the Bielsko-Biała Regional Hospital, the Diabetes Clinic of the Medi-Diab Nonpublic Medical Center in Katowice, and the Kosmonautów Health Center in Wrocław. In the Czech Republic, the location was the Ostrava University Hospital, and in Slovakia, the Svet Zdrovia hospital network, with the consent of the management of the institutions. The study was performed between March 2016 and August 2019.

Patients with T2DM were treated with a diet and oral antidiabetic drugs, with insulin if necessary. All patients reported for follow-up at the diabetes clinic approx once every three months. During their appointments at the clinic, the patients had their glucose and HbA1c levels

measured, their further pharmaceutical treatment was planned, and they underwent education focused on the appropriate diet and food content, considering levels of carbohydrates, protein and fat. Aerobic physical training was also recommended for the patients.

Methods

The values of the glucose measures (fasting blood glucose and glycated hemoglobin—HbA1c levels) were determined in all the patients. Next, surveys were carried out, using the following instruments: a demographic and clinical survey, and the ADDQoL questionnaire. The survey also collected the personal data of each patient: age, gender, place of residence, education, marital status, professional activity, body weight, comorbidities, duration of DM, DM complications, and medications taken. Only diabetes complications and comorbidities confirmed by a specialist were considered.

The ADDQoL questionnaire (developed by Clare Bradley) is a diabetes-specific instrument used for evaluating QoL both in T1DM and T2DM patients.[17] It consists of two general questions referring to the patient's QoL: 1) the current overall level of QoL, measured on a 7-grade scale (excellent, very good, good, neither good nor bad, bad, very bad, and extremely bad); 2) the specific influence of DM on QoL, measured on a 5-grade scale (very much better, much better, a little better, the same, and worse). The remaining components refer to 19 domains of QoL without the disease, and to the influence of DM on these aspects of life. Each domain includes two components: impact (from –3, maximum negative impact of DM, to +1, positive impact of DM), and importance (3—very important, 0—not at all important). The product of impact and importance ratings determines the weighted impact (WI) score. This value may range from –9 to +3 for every domain of the ADDQoL examined. The lower the WI score, the worse the aspect of life within the scope of a given domain. The average value of the weighted impact (AWI) score is also calculated for the whole scale. The AWI score is derived by dividing the sum of the weighted ratings by the number of applicable domains. The ADDQoL comprises the following domains: leisure activities, working life, journeys, holidays, physical health, family life, friendship and social life, personal relationships, sex life, physical appearance, self-confidence, motivation, people's reactions, feelings about the future, financial situation, living conditions, dependence on others, freedom to eat, and freedom to drink.[17,18] The ADDQoL was used in our study with the consent and license from the author, Clare Bradley (Health Psychology Research Unit, Royal Holloway, University of London) via www.healthpsychologyresearch.com. The license number for the Polish language version was CB521. The study in Poland relied on the Polish language version of the ADDQoL, as its psychometric properties, determined earlier, indicate that it is a reliable tool for the assessment of QoL in adult Polish patients with T1DM or T2DM.[19]

The other parts of the study relied on the Czech and Slovak versions of the ADDQoL. The license number for the Czech language version was CB636, and for the Slovak version it was CB638. Validation in the respective countries also confirmed the utility of the instrument for the evaluation of patients with T2DM in the Czech Republic and Slovakia.[20,21]

Before the start of the study, each patient was informed about its purpose by the authors. The questionnaires were completed personally and anonymously by each patient during an appointment with a physician. The time needed for survey completion was 20–30 minutes.

Statistical Analysis

Comparisons of qualitative variables in groups were performed using the chi-squared test (with Yates' correction for 2x2 tables) or Fisher's exact test (for low expected values). Comparisons of quantitative variables in two groups were performed using the Mann–Whitney test. Comparisons of quantitative variables in more than two groups were performed using the Kruskal–Wallis test. The Dunn test was used for post hoc analysis. Multivariate analysis of the simultaneous impact of many independent variables on one quantitative dependent variable was performed by linear regression. 95% confidence intervals were reported along with regression parameters. These analyses were performed with a 0.05 significance threshold. The R software, version 3.6.2 was used.[22]

Results

Statistically significant differences were also found when the data were compared between the countries. Polish patients were older (61.53±7.76 years) than Czechs (59.16±7) and Slovaks (58.8±7.02). BMI was significantly higher among Czech (26.87±3.79) and Polish respondents (26.18±4.67) than in the Slovak group (25.28±2.6). The duration of T2DM was longer among Slovaks than among Czechs (6±2.25 vs 5.36±2.4, p=0.02). The number of

patients who had completed higher education was the largest in the Polish group (16.36%). Poles were most likely and Slovaks least likely to live in cities (64.95% vs 37.88%, p<0.001). Professional activity was the highest among Czechs and the lowest among Poles (48.98% vs 29.91%, p<0.001). Poles were most likely to smoke (36%) and drink alcohol (35.51%), while Slovaks were the least likely (17.17%). Regarding comorbidities, the rate of hypertension was the highest among Slovaks (96.46%) and the lowest among Poles (80.37%). Concerning DM complications, Slovaks had the highest rate of retinopathy (55.05%) and the lowest rate of nephropathy (5.56%), while the opposite was observed in the Polish group (Table 1).

ADDQoL by Country

The mean overall QoL scores were slightly higher among Slovaks (3.47±0.98) than among Poles (3.41±0.92) and Czechs (3.38±0.93). The mean scores for the item "If I did not have diabetes, my quality of life would be" were slightly higher for Poles (2.65±0.92) than for Slovaks (2.6±0.88) and Czechs (2.57±0.93). Overall, respondents from all three countries rated their QoL as good or very good: Slovaks—59.19%, Poles—58.41%, Czechs—57.57%. Only one Polish respondent reported "excellent" QoL. In response to the item "If I did not have diabetes, my quality of life would be" all three groups expected it to be better: Slovaks—84.84%, Czechs—82.65%, Poles—81.31%. Again, only one Polish respondent expected their QoL would be worse. No significant differences were found (all p>0.05) (Table 2).

Table 3 shows weighted impact scores for each country. In the study group, the weighted impact scores were negative for all domains. The lowest scores in all three countries were found for "freedom to eat": –4.23±2.6 for Poland, –4.19±2.44 for Slovakia, and –4.16±2.49 for the Czech Republic; the highest—for "living conditions": –1.22±1.99 for Poland, –1.29±2.03 for the Czech Republic, and –1.31±2.02 for Slovakia (Table 4). Negative WI scores in the analyzed domains ranged between –1.22 ("living conditions") and –4.23 ("freedom to eat") for Polish patients, from –1.29 ("living conditions") to –4.16 ("freedom to eat") for Czechs, and from –1.31 ("living conditions") to –4.19 ("freedom to eat") for Slovaks (Table 4). No correlations were statistically significant (all p>0.05). The average weighted impact (AWI) score in the group was lowest for Slovakia (–2.38±1.64), followed by Poland (–2.31±1.6) and the Czech Republic (–2.3±1.63). No correlations were statistically significant (p>0.05) (Table 3).

Ranks

In each group studied, DM had the greatest impact on the patients' "freedom to eat". For Poles and Czechs, the second most affected domain was "freedom to drink", and for Slovaks, "feelings about the future". Conversely, the third most affected domain was "feelings about the future" for Poles and Czechs, and "freedom to drink" for Slovaks (Table 4). The least affected domains in all three groups were "living conditions", followed by "people's reaction".

Regression Analyses

The applied linear regression model was used to verify whether the selected socio-demographic factors (including gender, age, education, residence, marital status, professional activity) or clinical parameters (HbA1c levels, fasting blood glucose, BMI, duration of DM, complications, treatment used) can affect QoL by lowering the AWI score.

For Polish patients, the linear regression model demonstrated the following significant (p<0.05) AWI predictors:

- pre-university education: the regression parameter is 1.396, meaning that pre-university education increases the AWI score by a mean of 1.396 points compared to primary or vocational education;

- past smoking: the regression parameter is –1.459, meaning that past smoking decreases the AWI score by a mean of 1.459 points compared to never having smoked.

In the Polish group, the R^2 coefficient for the model was 29.68%, meaning that variables included in the model account for 29.68% of variance in AWI scores. The remaining 70.32% depends on variables not included in the model or random factors (Table 5).

For Czech patients, the linear regression model demonstrated that none of the characteristics analyzed were significant independent predictors of AWI (as all p>0.05).

In the Czech group, the R^2 coefficient for the model was 9.81%, meaning that variables included in the model account for 9.81% of variance in AWI scores. The remaining 90.19% depends on variables not included in the model or random factors (Table 5).

For Slovak patients, the linear regression model demonstrated the following significant (p<0.05) AWI predictors:

- higher education: the regression parameter is –23.067, meaning that higher education decreases the

Table 1 Patient Characteristics by Country

Parameter		Country			p
		PL (N=214)	CZ (N=196)	SK (N=198)	
Age [years]	Mean±SD Median Quartiles	61.53±7.76 62 55–65	59.16±7 58 54.75–65	58.8±7.02 61 52–62	p=0.001 * PL>CZ, SK
BMI [kg/m^2]	Mean±SD Median Quartiles	26.18±4.67 25.77 23.45–28.48	26.87±3.79 25.25 23.74–29.06	25.28±2.6 24.39 23.43–28.73	p<0.001 * CZ, PL>SK
Diabetes duration [years]	Mean±SD Median Quartiles	5.83±2.67 6 4–8	5.36±2.4 5 3.75–7	6±2.25 6 4–7	p=0.02 * SK>CZ
Glucose fasting [mg/dL]	Mean±SD Median Quartiles	154.32±56.26 135 123–179.5	156.43±41.61 140 121–189	151.09±38.43 132 121–189	p=0.331
HbA1c [%]	Mean±SD Median Quartiles	7.57±0.9 7.6 6.8–8.1	7.89±1.4 7.2 6.8–8.9	7.72±1.47 7.2 6.8–8.9	p=0.224
Gender	Female Male	100 (46.73%) 114 (53.27%)	82 (41.84%) 114 (58.16%)	96 (48.48%) 102 (51.52%)	p=0.389
Education	Vocational or primary Pre-university Higher	95 (44.39%) 84 (39.25%) 35 (16.36%)	86 (43.88%) 92 (46.94%) 18 (9.18%)	87 (43.94%) 101 (51.01%) 10 (5.05%)	p=0.003 *
Place of residence	Rural Urban Unknown	74 (34.58%) 139 (64.95%) 1 (0.47%)	88 (44.90%) 108 (55.10%) 0 (0.00%)	123 (62.12%) 75 (37.88%) 0 (0.00%)	p<0.001 *
Marital status	Not in relationship In relationship Unknown	68 (31.78%) 144 (67.29%) 2 (0.93%)	50 (25.51%) 146 (74.49%) 0 (0.00%)	54 (27.27%) 144 (72.73%) 0 (0.00%)	p=0.234
Professional activity	Currently working Not working	64 (29.91%) 150 (70.09%)	96 (48.98%) 100 (51.02%)	75 (37.88%) 123 (62.12%)	p<0.001 *
Smoking	Never Past Present Unknown	84 (39.25%) 49 (22.90%) 79 (36.92%) 2 (0.93%)	101 (51.53%) 40 (20.41%) 55 (28.06%) 0 (0.00%)	134 (67.68%) 34 (17.17%) 30 (15.15%) 0 (0.00%)	p<0.001 *
Alcohol	Drinking Not drinking	76 (35.51%) 138 (64.49%)	63 (32.14%) 133 (67.86%)	34 (17.17%) 164 (82.83%)	p<0.001 *
Comorbidities	Coronary artery disease Hypertension Heart failure Renal failure Eye diseases	64 (29.91%) 172 (80.37%) 45 (21.03%) 36 (16.82%) 69 (32.24%)	57 (29.08%) 183 (93.37%) 41 (20.92%) 34 (17.35%) 71 (36.22%)	63 (31.82%) 191 (96.46%) 42 (21.21%) 34 (17.17%) 90 (45.45%)	p=0.781 p<0.001 * p=0.921 p=0.974 p=0.051
Drugs	Oral antidiabetic Insulin Antihypertensive Statins	80 (37.38%) 148 (69.16%) 170 (79.44%) 73 (34.11%)	77 (39.29%) 121 (61.73%) 164 (83.67%) 53 (27.04%)	59 (29.80%) 121 (61.11%) 172 (86.87%) 75 (37.88%)	p=0.113 p=0.163 p=0.128 p=0.067

(*Continued*)

Table 1 (Continued).

Parameter		Country			p
		PL (N=214)	CZ (N=196)	SK (N=198)	
Complications of diabetes	Retinopathy	77 (35.98%)	96 (48.98%)	109 (55.05%)	p<0.001 *
	Nephropathy	30 (14.02%)	13 (6.63%)	11 (5.56%)	p<0.001 *
	Polyneuropathy	50 (23.36%)	48 (24.49%)	53 (26.77%)	p=0.958
	Diabetic foot	30 (14.02%)	41 (20.92%)	42 (21.21%)	p=0.234

Notes: p – Kruskal–Wallis test + post hoc analysis (Dunn test) for quantitative variables, chi-squared or Fisher's exact test for qualitative variables. *Statistically significant (p<0.05).

Table 2 Overall QoL in the Study Group

Parameter		Country		
		PL (N=214)	CZ (N=196)	SK (N=198)
In general, my present quality of life is	Mean±SD	3.41±0.92	3.38±0.93	3.47±0.98
	Median	3	3	3
	Quartiles	3–4	3–4	3–4
If I did not have diabetes, my quality of life would be	Mean±SD	2.65±0.92	2.57±0.93	2.6±0.88
	Median	3	3	3
	Quartiles	2–3	2–3	2–3
In general, my present quality of life is	Excellent (+3)	1 (0.47%)	0 (0.00%)	0 (0.00%)
	Very good (+2)	28 (13.08%)	30 (15.31%)	24 (12.12%)
	Good (+1)	97 (45.33%)	86 (43.88%)	90 (45.45%)
	Neither good nor bad (0)	63 (29.44%)	62 (31.63%)	59 (29.80%)
	Bad (−1)	22 (10.28%)	13 (6.63%)	19 (9.60%)
	Very bad (−2)	2 (0.93%)	4 (2.04%)	3 (1.52%)
	Extremely bad (−3)	1 (0.47%)	1 (0.51%)	3 (1.52%)
If I did not have diabetes, my quality of life would be	Very much better (−3)	23 (10.75%)	27 (13.78%)	22 (11.11%)
	Much better (−2)	70 (32.71%)	65 (33.16%)	66 (33.33%)
	A little better (−1)	81 (37.85%)	70 (35.71%)	80 (40.40%)
	The same (0)	39 (18.22%)	34 (17.35%)	30 (15.15%)
	Worse (1)	1 (0.47%)	0 (0.00%)	0 (0.00%)

Note: p – Kruskal–Wallis test for quantitative variables, chi-squared or Fisher's exact test for qualitative variables.

AWI score by a mean of 23.067 points compared to primary or vocational education;

- concurrent heart failure: the regression parameter is –29.643, meaning that this comorbidity decreases the AWI score by a mean of 29.643 points.

In the Slovak group, the R^2 coefficient for the model was 7.17%, meaning that variables included in the model account for 7.17% of variance in AWI scores. The remaining 92.83% depends on variables not included in the model or random factors (Table 5).

Discussion

Our study provides information on diabetes-related QoL and its evaluation by patients with T2DM in Poland, Slovakia, and the Czech Republic, based on a study using the ADDQoL, a broadly used, DM-specific scale.[9–13,19,23] In the literature, one can find papers on patients from specific countries, but comparative analyses are scarce.

In recent years, more attention has been paid not only to proper management and ensuring satisfactory adherence,[24–26] to DM treatment, but also to issues related to self-care and QoL in diabetic patients.[27] QoL in the physical, psychological, and social domains very often affects adherence and vice versa. The American Diabetes Association guidelines emphasize the need for a "patient-centered" approach to T2DM treatment, so as to preserve or improve the patients' QoL, prevent DM complications and reach blood glucose targets.[28]

Table 3 Weighted Impact Scores in the Group

Weighted Impact Score		Country		
		PL (N=214)	CZ (N=196)	SK (N=198)
Leisure activities	Mean±SD	−1.66±1.72	−1.68±1.73	−1.82±1.76
	Median	−2	−2	−2
	Quartiles	−2–0	−3–0	−3–0
Working life	Mean±SD	−2.67±2.85	−2.68±2.74	−2.74±2.89
	Median	−2	−2	−2
	Quartiles	−4–0	−4–0	−4–0
Journeys	Mean±SD	−2.13±2.38	−2.12±2.28	−2.31±2.46
	Median	−2	−2	−2
	Quartiles	−3–0	−3–0	−4–0
Holidays	Mean±SD	−2.42±2.54	−2.42±2.64	−2.68±2.74
	Median	−2	−2	−2
	Quartiles	−4–0	−4–0	−4–0
Physical health	Mean±SD	−2.52±2.4	−2.66±2.55	−2.62±2.44
	Median	−2	−2	−2
	Quartiles	−4–−1	−4–−1	−4–−1
Family life	Mean±SD	−1.92±2.47	−2.01±2.56	−2.07±2.5
	Median	−1	−1	−2
	Quartiles	−3–0	−3–0	−3–0
Friendship & social life	Mean±SD	−1.91±2.23	−1.98±2.19	−1.78±2.21
	Median	−1	−2	−1
	Quartiles	−3–0	−4–0	−3–0
Personal relationship	Mean±SD	−2.18±2.69	−1.82±2.5	−2.36±2.79
	Median	−1	0	−2
	Quartiles	−4–0	−3–0	−4–0
Sex life	Mean±SD	−2.41±2.71	−2.27±2.66	−2.6±2.7
	Median	−2	−2	−2
	Quartiles	−4–0	−4–0	−4–0
Physical appearance	Mean±SD	−2.34±2.8	−2.6±3.03	−2.5±2.99
	Median	−2	−2	−2
	Quartiles	−4–0	−4–0	−4–0
Self-confidence	Mean±SD	−2.25±2.58	−2.2±2.5	−2.43±2.67
	Median	−2	−2	−2
	Quartiles	−4–0	−4–0	−4–0
Motivation	Mean±SD	−2.48±2.39	−2.41±2.31	−2.53±2.33
	Median	−2	−2	−2
	Quartiles	−4–0	−4–0	−4–0
People's reaction	Mean±SD	−1.49±2.13	−1.32±1.98	−1.4±2.01
	Median	0	0	0
	Quartiles	−2–0	−2–0	−2–0
Feelings about future	Mean±SD	−2.83±2.59	−2.81±2.54	−3.07±2.53
	Median	−2	−2	−3
	Quartiles	−4–−0.75	−4–0	−4–−1

(*Continued*)

Table 3 (Continued).

Weighted Impact Score		Country		
		PL (N=214)	CZ (N=196)	SK (N=198)
Financial situation	Mean±SD	−2.44±2.39	−2.56±2.4	−2.44±2.32
	Median	−2	−2	−2
	Quartiles	−4–0	−4–0	−4–0
Living conditions	Mean±SD	−1.22±1.99	−1.29±2.03	−1.31±2.02
	Median	0	0	0
	Quartiles	−2–0	−2–0	−2–0
Dependence on others	Mean±SD	−1.9±2.46	−1.91±2.39	−1.96±2.42
	Median	−1	−1.5	−2
	Quartiles	−3–0	−3–0	−3–0
Freedom to eat	Mean±SD	−4.23±2.69	−4.16±2.49	−4.19±2.44
	Median	−4	−4	−4
	Quartiles	−6–−2	−6–−2	−6–−2
Freedom to drink	Mean±SD	−3±2.57	−2.96±2.41	−2.85±2.5
	Median	−2	−2	−2
	Quartiles	−4–−1	−4–−1	−4–−1
AWI		PL (N=214)	CZ (N=196)	SK (N=198)
	Mean±SD	−2.31±1.6	−2.3±1.63	−2.38±1.64
	Median	−2.03	−2.13	−2.17
	Quartiles	−3.27–−1.05	−3.39–−0.89	−3.35–−1.06

Note: p – Kruskal–Wallis test.

Table 4 Ranks in the Study Group

Ranks	PL	CZ	SK
Leisure activities	17	17	16
Working life	4	4	4
Journeys	13	12	13
Holidays	8	8	5
Physical health	5	5	6
Family life	14	13	14
Friendship & social life	15	14	17
Personal relationship	12	16	12
Sex life	9	10	7
Physical appearance	10	6	9
Self-confidence	11	11	11
Motivation	6	9	8
People's reaction	18	18	18
Feelings about future	3	3	2
Financial situation	7	7	10
Living conditions	19	19	19
Dependence on others	16	15	15
Freedom to eat	1	1	1
Freedom to drink	2	2	3

The ADDQoL language versions used in the present study have a good internal consistency, confirmed by the authors, and constitute a reliable instrument for investigating the QoL of patients with T2DM.[20,29]

Approx. 60% of the studied population of patients with T2DM declared at least a good level of QoL. On the other hand, over 80% of respondents in each country claimed their QoL would have been better without DM.

In the adult T2DM patients from the Czech Republic, Poland and Slovakia, DM was found to have an adverse impact on all 19 ADDQoL domains.

The effect of T2DM on the weighted impact scores in the ADDQoL differed between particular domains. The most unfavorable weighted impact score was observed in aspects of life such as "freedom to eat", "freedom to drink" and "feelings about the future" in Polish and Czech patients; and "freedom to eat", "feelings about the future", and "freedom to drink" in Slovak patients. The smallest influence of T2DM on the weighted impact score was found in terms of

Table 5 Linear Regression Results for Each Country

Poland					
Characteristic		**Parameter**	**95% CI**		**p**
Sex	Female Male	ref. 0.466	−0.717	1.649	0.443
Age	[years]	0.044	−0.023	0.11	0.203
BMI	[kg/m^2]	−0.042	−0.134	0.049	0.367
Education	Vocational or primary Pre-university Higher	ref. 1.396 0.788	 0.232 −0.837	 2.561 2.412	 0.021 * 0.345
Place of residence	Rural Urban	ref. −0.948	−2.119	0.222	0.117
Marital status	Not in relationship In relationship Unknown	ref. −0.376 −1.061	 −1.653 −5.455	 0.901 3.334	 0.566 0.638
Professional activity	Currently working Not working	ref. −0.575	−1.884	0.734	0.392
Smoking	Never Past Present	ref. −1.459 −1.144	 −2.479 −2.34	 −0.44 0.052	 0.006 * 0.065
Alcohol	Drinking Not drinking	ref. −0.751	−1.998	0.497	0.242
Diabetes duration	[years]	−0.308	−0.628	0.012	0.063
Coronary artery disease (comorbidities)	No Yes	ref. 0.708	−0.291	1.707	0.169
Hypertension (comorbidities)	No Yes	ref. 0.359	−1.555	2.273	0.714
Heart failure (comorbidities)	No Yes	ref. 0.548	−0.85	1.945	0.445
Renal failure (comorbidities)	No Yes	ref. −1.145	−2.707	0.416	0.155
Eye diseases (comorbidities)	No Yes	ref. 0.622	−0.384	1.628	0.23
Oral antidiabetic	No Yes	ref. 0.484	−0.742	1.71	0.442
Insulin	No Yes	ref. 0.096	−1.199	1.391	0.885
Antihypertensive	Yes No	ref. 0.058	−1.663	1.779	0.947
Statins	Yes No	ref. −0.402	−1.417	0.613	0.44
Retinopathy (complications of diabetes)	No Yes	ref. −0.093	−1.151	0.966	0.864

(*Continued*)

Table 5 (Continued).

Nephropathy (complications of diabetes)	No Yes	ref. 1.593	−0.047	3.234	0.061
Polyneuropathy (complications of diabetes)	No Yes	ref. −0.017	−1.17	1.135	0.976
Diabetic foot	No Yes	ref. 0.175	−1.07	1.42	0.784
Glucose fasting HbA1c	[mg/dL] [%]	−0.002 0.198	−0.008 −0.301	0.004 0.697	0.519 0.439
Czech Republic					
Characteristic		**Parameter**	**95% CI**		**p**
Gender	Female Male	ref. −1.244	−5.261	2.774	0.545
Age BMI Education	[years] [kg/m2] Vocational or primary Pre-university Higher	−0.121 0.222 ref. 2.938 8.491	−0.391 −0.289 −6.213 −23.698	0.149 0.734 12.089 40.68	0.381 0.396 0.53 0.606
Place of residence	Rural Urban	ref. 3.639	−0.63	7.907	0.097
Marital status	Not in relationship In relationship	ref. −7.177	−28.053	13.699	0.501
Professional activity	Currently working Not working	ref. −1.558	−26.617	23.502	0.903
Smoking	Never Past Present	ref. −4.846 −5.362	−17.754 −37.085	8.062 26.362	0.463 0.741
Alcohol	Drinking Not drinking	ref. 6.458	−13.012	25.927	0.517
Diabetes duration Coronary artery disease	[years] No Yes	−0.741 ref. −4.182	−4.937 −12.997	3.455 4.633	0.73 0.354
Heart failure (comorbidities)	No Yes	ref. −0.311	−7.124	6.503	0.929
Eye diseases (comorbidities)	No Yes	ref. −1.269	−4.31	1.771	0.414
Oral antidiabetic	No Yes	ref. 2.239	−11.324	15.802	0.747
Statins	Yes No	ref. −7.663	−29.26	13.933	0.488
Glucose fasting HbA1c	[mg/dL] [%]	0.047 1.412	−0.076 −2.484	0.171 5.309	0.456 0.478

(*Continued*)

Table 5 (Continued).

Slovakia					
Characteristic		**Parameter**	**95% CI**		**p**
Gender	Female Male	ref. 1.419	−1.956	4.794	0.411
Age BMI Education	[years] [kg/m2] Vocational or primary Pre-university Higher	0.861 −5.83 ref. −63.45 −23.067	−0.055 −11.871 −126.639 −44.301	1.777 0.212 −0.262 −1.832	0.067 0.06 0.051 0.035 *
Place of residence	Rural Urban	ref. 34.866	−1.241	70.973	0.06
Marital status	Not in relationship In relationship	ref. 79.749	0.492	159.007	0.05
Smoking	Never Past Present	ref. 61.233 −32.496	0.17 −65.581	122.296 0.589	0.051 0.056
Alcohol	Drinking Not drinking	ref. 3.257	−1.362	7.876	0.169
Diabetes duration	[years]	−2.555	−5.112	0.003	0.052
Coronary artery disease (comorbidities)	No Yes	ref. −40.833	−81.524	−0.141	0.051
Heart failure (comorbidities)	No Yes	ref. −29.643	−58.529	−0.758	0.046 *

Notes: p – multivariate linear regression. * Statistically significant (p<0.05).

"living conditions", "people's reactions" and "leisure activities" for Polish and Czech patients. For Slovak patients, the smallest influence of T2DM on the weighted impact score was found in terms of "living conditions", "people's reactions", and "friendship and social life".

In our study, T2DM had the most severe impact on the "freedom to eat" domain, suggesting that patients are most bothered by dietary restrictions or the need to use special nutrition. This is corroborated by previous studies on the QoL of patients with T2DM, both in Poland[29] and in other countries: Slovenia,[4] Greece,[10] Turkey[12] and Argentina,[4] as well as in a cross-sectional study including patients from nine European countries.[23]

In the present study, a strong negative impact of DM on patients' "freedom to drink" was also found. Respondents from all three countries reported "freedom to eat" and "freedom to drink" as the two domains most affected. One could presume that these aspects of diabetes education may be suboptimal and require more attention from medical personnel providing recurrent education to patients with T2DM. These results are undoubtedly contributed to by concerns about hyperglycemia, but also about weight gain or excess blood sugar levels.[18] Increasing the focus on these aspects could also improve metabolic control outcomes in patients with T2DM.

As the "living conditions" domain was the least affected for all patients in our study, T2DM does not seem to adversely affect a patient's financial standing (even though most respondents were not professionally active) or any other aspects of overall living conditions. Notably, alongside "living conditions", other little-affected domains were "people's reactions" and "friendship and social life", which indicates that diabetic patients in all three countries experience the fewest DM-related issues in their social life. Our results are corroborated by those reported in Slovenia by Turk et al[9] in Australia by Donald et al[30] in Malaysia by Daher et al[31] and in China by Kong et al.[13]

A study by Kuznetsov L et al, which included over 1800 patients, indicates a link between overall perceived QoL and long-term HbA1C outcomes. Patients reporting an adverse impact of DM on QoL had significantly higher HbA1C levels after 5 years. The authors suggest that this link between DM-specific QoL and glycemia should be considered in DM management, especially with regard to diet.[32]

In our study, a linear regression model was used to verify whether the selected socio-demographic factors (including gender, age, education, residence, marital status, professional activity) or clinical parameters (HbA1c levels, fasting blood glucose, BMI, duration of DM, complications, treatment used) can affect QoL by lowering the AWI score. For Polish patients, the linear regression model demonstrated that pre-university education and past smoking are significant independent AWI predictors. This means that patients with pre-university education experience a less negative impact of DM on QoL than those with primary or vocational education.[33] Similar findings were reported by Flatz A. et al in Switzerland. In turn, the QoL of patients who used to smoke was more affected by DM than in the case of those who had never smoked.

In the Polish group, the R^2 coefficient for the model was 29.68%, meaning that variables included in the model account for 29.68% of variance in AWI scores. The remaining 70.32% depends on variables not included in the model or random factors.

For Czech patients, the linear regression model demonstrated no significant independent predictors of AWI.

In the Czech group, the R^2 coefficient for the model was 9.81%, meaning that variables included in the model account for 9.81% of variance in AWI scores. The remaining 90.19% depends on variables not included in the model or random factors.

For Slovak patients, the linear regression model demonstrated that higher education and concurrent heart failure are significant independent AWI predictors. In that group, patients who had completed higher education experienced a much more negative impact of DM on QoL than those with primary or vocational education, which runs completely opposite to what Flatz A. found in a group of Swiss patients. Heart failure as a comorbidity also adversely affects DM-related QoL, reflected by the AWI score. A similar effect was reported by Wexler et al[34] who found that both heart failure and microvascular complications are associated with poorer perceived QoL.

In the Slovak group, the R^2 coefficient for the model was 7.17%, meaning that variables included in the model account for 7.17% of variance in AWI scores. The remaining 92.83% depends on variables not included in the model or random factors.

These findings suggest a need for more in-depth studies in larger and more diverse patient groups.

Remarkably, our study did not demonstrate any association between QoL and DM complications, even though about half of the patients studied did have some complications. The literature data are conflicting. Some studies show that patients with no complications have a better QoL,[12,20] while others show the opposite, ie, that complications have a significant negative impact.[35]

Similarly, insulin therapy for T2DM was not a predictor of poorer QoL in our study group. The reviewed publications by other authors report divergent findings. In the Spanish PANORAMA study,[36] as well as a cross-sectional study covering nine European countries,[23] patients treated with insulin experienced a deterioration of QoL.[37]

Our findings regarding metabolic control and obesity are similar. Though all patients had excessive HbA1C levels and were overweight, neither of these factors was found to be an independent predictor of poorer QoL.

Study Strengths and Limitations

Our results are consistent with those reported by authors of studies performed in other countries. Our study demonstrates that T2DM represents a growing public health issue, not just in the countries studied here, but also elsewhere, as it adversely affects not only patients' health but also their perceived QoL in all of the aspects analyzed. The findings reported here do not fully reflect all the problems experienced by T2DM patients in the populations that were studied, and therefore further studies seem warranted, including other more accurate clinical characteristics and a more diverse patient group, which would allow for the performance of additional analyses.

A strength of the ADDQoL is that it measures quality of life in specific, potentially relevant areas of people's lives. A consequence, however, is that not all areas are applicable to all respondents. As a result, most respondents did not provide complete data for all ADDQoL domains.

Conclusions

In summary, our findings demonstrate that T2DM has a negative impact on all aspects of patients' QoL, which is the strongest in terms of the freedom to eat and dietary habits, regardless of the country. Education, past smoking,

and concurrent heart failure were the only independent predictors of QoL in our study. This suggests a need for further research that would include more variables and a larger number of patients.

Disclosure

The authors report no conflicts of interest in this work.

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