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Satisfaction with life in young adults with type 1 diabetes mellitus

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The rules for therapy and self-monitoring in type 1 diabetes mellitus (T1DM) can significantly affect the satisfaction and quality of life of young people. This study assesses the level of life satisfaction in young adults with T1DM and presents the impact of various sociodemographic factors, treatment methods and comorbid conditions on their satisfaction. The study was based on an original survey and a psychological questionnaire, *the Satisfaction with Life Scale* (SWLS), conducted among young people with T1DM who had been living with the condition for more than one year. A total of 120/222 women with T1DM aged 18–35 years were sick for more than 1 year and were treated with a personal insulin pump. The median (interquartile range (IQR)) concentration of glycosylated haemoglobin (HbA1c) was 7.65% (6.80–8.70%). The average raw score for the respondents' answers to the statements included in the SWLS psychological questionnaire was 19.9 ± 6.2, with a median (IQR) of sten score for these respondents' answers was 5.00 (4.00–7.00). The survey revealed a negative correlation between satisfaction with life and HbA1c levels (raw score: $R = -0.34$, $p = 0.00034$; sten score: $R = -0.23$, $p = 0.00042$) and a weak positive correlation between life satisfaction and age (raw score: $R = 0.14$, $p = 0.0444$; sten score: $R = 0.12$, $p = 0.0636$). Patients with a higher HbA1c levels reported lower life satisfaction (raw score: $-p = 0.00034$; sten score: $p = 0.00042$). Young people with T1DM who did not keep a "traditional" paper self-monitoring journal (raw score: $p = 0.01$; sten score: $p = 0.04$), who used a continuous glucose monitoring system (raw score: $p = 0.01$; sten score: $p = 0.009$), who did not suffer from other chronic diseases, such as hypothyroidism (raw score: $p = 0.002$; sten score: $p = 0.002$) and hyperthyroidism (raw score: $p = 0.04$; sten score: $p = 0.02$), and who had celiac disease (raw score: $p = 0.006$; sten score: $p = 0.004$) were more satisfied with their lives. Most respondents reported average life satisfaction. Satisfaction with life is influenced by comorbidities, such as hypothyroidism, hyperthyroidism, and coeliac disease. A lower level of satisfaction with life is associated with uncontrolled T1DM. The use of modern monitoring and treatment technologies improves satisfaction with life in young adults with T1DM.

Abbreviations

T1DM	Type 1 diabetes mellitus
SWLS	Satisfaction with life scale
DCCT	Diabetes control and complications trial
N	Number
SD	Standard deviation
Q_{25}	25th percentile
Q_{75}	75th percentile
IQR	Interquartile range
HbA1c	Glycosylated haemoglobin level
HRQOL	Health-related quality of life
CSII	Continuous subcutaneous insulin infusion

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CGM	Continuous glucose monitoring
rt-CGM	Real-time continuous glucose monitoring
QOL	Quality of life

Type 1 diabetes mellitus (T1DM) is one of the most common chronic childhood diseases. It leads to autoimmune destruction of pancreatic β cells and insulin deficiency[1–4].

In 2021, approximately 8.4 million people had T1DM, including 1.5 million (18%) younger than 20, 5.4 million (64%) aged 20–59, and 1.6 million (18%) aged 60 and older. By 2040, the number of people with T1DM is expected to reach 13.5–17.4 million. Inadequately monitored T1DM or related complications shorten life expectancy[5].

T1DM is usually diagnosed during childhood or puberty[6]. The early onset of chronic diseases, such as T1DM, entails a longer duration of living with the disease, a greater probability of long-term complications, reduced life satisfaction, and worse quality of life.

T1DM influences the emotional, mental, professional and social lives of diabetic patients and their relatives[7–10]. T1DM requires daily self-monitoring, which includes strict compliance with insulin therapy via an insulin pen (injector) or pump, regular monitoring of blood glucose and intramuscular fluids, counting carbohydrates or carbohydrate units, following a balanced diet, and regular physical activity[10,11]. Noncompliance with self-monitoring and therapy protocols may result in severe acute metabolic disorders, chronic complications, and death[4,11–13]. T1DM may negatively impact patients' everyday lives[14].

Legal guardians are responsible for T1DM treatment during childhood and puberty[15]. Reduced parental control and new educational or work commitments change everyday responsibilities[16,17].

Young adults with T1DM face contemporary challenges, but are expected to take full responsibility for treating and monitoring their disease. They must be highly committed to self-monitoring and treatment, including in particular, healthy lifestyles; regular diabetes education, normalising glucose levels, lipids, weight and blood pressure; and protecting heart, vessel and kidney health[18–20]. Optimal blood level monitoring reduces the risk of disease progression and complications[19,21,22].

T1DM also entails poor quality of life and mental strain[4,14,23].

Patients' mental condition and mood influence almost all aspects of the therapeutic process. Most frequently, patients fail to adhere to medical recommendations adequately due to their psychological issues, which must be diagnosed and, where relevant, treated with psychotherapeutic interventions. The mental health of young adults with T1DM has a significant effect on their fulfilment[18].

Well-being is a crucial element of health. Satisfaction with life is a key indicator of well-being. Subjective well-being comprises three components: satisfaction with life, positive feelings, and the absence of negative feelings[24,25]. No prior studies in Poland have assessed life satisfaction in young adults with T1DM; therefore, this study assesses the level of satisfaction with life in a group of Polish young adults with T1DM.

This study assessed the level of satisfaction with life in young adults with T1DM and presents the impact of various sociodemographic factors, treatment methods and comorbidities on their life satisfaction.

Materials and methods
Study design, setting and participants
The cross-sectional survey was conducted from 01.08.2023 to 01.08.2024.

Participants were young adults with T1DM diagnosed for more than one year, treated at one of several diabetes clinics in the Pomeranian Voivodeship, and members of the Voivodeship Branch of Gdansk of the Polish Association of Diabetics. The target sample size was 500 patients. Surveys were distributed randomly. Participation was anonymous, and paper-based versions were used.

Methods
The survey involved an original Polish survey form and a Polish version of the standard psychological questionnaire of the *Satisfaction with Life Scale* (SWLS) developed by Diener, Emmons, Larsen, and Griffin from the Psychology Department of Illinois University (adjusted to Polish conditions by Z. Juczyński)[25].

Original survey form
The first page of the survey form included information about the study and an invitation to participate.

The survey form included questions concerning sociodemographic data (sex, age, place of residence, education, marital status, professional activity, school activities, use of addictive substances) and medical data (glycosylated haemoglobin (HbA1c) value, duration of disease, existence of chronic complications, T1DM self-monitoring and treatment methods, regularity of meetings with nurses and doctors).

Satisfaction with life scale (SWLS)
The SWLS comprises five statements: 1. In most ways, my life is close to my ideal. 2. The conditions of my life are excellent. 3. I am satisfied with my life. 4. So far, I have gotten the important things I want in life. 5. If I could live my life over, I would change almost nothing.

The scores reflected the level of satisfaction with life. Each respondent assessed the degree to which the above statements applied to their life. Each statement was scored from 1 to 7, where 1 indicates "strongly disagree" and 7 indicates "strongly agree". The Cronbach's alpha reliability coefficient for the Polish version of the scale established that 371 adults were satisfactory (0.81). The scale stability coefficient established in a two-time study of a group of 30 people with an interval of six weeks was 0.86. The Cronbach's alpha for the original version of the scale was 0.87[26]. The total SWLS score was the sum of all five statements, with raw scores ranging from 5 to

35. In accordance with the interpretation, the higher the scores, the greater the satisfaction with life. Raw scores were then converted into sten scores.

The score must be interpreted according to the characteristics of the standard ten-point scale. Sten scores from 1 to 4 are considered low, and 7 to 10 are considered high. Scores of 5 and 6 are deemed average[26].

Data collection
The researchers distributed the survey forms and psychological questionnaires to participants in person. Participation was voluntary. HbA1c values were obtained from medical records, and patients reported the remaining data via paper surveys. The survey was approved by the Management of the Healthcare Institution and the President of the Voivodeship Branch of the Gdansk of the Polish Association of Diabetics in the Pomeranian Voivodeship, as well as by the Independent Bioethical Commission for Scientific Studies at the Medical University in Gdansk (KB/306/2023).

Description of statistical methods
Data were subjected to statistical processing. The number of cases (N), mean, standard deviation (SD), median,, and lower and upper quartiles (25Q-75Q) of the quantitative parameters were calculated for all groups.

Depending on the distribution, the following quantitative data were presented:

1. Mean ± SD for normally distributed variables;
2. Median and interquartile range (IQR (25Q–75Q)) for non-normally distributed variables.

Qualitative variables are presented as absolute values and percentages (%).

The normality of distributions was tested using the Shapiro–Wilk test, and the homogeneity of variance was checked using Levene's test.

Verification of the hypothesis of equality of mean parameters in independent groups with homogeneous variance was performed using one-way analysis of variance (ANOVA) or for groups with heterogeneous variance by the nonparametric Mann–Whitney U test (for two groups) and the Kruskal–Wallis test (for three or more groups). For comparisons of three or more groups, multiple (two-sided) comparisons were also performed.

A p value of less than 0.05 was required to reject the null hypothesis. Statistical analysis was performed using the software package Statistica Ver. 13.3. (TIBCO Software Inc.). Post hoc power analysis was performed using the calculator at https://clincalc.com/stats/power.aspx.

Results
Description of the participants
The survey included 222 young adults with T1DM aged 18–35 years (18–25 years–114/222 (51.4%); 26–30 years–56/222 (25.2%); and 31–35 years–52/222 (23.4%)).

Most respondents were women who had lived with T1DM for more than 10 years, were treated with a personal insulin pump, resided in a town, had secondary education, were single, were active in the labour market, were not currently studying, did not smoke and consumed alcohol. A total of 9/222 (4.1%) of the respondents were treated with intelligent insulin pens (injectors), 109/222 (49.1%) with traditional pump systems, and 6/222 (2.7%) with diabetes pump patches. Of the participants,104/221 (47.1%) used real-time continuous glucose monitoring (rtCGM), and 33/110 (30%) used flash glucose monitors.

The median (IQR) age and HbA1c level were 25.0 (22.0–30.0) and 7.65% (6.80–8.70%); Tables 1 and 2, respectively.

Satisfaction with life
The respondents' scores on the Satisfaction with Life scale were analysed.

The mean raw score for the statements included in the SWLS psychological questionnaire was 19.9 ± 6.2, and the median (IQR) of sten score was 5.00 (4.00–7.00).

Impact of various factors on satisfaction with life
The survey revealed a negative association between satisfaction with life and HbA1c levels (Fig. 1a and b) and a weak positive relationship between the respondents' satisfaction with life and their age (Fig. 2).

Satisfaction with life was not determined by sex, place of residence, education level, marital status, professional and school activities, disease duration, diagnosed hypertension, diabetic retinopathy, neuropathy, or lipohypertrophy, use of addictive substances, treatment methods (insulin pen (injector)/insulin pump), use of a glucometer, electronic self-monitoring journal, carbohydrate or carbohydrate unit counting, or the use of mobile applications for calculating carbohydrate content (Tables 1 and 3).

Regular educational meetings with a diabetes nurse educator and a dialectologist at the Diabetes Clinic did not influence satisfaction with life (Table 3).

Satisfaction with life in young people with T1DM who do not suffer from hypothyroidism, hyperthyroidism, or coeliac disease was greater (Table 2). Patients who do not keep a "traditional" self-monitoring journal are more satisfied with life (Table 3).

Satisfaction with life in young people with T1DM who do not use continuous glucose monitoring systems was lower (Table 3).

Discussion
The purpose of this study was to assess the level of satisfaction with life in young adults with T1DM and present the impact of various sociodemographic factors, methods of treatment and comorbidities on this outcome.

Sociodemographic data		N (%)	Satisfaction with life-raw score mean ± SD/median (Q1, Q3)	Satisfaction with life-standard ten mean ± SD/median (Q1, Q3)
Sex	Female	120 (54.1%)	19.2 ± 6.1	5.13 ± 2.22
	Male	102 (45.9%)	20.7 ± 6.3	5.59 ± 2.16
P			0.08**	0.12**
Age (years)		222 (100%)	25.0 (22.0, 30.0)	
Place of residence	Town	182 (81.9%)	19.8 ± 6.2	5.3 ± 2.19
	Village	40 (18.1%)	20.4 ± 6.4	5.55 ± 2.25
P			0.55**	0.51**
Education	Primary	16 (7.2%)	18.5 (12.5, 22.0)	5.00 (3.00, 6.00)
	Secondary	99 (44.6%)	20.0 (15.0, 25.0)	5.00 (4.00, 7.00)
	Vocational	32 (14.4%)	19.0 (13.5, 21.0)	5.00 (3.00, 6.00)
	Higher	75 (33.8%)	21.0 (16.0, 26.0)	6.00 (4.00, 7.00)
P			0.06***	0.07***
Marital status	Single	142 (64%)	20.2 ± 6.1	5.44 ± 2.19
	Non-single	80 (36%)	19.4 ± 6.4	5.18 ± 2.22
P			0.4**	0.39**
Active in the labour market/ professionally active	Yes	153(78.5%)	19.9 ± 6.3	5.32 ± 2.2
	No	42 (21.5%)	20 ± 5.6	5.43 ± 1.96
P			0.96**	0.77**
Continuation of school education	Yes	73 (32.8%)	19.9 ± 6	5.34 ± 2.09
	No	149 (67.1%)	19.9 ± 6.4	5.34 ± 2.26
P			0.97**	0.99**
Duration of disease	≤ 10 years	92 (41.4%)	20.4 ± 5.8	5.50 ± 2.05
	11–20 years	94 (42.3%)	18.9 ± 6.6	4.99 ± 2.33
	≥ 21 years	36 (16.2%)	21.3 ± 6.1	5.86 ± 2.14
P			0.07**	0.08**
Smoking	Yes	64 (28.8%)	18.7 ± 5.8	5.00 (4.00, 6.00)
	No	158 (71.2%)	20.4 ± 6.4	5.50 (4.00, 7.00)
P			0.06**	0.08***
Alcohol consumption	Yes	69 (31.1%)	21 ± 5.9	5.75 ± 2.08
	No	153 (68.9%)	19.4 ± 6.3	5.16 ± 2.23
P			0.06**	0.06**

Table 1. Sociodemographic data vs. satisfaction with life in young adults with T1DM. *Mann–Whitney U test; **ANOVA; ***Kruskal-Wallis test; *T1DM* Type 1 diabetes mellitus, *N* numer, *SD* standard deviation, Q_1–Q_{25} 25th lower quartile, Q_3–Q_{75} 75th upper quartile interquartile range.

The survey involved 222 young adults with T1DM aged 18–35 with T1DM. Most respondents were women who had lived with T1DM for more than 10 years, were treated with a personal insulin pump, resided in a town, had secondary education, were single, were active in the labour market, were not currently in school, did not smoke and consumed alcohol. The median (IQR) age and HbA1c level were 25.0 (22.0–30.0) and 7.65% (6.80–8.70%), respectively. The mean raw score for the respondents' answers to the statements included in the SWLS psychological questionnaire was 19.9 ± 6.2, and the median (IQR) sten score for these respondents' answers was 5.00 (4.00–7.00).

A comparable study by Cyranka et al. assessed psychological parameters, including satisfaction with life, in young people with T1DM at their first meeting at the adult clinic during the transition period. Their study involved 50 young adults (28.56% women, with a mean age of 19.2 ± 1.4 years, a mean disease duration of 9.8 ± 4.3 years, and a mean HbA1c level of 7.5 ± 1.2%. 68% (*n* = 34) were treated with a personal insulin pump. Most respondents (21.42%) reported medium levels of satisfaction with life. The average raw SWLS score was 19.8 ± 5.9, with a median of 5.4 ± 2.1[27].

Although our study group was larger and the ages of the participants were different, the SWLS results were similar.

In our survey, satisfaction with life was not determined by sex, place of residence, education, marital status, professional and school activities, disease duration, diagnosed hypertension, diabetic retinopathy, neuropathy, or lipohypertrophy, use of addictive substances, treatment methods (insulin pen (injector)/insulin pump), use of a glucometer, an electronic self-monitoring journal, carbohydrate or carbohydrate unit counting, mobile applications for carbohydrate tracking, or regular appointments with nurses and doctors at the Diabetes Clinic.

We observed that satisfaction with life in young people with T1DM with coexisting hypothyroidism, hyperthyroidism and coeliac disease was lower.

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Coexisting diseases		N (%)	Satisfaction with life-raw score mean ± SD/median (Q1, Q3)	Satisfaction with life-standard ten mean ± SD/median (Q1, Q3)
HbA1c level (%)		222 (100%)	7.65 (6.80, 8.70)	
Hypertension	Yes	26 (11.7%)	19.0 (14.0, 24.0)	5.00 (3.00, 7.00)
	No	196 (88.3%)	20.0 (15.5, 24.0)	5.00 (4.00, 7.00)
p			0.54*	0.59*
Hypothyroidism	Yes	71 (32%)	18 ± 5.7	4.69 ± 1.95
	No	151 (68%)	20.8 ± 6.3	5.65 ± 2.25
p			0.002** (post hoc power = 91.0%)	0.002** (post hoc power = 90.2%)
Hyperthyroidism	Yes	11 (5%)	16.0 (12.0, 22.0)	4.00 (3.00, 6.00)
	No	211 (95%)	20.0 (16.0, 25.0)	5.00 (4.00, 7.00)
p			0.04*	0.02*
Coeliac disease	Yes	16 (7.2%)	15.0 (12.5, 20.0)	3.50 (3.00, 5.00)
	No	206 (92.8%)	20.0 (16.0, 25.0)	5.00 (4.00, 7.00)
p			0.006* (post hoc power = 83.5%)	0.004* (post hoc power = 87.8%)
asthma	Yes	7 (3.2%)	–	–
	No	214 (96.8%)	–	–
p			–	–
Rheumatoid arthritis	Yes	5 (2.3%)	–	–
	No	217 (97.7%)	–	–
p				–
Atherosclerosis	Yes	3 (1.4%)	–	–
	No	219 (98.6%)	–	–
p			–	–
Diabetic nephropathy	Yes	5 (2.3%)	–	–
	No	217 (97.7%)	–	–
p			–	–
Diabetic retinopathy	Yes	10 (4.5%)	16.5 (9.0, 24.0)	4.00 (1.00, 7.00)
	No	212 (95.5%)	20.0 (16.0, 24.0)	5.00 (4.00, 7.00)
p			0.13*	0.16*
Diabetic neuropathy	Yes	12 (5.4%)	20.0 (11.5, 22.5)	5.50 (2.00, 6.50)
	No	210 (94.6%)	20.0 (15.0, 24.0)	5.00 (4.00, 7.00)
p			0.33*	0.38*
Lipohypertrophy	Yes	44 (19.8%)	19 ± 7	5 ± 2.4
	No	178 (80.2%)	20.1 ± 6	5.43 ± 2.15
p			0.27**	0.25**
Lipoatrophy	Yes	5 (2.3%)	–	–
	No	217 (97.7%)	–	–
p			–	-

Table 2. Coexisting diseases vs. life satisfaction in young adults with T1DM. *Mann–Whitney U test; **ANOVA; ***Kruskal–Wallis test; *T1DM* Type 1 diabetes mellitus, *N* numer, *SD* standard deviation, Q_1–Q_{25} 25th lower quartile, Q_3–Q_{75} 75th upper quartile interquartile range.

Charzyńska and colleagues assessed the relationships between diabetes duration, positive and negative components of self-compassion (i.e., self-compassion and self-coldness) and life satisfaction among 112 individuals with T1DM. The mean age of the respondents was 28.29 ± 7.6 years, and the average duration of diabetes was 13.75 ± 8.78 years. Notably, 73% of respondents had intimate relationships. A total of 27.7% of patients were dissatisfied or strongly dissatisfied with their life, 18.8% were much above average, 33% had an average level of satisfaction, and 20.5% were satisfied or very satisfied. The duration of diabetes was not substantially correlated with satisfaction with life[11].

The results of Charzyńska's study are consistent with our results.

Compliance with strict self-monitoring and treatment rules adversely impacts emotional well-being and causes feelings of fear, anxiety, distress, guilt and shame, resulting in depression and anxiety[11,28–30].

Individuals with diabetes report a lower level of satisfaction with life than the general population, which is connected to the chronic nature of the disease[7,11,31–33].

The duration of diabetes and chronic hyperglycaemia may contribute to multi-organ damage and cause various complications, such as diabetic retinopathy, nephropathy, and cardiovascular disorders[34,35].

Hart et al. evaluated the quality of life of 281 patients with T1DM at the Isala Clinic in Zwolle, the Netherlands. They found that hyperglycaemia and macrovascular complications adversely impact the quality of life of patients with T1DM[36].
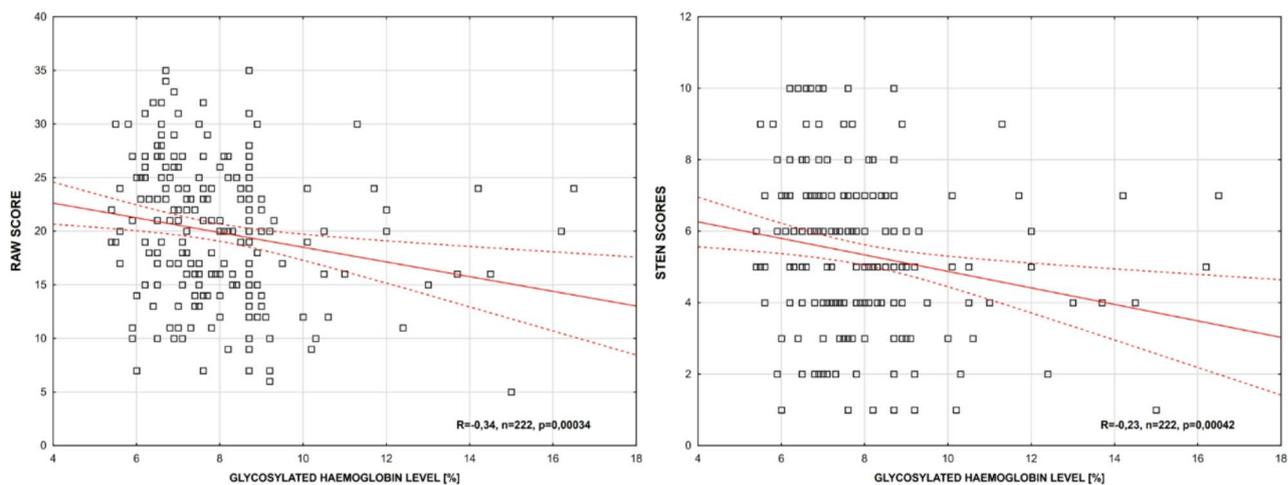
Fig. 1. (**a**) and (**b**) Satisfaction with life in young adults with T1DM in relation to the respondents' HbA1c level.
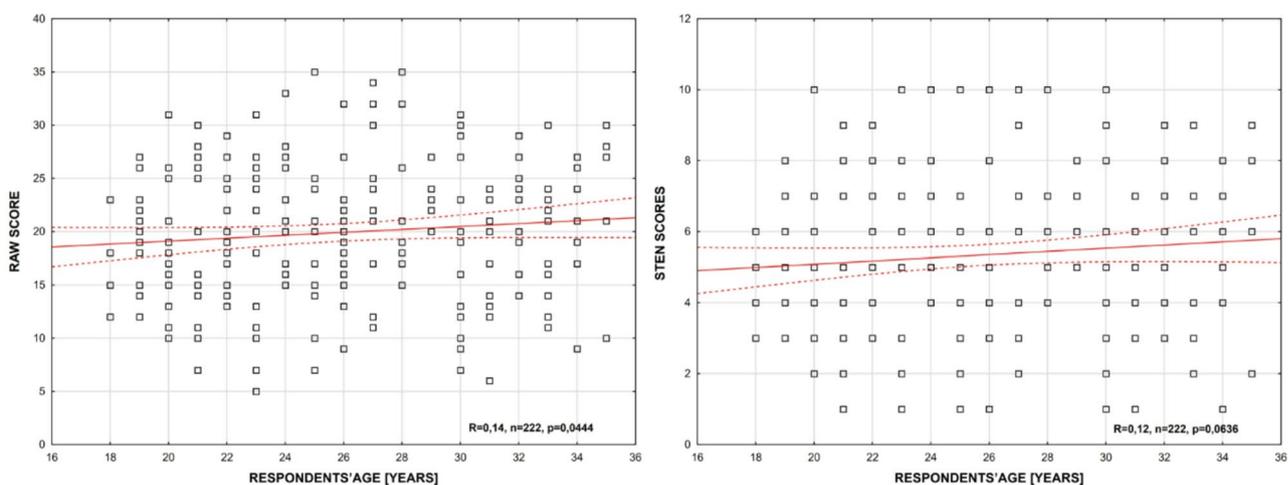

Fig. 2. (**a**) and (**b**) Satisfaction with life in young adults with T1DM in relation to the respondents' age.

These results contrast with our study. While we did not find a significant association between disease duration and life satisfaction, we did observe that patients with higher HbA1c levels were associated with lower satisfaction with life. Only 23% of respondents in our study reported regular meetings with diabetes nurse educators, while 80.6% attended regular sessions with physicians.

Additionally, Danish researchers compared 2415 adults (aged 18–98 years) with T1DM with 48,511 adults (aged 18–103 years) from the general population. They examined their health-related quality of life, professional status (employment level, working hours, and sick leave), and education level. Adults with T1DM experienced lower health-related quality of life, had higher unemployment rates, had more sick leave per annum, and were slightly better educated. Differences in health-related quality of life increased with age and were more pronounced in women than men[14].

Our study did not include comparisons with the general population. We found a weak correlation between the level of satisfaction with life and age.

Wikbland and colleagues assessed health-related quality of life (HRQOL) in patients with long-standing insulin-dependent diabetes mellitus. Their study found that people with diabetes ($n = 108$) reported the same quality of life as the general population. However, patients with poor metabolic control (HbA1c ≥ 9%) assessed their physical and emotional well-being much lower than those with lower HbA1c values. Almost 15% of patients reported experiencing 1–5 incidents of hypoglycaemia in the past 6 months. Furthermore, 39% of respondents did not have diabetes complications and assessed their general health better than those already experiencing late complications[37].

In contrast, most respondents in our study did not report chronic diabetes complications. Only 19.8% and 2.3% experienced lipohypertrophy and lipoatrophy, respectively. Hypertension was reported by 11.7%, diabetic neuropathy by 5.4%, and diabetic retinopathy by 4.5% of exam patients.

T1DM self-monitoring and treatment method vs. satisfaction with life in young adults with T1DM		N (%)	Satisfaction with life-raw score mean ± SD/median (Q1, Q3)	Satisfaction with life-standard ten mean ± SD/median (Q1, Q3)
Insulin pens (injector)	Yes	108 (48.6%)	19.7 ± 6.3	5.28 ± 2.25
	No	114 (51.4%)	20.1 ± 6.2	5.4 ± 2.16
p			0.67**	0.67**
Insulin pump	Yes	115 (51.8%)	20 ± 6	5.37 ± 2.08
	No	107 (48.2%)	19.8 ± 6.5	5.32 ± 2.33
p			0.81**	0.87**
Glucometer	Yes	79 (35.6%)	19.0 (15.0, 23.0)	5.00 (4.00, 6.00)
	No	143 (64.4%)	20.0 (15.0, 25.0)	5.00 (4.00, 7.00)
p			0.11*	0.11*
Continuous glucose monitoring system	Yes	137 (61.7%)	21.0 (16.0, 25.0)	6.00 (4.00, 7.00)
	No	85 (38.3%)	19.0 (15.0, 22.0)	5.00 (4.00, 6.00)
p			0.01* (post hoc power = 63.9%)	0.009* (post hoc power = 63.9%)
"Traditional" written self-monitoring journal	Yes	22 (9.9%)	16.0 (12.0, 22.0)	4.00 (3.00, 6.00)
	No	200 (90.1%)	20.0 (16.0, 25.0)	5.00 (4.00, 7.00)
p			0.01* (post hoc power = 69.7%)	0.04* (post hoc power = 65.0%)
"Electronic" self-monitoring journal	Yes	60 (27%)	19.8 ± 6.3	5.35 ± 2.27
	No	162 (73%)	19.9 ± 6.2	5.34 ± 2.18
p			0.87**	0.97**
Calculation of grams of carbohydrates or carbohydrate units	Yes	32 (14.4%)	21.1 ± 6.2	5.69 ± 2.18
	No	190 (85.6%)	19.7 ± 6.2	5.28 ± 2.2
p			0.25**	0.33**
Use of mobile applications to calculate grams of carbohydrates or carbohydrate units	Yes	82 (36.9%)	20.8 ± 6.4	5.71 ± 2.29
	No	140 (63.1%)	19.3 ± 6.1	5.13 ± 2.13
p			0.08**	0.05**
Regular meetings with diabetologist at the Diabetes Clinic	Yes	179 (80.6%)	20.1 ± 6.1	5.43 ± 2.16
	No	43 (19.4%)	18.9 ± 6.7	4.98 ± 2.35
p			0.25**	0.22**
Regular educational meetings with a nurse being a diabetes educator at the Diabetes Clinic	Yes	51 (23%)	20.5 ± 6.5	5.63 ± 2.34
	No	171 (77%)	19.7 ± 6.2	5.26 ± 2.16
p			0.39**	0.29**

Table 3. T1DM self-monitoring and treatment method vs. satisfaction with life in young adults with T1DM. *Mann–Whitney U test; **ANOVA; ***Kruskal–Wallis test; *T1DM* Type 1 diabetes mellitus, *N* numer, *SD* standard deviation, Q_1–Q_{25} 25th lower quartile, Q_3–Q_{75} 75th upper quartile interquartile range.

Sparring and colleagues analysed HRQOL in 839 Swedish individuals diagnosed with diabetes between the ages of 15 and 34. Their findings showed that people with diabetes have a lower quality of life than healthy individuals. Factors negatively affecting them included diabetes duration, being female, having a lower education level, and being unmarried or not cohabitating[38]. Our study did not confirm the influence of sociodemographic factors on quality of life in patients with T1DM.

The Diabetes Control and Complications Trial (DCCT) explicitly demonstrated that intensive glucose monitoring reduces the risk of micro- and macrovascular complications in patients with T1DM. However, it is often difficult to reach this control level[39–41]. Advances in diabetes technologies, such as continuous subcutaneous insulin infusion (CSII), continuous glucose monitoring (CGM), and smart insulin pens (injectors), allow patients with T1DM to perform intensive self-monitoring and therapeutic procedures, improving metabolic control[42]. Glucose monitoring is a central element in treating T1DM. CGM devices assist patients in achieving optimum glucose monitoring levels, preventing acute metabolic disorders and positively influence their quality of life by providing a sense of security, confidence in self-monitoring, flexibility in everyday life, and reducing stress and dependence on third parties[43,44]. These devices now typically transmit glucose levels to a receiver (usually a personal insulin pump or a mobile application) and create "electronic" self-monitoring journals[45].

Our study revealed that, compared with people who use these methods, those with T1DM who keep a "traditional" written self-monitoring journal and do not use continuous glucose monitoring systems reported lower satisfaction than those who use those methods.

Charleer and colleagues evaluated the impact of real-time continuous glucose monitoring (rt-CGM) on glycaemia control, hospitalisation rates, absences at work, and quality of life (QOL) in adults with T1DM receiving CSII therapy. The survey covered 515 adults, including 417 (81%) who applied rt-CGM for at least 12

months. Mean HbA1c decreased from $7.7 \pm 0.9\%$ (61 ± 9.8 mmol/mol) at baseline to $7.4 \pm 0.8\%$ (57 ± 8.7 mmol/mol) after 12 months ($p < 0.0001$). Hospitalisations due to severe hypoglycaemia or ketoacidosis decreased from 16 to 4% ($p < 0.0005$), while the number of work absences and fear of hypoglycaemia decreased, significantly improving the quality of life[46]. The authors reported an improvement in the quality of life associated with using rt-CGM. Our study also revealed that the satisfaction with life of young people with T1DM who used a continuous glucose monitoring system was better than that of patients who did not.

Quality of life is influenced by objective and subjective factors. Awareness of one's own disease, the incurability of that disease, threats related to acute metabolic disorders, and potential distant complications may negatively impact T1DM patients' satisfaction with life and quality of life. Due to difficulties connected with T1DM self-monitoring and therapy procedures, patients and their relatives must be active and constantly motivated.

Research strengths and limitations
Research strengths include:

- a homogeneous population.
- authors used a Polish version of the *Satisfaction with Life Scale* (SWLS).
- scarcity of published articles and studies on this topic in Poland.

Research limitations include:

- an insufficient number of respondents.
- conducted among young adults with T1DM solely in one region of Poland.
- not conducting the survey in all Diabetes Clinics for adults in the Pomeranian region.
- the original questionnaire did not include questions concerning anorexia, bulimia, nutritional disorders, or diabetic foot disease related to diabetes in patients with T1DM;
- Cronbach's alpha was not calculated for the Polish version of the SWLS used in this study.

Conclusion
Most respondents reported an average level of satisfaction with life. Life satisfaction is influenced by additional diseases, such as hypothyroidism and hyperthyroidism, as well as coeliac disease. A lower level of satisfaction with life is associated with uncontrolled T1DM. Conversely, modern monitoring and treatment technologies improve satisfaction with life in young adults with T1DM.

Further studies assessing life satisfaction in this population are warranted to evaluate whether modern technologies improve quality of life and patient satisfaction.

Data availability
Availability of data and materials: Data available on request due to privacy restriction. The corresponding author has the database.

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Author contributions

Conceptualization, A.S.-B.; methodology A.S.-B. and M.R.; formal analysis, A.S.-B. and M.R.; investigation, A.S.-B.; resources, A.S.-B. and K.M.; data curation, A.S.-B., K.M., M.K. and E.D.; writing—original draft preparation, A.S.-B.; writing—review and editing, A.S.-B.; visualization, A.S.-B. and K.M.; supervision, A.S.-B.; project administration, A.S.-B. All authors have read and agreed to the published version of the manuscript.

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Declarations

Competing interests

The authors declare no competing interests.

Ethics approval

Institutional Review Board Statement: The study was approved by the Independent Bioethics Committee for Scientific Research of the Medical University of Gdansk (KB/306/2023) and conducted according to the guidelines of the Declaration of Helsinki. Informed Consent Statement: Participation in the survey was voluntary, and the study was anonymous. Every participant agreed to participate, and informed consent was obtained from all participants. The consent of the study participant for publication is not applicable.

Additional information

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