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Association between Life Satisfaction and HbA1c in People with Type 1 and Type 2 Diabetes: A Single Center, Cross-Sectional Study

ABSTRACT

Objective: The aim of the research was to determine the relationship between life satisfaction and the level of glycated hemoglobin in people suffering from diabetes.

Materials and methods: The Satisfaction with Life Scale (SWLS) by E. Diner (a Polish adaptation by Z. Juczynski) was used and the HbA1c value of patients with diabetes was determined using the Bayer A1cNow + analyzer. The study included 104 people. The research was conducted in 2021.

Results: A high level of the Satisfaction with Life Scale was obtained by 68.3% of the respondents, 15.4% of the respondents achieved an average result, 16.3% of the respondents were characterized by a low level of satisfaction with life. The life satisfaction of people with diabetes was influenced by education, age, place of residence, and the level of glycated hemoglobin.

The glycated hemoglobin results of 70.2% of the respondents were normal. Every third respondent (29.8%) had a result above 7%. The average level of the indicator in question was 7.0 +/– 1.2. The type of treatment and the frequency of tests performed had an impact on the average HbA1c level. The age of the respondents and the frequency of the tests performed had an influence on the correct values of glycated hemoglobin.

Conclusions: Life satisfaction increased with the decrease in glycated hemoglobin. Diverse research reports on the discussed issues indicate a further need for in-depth analyses. (Clin Diabetol 2023; 12; 1: 60–68)

Keywords: life satisfaction, diabetes, chronic disease, glycated hemoglobin, the satisfaction with life scale, patients with diabetes, research

Introduction

The level of life satisfaction has an impact on the assessment of the situation and choices made by individuals. It is of particular importance for chronically ill patients whose daily existence is associated with a struggle with health problems, as in the case of patients with diabetes.

Diabetes mellitus is a group of metabolic diseases manifested by hyperglycemia, which may be caused by defects in insulin secretion or function. Hyperglycemia may lead to damage and failure of various organs, e.g. the eyes, kidneys, nervous system, heart, and blood vessels [1].

Diabetes is becoming an increasing challenge for the modern world, and the number of people suffering from this disease has tripled over the last two decades.

Currently, 9.3% of the general population is affected by diabetes worldwide [2]. Each year, approximately 1.6 million people die of the disease. According to the population data, there are over 2 million patients with diabetes in Poland, which accounts for nearly 8% of the adult population [3]. Diabetes is considered a social and lifestyle disease constituting a serious medical, family, and economic problem [4].

The feeling of life satisfaction supports greater activity in professional and personal life and helps to overcome life difficulties, including those related to diseases. Juczynski defines life satisfaction as a result of comparison of one's present situation with one's personal standards. A satisfactory result of the comparison gives a feeling of satisfaction. In the case of large discrepancies between the expectations and the achieved outcomes, the level of life satisfaction declines dramatically [5, 6]. Since diseases, especially a chronic condition, exert negative effects on all areas of life, they may influence the life satisfaction level [7]. Diabetes affects not only patients but also their entire environment. The patients and their families have to adapt to the new reality, often making radical changes in the current system of values or in the rhythm of life [5, 8].

The main goal in the treatment of patients with diabetes is to achieve good glycemic control in order to eliminate or substantially reduce the development of complications. The HbA1c value indicates the mean glycemia level in the last 3 months before the examination, with 50% of blood HbA1c generated within the last month before the test. The HbA1c determination result shows the mean blood glucose level based on the night, pre-, and postprandial values, in contrast a single measurement result, which is often the case in patients using glucose meters. According to the recommendations of both the Diabetes Poland and the American Diabetes Association (ADA), a patient with diabetes should have the glycated hemoglobin level measured regularly. The measurement in patients with a stable course of the disease should be conducted once a year. In the case of patients who do not achieve the goals of the treatment or whose therapy has to be changed, the level of glycated hemoglobin should be measured quarterly [9, 10].

HbA1c measurements should be based on the patient clinical status and treatment strategies. The determination should be performed with NGSP (National Glycohemoglobin Standardization Program) certified methods, e.g. the POC (point of care) method. According to the ADA, the use of POC determinations facilitates more timely therapeutic decisions. The patient obtains the result and the decision regarding the further treatment at the same doctor appointment.

The patient does not have to go to the laboratory and wait for the analysis result. Otherwise, such a delay may postpone the therapeutic decision. The method of HbA1c determination at the collection site has its supporters and opponents. However, there are numerous studies confirming the effectiveness and reliability of the POC determination of HbA1c with the use of the A1cNow+ analyzer [11, 12].

Aim of the study

The aim of the study was to determine the relationship between the level of life satisfaction and the glycated hemoglobin level in patients with diabetes.

Materials and methods

The study was conducted in patients with diabetes between July and September 2021. A positive opinion on the study was obtained from the Bioethics Committee at the Pope John Paul II State School of Higher Education in Biala Podlaska (Resolution of the Bioethics Committee no. 1/2020). The study was carried out at the Diabetes Outpatient Clinic at the Provincial Specialist Hospital in Biała Podlaska. The participants were informed about the aim of the study and were guaranteed information confidentiality. All patients consented to participate in the study. The study involved 104 participants. A diagnostic survey was used as the research method, and the HbA1c level was determined via POC testing with the use of the A1cNow+ analyzer from Bayer. The Satisfaction with Life Scale and additionally a questionnaire were used. The questionnaire included questions about the following socio-demographic parameters: age, gender, education, place of residence, type of diabetes, duration of the disease, type of therapy, frequency of contact with a specialist, and frequency of glycated hemoglobin determination. The respondents were also asked to provide information on comorbidities.

The level of life satisfaction was assessed using the Satisfaction with Life Scale (SWLS) proposed by Diener, Emmons, Larsen, and Griffin (a Polish adaptation by Juczynski) [6]. The questionnaire consisted of five statements. The respondents reacted to the statements by indication of their applicability in their lives. The answers were given using the seven-point Likert scale, where 1 means "I completely disagree" and 7 means "I completely agree". After adding up the response scores, it was possible to achieve an overall score ranging from 5 to 35 points: the higher the score, the greater the feeling of life satisfaction.

The measurement of glycated hemoglobin (HbA1c) was performed by a registered nurse. Before each blood drop collection, the batch numbers and the expiry date

of the kits were checked. During the test, all components of the kits were used at room temperature. The HbA1c determination procedure with the use of the A1c Now+ instrument is fully automated and does not require calibration. The result was ready 5 minutes after the blood drop was applied onto the test cassette. The device performs internal chemical and electronic quality checks and signals potential errors occurring during the analysis.

Statistical methods

The statistical analysis was carried out using STATISTICA v.13 software. Pearson's Chi-square test was used to detect statistically significant differences in the case of qualitative variables, whereas quantitative variables were analyzed with the use of the non-parametric Mann-Whitney U test, the Kruskal-Wallis test, and the post-hoc Kruskal-Wallis test. Since the results of the HbA1c level and the SWLS level (Shapiro-Wilk test) were not normally distributed, the data in Figure 1 and Figure 2 are presented as medians. The analysis of the relationships between the quantitative variables was carried out using the Spearman's rank-order correlations. The level of significance was $p = 0.05$ in all analyzed cases.

Characteristics of the study group

The study involved 104 patients with diabetes. The most numerous groups were composed of females (53.8%), subjects with secondary (34.6%) or vocational education (29.8%), and urban residents (67.3%). The mean age of the respondents was 68.0 ± 9.2 years. The youngest patient was 38 years old and the oldest respondent was 85 years old (Tab. 1).

The majority of the respondents were diagnosed with type 2 diabetes (95.1%). The most common type of treatment was based on the use of tablets (66.3%). The mean duration of the disease was 10.6 ± 8.9 years. In addition to diabetes, most of the respondents (88.5%) had other comorbidities. Most often, these were arterial hypertension (76.0%) and other cardiac diseases (17.3%), obesity (7.7%), stroke (7.7%), and other conditions (9.6%), e.g. schizophrenia, psoriasis, RA, Parkinson's disease, kidney disease, orthopedic diseases, and stomach ulcers. The respondents most often had contact with the attending physician once a month (35.9%) or once every six months (24.3%). Over half of the respondents (52.9%) had the HbA1c level tested very rarely, i.e. once every 5 years. Every third respondent (30.8%) declared that it was their first measurement of this type. Only one in four respondents (24.0%) participated in a support group for patients with diabetes (Tab. 2).

Table 1. Characteristics of the Respondents

Question	n	%
Gender		
Female	56	53.8
Male	48	46.2
Education		
Primary	25	24.0
Vocational	31	29.8
Secondary	36	34.6
Higher	12	11.5
Place of residence		
Countryside	34	32.7
City	68	67.3
Statistical analysis results for the variable: age		
Mean	68.0	Shapiro-Wilk
Standard deviation	9.2	W = 0.97;
Minimum	38.0	p = 0.0081*
Maximum	85.0	
Median	69.5	

*Significantly different from the normal distribution at $p < 0.05$

Results

Table 3 presents the level of life satisfaction declared by the respondents after transformation of raw data in accordance with the adaptation proposed by Juczynski's. Three categories of life satisfaction levels: low, moderate, and high were established. The analysis results indicate that the low level of life satisfaction was declared by 16.3% of the respondents, and the moderate level was indicated by 15.4% of the patients. Most of the respondents (68.3%) constituted a group with a high SWLS score. The mean level of this indicator was 24.8 ± 6.3. The statistical analysis showed a significant difference between the SWLS level and the Gaussian curve ($p < 0.0001$) (Tab. 3).

The median level of life satisfaction in the entire respondent group was M = 27.0. The statistical analysis of the effect of the variables on the life satisfaction level revealed significant differences in the case of education ($p = 0.0429$), place of residence ($p = 0.0064$), and the HbA1c level ($p = 0.0107$). The highest statistically significant level of life satisfaction was declared by patients with higher education (M = 29.0) vs. respondents with vocational education (M = 24.0), urban residents (M = 28.0) vs. rural respondents (M = 24.0), and patients with normal HbA1c levels (M = 28.0) vs. those with elevated HbA1c (M = 24.0) (Fig. 1).

The statistical analysis of the relationship between the two HbA1c and SWLS factors revealed a significant

Table 2. Characteristics of the Treatment Process

Question	n	%
Diabetes type		
Type 1	5	4.9
Type 2	97	95.1
Type of treatment		
Tablets	69	66.3
Insulin therapy	17	16.3
Combination therapy	13	12.5
Diet	5	4.8
Type of comorbidities		
Arterial hypertension	79	76.0
Cardiac diseases	18	17.3
Obesity	8	7.7
Stroke	8	7.7
Other	10	9.6
None	12	11.5
Contact with the doctor		
Once a month	37	35.9
Every 6 months	25	24.3
Once a year	19	18.4
Less often than once a year	22	21.4
Frequency of HbA1c measurement		
Every 6 months	9	8.7
Once a year	8	7.7
Once every 5 years	55	52.9
First measurement	32	30.8
Participation in a support group		
No	79	76.0
Yes	25	24.0
Statistical analysis results for the variable:		
duration of disease		
Mean	10.6	Shapiro-Wilk
Standard deviation	8.9	W = 0.86;
Minimum	0.5	p < 0.0001*
Maximum	46.0	
Median	8.0	

*Significantly different from the normal distribution at p < 0.05

Table 3. Levels of the Satisfaction with Life Scale (SWLS)

	n	%
Life satisfaction levels		
Low	17	16.3
Moderate	16	15.4
High	71	68.3
Descriptive statistics		
Mean	24.8	Shapiro-Wilk
Standard deviation	6.3	W = 0.92;
Minimum	10.0	p < 0.0001*
Maximum	35.0	
Median	27.0	

*Significantly different from the normal distribution at p < 0.05

demonstrated between the age and the HbA1c level (R = −0.2132; p=0.0298). No significant correlation was found between the duration of the disease and the SWLS level (p = 0.5040) (Tab. 4).

The glycated hemoglobin level in the majority of the respondents (70.2%) was normal. However, it was elevated in almost every third respondent (29.8%). The mean level of this indicator was 7.0 ± 1.2. The statistical analysis showed a significant difference between the HbA1c levels and the Gaussian curve (p = 0.0004).

The median level of glycated hemoglobin in the entire respondent group was M = 6.8 (Tab. 5).

The effect of such socio-demographic factors as the gender, education, place of residence, type of diabetes, type of treatment, frequency of appointments with a specialist, frequency of HbA1c determination, participation in a support group, and life satisfaction on the level of glycated hemoglobin in patients with diabetes was assessed as well.

The statistical analysis of the impact of these variables on the level of the analyzed indicator showed significant differences in the case of the type of treatment (p = 0.0054) and HbA1c determination frequency (p = 0.0115). The lowest statistically significant HbA1c level was reported in patients receiving diet-based treatment (M = 5.6), compared with the insulin-treated respondents (M = 7.4) or those receiving a combination therapy (M = 7.8), and in respondents who declared that their glycated hemoglobin level was determined for the first time (M = 6.4) in comparison with patients undergoing regular examinations (M = 7.7) (Fig. 2).

Discussion

It has been documented that the life satisfaction level improves the clinical outcomes of examinations in patients with diabetes [13, 14]. Therefore, the results of the present study can be regarded as positive findings.
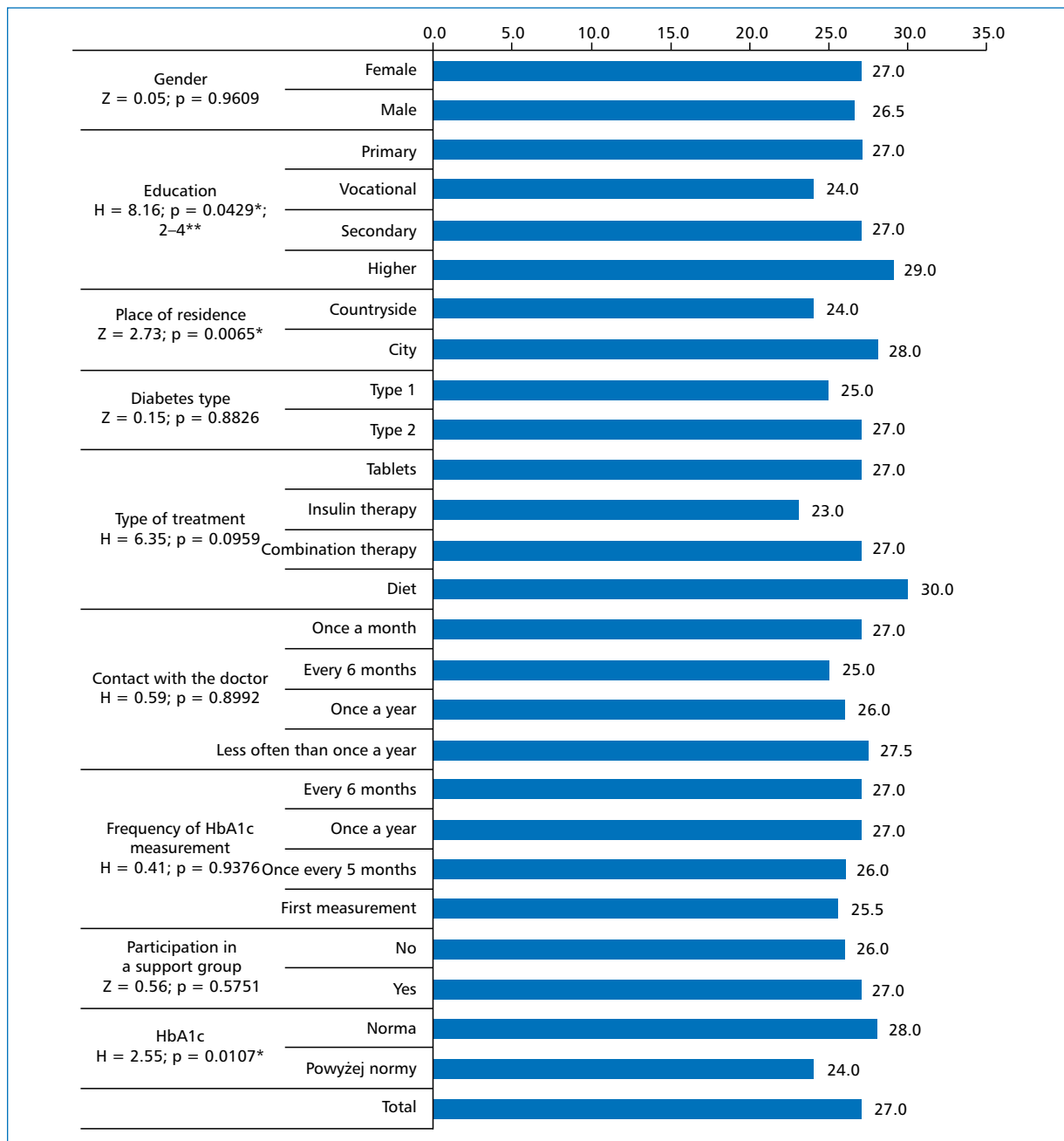
weak correlation (p = 0.0414). The negative correlation coefficient indicated that an increase in the HbA1c content reduced the life satisfaction level (SWLS) (Fig. 3).

The analysis of the relationships of the age and the duration of the disease with the HbA1c level and SWLS showed significant correlations in most cases. A significant weak positive correlation was found between the age and the SWLS level and between the duration of the disease and the HbA1c level (R = 0.3227; p = 0.0008 and R = 0.2343; p = 0.0167, respectively). In turn, a significant weak negative correlation was

Figure 1. SWLS vs. Some Characteristics of the Respondents
F — value of the Mann-Whitney U test; H — value of the Kruskal-Wallis test
*Significant difference at p < 0.05; **Variables between which there were significant differences in the post-hoc Kruskal-Wallis test
HbA1c — glycated hemoglobin; SWLS — Satisfaction with Life Scale

Most of the respondents (68.3%) achieved a high SWLS score, 15.4% were characterized by a moderate SWLS level, and only 16.3% of the patients exhibited a low life satisfaction level. Ayman et al. [15] used the same tool to survey 793 patients with type 2 diabetes in Jordan. Similar to the present results, it turned out that their patients were characterized by a moderate to high level of life satisfaction. Patients surveyed by Charzynska et al. [16] achieved lower SWLS values. More patients were dissatisfied with life (27.7%), 18.8% achieved a score below the moderate value, 33% declared moderate satisfaction with life, only 20.5% were satisfied or very satisfied with their lives.

The mean SWLS value in the present study was 24.8 ± 6.3. The lowest score was 10 points and the highest was 35 points. These are higher results than those reported by Badura-Brzoza et al. Patients with type 1 diabetes achieved scores in the range from 10 to 34

Table 4. Effect of Age and Duration of the Disease on HbA1c and SWLS Values

Pair of variables	Spearman's rank-order correlation			
	n	R	t(N-2)	p
Age x HbA1c	104	−0.2132	−2.20	0.0298*
Age x SWLS	104	0.3227	3.44	0.0008*
Disease duration x HbA1c	104	0.2343	2.43	0.0167*
Disease duration x SWLS	104	−0.0663	−0.67	0.5040

*Significant differences at p < 0 .05
HbA1c — glycated hemoglobin; SWLS — Satisfaction with Life Scale

Table 5. Glycated Hemoglobin (HbA1c) Test Results

	n	%
HbA1c		
Normal	73	70.2
Elevated	31	29.8
Descriptive statistics for the variable: HbA1c		
Mean	7.0	Shapiro-Wilk
Standard deviation	1.2	W = 0.94;
Minimum	5.2	p = 0.0004
Maximum	10.9	
Median	6.8	

points, with the mean score of 21.93 ± 5.69 points. Patients with type 2 diabetes scored from 10 up to 30 points, with the mean value of 19.90 ± 5.15 [17].

Life satisfaction level in relation to socio-demographic variables

The chronic course of diabetes has an impact on the well-being of the patients. The authors of the present study have analyzed factors that can help patients with diabetes to lead a more satisfying life. It turned out that the patients with higher education, a normal glycated hemoglobin level, and living in a city declared greater satisfaction with life.

This seems reasonable, as the urban living environment facilitates access to medical care and specialists and offers greater access to products recommended in the diet of a patient with diabetes. The correlations with the level of education may also be explained. The education factor exerts an influence on not only the hierarchy of values and lifestyle but also attitudes towards health and disease. It can be assumed that subjects with higher education use more rational diets and are more active in seeking medical care. Higher education can also help to acquire greater medical knowledge and greater awareness of its important role. Additionally, higher education is often associated with higher income. Low income may limit patient's money spending decisions [18].

In this study, patients with a normal HbA1c level scored higher SWLS values than those with elevated HbA1c. This correlation corresponds to the results reported by Ayman et al., who showed that an increase in HbA1c was accompanied by a decrease in the level of life satisfaction. Such relationships have been confirmed by the American Diabetes Association and by the results of studies conducted by Stahl-Pehe et al. [13–15]. In turn, Juruć et al. [19] studied 60 patients with type 1 diabetes in Poznan and found no significant relationship between the HbA1c value and the life satisfaction level.

In the analyzed studies, there was no correlation between the SWLS scores and the duration of the disease, but a significant correlation was found between SWLS and the age of the respondents: the older the patients, the greater the percentage of declared life satisfaction. As reported by some researchers, the longer duration of the disease was negatively correlated with the assessment of life satisfaction [17, 20, 21]. In the present study, no significant relationship was found between the duration of diabetes and life satisfaction. Similar conclusions were reported by Charzynska et al. [16]. The discrepant results indicate a need for further research in this area.

The statistical analysis of the influence of the gender and the type of treatment on the SWLS result did not show any significant differences in any of the analyzed cases. Similarly, Ayman et al. [15] found no significant differences between male and female patients, and the type of treatment was a marginal predictor of life satisfaction.

Glycated hemoglobin level in relation to socio-demographic variables

In the present study, the glycated hemoglobin levels in the blood of most of the respondents (70.2%) were normal. However, almost every third respondent had a level above 7% (29.8%). The mean level of this index was 7.0 ± 1.2, which was similar to the results reported by many authors examining the level of glycated hemoglobin in patients with diabetes. Suzuki-
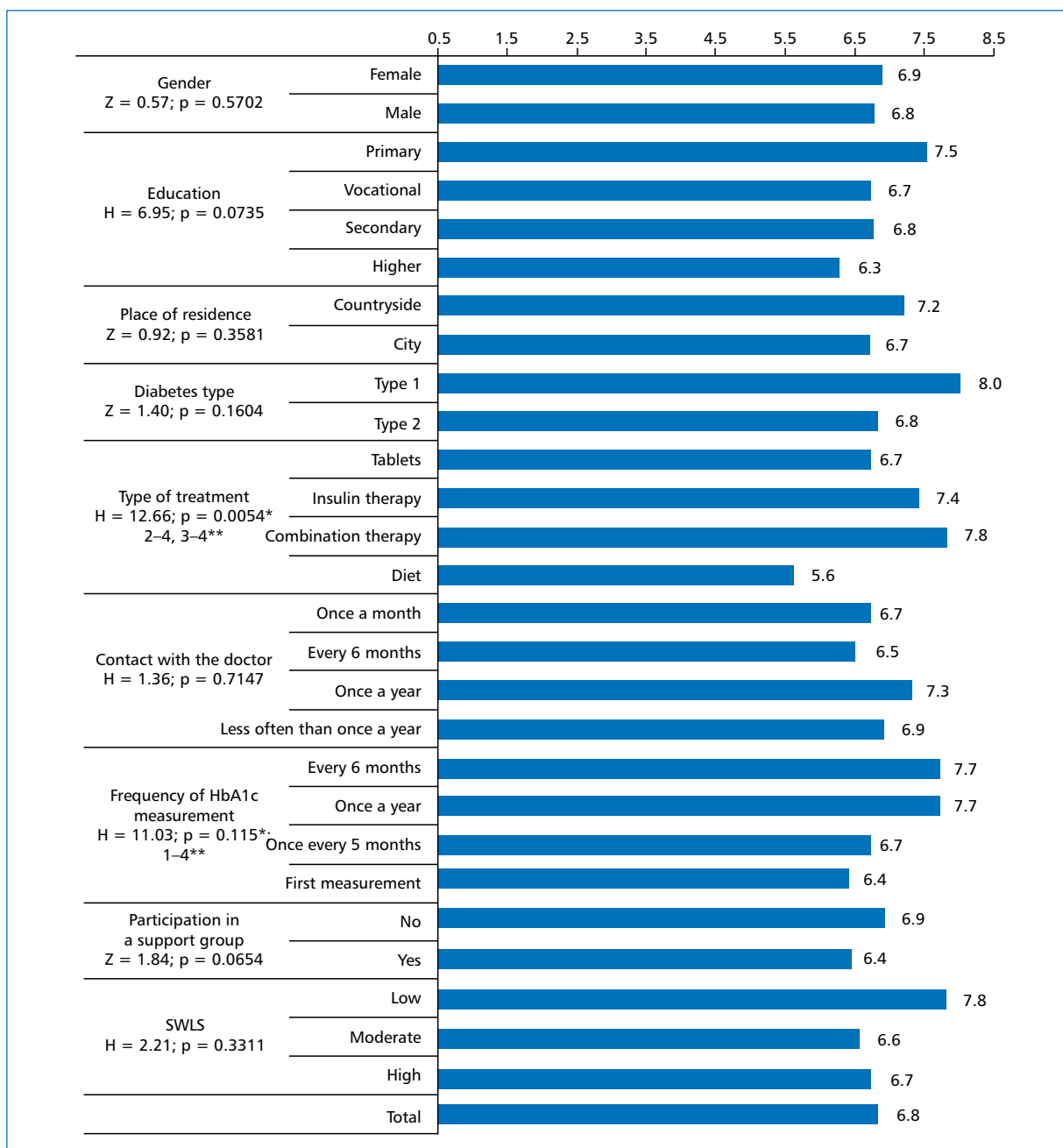
Figure 2. Mean Glycated Hemoglobin Levels vs. Some Characteristics of the Respondents
F — value of the Mann-Whitney U test; H — value of the Kruskal-Wallis test
*Significant difference at p < 0.05; ** Variables between which there were significant differences in the *post-hoc* Kruskal-Wallis test
HbA1c — glycated hemoglobin; SWLS — Satisfaction with Life Scale

Saito et al. [22] demonstrated the mean HbA1c level of 6.9%. The majority of the respondents surveyed by Ayman et al. [15] had normal HbA1c levels (52%), and the mean level of the parameter was 7.5%. Juruć et al. [19], who surveyed patients with type 1 diabetes in Poznan, found higher levels of glycated hemoglobin in their study group, with the mean value of 8.04%. This was probably associated with the fact that only patients with type 1 diabetes participated in the study.

The present study showed statistically significant differences between the type of treatment, frequency of blood tests, duration of the disease, the age of the respondents, and the level of glycated hemoglobin. The lowest HbA1c levels were detected in patients following a diabetic diet, in comparison with those receiving insulin or combination therapy. Probably, the level of this blood parameter contributed to the decision on limitation of the treatment to dietary recommenda-
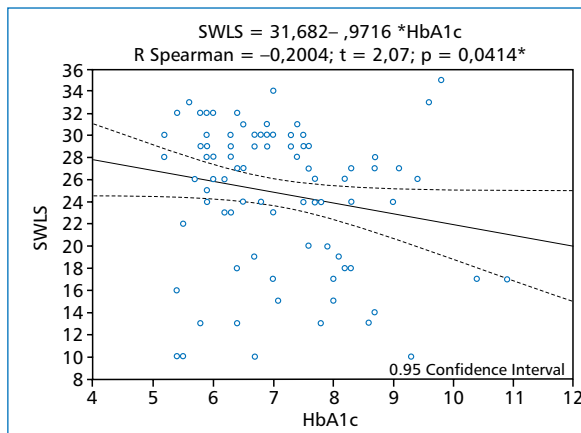
Figure 3. Linear Relationship between the SWLS and the HbAc1 Level
HbA1c — glycated hemoglobin; SWLS — Satisfaction with Life Scale

tions. In a patient group examined by Yuan et al. [23], a statistical correlation was found between drug types and glycemic control in males and females. In contrast, the type of treatment exhibited marginal relationships with HbA1c in a study conducted by Ayman et al. [15].

The duration of the disease is another determinant of the psychosocial functioning of a patient with diabetes. The present study has shown that the longer duration of the disease is negatively correlated with the metabolic control in the group of patients with diabetes. Similar conclusions were formulated by Badura-Brzoza et al. [17]. These relationships may also be explained by the burnout syndrome associated with reluctance to control glycemia appearing several years after the onset of the disease [24]. Different results were reported by researchers from Taiwan; they proved that the longer duration of diabetes (11–15 years) was positively correlated with HbA1c levels in all patients, whereas the shorter duration of diabetes (0–5 years) was negatively associated with HbA1c levels in the blood of examined females [23]. Similar results were obtained by Polish authors, who divided their patients into three groups according to their age and the duration of the disease. The group of the youngest patients with the shortest duration of the disease exhibited worse carbohydrate metabolism control measured by the percentage of HbA1c in comparison with the other two groups with the longer duration of the disease [25]. According to the International Diabetes Federation (IDF), HbA1c levels below 7% in elderly patients may indicate excessive intensity of diabetes treatment. In such a case, the therapy should be modified [26]. A statistically significant difference between the age of the respondents and the glycated hemoglobin level was also noted in the present study.

The effect of the education factor on glycemic control is ambiguous. Some authors confirm but others do not find such a relationship. In this study, there was no statistically significant difference between the level of glycated hemoglobin and the education level in the surveyed group. No such relationships were observed by Mellergård [27]. In turn, in a study conducted by Yang et al. [28] in a group of 5957 patients in China, higher education was statistically significantly correlated with normal HbA1c values. Similarly, higher education levels were consistently associated with lower HbA1c levels in a patient group investigated by Willers [29].

The present study showed no statistically significant correlations between the gender and the glycated hemoglobin levels, whereas such a relationship in a group of patients with type 2 diabetes was reported by Mellergard. Males had significantly higher HbA1c values than females [27]. The absence of such a relationship in the present study may be associated with the small size of the patient group. This is a limitation of our research but concurrently a motivating factor to undertake further studies in this field.

Conclusions

A positive finding of the study was the high life satisfaction level declared by the respondents, especially given the fact that their mean age was 68.0 ± 9.2 years

It was found that the life satisfaction level increased with a decrease in glycated hemoglobin, which may indicate a relationship between the mental and physical well-being of patients with diabetes.

The discrepant research reports on the analyzed issue indicate a need for further comprehensive investigations.

Conflict of interest

None declared.

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