



Original Article

Management of diabetes mellitus and patients' attitude towards the disease: Data from a nationwide study in Greece

Anastasios Tentolouris^a, Ioanna Eleftheriadou^a, Evangelia Tzeravini^a,
Kostas Athanasakis^b, Ioanna A. Anastasiou^a, John Kyriopoulos^b, Nikolaos Tentolouris^{a,*}

^a Diabetes Center, First Department of Propaedeutic Internal Medicine, Medical School, National and Kapodistrian University of Athens, Laiko General Hospital, Athens, Greece

^b Department of Health Economics, National School of Public Health, Athens, Greece

ARTICLE INFO

Article history:

Received 28 December 2018

Accepted 18 January 2019

Keywords:

Attitude

Diabetes mellitus

Insulin concerns

Management

Prevalence

Self-monitoring of blood glucose

Treatment patterns

Greece

ABSTRACT

Aim: To examine management of diabetes mellitus (DM) and patients' attitude towards DM in a random sample of the adult Greek population.

Methods: We selected a random sample of adults with self-reported DM ($n = 1002$) from a population-based nationwide study using the effective random sampling technique. Collection of data was performed through phone interviews.

Results: Prevalence of type 1 DM was 3.5% and of type 2 DM 96.5%. Prevalence of type 1 DM declined while of type 2 DM increased with age. No gender or residency differences were found between type 1 and type 2 DM. A total of 72.0% of subjects with type 2 DM were treated with oral antidiabetic drugs (OAD), 11.5% were treated with insulin and 7.1% were treated with both OAD and insulin. Internists specialized in DM were mainly doctors who started insulin treatment. Almost half of insulin naive subjects were skeptical towards insulin initiation and their main concern was the needle punch.

Conclusions: In a random nationwide sample of the adult population in Greece the majority of subjects with self-reported DM had type 2 DM. Most patients with type 2 were treated with OAD. Almost half of insulin naive subjects were skeptical towards insulin initiation.

© 2019 Diabetes India. Published by Elsevier Ltd. All rights reserved.

1. Introduction

Diabetes mellitus (DM) is a major cause of morbidity and mortality worldwide and according to the International Diabetes Federation one in eleven adults has DM [1]; the prevalence of DM is expected to rise to one in ten adults in 2040 [1]. Hence, the understanding of patients' approach towards their disease is essential to confront this epidemic.

Previous studies reported on the overall prevalence of DM in Greece [2–4]. According to the Government Center for Social Security (IDIKA), the prevalence of diagnosed and treated with anti-diabetic drugs in Greece in the years 2014–2015 was 7% [3]. The majority (96.6%) of the cases had type 2 DM, while the prevalence of type 1 DM was (3.4%) [2,3]. Higher prevalence of DM has been reported in other countries [5].

Greece suffers from economic crisis, which started in 2007 and continues for 10 years until today [6]. Thus, information regarding

patients' type of treatment, their attitude towards insulin use or the frequency of self-monitoring blood glucose (SMBG) measurements are important to understand patients' involvement in the management of the disease in real life. This is essential since nowadays, modern medicine is dominated by “evidence-based medicine” [7]. Previous studies mainly from the USA reported on patterns of treatment and patients' attitudes towards DM [8–11]; however, data from Greece regarding patient attitudes, type of treatment and overall DM management according to type of DM are limited.

The aim of this observational study was to examine the prevalence of type 1 and type 2 DM, treatment patterns, patients' attitude towards insulin use and frequency of self-monitoring in a random sample of the diabetic adult population in Greece.

2. Subjects, materials and methods

2.1. Study population

The study was conducted by the National Public Health School

* Corresponding author. 17 Agiou Thoma St, 11527, Athens, Greece.

E-mail address: ntentol@med.uoa.gr (N. Tentolouris).

of Greece and the Diabetes Center of our Hospital. Based on 2001 census, we selected randomly a subgroup of participants with DM from a population that included 12639 households (30843 inhabitants aged ≥ 19 years) and they were stratified by gender, age and district. The selected sample was representative of the diabetic adult population of Greece.

2.2. Procedures

A structured questionnaire was built to report type 1 and type 2 DM prevalence as well as the attitude of the patients with DM towards their disease. The questionnaire was built to be easily understood by the participants and to get as much information as possible.

Collection of data was performed by the method of qualitative phone interviews based on a rigid electronic structured questionnaire and use of the electronic system CATI (Computer-Assisted Telephone Interviewing) by the Greek Public Opinion company (G.P.O. A.E., Athens, Greece). The phone interviews were performed after automatic phone calls from the call center in random telephone numbers that corresponded to chosen sampling units.

A pilot study started in July 2010 and the personnel that performed the phone interview attended a training course to understand the purpose and the methods of the study. Throughout the duration of the study, all collected data were centrally controlled and checked for missing information. In addition, 15.0% of the interviews were verified from supervisors via the special software of listening and visual monitoring. The full study was performed in August and September in the year 2010.

Data on the prevalence of DM and main comorbidities were published previously [12]. According to that publication, 2035 subjects (prevalence 6.6%) self-reported that they were diagnosed with DM. A total of 1002 out of 2035 participants with reported DM were randomly selected and were further questioned for the type of DM, type of treatment, their attitude towards treatment with insulin, and frequency of self-monitoring. The effective random sampling technique was used to reduce sampling bias; thus, from the subjects diagnosed with DM in the initial cohort -that was a representative sample of the adult population of Greece and were stratified by gender, age and district- the even numbers of subjects with self-reported DM per district were selected from the database and were questioned for DM-related parameters.

2.3. Assessment of DM prevalence and patients' attitude towards the disease

Participants were asked about the type of DM and possible answers were: type 1 DM, type 2 DM or unknown. If the participants' response was unknown, they were further asked about the age of DM onset, the medical history of hospitalization with ketoacidosis and the use of insulin after diagnosis. When the onset of DM was <30 years of age in the presence of symptoms of diabetes and/or ketoacidosis and the patient had been treated continuously with insulin after the diagnosis, DM was considered as type 1 DM; all other cases were considered as type 2 DM. Furthermore, subjects were asked about the type of treatment and possible responses were: diet and exercise, oral antidiabetic drugs (OAD), combination of OAD and insulin, insulin only or other injectable medication except for insulin. Patients who were treated with insulin were further questioned about the type and the brand name of insulin they used as well as the specialty of the doctor who initiated insulin use; possible answers were: internist with specialty in diabetes, endocrinologist, internist not specialized in diabetes, general practitioner, cardiologist or other specialty. Participants who were not treated with insulin were asked about their willingness to start

insulin and their concerns regarding insulin use; more than one answer to the questions was possible. Finally, individuals were questioned about the possession and use of a SMBG device. Those who used a SMBG system were further asked about the frequency of measurements per week and their satisfaction with the support provided by the companies that sell the glucometers.

2.4. Statistical analysis

The Statistical Package for the Social Sciences (IBM SPSS software version 22.0 for Windows, Armonk, NY, USA) was used for the statistical analysis. Categorical variables are presented as number and percentage (n, %) and non-parametric variables as median value (25, 75 percentile). The Pearson chi-square test (χ^2) was used to compare categorical variables and the Mann-Whitney test was used to assess differences of non-parametric variables. *P* values < 0.05 were considered statistically significant.

2.5. Ethics approval

The study protocol was approved by the Scientific Committee of our Hospital (Hospital Scientific Committee of Laiko Hospital Decision: 251/3-5-2010) and was conducted according to the recommendations of the Declaration of Helsinki [13].

3. Results

Thirty-five participants (prevalence 3.5%) answered that they were diagnosed with type 1 DM, 869 (86.7%) were diagnosed with type 2 DM and 98 (9.8%) were not aware of the type of DM. When we further analyzed the patients that did not know the type of DM, all were diagnosed with DM after the age of 30 years, none had symptoms of DM or reported ketoacidosis at the time of the diagnosis, and none was treated with insulin after the diagnosis of DM. Thus, we can relatively safely conclude that all the unknown participants had type 2 DM and that the overall prevalence of type 2 DM was 96.5%. Type of DM classified according to age, gender, and residency are presented in Table 1. We did not find any gender or residency (urban vs. rural) difference in the prevalence of type 1 or type 2 DM. The prevalence of type 1 DM decreased while of type 2 DM increased with age.

Regarding anti-diabetic treatment, all 35 patients with type 1 DM were treated with insulin. Thirty-one patients with type 1 DM (88.6%) were treated with basal bolus insulin regimens, while 4 patients (11.4%) were treated with premix insulin regimens.

Among participants with type 2 DM, OAD was the most frequent treatment (72.0%). A total of 77 (9.0%) individuals were managed with diet and exercise, 69 (7.1%) received both OAD and insulin, 111 patients were treated with insulin only (11.5%) and 4 patients (0.4%) were treated with other injectable therapy. Treatment of patients with type 2 DM is shown on Table 2.

A total of 215 patients with both types of DM (35 with type 1 DM and 180 with type 2 DM) were treated with several insulin regimens. Types of insulin are shown in Table 3.

Individuals using insulin were also asked about the specialty of the physician who initiated insulin treatment. Among them, 140 (65.2%) reported that insulin therapy was initiated by a diabetes specialist internist, while 23 (10.7%) and 34 (15.8%) by an endocrinologist and an internist, respectively. The specialty of the physician who started insulin treatment according to gender and age are shown in Table 4.

Individuals not treated with insulin ($n = 787$) were asked about their willingness to start insulin therapy, if needed and suggested by the physician. A total of 317 (40.3%) answered that were not willing to start insulin, 260 (33.0%) replied positively, while 102

Table 1
Type of diabetes mellitus classified according to age, gender and residency.

	Overall n (%)	Gender n (%)		$\chi^2 = 1.37$ $p = 0.241^*$	Age n (%)			$\chi^2 = 20.83$ $p < 0.001^{**}$	Residency n (%)		$\chi^2 = 0.03$ $p = 0.867^{***}$
		Men	Women		19–44 n (%)	45–64 n (%)	>65 n (%)		Urban	Rural	
Type 1 DM	35 (3.5)	16 (2.9)	19 (4.3)		6 (16.7)	15 (3.9)	14 (2.4)		25 (3.6)	10 (3.3)	
Type 2 DM	967 (96.5)	539 (97.1)	428 (95.7)		30 (83.3)	367 (96.1)	570 (97.6)		678 (96.4)	289 (96.7)	
Overall	1002 (100.0)	555 (100.0)	447 (100.0)		36 (100.0)	382 (100.0)	584 (100.0)		703 (100.0)	299 (100.0)	

Data are presented as n (%).

* p value for the comparison between men and women with type 1 diabetes vs. type 2 diabetes.

** p value for the comparison between age-groups with type 1 diabetes vs. type 2 diabetes.

*** p value for the comparison between residents in urban and rural areas with type 1 diabetes vs. type 2 diabetes.

DM: diabetes mellitus.

Table 2
Treatment of participants with type 2 diabetes mellitus.

Diet & exercise	87 (9.0)
Oral antidiabetic drugs	696 (72.0)
Insulin only	111 (11.5)
Basal	73 (65.8) ^a
Basal-bolus	7 (6.3) ^a
Premixed-insulin	30 (27.0) ^a
Only bolus	1 (0.9) ^a
Oral medication & insulin	69 (7.1)
Basal	61 (88.4) ^b
Basal-bolus	1 (1.5) ^b
Premixed-insulin	7 (10.1) ^b
Other injectable therapy	4 (0.4)
Overall	967 (100.0)

Data are presented as n (%).

^a Percentage of the patients treated with insulin only ($n = 111$).

^b Percentage of the patients treated with oral medication and insulin ($n = 69$).

(13.0%) and 62 (7.9%) answered that they would or would not probably start insulin use, respectively. The intensification of patients to start insulin treatment regimens according to age, gender and residency is shown in Table 5. No significant differences were found in terms of willingness to start insulin treatment with regards to gender, age-group or residency. Regarding concerns on insulin treatment, 251 (31.9%) of the patients were not worried about insulin therapy, while 157 (19.9%) were afraid of the needle puncture and 44 (5.6%) were afraid of hypoglycemia, as shown in Table 6.

Table 3
Type of insulin classified according to type of diabetes mellitus.

	Overall n (%)	Type of DM n (%)	
		Type 1 DM	Type 2 DM
Basal insulin	174 (100.0)	31 (100.0)	143 (100.0)
Glargine	91 ^a (52.3)	29 (93.6)	62 (43.3)
Detemir	6 (3.5) ^a	0	6 (4.2)
NPH, Protaphane	11 (6.3) ^a	2 (6.4)	9 (6.3)
Unknown	66 (37.9) ^a	0	66 (46.2)
Prandial Insulin	39 (100.0)	31 (100.0)	8 (100.0)
Lispro	14 (35.9) ^b	11 (35.5)	3 (37.5)
Aspart	8 (20.5) ^b	8 (25.8)	0
Glulisine	7 (18.0) ^b	7 (22.6)	0
Actrapid, Regular	6 (15.4) ^b	3 (9.7)	3 (37.5)
Unknown	4 (10.2) ^b	2 (6.4)	2 (25.0)
Pre-mixed insulin	41 (100.0)	4 (100.0)	37 (100.0)
Actrapid, Regular, NPH, Isophane-Premixed insulin	39 (95.1) ^c	4 (100.0)	35 (94.6)
Lispro-Premixed insulin	0	0	0
Aspart-Premixed insulin	0	0	0
Unknown	2 (4.9) ^c	0	2 (5.4)

Data are presented as n (%).

DM: diabetes mellitus, NPH: neutral protamine Hagedorn.

^a Percentage is among patients using basal insulin.

^b Percentage is among patients using prandial insulin.

^c Percentage is among patients using pre-mixed insulin.

Regarding the possession and use of a SMBG device, 918 (91.6%) of the total cohort stated that they had a glucometer; there was no significant difference in terms of gender ($\chi^2 = 0.02$, $p = 0.904$), age-group ($\chi^2 = 3.50$, $p = 0.174$) or residency ($\chi^2 = 2.19$, $p = 0.139$) in the use of a SMBG device. Patients with type 1 DM monitored (median value, interquartile range) their blood glucose 12.0 (7.0–21.0) times per week, while patients with type 2 DM 3.0 (2.0–7.0) times per week ($p < 0.001$). Patients with type 2 DM treated with insulin regimens measured their blood glucose 10.0 (5.0–14.0) times per week, while those not receiving insulin 3.0 (1.0–7.0) times per week ($p < 0.001$). The frequency of SMBG is shown in Table 7.

In addition, 612 (66.7%) of those who possessed a glucometer replied that they received adequate support from the companies that provide the devices, 255 (27.7%) responded neutrally, and 51 (5.6%) were not satisfied with the services. No significant differences were found in terms of information and support provided from the companies of the SMBG devices in terms of gender, age-group or residency (data not shown).

4. Discussion

In this observational study, we found that the prevalence of self-reported type 1 DM was 3.5% and of type 2 DM 96.5% in a random sample of individuals with DM in Greece. We also investigated for the first time in Greece the attitude of patients with DM towards their disease in terms of the type of DM, different treatment patterns and their concerns about insulin therapy.

Table 4
Specialty of doctor who started insulin treatment.

	Overall n (%)	Gender n (%)		Type of diabetes n (%)	
		Male	Female	Type 1 DM	Type 2 DM
Internist-Diabetologist	140 (65.1)	85 (67.4)	55 (61.8)	23 (65.7)	117 (65.0)
Endocrinologist	23 (10.7)	15 (11.9)	17 (19.1)	6 (17.1)	17 (9.5)
Internist	34 (15.8)	17 (13.5)	8 (9.0)	3 (8.6)	31 (17.2)
General Practitioner	5 (2.4)	2 (1.6)	3 (3.4)	2 (5.7)	3 (1.7)
Cardiologist	2 (0.9)	2 (1.6)	0	0	2 (1.1)
Other	2 (0.9)	2 (1.6)	0	0	2 (1.1)
Unknown	9 (4.2)	3 (2.4)	6 (6.7)	1 (2.9)	8 (4.4)
Overall	215 (100.0)	126 (100.0)	89 (100.0)	35 (100.0)	180 (100.0)

Data are presented as n (%).
DM: diabetes mellitus.

Table 5
Willingness of starting insulin therapy in participants with type 2 diabetes not treated with insulin according to age, gender and residency.

	Overall	Gender		Age			Residency	
		Male	Female	19–44	45–64	>65	Urban	Rural
Yes	260 (33.0)	147 (34.3)	113 (31.6)	9 (36.0)	113 (35.0)	138 (31.4)	180 (32.6)	80 (34.0)
Probably yes	102 (13.0)	59 (13.8)	43 (12.0)	3 (12.0)	57 (17.7)	42 (9.5)	72 (13.0)	30 (12.8)
Probably no	62 (7.9)	39 (9.1)	23 (6.4)	0	26 (8.1)	36 (8.2)	43 (7.8)	19 (8.1)
No	317 (40.3)	161 (37.4)	156 (43.6)	12 (48.0)	101 (31.4)	204 (46.4)	219 (39.7)	98 (41.7)
I do not know	46 (5.8)	23 (5.4)	23 (6.4)	1 (4.0)	25 (7.8)	20 (4.5)	38 (6.9)	8 (3.4)
Overall	787 (100.0)	429 (100.0)	358 (100.0)	25 (100.0)	322 (100.0)	440 (100.0)	552 (100.0)	235 (100.0)

Data are presented as n (%).

Table 6
Concerns regarding insulin use in patients with type 2 diabetes mellitus who are insulin-naïve stratified according to age, gender and residency.

	Overall ^a	Gender		Age			Residency	
		Male	Female	19–44	45–64	>65	Urban	Rural
No concerns	251 (31.9)	156 (36.4)	95 (26.5)	9 (36.0)	101 (31.4)	141 (32.0)	181 (32.8)	70 (30.0)
I do not know	198 (25.1)	107 (24.9)	91 (25.4)	7 (28.0)	67 (20.8)	124 (28.2)	142 (25.7)	56 (23.8)
Needle punch	157 (19.9)	78 (18.2)	79 (22.1)	6 (24.0)	80 (24.8)	71 (16.1)	113 (20.5)	44 (18.7)
Hypoglycemia	44 (5.6)	25 (5.8)	19 (5.3)	2 (8.0)	13 (4.0)	29 (6.6)	22 (4.0)	22 (9.4)
Effect on lifestyle	36 (4.6)	17 (4.0)	19 (5.3)	1 (4)	18 (5.6)	17 (3.9)	27 (4.9)	9 (3.8)
General fear	31 (3.9)	13 (3.0)	18 (5.0)	0	16 (5.0)	15 (3.4)	18 (3.2)	13 (5.5)
Other side effects	22 (2.8)	8 (1.9)	14 (3.9)	0	6 (1.8)	16 (3.6)	13 (2.4)	9 (3.8)
Painful/annoying	17 (2.2)	10 (2.3)	7 (1.9)	0	8 (2.5)	9 (2.0)	14 (2.5)	3 (1.3)
I do not want	10 (1.3)	6 (1.4)	4 (1.1)	0	2 (0.6)	8 (1.8)	6 (1.1)	4 (1.7)
Burden of the body	5 (0.6)	2 (0.5)	3 (0.8)	0	4 (1.2)	1 (0.3)	3 (0.5)	2 (0.8)
Not necessary	2 (0.3)	2 (0.5)	0	0	1 (0.3)	1 (0.3)	1 (0.2)	1 (0.4)
Other	11 (1.4)	4 (0.9)	7 (1.9)	0	3 (0.8)	8 (0.8)	9 (1.6)	2 (0.8)
No answer	3 (0.4)	1 (0.2)	2 (0.6)	0	3 (0.9)	0	3 (0.5)	0

Data are presented as n (%).

^a More than one answer to the questions was possible.

Table 7
Frequency of weekly blood glucose measurements according to type of diabetes mellitus.

Number of measurements	Type 1 DM	Type 2 DM	
		Insulin users	Non-insulin users
0	1 (2.9)	1 (0.6)	23 (2.9)
1	1 (2.9)	5 (2.8)	158 (20.1)
2	1 (2.9)	10 (5.6)	123 (15.6)
3	3 (8.6)	17 (9.4)	111 (14.1)
4–6	2 (5.7)	15 (8.3)	99 (12.6)
7–10	9 (25.7)	47 (26.1)	129 (16.4)
>11	18 (51.4)	81 (45.0)	47 (6.0)
Unknown	0	1 (0.6)	83 (10.5)
No answer	0	3 (1.6)	14 (1.8)
Overall	35 (100.0)	180 (100.0)	787 (100.0)

Data are presented as n (%).
DM: diabetes mellitus.

The prevalence of type 1 and type 2 DM found in our study is in accordance with data from previous studies in Greece. Liatis et al. using data from the nation-wide prescription database in 2014–2015, demonstrated that 3.4% of individuals with DM were diagnosed with type 1 DM [3]. In a previous study from our group, the prevalence of self-reported type 1 and type 2 DM was 4.0% and 96.0%, respectively in the time period 1996–1999 [2]. The American Diabetes Association (ADA) estimates that the prevalence of type 1 DM is higher, between 5 and 10% for type 1 and 90–95% for type 2 DM [5]. Recent data suggest that there is an increase in the prevalence and incidence of type 1 DM worldwide [14].

The higher prevalence of type 1 DM in males found in previous studies, including the Greek study from Liatis et al. was not confirmed in our study [3,15]. As expected, and in agreement with previous reports, we found that the prevalence of type 1 DM decreased, while that of type 2 DM increased with age [15,16].

Regarding treatment of patients with type 2 DM, most of them (72.0%) were treated with OAD. Liatis et al. demonstrated that 80.6%

of Greek patients with type 2 DM were managed with OAD [3]; however, they reported data for patients treated with antidiabetic medications, while those managed with diet and exercise were not included in their study and this probably explains the higher percentage of subjects managed by OAD in their study. In other smaller studies from Greece and from the USA approximately 61.0% of patients with type 2 DM were treated with OAD [8,17]. Independently of the differences, there is a rapid increase in the use of OAD [18]. In addition, Liatis et al. demonstrated that 7.0% of the patients were treated exclusively with insulin, while this number was higher (11.5%) in our study [3]. Furthermore, we found that 7.1% of the participants were treated with both OAD and insulin in comparison with previous data that reported that 12.4% of the people with type 2 DM in Greece were treated with both OAD and insulin [3]. Interestingly, 9.0% of individuals were managed with diet and exercise only, while this percentage was 14.0% in the USA [8,19]. Furthermore, only a few patients (0.4%) were using other injectable therapy, a term that was referring to the use of glucagon like peptide one agonists (GLP-1A). In the year 2015, Liatis et al. found that the percentage of GLP-1 and/or sodium-glucose transporters-2 inhibitors users has increased to 4.6% [3]. Data from the Nutrition Examination Survey (NHANES) which was performed among 2425 adults participants with all types of DM between the years 2005 and 2012, demonstrated that 14.1% of the participants were treated exclusively with insulin, 56.9% were treated with OAD, 14.9% were treated with both insulin and OAD and 14.1% were not receiving any treatment [19].

Among patients with type 1 DM, insulin glargine was by far the most used basal insulin; a small proportion of patients were treated with NPH insulin and 11.4% with pre-mixed insulin, even though it is highly suggested by the ADA that they should be treated with multiple daily injections of prandial and basal insulin or continuous subcutaneous insulin infusion [20].

Regarding the specialty of the doctor who initiated patients in insulin use, most of the participants answered that an internist who is specialized in diabetes. Our data agree with those of the USA in 2001 showing that among 23.4 million outpatient prescriptions in the USA, an internist was the most common physician specialty who prescribed OAD, followed by a general practitioner [18].

Among patients that were not treated with insulin, almost half of them replied that they would not, or they would probably not start insulin use even if their doctor had recommended it. Historically, insulin is considered as the last therapeutic option for patients with type 2 DM, even though it is the safest and more effective antidiabetic drug [21]. This “psychological insulin resistance” (PIR) can be defined as psychological opposition towards insulin use in both people with diabetes and their prescribers [9]. A total of 28.0% of insulin naive-patients with type 2 DM reported PIR, and they were unwilling to start insulin if prescribed while a substantial number of the rest expressed significant unwillingness [10].

Participants were further questioned about their concerns on insulin use. Approximately one-third of them answered that they did not have any concerns, while one quarter replied that they were not aware of the exact fear on insulin. One-fifth of them was afraid of the needle punch. Previous studies reported that needle punch is a real burden, even in young patients with type 1 DM, where 27.0% of them reported needle anxiety [11]. Interestingly, only a small proportion of the individuals were afraid of hypoglycemia or pain. In addition, only 4.6% of them were concerned about insulin's effect on their lifestyle, even though it has been described as “social stigma” [9]. Men were less concerned about insulin use, implying that women are more reluctant to begin insulin treatment and indicated a greater fear of injection as well as social stigmatization by the use of insulin, as described previously [22].

Regarding SMBG measurement, it is known that patients with

DM who perform SMBG more frequently have better glycemic control [23,24]. In our study, more than half of the patients with type 1 DM performed SMBG often, while almost 25% of them performed SMBG once per day only. Similar patterns were noticed in patients with type 2 DM that were treated with insulin.

The main strength of our study is that the subgroup of patients with DM were selected from a random sample of the total adult population in Greece. In addition, this is the first study in this country to describe patients' attitude towards their disease. On the other hand, there are several limitations. Firstly, as in most population-based studies, type of DM was self-reported and not confirmed diagnostically. Secondly, we did not collect data about other types of DM such as gestational diabetes. Thirdly, we did not have data about the type of OAD that the patients were receiving and data on diabetes control. In addition, we have no data about the percentage of people using new long-acting basal insulin analogues that are associated with lower hypoglycemic events [25,26]. Finally, we used the effective random sampling technique to reduce sampling bias for the selection of the random sample with self-reported DM stratified per district only and not for other variables such as age and gender. However, as the initial cohort of the 12639 households (30843 adults habitants) was stratified by gender, age and district and was representative of the adult population of Greece [12], the technique used in this study can reduce but cannot eliminate selection bias.

In summary, in this study we found that the prevalence of self-reported type 1 DM and type 2 DM in a random sample of individuals with DM in Greece was 3.5% and 96.5%, respectively. Most people with type 2 DM were treated with OAD. Internists specialized in diabetes were principally doctors who started insulin treatment. Almost half of insulin naive subjects with type 2 DM were skeptical towards insulin initiation and use and their main concern was the needle punch.

Conflicts of interest

The authors declare that there is no conflict of interest.

Funding

This study received no funding.

Acknowledgements

None.

References

- [1] International Diabetes Federation. IDF diabetes atlas. eighth ed. Brussels, Belgium: International Diabetes Federation; 2017.
- [2] Tentolouris N, Andrianakos A, Karanikolas G, Karamitsos D, Trontzas P, Krachtis P, et al. Prevalence of diabetes mellitus and obesity in the general adult population of Greece: a door-to-door epidemiological study. *Diabet Med* 2009;26(4):451–2.
- [3] Liatis S, Dafoulas GE, Kani C, Politi A, Litsa P, Sfikakis PP, et al. The prevalence and treatment patterns of diabetes in the Greek population based on real-world data from the nation-wide prescription database. *Diabetes Res Clin Pract* 2016;118:162–7.
- [4] Melidonis AM, Tourmis SM, Kompoti MK, Lentzas IL, Roussou VR, Iraklianos SL, et al. Increased prevalence of diabetes mellitus in a rural Greek population. *Rural Rem Health* 2006;6(1):534.
- [5] American Diabetes Association. Classification and diagnosis of diabetes. *Diabetes Care* 2017;40(Suppl 1):S11–24.
- [6] Kentikelenis A, Karanikolas M, Papanicolas I, Basu S, McKee M, Stuckler D. Health effects of financial crisis: omens of a Greek tragedy. *Lancet* 2011;378(9801):1457–8.
- [7] Bensing J. Bridging the gap. The separate worlds of evidence-based medicine and patient-centered medicine. *Patient Educ Counsel* 2000;39(1):17–25.
- [8] Kerr EA, Heisler M, Krein SL, Kabeto M, Langa KM, Weir D, et al. Beyond comorbidity counts: how do comorbidity type and severity influence diabetes

- patients' treatment priorities and self-management? *J Gen Intern Med* 2007;22(12):1635–40.
- [9] Brod M, Kongso JH, Lessard S, Christensen TL. Psychological insulin resistance: patient beliefs and implications for diabetes management. *Qual Life Res* 2009;18(1):23–32.
- [10] Polonsky WH, Fisher L, Guzman S, Villa-Caballero L, Edelman SV. Psychological insulin resistance in patients with type 2 diabetes: the scope of the problem. *Diabetes Care* 2005;28(10):2543–5.
- [11] Simmons JH, McFann KK, Brown AC, Rewers A, Follansbee D, Temple-Trujillo RE, et al. Reliability of the diabetes fear of injecting and self-testing questionnaire in pediatric patients with type 1 diabetes. *Diabetes Care* 2007;30(4):987–8.
- [12] Tentolouris A, Eleftheriadou I, Athanasakis K, Kyriopoulos J, Tsimigras DI, Grigoropoulou P, et al. Prevalence of diabetes mellitus as well as cardiac and other main comorbidities in a representative sample of the adult Greek population in comparison with the general population. *Hellenic J Cardiol* 2018 [Epub ahead of print].
- [13] World Medical Association. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. *J Am Med Assoc* 2013;310(20):2191–4.
- [14] Dabelea D, Mayer-Davis EJ, Saydah S, Imperatore G, Linder B, Divers J, et al. Prevalence of type 1 and type 2 diabetes among children and adolescents from 2001 to 2009. *J Am Med Assoc* 2014;311(17):1778–86.
- [15] Diaz-Valencia PA, Bougneres P, Valleron AJ. Global epidemiology of type 1 diabetes in young adults and adults: a systematic review. *BMC Public Health* 2015;15:255.
- [16] Menke A, Casagrande S, Geiss L, Cowie CC. Prevalence of and trends in diabetes among adults in the United States, 1988–2012. *J Am Med Assoc* 2015;314(10):1021–9.
- [17] Tentolouris N, Andrianakos A, Karanikolas G, Karamitsos D, Trontzas P, Krachtis P, et al. Type 2 diabetes mellitus is associated with obesity, smoking and low socioeconomic status in large and representative samples of rural, urban, and suburban adult Greek populations. *Hormones (Athens)* 2012;11(4):458–67.
- [18] Wysowski DK, Armstrong G, Governale L. Rapid increase in the use of oral antidiabetic drugs in the United States, 1990–2001. *Diabetes Care* 2003;26(6):1852–5.
- [19] Selvin E, Parrinello CM, Daya N, Bergenstal RM. Trends in insulin use and diabetes control in the U.S.: 1988–1994 and 1999–2012. *Diabetes Care* 2016;39(3):e33–5.
- [20] American Diabetes Association. Erratum. Pharmacologic approaches to glycemic treatment. Sec. 8. In standards of medical care in diabetes-2017. *Diabetes care* 2017;40(suppl. 1):S64–S74. *Diabetes Care* 2017;40(7):985.
- [21] Ioannidis I. Diabetes treatment in patients with renal disease: is the landscape clear enough? *World J Diabetes* 2014;5(5):651–8.
- [22] Nam S, Chesla C, Stotts NA, Kroon L, Janson SL. Factors associated with psychological insulin resistance in individuals with type 2 diabetes. *Diabetes Care* 2010;33(8):1747–9.
- [23] Karter AJ, Ackerson LM, Darbinian JA, D'Agostino Jr RB, Ferrara A, Liu J, et al. Self-monitoring of blood glucose levels and glycemic control: the Northern California Kaiser Permanente Diabetes registry. *Am J Med* 2001;111(1):1–9.
- [24] Miller KM, Beck RW, Bergenstal RM, Goland RS, Haller MJ, McGill JB, et al. Evidence of a strong association between frequency of self-monitoring of blood glucose and hemoglobin A1c levels in T1D exchange clinic registry participants. *Diabetes Care* 2013;36(7):2009–14.
- [25] Madenidou AV, Paschos P, Karagiannis T, Katsoula A, Athanasiadou E, Kitsios K, et al. Comparative benefits and harms of basal insulin analogues for type 2 diabetes: a systematic review and network meta-analysis. *Ann Intern Med* 2018;169(3):165–74.
- [26] Tentolouris A, Eleftheriadou I, Tentolouris N. Insulin degludec U100 is associated with lower risk for severe and symptomatic hypoglycemia as compared with insulin larginine U100 in subjects with type 1 diabetes. *Ann Transl Med* 2018;6(3):63.