ORIGINAL ARTICLE

Annals of Agricultural and Environmental Medicine 2023, Vol 30, No 3, 483–489
www.aaem.pl

Blood glucose level testing in Poland – do socio-economic factors influence its frequency? A nationwide cross-sectional survey

Justyna Grudziąż-Sękowska[1,A-F] ✉, **Kuba Bartłomiej Sękowski**[1,C-D,F], **Jarosław Pinkas**[1,A,E-F], **Mateusz Jankowski**[1,A,E-F]

[1] *Centre of Postgraduate Medical Education, School of Public Health, Warsaw, Poland*
A – Research concept and design, B – Collection and/or assembly of data, C – Data analysis and interpretation, D – Writing the article, E – Critical revision of the article, F – Final approval of the article

Grudziąż-Sękowska J, Sękowski KB, Pinkas J, Jankowski M. Blood glucose level testing in Poland – do socio-economic factors influence its frequency? A nationwide cross-sectional survey. Ann Agric Environ Med. 2023; 30(3): 483–489. doi: 10.26444/aaem/162964

Abstract

Introduction and Objective. The number of patients diagnosed with diabetes is constantly increasing. Opportunistic screening for diabetes, based on blood glucose tests, can result in early diagnosis and mitigation of its complications. The aim of the study was to assess the frequency of blood-glucose tests in adults in Poland, and factors associated with the frequency of blood-glucose tests, including respondents' knowledge about diabetes.

Materials and method. In June 2022, a nationwide cross-sectional survey was carried out among adults in Poland.` The survey used a computer-assisted web interview technique and a self-developed questionnaire that included questions on respondents' self-reported knowledge of diabetes, time since last blood glucose test and socio-demographic characteristics of participants.

Results. The study population comprised 1,051 individuals aged 18–85 years, among whom 53.3% were females. Over a third of respondents (36.3%) declared a bad or rather bad knowledge about diabetes. Almost half of the respondents (48.7%) had a blood glucose test in the last 12 months, and 12.4% declared that they had never had a blood glucose test. Among respondents without diagnosed diabetes, female gender (OR=1.30, 0.96–1.76; p=0.009), age over 50 years (p<0.05), history of diabetes in the respondent's family (OR=1.83, 1.33–2.51; p<0.001), and good or at least moderate level of knowledge of diabetes were significantly associated (p<0.05) on blood glucose test frequency.

Conclusions. The presented data manifest the need to intensify screening for diabetes combined with implementing a comprehensive education strategy regarding diabetes in Poland.

Key words

diabetes mellitus, public health, guideline adherence, blood glucose, prediabetic state, preventive health services

INTRODUCTION

Diabetes mellitus is a major public health concern worldwide [1]. It has a high burden in Europe, especially in countries like Poland which experienced significant improvements in living standards resulting in changes in the lifestyles of their population [1]. Every year, approximately 300,000 Poles are diagnosed with diabetes mellitus, of which type 2 diabetes represents over 90% of cases [2]. It is estimated that even one-third of Poles with diabetes or pre-diabetes remain undiagnosed [3]. Moreover, a particularly large number of individuals with diabetes in Poland have developed complications related to this condition [4]. The number of limb amputations related to diabetes has risen significantly in the recent decade [5].

Because of the Covid-19 epidemic many patients with chronic conditions had restricted access to healthcare services [6]. This may have resulted in increased health debt due to delayed diagnosis and worse disease management [7]. Predictions based on historical data on diabetes incidence and demographic prognosis for Poland show a high risk of a further increase in both incidence and morbidity [8]. Therefore, effective diabetes management is one of the biggest struggles for the Polish healthcare system.

Early detection of diabetes remains a key goal of many preventive strategies [9], as it reduces the occurrence and severity of diabetes-related complications [10]. In 1997, The American Diabetes Association (ADA) Expert Committee on the Diagnosis and Classification of Diabetes Mellitus suggested that all non-diabetic persons aged 45 should be checked every three years for diabetes as part of their usual medical treatment (opportunistic screening). Recently, the US Preventive Services Task Force (USPSTF) advised lowering this age limit to 35 in patients who were overweight or obese [11]. The most recent ADA recommendations go even further by recommending opportunistic screening of patients over the age of 35 [12]. The recommendations of the Polish Diabetes Association (PTD) from 2021 are more restrictive and recommend testing all patients over 45, as well as those who are younger if they are overweight or obese [13].

Screening with either fasting plasma glucose levels or oral glucose tolerance tests is recommended by both international (ADA and USPSTF) and domestic (PTD) organizations. [11–13]. Both tests should be ordered by a physician who assessed the risk of diabetes in a patient of a certain age or with identified risk factors. In Poland, such tests are offered to patients over the age of 40 who manifest risk factors as a part of a '40+' preventive initiative.

✉ Address for correspondence: Justyna Grudziąż-Sękowska, Centre of Postgraduate Medical Education, Public Health School, Warsaw, Poland
E-mail: jgrudziaz@cmkp.edu.pl

Received: 02.02.2023; accepted: 03.04.2023; first published: 17.04.2023

Some recent studies prove that random (casual) plasma glucose test – frequently included in laboratory tests performed during routine visits – is perceived as an effective supplement for screening high-risk patients [14]. Despite different thresholds for diagnosis of diabetes (or pre-diabetes), all blood tests provide an opportunity to identify patients at an early stage of the disease and thus prevent its further development [15].

Current studies in patients with diabetes show that knowledge about diabetes may influence the level of self-care and glycaemic control [16]. Based on the results of studies concerning knowledge-behaviour relations in diabetes [17] and other non-communicable diseases [18], it is reasonable to assume that also in the case of diabetes, better health literacy should result in healthier behaviours, including the use of preventive blood glucose tests.

OBJECTIVE

The aim of the study is to examine the frequency of blood-glucose tests in adults in Poland, and to identify characteristics linked with the frequency of blood-glucose testing, such as patients' knowledge of diabetes.

MATERIALS AND METHOD

The data used in this study were collected during a cross-sectional survey performed in Poland between June 24 – June 27 2022, on a non-probability quota sample of 1,051 persons. Under the direction of the authors, who provided the study's scientific background, data were gathered by a specialist polling organization (Nationwide Research Panel Ariadna) [19]. About 100,000 unique users of the Nationwide Research Panel Ariadna were able to be randomly chosen as respondents thanks to the computer-assisted web interview (CAWI) method and a dedicated IT system (online panel). Based on the most recent reports provided by the Polish Central Statistical Office, quota sampling was based on a stratification model (gender, age, and place of residence) tailored to the demographic features of the Polish population.

The research was conducted using a questionnaire developed for the purpose of the study. A Likert-type scale was used to assess the level of respondents' self-reported knowledge of diabetes, with 5 possible answers (very bad; rather bad; moderate; rather good; very good knowledge of diabetes). The frequency of blood-glucose tests was measured as time since the last test, with 6 possible answers (never, over 3 years ago, 2–3 years ago, 1–2 years ago, 1–12 months ago, and less than 1 month ago).

The questions concerning the respondents' health status included: 'Has a doctor ever informed you that you have diabetes?' (yes/no). A question on the respondent's family history of diabetes was included.

The study protocol and the questionnaire received approval from the Ethical Review Board at the Centre of Postgraduate Medical Education in Warsaw, Poland (Approval No. 70/2022; dated 8 June 2022).

The obtained data were analyzed using the SPSS ver. 28 (IBM Corp., Armonk, NY, USA).

The distribution of categorical variables was illustrated with frequencies and proportions. To compare categorical variables, cross-tabulations and chi-squared tests were performed. A logistic regression was used to analyze the associations between the personal characteristics of respondents (exposure) and the frequency of blood glucose tests (outcome). The strength of the association was measured using the odds ratio (OR) and 95% confidence intervals (95%CI). The level of statistical significance was set at $p < 0.05$.

RESULTS

Study population. The study population comprised 1,051 individuals aged 18–85 years, of whom 46.7% were males (Tab. 1). The majority of the respondents had children (61.2%), were married (49.5%), and had higher education (42.8%). Almost a third (32.3%) lived in rural areas. Over a tenth (10.5%) of the respondents reported having diabetes, while 43.8% said their family had a history of the disease. Most of the individuals reported being active in the labour market (63.1%) and described their financial situation as good (38.6%) or moderate (38.2%) (Tab. 1).

Self-reported knowledge of diabetes. Only 17.3% of respondents claimed to have a good or very good knowledge about diabetes, whereas the majority (46.3%) reported a moderate understanding of this disease. In comparison, a bad or rather bad level of knowledge was declared by over a third (36.3%) of respondents (Tab. 2).

The percentage of respondents who self-reported given levels of knowledge about diabetes varied significantly ($p<0.05$) depending on gender, educational attainment, number of children, and household size. Moreover, those who had been diagnosed with diabetes and those who had a family history of the disease reported having good or very good knowledge of diabetes more frequently (47.3% and 24.4%, respectively).

There were statistically significant differences ($p<0.05$) in the percentage of respondents' self-reported knowledge of diabetes by gender, educational level, having children, and the number of household members. Moreover, respondents diagnosed with diabetes and those with a history of diabetes in the family more often declared good or very good knowledge of diabetes (47.3% and 24.4%, respectively).

There was no impact of the respondents' age and place of residence, as well as marital, financial and occupational status, on the declared level of knowledge of diabetes (Tab. 2).

Time since last blood glucose test. Most respondents (51.3%) had a blood glucose test performed more than a year before the date of the study. In the case of over a quarter of respondents (26.5%), the time since the last test was more than 3 years, or such a test had never been performed.

There were statistically significant differences ($p<0.05$) in the declared time since the last blood glucose test by gender and age, as well as having children and marital status (Tab. 3). Females, older individuals, and those with children, declared having a blood glucose test performed more recently in all analyzed time intervals. A significantly lower proportion of those respondents (females, of older age, with children) declared that they had never been subject to such a test.

Moreover, the time since the last blood glucose test was much shorter for those who had been diagnosed with diabetes and for those who had a family history of the disease (47.3%

Table 1. Characteristics of the study population (n=1051).

Variable	Total sample (n=1,051)	
	n	%
Gender		
female	560	53.3
male	491	46.7
Age		
18–34	338	32.2
35–49	287	27.3
50–64	286	27.2
65+	140	13.3
Higher education		
yes	450	42.8
no	601	57.2
Marital status		
single	250	23.8
married	520	49.5
informal relationship	164	15.6
divorced or widowed	117	11.1
Having children		
yes	643	61.2
no	408	38.8
Size of place of residence		
rural area	339	32.3
city with less than 20,000 residents	122	11.6
city with 20,000–99,999 inhabitants	237	22.5
city with 100,000–499,999 inhabitants	200	19.0
city with more than 500,000 inhabitants	153	14.6
Living alone		
yes	159	15.1
no	892	84.9
Currently employed or self-employed		
yes	663	63.1
no	388	36.9
Self-reported financial status		
good	401	38.2
moderate	406	38.6
bad	244	23.2
Diabetes diagnosis by a doctor		
yes	110	10.5
no	941	89.5
History of diabetes in the family		
yes	460	43.8
no	591	56.2

and 24.4%, respectively). The respondents' education, place of residence, marital status, number of people in the household, and financial and occupational status had no impact on the declared time since the last blood glucose test (Tab. 3).

Factors associated with blood glucose tests within the last 3 years among respondents without diagnosed diabetes. Among respondents without diagnosed diabetes, female gender (OR=1.30, 0.96–1.76; p=0.009), history of diabetes in the respondent's family (OR=1.83, 1.33–2.51; p<0.001) and a good or at least moderate level of self-reported knowledge of diabetes (p<0.001) were significantly associated with higher odds of having a blood glucose test performed within the last 3 years (Tab. 4).

DISCUSSION

This study showed that a substantial part (51.3%) of Poles over 18 years of age had a blood glucose test performed more than 12 months prior to the study date, 14.1% had such a test performed more than 3 years earlier, and another 12.4% had never had their blood glucose tested. In the group aged 35–49 (above the advised age limit for opportunistic screening for diabetes), the percentage of respondents who had their blood glucose tested more than 3 years earlier or had never been tested remained high (13.9% and 11.8%, respectively). Among respondents without diagnosed diabetes, female gender, age over 50, presence of diabetes in the respondent's family, as well as a good or at least moderate level of self-reported knowledge of diabetes, were significantly associated (p<0.05) with higher odds of having a blood glucose test performed within the last 3 years.

According to the best knowledge of the authors, the current study is the only one on the use of preventive health services related to diabetes. However, a more general survey from 2016 on the perception of health among Poles revealed a similar number of respondents (9%) not undergoing medical screenings that included blood tests [20].

Only 4 of the 11 variables included in this study (age, gender, presence of diabetes in the respondent's family, and their knowledge of diabetes) significantly influenced the shortening of time since the last blood glucose test. Other factors, including such socio-economic metrics as a place of residence and financial situation, were not reflected in the respondents' use of blood glucose tests.

Observations concerning respondents' financial situation corresponded with the results of studies on the incidence of diabetes, which proved that the effects of differences in income level [21] or occupational status [22] were less significant than education level. However, the irrelevance of the respondents' place of residents is contrary to the results of other studies which showed significant differences in self-rated health status between urban and rural populations in Poland [23]. This may result from the lack of awareness of diabetes, which causes people to ignore the disease's early warning signs or difficulty in accessing healthcare in the rural areas of Poland.

A substantial shortening of time elapsed since the last blood glucose test was observed in older patients (age groups 50–64 and 65+). Patients from those groups (not diagnosed with diabetes) more often had had a blood glucose test within the last 3 years. This result may be the effect of the screening recommendations of the PTD being more restrictive than those made by the ADA and USPSTF. It is possible that patients under 45 years in Poland, have their blood glucose tested only when they are overweight or obese, and not as a part of screening for diabetes. This approach can be seen in the '40+' initiative which encompasses blood glucose tests in patients over the age of 40 and with risk factors, as a part of preventive health services provided under the general health insurance scheme.

Table 2. Self-reported level of knowledge about diabetes according to socio-demographic factors (n=1,051)

Variable	Self-reported level of knowledge about diabetes – percentage of respondents according to socio-demographic factors					
	very bad	rather bad	moderate	rather good	very good	p
	n (%)	n (%)	n (%)	n (%)	n (%)	
Overall	80 (7.6)	302 (28.7)	487 (46.3)	137 (13.0)	45 (4.3)	
Gender						
female	33 (5.9)	148 (26.4)	271 (48.4)	82 (14.6)	26 (4.6)	**0.03**
male	47 (9.6)	154 (31.4)	216 (44.0)	55 (11.2)	19 (3.9)	
Age						
18–34	32 (9.5)	110 (32.5)	144 (42.6)	40 (11.8)	12 (3.6)	0.7
35–49	21 (7.3)	79 (27.5)	139 (48.4)	35 (12.2)	13 (4.5)	
50–64	17 (5.9)	80 (28.0)	134 (46.9)	41 (14.3)	14 (4.9)	
65+	10 (7.1)	33 (23.6)	70 (50.0)	21 (15.0)	6 (4.3)	
Higher education						
yes	26 (5.8)	122 (27.1)	209 (46.4)	68 (15.1)	25 (5.6)	**0.04**
no	54 (9.0)	180 (30.0)	278 (46.3)	69 (11.5)	20 (3.3)	
Marital status						
single	26 (10.4)	79 (31.6)	109 (43.6)	27 (10.8)	9 (3.6)	0.2
married	33 (6.3)	145 (27.9)	240 (46.2)	76 (14.6)	26 (5.0)	
informal relationship	7 (4.3)	51 (31.1)	78 (47.6)	21 (12.8)	7 (4.3)	
divorced or widowed	14 (12.0)	27 (23.1)	60 (51.3)	13 (11.1)	3 (2.6)	
Having children						
yes	40 (6.2)	170 (26.4)	307 (47.7)	96 (14.9)	30 (4.7)	**0.01**
no	40 (9.8)	132 (32.4)	180 (44.1)	41 (10.0)	15 (3.7)	
Size of the place of residence						
rural area	28 (8.3)	115 (33.9)	150 (44.2)	34 (10.0)	12 (3.5)	0.3
city below 20,000 residents	10 (8.2)	29 (23.8)	58 (47.5)	19 (15.6)	6 (4.9)	
city from 20,000 to 99,999 residents	19 (8.0)	57 (24.1)	119 (50.2)	33 (13.9)	9 (3.8)	
city from 100,000 to 499,999 residents	12 (6.0)	61 (30.5)	94 (47.0)	27 (13.5)	6 (3.0)	
city above 500,000 residents	11 (7.2)	40 (26.1)	66 (43.1)	24 (15.7)	12 (7.8)	
Living alone						
yes	20 (12.6)	36 (22.6)	79 (49.7)	16 (10.1)	8 (5.0)	**0.03**
no	60 (6.7)	266 (29.8)	408 (45.7)	121 (13.6)	37 (4.1)	
Currently employed or self-employed						
yes	48 (7.2)	188 (28.4)	308 (46.5)	90 (13.6)	29 (4.4)	0.9
no	32 (8.2)	114 (29.4)	179 (46.1)	47 (12.1)	16 (4.1)	
Self-reported financial status						
good	24 (6.0)	116 (28.9)	179 (44.6)	62 (15.5)	20 (5.0)	0.4
moderate	35 (8.6)	112 (27.6)	201 (49.5)	43 (10.6)	15 (3.7)	
bad	21 (8.6)	74 (30.3)	107 (43.9)	32 (13.1)	10 (4.1)	
Diabetes diagnosis by a doctor						
yes	2 (1.8)	11 (10.0)	45 (40.9)	29 (26.4)	23 (20.9)	**<0.001**
no	78 (8.3)	291 (30.9)	442 (47.0)	108 (11.5)	22 (2.3)	
History of diabetes in the family						
yes	15 (3.3)	106 (23.0)	227 (49.3)	86 (18.7)	26 (5.7)	**<0.001**
no	65 (11.0)	196 (33.2)	260 (44.0)	51 (8.6)	19 (3.2)	

Obesity, the greatest single risk factor for the onset of type 2 diabetes [24], is considered a reason to administer a blood glucose test in patients under the general age for screening tests (35 years according to ADA and USPSTF, 45 years according to PTD). The prevalence of adult female obesity is often higher than the prevalence of adult male obesity in most populations [25]. However, in Poland, men are more likely than women (68.9% vs. 48.2%) to be overweight or obese [26]. This should result in more men than women having their blood glucose tested, which was not observed in this study.

In the current study, women, compared to men, were more likely to have had a blood sugar test in the past 3 years. This

Table 3. Time since last blood glucose test according to socio-demographic factors (n=1,051)

Variable	Time since the last blood glucose test among adults in Poland according to socio-demographic factors						
	in the last month	more than a month ago, but not more than 12 months ago	more than a year ago, but not more than 2 years ago	over 2 years ago but not more than 3 years ago	over 3 years ago	never	p
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	
Total	220 (20.9)	292 (27.8)	171 (16.3)	90 (8.6)	148 (14.1)	130 (12.4)	
Gender							
female	126 (22.5)	161 (28.7)	94 (16.8)	53 (9.5)	79 (14.1)	47 (8.4)	**0.002**
male	94 (19.1)	131 (26.7)	77 (15.7)	37 (7.5)	69 (14.1)	83 (16.9)	
Age							
18–34	41 (12.1)	77 (22.8)	58 (17.2)	37 (10.9)	53 (15.7)	72 (21.3)	**<0.001**
35–49	52 (18.1)	84 (29.3)	52 (18.1)	25 (8.7)	40 (13.9)	34 (11.8)	
50–64	77 (26.9)	90 (31.5)	45 (15.7)	15 (5.2)	39 (13.6)	20 (7.0)	
65+	50 (35.7)	41 (29.3)	16 (11.4)	13 (9.3)	16 (11.4)	4 (2.9)	
Higher education							
yes	93 (20.7)	128 (28.4)	75 (16.7)	42 (9.3)	64 (14.2)	48 (10.7)	0.8
no	127 (21.1)	164 (27.3)	96 (16.0)	48 (8.0)	84 (14.0)	82 (13.6)	
Marital status							
single	37 (14.8)	64 (25.6)	37 (14.8)	28 (11.2)	34 (13.6)	50 (20.0)	**<0.001**
married	132 (25.4)	145 (27.9)	90 (17.3)	43 (8.3)	69 (13.3)	41 (7.9)	
informal relationship	22 (13.4)	42 (25.6)	32 (19.5)	9 (5.5)	26 (15.9)	33 (20.1)	
divorced or widowed	29 (24.8)	41 (35.0)	12 (10.3)	10 (8.5)	19 (16.2)	6 (5.1)	
Having children							
yes	154 (24.0)	192 (29.9)	109 (17.0)	60 (7.8)	94 (14.6)	44 (6.8)	**<0.001**
no	66 (16.2)	100 (24.5)	62 (15.2)	40 (9.8)	54 (13.2)	86 (21.1)	
Size of place of residence							
rural area	67 (19.8)	89 (26.3)	46 (13.6)	37 (10.9)	46 (13.6)	54 (15.9)	0.5
city with less than 20,000 inhabitants	28 (23.0)	32 (26.2)	24 (19.7)	9 (7.4)	15 (12.3)	14 (11.5)	
city with 20,000–99,999 inhabitants	48 (20.3)	71 (30.0)	40 (16.9)	18 (7.6)	37 (15.6)	23 (9.7)	
city with 100,000–499,999 inhabitants	37 (18.5)	61 (30.5)	30 (15.0)	16 (8.0)	31 (15.5)	25 (12.5)	
city with more than 500,000 inhabitants	40 (26.1)	39 (25.5)	31 (20.3)	10 (6.5)	19 (12.4)	14 (9.2)	
Living alone							
yes	36 (22.6)	46 (28.9)	24 (15.1)	13 (8.2)	15 (9.4)	25 (15.7)	0.4
no	184 (20.6)	246 (27.6)	147 (16.5)	77 (8.6)	133 (14.9)	105 (11.8)	
Currently employed or self-employed							
yes	122 (18.4)	183 (27.6)	116 (17.5)	53 (8.0)	101 (15.2)	88 (13.3)	**0.06**
no	98 (25.3)	109 (28.1)	55 (14.2)	37 (9.5)	47 (12.1)	42 (10.8)	
Self-reported financial status							
good	81 (20.2)	103 (25.7)	69 (17.2)	34 (8.5)	69 (17.2)	45 (11.2)	0.3
moderate	90 (22.2)	112 (27.6)	58 (14.3)	39 (9.6)	49 (12.1)	58 (14.3)	
bad	49 (20.1)	77 (31.6)	44 (18.0)	17 (7.0)	30 (12.3)	27 (11.1)	
Diabetes diagnosis by a doctor							
yes	81 (73.6)	10 (9.1)	11 (10.0)	4 (3.6)	4 (3.6)	0 (0.0)	**<0.001**
no	139 (14.8)	282 (30.0)	160 (17.0)	86 (9.1)	145 (15.4)	129 (13.7)	
History of diabetes in the family							
yes	114 (24.8)	146 (31.7)	74 (16.1)	42 (9.1)	51 (11.1)	33 (7.2)	**<0.001**
no	106 (17.9)	146 (24.7)	97 (16.4)	48 (8.1)	97 (16.4)	97 (16.4)	

disparity could have resulted from different approaches to health manifested by men and women in Poland. Many studies show that women in Poland are more aware and focused on their health status and more determined to fulfil their health needs actively [27, 28]. This disparity can also be explained by the fact that women in Poland live in larger towns and have a higher average level of education [29] – factors often associated with better access to healthcare services and higher awareness of risk factors and symptoms of diseases [17]. Even though in this study none of those

Table 4. Factors associated with time since the last blood glucose test among respondents without diabetes (n=941)

Variable	Factors associated with blood glucose test within the last 3 years (n=941)			
	Univariable logistic regression		[a] Multivariable logistic regression	
	OR (95%CI)	p-value	OR (95%CI)	p-value
Gender				
female	1.59 (1.20–2.11)	**0.001**	1.30 (0.96–1.76)	**0.009**
male	Reference		Reference	
Age				
18–34	Reference		Reference	
35–49	2.58 (1.51–4.41)	**0.008**	1.43 (0.96–2.14)	0.08
50–64	1.93 (1.34–2.80)	**<0.001**	1.62 (1.04–2.54)	**0.03**
65+	2.58 (1.51–4.41)	**<0.001**	2.36 (1.28–4.36)	**0.006**
Higher education				
yes	1.19 (0.89–1.58)	0.2		
no	Reference			
Marital status				
married, divorced or widowed	1.71 (1.29–2.28)	**<0.001**	1.29 (0.86–1.92)	0.2
single	Reference		Reference	
Having children				
yes	1.71 (1.29–2.27)	**<0.001**	1.04 (0.69–1.58)	0.8
no	Reference		Reference	
Size of the place of residence				
rural area	Reference		-	-
city with less than 20,000 inhabitants	1.26 (0.77–2.06)	0.4	-	-
city with 20,000–99,999 inhabitants	1.27 (0.86–1.87)	0.2	-	-
city with 100,000 499,999 inhabitants	1.06 (0.71–1.57)	0.8	-	-
city with more than 500,000 inhabitants	1.38 (0.87–2.19)	0.2	-	-
Living alone				
yes	1.05 (0.70–1.57)	0.8	-	-
no	Reference		-	-
Currently employed or self-employed				
yes	0.82 (0.61–1.10)	0.2	-	-
no	Reference		-	-
Self-reported financial status				
good	0.76 (0.52–1.12)	0.2	-	-
moderate	0.84 (0.57–1.23)	0.4	-	-
bad	Reference		-	-
History of diabetes in the family				
yes	2.10 (1.56–2.83)	**<0.001**	1.83 (1.33–2.51)	**<0.001**
no	Reference		Reference	
Self-reported level of knowledge on diabetes				
good	6.45 (3.51–11.86)	**<0.001**	5.45 (2.93–10.14)	**<0.001**
moderate	2.24 (1.66–3.03)	**<0.001**	2.02 (1.48–2.76)	**<0.001**
bad	Reference		Reference	

[a] Only the variables significant in bivariate analyses were included in the univariable analysis

variables (education level or place of residence) were found to solely influence the frequency of blood glucose tests in both the univariable and multivariable analyses, it can be hypothesized that those factors determine the respondents' knowledge of diabetes.

Awareness of the symptoms of diabetes is critical for its early diagnosis and further efficient management [30]. However, many patients disregard the early signs and symptoms of the disease. Due to slow progression, such signs and symptoms are not considered a serious problem [31], and are not associated with the development of diabetes.

This study shows that diabetes awareness in Poland is rather low. More than twice as many respondents had 'bad' (28.7%) or 'very bad' (28.7%) knowledge about diabetes than those who said that their knowledge was 'rather good' (13%) or 'very good' (4.3%). Higher education and being a woman were linked to better self-reported diabetes knowledge. The respondents' levels of knowledge varied significantly due to their personal experience of being a diabetic or having a diabetic person in the family. These results correspond with the results of other studies aimed at assessing the awareness of diabetes-related issues among different patient groups [32, 33] and in the general population [34, 17] in Poland.

The high number of patients unaware of their condition raises the importance of screening. There is a consensus that a fasting plasma glucose test, an oral glucose tolerance test, an A1C test, as well as a random plasma glucose test, can all be used to diagnose type 2 diabetes, the most common type of diabetes [35]. Therefore, every blood test that measures glucose levels can serve as a tool for screening for diabetes, or at least prediabetes. The effectiveness of such an approach depends on the correct frequency of blood glucose testing, which should comply with recognized standards.

The level of knowledge about diabetes proved to be strongly linked to the frequency of blood glucose tests performed in patients without diabetes. Patients with very good or rather good self-declared knowledge about diabetes were several times more likely to have had their blood glucose tested within recommended 3-year period than patients with moderate or bad levels of knowledge. Such differences may indicate some form of patient expectations influencing the decisions of the medical professional [36].

The following practical implications should be mentioned. The observed inadequate testing frequency, combined with a low overall level of knowledge about diabetes, does not allow for the early detection of diabetes or pre-diabetes, and is unlikely to lower the number of untreated cases of type 2. The presented data manifest the need to intensify screening for diabetes, combined with implementing a comprehensive diabetes education and communication strategy in Poland.

Limitations of the study. The CAWI research method poses some limitations resulting from the lack of direct interaction between the interviewer and the respondent. As a result, it was impossible to evaluate the responders' skills and comprehension of the questions posed. Also, a history of diabetes (both diagnosed by a physician and diabetes in the family) was self-reported, and due to the research design, medical records were not validated. Nevertheless, this study provides the most comprehensive and up-to-date oversight into factors influencing the use of blood glucose testing for diagnosing diabetes in Poland.

CONCLUSIONS

The results of this study show a low number of respondents who undergo blood glucose tests within the recommended time intervals. In the case of Poland, restrictive national recommendations for diabetes screening and limited offer of preventive health services provided under the general health insurance scheme result in fewer younger patients undergoing blood glucose tests.

Blood glucose testing conducted more frequently was linked to respondents' older age and female gender. Simultaneously, other socio-economic factors, including place of residence and financial situation, had no significant impact on the frequency of blood glucose testing. The strong association between a better understanding of diabetes and more frequent blood glucose tests proves the purposefulness of awareness-raising actions.

Informed Consent Statement

Participation in the study was voluntary. All participants declared informed consent.

REFERENCES

1. Tinajero MG, Malik VS. An Update on the Epidemiology of Type 2 Diabetes: A Global Perspective. Endocrinol Metab Clin North Am. 2021;50(3):337–355. doi:10.1016/j.ecl.2021.05.013
2. Topor-Madry R, Wojtyniak B, Strojek K, et al. Prevalence of diabetes in Poland: a combined analysis of national databases. Diabet Med. 2019;36(10):1209–1216. doi:10.1111/dme.13949
3. Zatońska K, Basiak-Rasała A, Różańska D, et al. Changes in diabetes prevalence and corresponding risk factors – findings from 3- and 6-year follow-up of PURE Poland cohort study. BMC Public Health. 2020;20(1):843. doi:10.1186/s12889–020–08970–5
4. Mordarska K, Godziejewska-Zawada M. Diabetes in the elderly. Prz Menopauzalny. 2017;16(2):38–43. doi:10.5114/pm.2017.68589
5. Polish Ministry of Health. Diabetes in numbers. Retrieved from: https://pacjent.gov.pl/artykul/cukrzyca-w-liczbach (accessed December 12, 2022)
6. Mularczyk-Tomczewska P, Zarnowski A, Gujski M, et al. Barriers to accessing health services during the COVID-19 pandemic in Poland: A nationwide cross-sectional survey among 109,928 adults in Poland. Front Public Health. 2022;10:986996. Published 2022 Sep 8. doi:10.3389/fpubh.2022.986996
7. Chaiban L, Benyaich A, Yaacoub S, Rawi H, Truppa C, Bardus M. Access to primary and secondary health care services for people living with diabetes and lower-limb amputation during the COVID-19 pandemic in Lebanon: a qualitative study. BMC Health Serv Res. 2022;22(1):593. doi:10.1186/s12913–022–07921–7
8. Organisation for Economic Co-operation and Development. Health at a Glance: Europe 2020. Retrieved from: https://www.oecd-ilibrary.org/social-issues-migration-health/health-at-a-glance-europe-2020_82129230-en (accessed December 12, 2022)
9. Forouhi NG, Wareham NJ. Epidemiology of diabetes. Medicine (Abingdon). 2014;42(12):698–702. doi:10.1016/j.mpmed.2014.09.007
10. Herman WH, Ye W, Griffin SJ, et al. Early Detection and Treatment of Type 2 Diabetes Reduce Cardiovascular Morbidity and Mortality: A Simulation of the Results of the Anglo-Danish-Dutch Study of Intensive Treatment in People With Screen-Detected Diabetes in Primary Care (ADDITION-Europe). Diabetes Care. 2015;38(8):1449–1455. doi:10.2337/dc14–2459
11. USPSTF, Prediabetes and Type 2 Diabetes: Screening, Final Recommendation Statement. Retrieved from: https://www.uspreventiveservicestaskforce.org/uspstf/recommendation/screening-for-prediabetes-and-type-2-diabetes#bootstrap-panel--6 (accessed December 12, 2022)
12. ADA, Standards of Medical Care in Diabetes—2022 Abridged for Primary Care Providers. Retrieved from: https://diabetesjournals.org/clinical/article/40/1/10/139035/Standards-of-Medical-Care-in-Diabetes-2022 (accessed December 12, 2022)
13. 2021 Guidelines on the management of patients with diabetes. A position of Diabetes Poland. Clin Diabetol 2021;10:1. doi: 10.5603/DK.2021.0001.
14. Standards of Medical Care in Diabetes—2022 Abridged for Primary Care Providers. Retrieved from: https://diabetesjournals.org/clinical/article/40/1/10/139035/Standards-of-Medical-Care-in-Diabetes-2022 (accessed December 12, 2022)
15. Rhee MK, Ho YL, Raghavan S, et al. Random plasma glucose predicts the diagnosis of diabetes. PLoS One. 2019;14(7):e0219964. Published 2019 Jul 19. doi:10.1371/journal.pone.0219964
16. Marciano L, Camerini AL, Schulz PJ. The Role of Health Literacy in Diabetes Knowledge, Self-Care, and Glycemic Control: a Meta-analysis. J Gen Intern Med. 2019;34(6):1007–1017. doi:10.1007/s11606–019–04832-y
17. Sękowski K, Grudziąż-Sękowska J, Pinkas J, Jankowski M. Public knowledge and awareness of diabetes mellitus, its risk factors, complications, and prevention methods among adults in Poland-A 2022 nationwide cross-sectional survey. Front Public Health. 2022;10:1029358. doi:10.3389/fpubh.2022.1029358
18. Aaby A, Friis K, Christensen B, Rowlands G, Maindal HT. Health literacy is associated with health behaviour and self-reported health: A large population-based study in individuals with cardiovascular disease. Eur J Prev Cardiol. 2017;24(17):1880–1888. doi:10.1177/2047487317729538
19. The Nationwide Research Panel Ariadna. About us (2023). Retrieved from: https://panelariadna.com/ (accessed January 30, 2023)
20. CBOS, Zdrowie i prozdrowotne zachowania Polaków. Komunikat z badań NR 138/2016, Warszawa, październik 2016 ISSN 2353–5822. Retrieved from: https://www.cbos.pl/SPISKOM.POL/2016/K_138_16.PDF (accessed December 12, 2022).
21. Williams ED, Tapp RJ, Magliano DJ, Shaw JE, Zimmet PZ, Oldenburg BF. Health behaviours, socioeconomic status and diabetes incidence: the Australian Diabetes Obesity and Lifestyle Study (AusDiab). Diabetologia. 2010;53(12):2538–2545. doi:10.1007/s00125–010–1888–4
22. Robbins JM, Vaccarino V, Zhang H, Kasl SV. Socioeconomic status and diagnosed diabetes incidence. Diabetes Res Clin Pract. 2005;68(3):230–236. doi:10.1016/j.diabres.2004.09.007
23. Tobiasz-Adamczyk B, Zawisza K. Urban-rural differences in social capital in relation to self-rated health and subjective well-being in older residents of six regions in Poland. Ann Agric Environ Med. 2017;24(2):162–170. doi:10.26444/aaem/74719
24. Aras M, Tchang BG, Pape J. Obesity and Diabetes. Nurs Clin North Am. 2021;56(4):527–541. doi:10.1016/j.cnur.2021.07.008
25. Cooper AJ, Gupta SR, Moustafa AF, Chao AM. Sex/Gender Differences in Obesity Prevalence, Comorbidities, and Treatment. Curr Obes Rep. 2021;10(4):458–466. doi:10.1007/s13679–021–00453-x
26. Stoś K, Rychlik E, Woźniak A, et al. Prevalence and Sociodemographic Factors Associated with Overweight and Obesity among Adults in Poland: A 2019/2020 Nationwide Cross-Sectional Survey. Int J Environ Res Public Health. 2022;19(3):1502. doi:10.3390/ijerph19031502
27. Hildt-Ciupińska K, Pawłowska-Cyprysiak K. Men's knowledge and beliefs about their care for health: results of in-depth interviews. Bezpieczeństwo Pracy: nauka i praktyka. 2019;8:17–20. doi:10.5604/01.3001.0013.3195
28. Gruszczyńska M, Bąk-Sosnowska, M, Plinta R. Zachowania zdrowotne jako istotny element aktywności życiowej człowieka. Stosunek Polaków do własnego zdrowia. Hygeia Public Health 2015;50(4):558–565.
29. Central Statistical Office of the Republic of Poland, Population. Size and structure and vital statistics in Poland by territorial division in 2022. As of 30 June 2022. Retrieved from: https://stat.gov.pl/en/topics/population/population/population-size-and-structure-and-vital-statistics-in-poland-by-territorial-division-in-2022-as-of-30-june-2022,3,32.html (accessed December 12, 2022).
30. American Diabetes Association. (4) Foundations of care: education, nutrition, physical activity, smoking cessation, psychosocial care, and immunization. Diabetes Care. 2015;38 Suppl:S20-S30. doi:10.2337/dc15-S007
31. Ramachandran A. Know the signs and symptoms of diabetes. Indian J Med Res. 2014;140(5):579–581
32. Abramczyk A. The Family Knowledge about the Disease and Complications Risk among Diabetic Patients in Poland. J Data Mining Genomics Proteomics 2013;4(142):2153–0602. doi:10.4172/2153–0602.1000142
33. Kwiendacz, H, Nabrdalik K, Brzoza Z, et al. Knowledge about diabetes mellitus among Polish medical students. Clinical Diabetology 2020;9(4):245–252. doi: 10.5603/DK.2020.0023
34. Sobierajski, T. Coalition for fight against diabetes. Report: social image of diabetes [Polish] (2017). Retrieved from: https://nazdrowie.pl/wp-content/uploads/2017/11/Spo%C5%82eczny-obraz-cukrzycy_raport.pdf (accessed December 12, 2022).
35. Pippitt K, Li M, Gurgle HE. Diabetes Mellitus: Screening and Diagnosis [published correction appears in Am Fam Physician. 2016 Oct 1;94(7):533]. Am Fam Physician. 2016;93(2):103–109
36. Laferton JA, Kube T, Salzmann S, Auer CJ, Shedden-Mora MC. Patients' Expectations Regarding Medical Treatment: A Critical Review of Concepts and Their Assessment. Front Psychol. 2017;8:233. doi:10.3389/fpsyg.2017.00233