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SURVEY RESEARCH ARTICLE

Internists' and Endocrinologists' Knowledge and Attitudes Regarding Periodontal Disease, Caries, Xerostomia and Diabetes Mellitus: A National Survey

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Abstract

Objectives: The present study aims to investigate the current knowledge, attitudes and behaviors of clinicians dealing with diabetes regarding the relationship of Diabetes Mellitus (DM) and odostomatological diseases, such as periodontal disease, xerostomia and caries.

Methods: A twenty-four item closed-ended multiple-choice questionnaire was completed by 225 Greek medical doctors. The sample was divided into three groups according to specialty: a) Endocrinologists; b) Internists; c) Internal medicine registrars. Bivarate analysis, Fisher test, and Spearman correlation were used for statistical analysis.

Results: Most doctors were aware of the bi-directional relationship between periodontal disease and DM. Regarding the relationship between DM and xerostomia, 50% of doctors were unaware that patients with DM have an increased risk of xerostomia and were unfamiliar with the relevant studies. Nearly 50% of doctors agreed that patients with diabetes are at increased risk of developing caries. Age, specialty, and years of expertise had an impact on the way of doctors' answer. Finally, 78.6% of doctors treating diabetes considered that they should cooperate with dentists to reduce their patients' risk of odontostomatological complications.

Conclusion: The relationship between diabetes and dental problems is often underestimated. Implementation of medical and dental educational programs oriented in increasing inter-professional education as well as collaboration between dentists and doctors dealing with diabetes, are needed in order to achieve the goal of better care of patients with diabetes.

Key Words: *Diabetes; Caries; Periodontal disease; Xerostomia; Attitudes; Knowledge; Inter-professional education*

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Introduction

Nowadays, efforts have been made to recognize oral health as an integral part of overall health. Current research in dental medicine trends toward identifying the link between oral health and various metabolic and systemic diseases. Diabetes mellitus (DM) is the most common metabolic disorder in the general population and predisposes to various co-morbidities and complications that affect health.

DM is a chronic metabolic disorder characterized by hyperglycemia due to defects in insulin secretion and action. Chronic hyperglycemia results in default in the metabolism of carbohydrates, fat, and proteins and can lead to damage and failure of multiple organs [1]. According to WHO, 347 million people worldwide have diabetes, and it is projected that by the year 2030, diabetes will be the seventh leading cause of death [2]. The most common long-term complications of diabetes mellitus are cardiovascular disease, retinopathy, nephropathy, and peripheral and autonomic neuropathy [3]. Also, various oral and dental manifestations of DM have been reported. Patients with diabetes are at an increased risk for odontostomatological complications such as coronal caries, root caries, candidiasis, erosion, xerostomia, and periodontal disease [4]. Periodontal disease has been recognized as the sixth leading complication of diabetes [5]. The relationship between periodontitis and diabetes is now considered a bidirectional association [6,7]. In patients with diabetes, microvascular disease and deterioration of microcirculation conditions may impair saliva secretion and composition [8]. In addition, the metabolic control of DM is vital for the maintenance of saliva flow rate and buffering capacity and caries prevalence [8].

Dentists are taught about the oral-systemic association during their professional education [7]. What is less clear is whether medical doctors treating patients with diabetes are familiar with the relationship between DM and odontostomatological diseases. To our knowledge, only two previous studies have investigated this topic [9,10]. The first one suggested that internists and endocrinologists had some knowledge about the impact of diabetes on oral health and a possible link between periodontal disease and diabetes mellitus; however, the majority did not have sufficient familiarity with the relevant studies on this association [9]. The second study revealed that endocrinologists and dentists were not equally equipped with knowledge about the relationship between DM and periodontitis, and there was a wide gap between their practice and the current evidence [10]. So, these studies related to a sample of doctors in a particular USA state and a region of China, respectively. There are no published studies investigating medical doctors' knowledge and attitudes about the relationship between oral manifestations and diabetes in Europe. Besides, the latter study reflected only the knowledge and beliefs about the association between diabetes and periodontal disease, and there is no published data on the relationship between diabetes and caries or/and xerostomia. Given these health professionals' role in treating most adult patients with diabetes, investigating their knowledge about oral health and its potential impact on patient education is essential.

The present study aimed to investigate the knowledge and attitudes of internists, endocrinologists, and registrants in internal medicine in Greece, regarding the relationship between DM and odontostomatogical diseases,

such as periodontal diseases, xerostomia, and caries. The ultimate scope was to highlight possible weaknesses and to strengthen cooperation between medical and dental professionals in order to provide the appropriated integrated care in patients with diabetes.

Materials and Methods

This survey study used questionnaires sent to endocrinologists, internists and internal medicine registrars treating patients with diabetes mellitus. All participants were asked to sign a consent form after explaining the survey's objectives. The sample was selected among members of the Hellenic Diabetes Association participating in a two-day diabetes conference for diabetes. The participants were stratified according to their specialty, and three categories were created: a) Endocrinologists; b) Internists; and c) Internal medicine registrars. The randomized stratified sampling technique of these three categories was used to select the final study population. Of the 225 who were initially contacted, a total of 196 questionnaires were completed (n=196).

The questionnaire contained 24 questions and consisted of 4 thematic domains: a) demographics; b) knowledge of the relationship between DM and periodontitis; c) knowledge of the relationship between DM and xerostomia; and d) knowledge of the relationship between DM and caries. The responses were grouped using the 5-grade Likert scale.

The questionnaire was pilot tested, before finalizing, by three internists and two Endocrinologists, and their observations on the structure, clarity, and understanding of the questions were considered in the final formulation of the questionnaire. The final form of the questionnaire is presented in Annex 1.

The data were analyzed with the SPSS statistical version 22 (IBM Statistics, Chicago, IL, USA). Bivariate analysis, Fisher test, and Spearman correlation analysis were used for statistical analysis. A p-value below 0.05 was considered statistically significant.

Results

The rate of response rate of the questionnaires by category of specialty is shown in Table 1. Response rates for the return of the questionnaires were 86%, 84%, and 88% for endocrinologists, internists, and registrants, respectively. These percentages did not differ among the three specialties.

The distribution of participants in the study based on gender, age, and years of professional experience in treating DM by specialty category is presented in Table 2.

TABLE 1
Response rates of questionnaires by specialty

	Endocrinologist	Internists	Registrants
Response rate	38/44 (86%)	130/154 (84%)	28/33 (88%)

TABLE 2
The distribution of doctors based on gender, age and years of experience

	Endocrinologist		Internists		Registrants	
Sex	N	**%**	N	**%**	N	**%**
Female	16	42%	60	46%	16	57%
Male	22	58%	70	54%	12	43%
Age	N	**%**	N	**%**	N	**%**
≤40	8	21%	20	15%	38	100%
41-50	10	26%	30	23%	0	0%
51-60	8	21%	66	52%	0	0%
≥60	12	32%	14	10%	0	0%
Years of experience	N	**%**	N	**%**	N	**%**
≤10	11	27%	12	24%	38	100%
11-20	10	26%	34	26%	0	0%
21-30	16	42%	80	47 %	0	0%
≥30	1	5%	4	3 %	0	0%

The results of the opinion and views of doctors about the relationship of DM with periodontal disease, xerostomia, and caries are shown in Table 3. Most doctors were aware of the bi-directional relationship between periodontal disease and DM. In detail, 88.8% of the study sample agreed that the evidence connecting periodontal disease with systematic health is strong, and 73.5% stated that DM and periodontal disease are associated. Also, 76.5% agreed that patients with DM are at increased risk of developing severe periodontal disease. Furthermore, 78.5% answered that periodontal disease affects glycemic control, while 70.5% believed that periodontitis treatment improves glycemic control. Additionally, 78.6% of doctors agreed that poor glycemic control is associated with periodontal disease. However, a significant proportion of 42% were unaware of the relevant literature and studies relating DM to periodontal disease, while 68.45% of doctors confirmed that they need more information and knowledge about periodontal disease and its effects on DM. Finally, most doctors (91.5%) stated that they need more information and education about periodontal disease and its association with DM.

As far as the relationship between DM and dry mouth is concerned, there was a division of doctors' views; 49% were unaware of the strong evidence between DM and xerostomia and half did not know the relevant studies. In addition, 56.1% of doctors did not know whether patients with diabetes mellitus are at increased risk of dry mouth. Also, 66.1% of doctors revealed that they need more information about dry mouth and its effects on diabetes.

Regarding the views of registrant doctors dealing with diabetes and its relationship to dental caries, the results showed that 65.3% agreed that caries are related to systematic health. Interestingly, 54.6% did not know whether the relationship between caries and diabetes is strong, and 62.2% were unaware of the relevant studies. Moreover, 53% of

TABLE 3

Summary of doctors' views on the relationship among DM and periodontal disease, xerostomia, and caries

	Strongly agree		Agree		I don't Know		Disagree		Strongly disagree	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*
The research evidence is strong in the relationship between periodontal disease and general health	54	27.6%	120	61.2%	20	10.2%	2	1%		
The research evidence is strong in the relationship between periodontal disease and diabetes	28	14.3%	116	59.2%	48	24.5%	4	2%		
The doctor is aware of the studies linking periodontal disease with diabetes	6	3.1%	108	55.1%	74	37.8%	6	3.1%	2	1%
Patients with diabetes are at increased risk for severe periodontal disease	34	17.3%	116	59.2%	42	21.4%	4	2%		
In the case of a periodontal disease patient, he/ she is more likely to have poor glycemic control than a patient with healthy gums	32	16.3%	122	62.2%	34	17.3%	8	4.1%		
Treatment of periodontal disease can improve glycemic control	32	16.3%	106	54.1%	46	23.5%	10	5.1%	2	1%
Patients with poor glycemic control are more likely to have periodontal disease	40	20.4%	114	58.2%	36	18.4%	6	3.1%		
Doctors should be taught about periodontal disease	50	25.5%	130	66.3%	14	7.1%	2	1%		
More information about diabetes and its effects on periodontal disease is needed	40	20.4%	94	48%	44	22.4%	18	9.2%		
The research evidence is strong in the relationship between xerostomia and diabetes	18	9.2%	82	41.8%	86	43.9%	6	3.1%	4	2%
The doctor is aware of the studies linking xerostomia with diabetes	24	12.2%	74	37.8%	94	48%	4	2%		
Patients with diabetes are at increased risk for xerostomia	12	6.1%	74	37.8%	104	53.1%	4	2%	2	1%
The research evidence is strong in the relationship between xerostomia and general health	24	12.2%	94	48%	70	35.7%	8	4.1%		
More information about diabetes and its effects on xerostomia is needed	22	11.2%	108	55.1%	48	25%	15	9.2%		
The research evidence is strong concerning the relationship between caries and diabetes	18	9.2%	72	36.7%	100	51%	6	3.1%		
The doctor is aware of the studies linking the caries with diabetes	6	3.1%	68	34.7%	108	55.1%	12	6.1%	2	1%
Patients with diabetes are at increased risk for caries	14	7.1%	90	45.9%	74	37.8%	16	8.2%	2	1%
The research evidence is strong in the relationship between caries and general health	28	14.3%	76	38.8%	70	35.7%	22	11.2%		
More information about diabetes and its effects on caries is needed	56	28.6%	98	50%	42	21.4%				
Doctors must cooperate with dentists to reduce the risk of developing periodontal disease, caries, and xerostomia of their patients	56	28.6%	100	51%	40	20.4%				

doctors answered that patients with diabetes are at increased risk of developing caries. As with periodontal disease and xerostomia, many doctors (78.6%) revealed the need for more information and knowledge about caries and their effect on diabetes and vice versa. Finally, 78.6% of the study sample agreed that doctors should cooperate with dentists to reduce the risk of developing periodontal disease, caries, and dry mouth in their patients.

Statistical analysis showed differences in doctors' views among the specialties in some questions. For example, in the question of whether patients with DM are at increased risk of developing severe periodontal disease, there were differences in the responses of endocrinologists and internists; endocrinologists confirmed the relationship in a more significant percentage than internists (p=0.011). The same pattern of answers appeared in the questions: if patients with poor glycemic control are more likely to have periodontal disease (p=0.015); if they are informed about studies associating dry mouth to diabetes (p=0.009); if more information is needed on dry mouth and its effects on diabetes (p=0.041); if the evidence from the research is strong concerning the relationship among dry mouth and general health and diabetes (p=0.025); if they are informed about studies associating caries to diabetes (p=0.002); if patients with diabetes are at increased risk of caries (p=0.03); if more information is needed on caries and its effects on diabetes (p=0.028) and finally if medical doctors have to cooperate with dentists to reduce the risk of developing periodontal disease, caries and xerostomia of their patients (p=0.024). On the other hand, the internists agreed with a higher percentage than endocrinologists (p=0.001) that the research's current evidence concerning the relationship between xerostomia and diabetes is vital.

Correlation analysis shower showed that gender did not affect the way doctors respond. On the other hand, the age and years of work experience were positively correlated with the type of doctors' answers (p=0.008 and p=0.000).

Discussion

The response rate of doctors in the questionnaires ranged from 72-78%. This percentage is higher than in other studies with a similar methodology performed on doctors in the United States [9,11]. Overall, a high response rate means slight bias. Generally, a higher than 70% response rate ensures representative results [11]. The high participation of doctors in completing the questionnaire may be attributed to an increased personal interest in the aim of the study.

The active members of the Hellenic Diabetes Society were selected to participate in the study population. The Hellenic Diabetes Association is one of the most significant scientific companies dealing with diabetes mellitus in Greece. Its members are internists and endocrinologists with clinical expertise in the treatment of diabetes and/or work in Diabetes clinics as well as doctors who have been proven to be involved in the treatment of DM. Also, this scientific society was chosen for practical reasons; the sample could be more easily assembled, and more homogeneous, and the randomization could be quickly applied.

The analysis of the questionnaires showed that the doctors' knowledge and opinions about the relationship between DM and periodontal disease are solid and many of them agreed that there is a two-way relationship between these two pathological conditions. Indeed, the

answers concerning the relationship between DM-periodontal disease in comparison to those related to the relationship between DM-xerostomia and DM-caries showed variation. A large percentage of doctors, between 47-49%, were unaware of the relationship between DM-xerostomia and DM-caries. In contrast, most doctors were aware of the relationship between DM and periodontal disease, which can be explained by the increasing body of published evidence on the topic. In the PubMed database, there are 1,118 studies relevant to the topic. Of these, 471 studies have been published in medical journals in the field of DM that is more easily accessible to doctors involved in diabetes treatment.

Additionally, several medical books referral to diabetes contain references linking DM to periodontal disease. Periodontitis is often referred to as the sixth complication of DM [4]. Additionally, several national scientific conferences, workshops, lectures, or round tables about DM effects on oral health are focused on the relationship of DM with periodontal disease. In contrast, only rarely the relationship of DM to other dental manifestations such as xerostomia and caries is included in the conferences' agenda.

Also, the interest and research on the possible bi-directional relationship between DM and periodontal disease enhanced when DM was associated with heart disease, microbial and immune response, and metabolic dysregulation [12]. On the other hand, published data on xerostomia and caries are significantly fewer in number (547 studies). Moreover, an even smaller number has been published in medical journals (172 studies) and the rest in dental journals.

However, a large percentage of doctors surveyed, ranging from 50-66%, were unaware of the relevant studies associating the DM with periodontal disease, xerostomia, and dental caries. This means that a percentage of doctors agree that DM-periodontal disease has a strong correlation, but they do not know the relevant literature. Possibly, this knowledge derives from other sources such as lectures, opinions of other colleagues and experts, etc.

This study highlights the demand and the need for doctors dealing with diabetes to have more information and education about oral complications of DM, such as periodontal disease, xerostomia, and dental caries. Indeed, the World Dental Federation 2013, at the 101st annual conference, issued an official text titled "Oral and General Health with an invitation for collaborative work" referring to this necessity and interconnection [9]. Knowledge of the relationship between DM and oral manifestations, especially periodontal disease, xerostomia, and caries, is of fundamental importance in preventing odontostomatological complications and improving both glycemic control and the quality of patients' life.

Generally, medical students receive two or fewer oral health education hours during their school years [13]. It has been reported that many doctors often fail to examine the oral cavity, including teeth and supporting structures [10]. This is vital when doctors examine a patient with diabetes as the mouth and teeth condition is often indicative of abnormal glycemic status and thus clinically crucial for the proper treatment of DM. However, only a few studies have documented the knowledge and attitudes of doctors about the relationship between DM and oral manifestations [10,13]. In fact, according to the recommendation of the Clinical Practice of

the American Diabetes Society (ADA), referral for dental examination is one of the components of proper assessment of diabetes [14]. So, in stark contrast to current recommendations, less than one-third of endocrinologists reported, according to previously published data, that they routinely advise patients with diabetes to visit a dentist [15]. Moreover, patients with diabetes mellitus anticipate health professionals to inform them about all possible complications of DM [16].

In our study, sex did not affect how doctors responded to the questionnaire, as opposed to the age and years of clinical practice. These findings are consistent with previous studies [10,13], showing that age and years of practice were positively and usually linearly correlated with the attitudes of health scientists. It seems that the critical thinking process is encouraged by incorporating the basic knowledge, experience, and clinical reasoning that supports the professional practice and is related to the years of practice [17].

Finally, an important finding from the above study is that a substantial percentage (about 80%) of doctors express the need to cooperate with dentists to reduce the risk of developing periodontal disease, caries, and xerostomia patients. This is not the first time it has been expressed since a study in the USA reported that doctors also agree that there should be cooperation between doctors and dentists for the joint education and treatment of people with diabetes [10]. Therefore, the time may be suitable for implementing strategies in medical and dental programs to increase inter-professional education and cooperation to prepare doctors and dentists for the best-integrated care of patients with diabetes.

Conclusion

The main findings of the study can be summarized as follows: Doctors' response rates in completing the questionnaires were very high and ranged from 86-88%. Most doctors knew the bi-directional relationship between periodontal disease and DM. Interestingly, a significant percentage of these doctors were unaware of the relevant literature and studies linking the DM to periodontal disease and agreed that more information and knowledge about periodontal disease and its impact on the DM is needed. Regarding the relationship between DM and dry mouth, half of the doctors did not know whether patients with diabetes mellitus have an increased risk of dry mouth and were not aware of the relevant studies from the literature. Nearly half percent of doctors agreed that patients with diabetes are at increased risk of developing caries. However, the proportion of doctors familiar with the relevant literature was even lower. There was a difference in the way doctors responded to specific questions, depending on the specificity. On the other hand, gender did not affect the way doctors' respond.

On the contrary, the age and years of expertise interfered with the type of doctors' answers. Age and years of practice are positively and usually linearly correlated with the attitudes of health scientists. Finally, a large percentage of experts considered that doctors should cooperate with dentists to reduce the risk of developing periodontal disease, caries, and dry mouth in their patients. Interprofessional collaboration between dentists and doctors dealing with diabetes is needed to provide integrated therapeutic and preventive care to patients with diabetes.

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