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Influenza vaccination in people with type 2 diabetes, coverage, predictors of uptake, and perceptions. Result of the MADIABETES cohort a 7 years follow up study

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ABSTRACT

Objectives: We aim to determine influenza vaccination uptake among people with diabetes included in the MADIABETES cohort study in order to identify predictors of uptake and to analyze reasons for adherence and non-adherence with vaccination.

Methods: Using data from the MADIABETES Study we conducted a retrospective case record form based study without controls. We included outpatients with type 2 diabetes mellitus. Information was obtained from computerized clinical records and by telephone survey.

Methods: The main dependent variables were influenza vaccination uptake in the year 2013 and the reason for receiving or refusing vaccination.

Results: Overall, 65.7% had received the influenza vaccine in 2013. The mean number of influenza vaccines received from 2007 to 2013 was 3.24 (SD1.15), although 19.23% had not received any influenza vaccine and 23.3% had been vaccinated against pneumococcus. The variables that increased the probability of being vaccinated were inclusion in the age-based recommendation ($\geqslant$60 years), having a chronic respiratory disease, previous pneumococcal vaccination, higher number of visits to the general practitioner, higher number of influenza vaccines, and longer time since diabetes diagnosis. A higher mean glycated haemoglobin value in 2013 was associated with a reduced probability of vaccination.

Results: Most patients (90%) agreed to be vaccinated following their physician's advice because of their age or their chronic conditions. The most common reason for refusal among men was the belief that they were not at risk (41.6% vs. 29.79% in women); the most common reason for refusal among women was fear of adverse reactions (32.53% vs. 20.23% in men).

Conclusions: The uptake of influenza vaccination among diabetic patients in the present study was below desirable levels. The main barrier to vaccination was lack of knowledge regarding the need for and risks and advantages of influenza vaccination. Healthcare professionals should educate and encourage influenza vaccination among people with diabetes.

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1. Introduction

During the last few decades, diabetes has become a major public health problem because of its increasing prevalence worldwide [1]. Recent data from a Spanish population-based study reported a prevalence of diabetes of 13.8% [2]. Type 2 diabetes mellitus (T2DM) is the most prevalent form of diabetes. The prevalence of T2DM has increased in parallel with cultural and societal changes to the extent that over 90% of diabetic adults in high-income countries have T2DM [1–3].

People with diabetes are more likely to die or be admitted to hospital as a result of influenza than healthy individuals [3,4].

Several observational studies of the effectiveness of the influenza vaccine in diabetes patients [5–8] found that vaccination reduced diabetes-related hospital admissions during epidemics and that influenza-related mortality decreased [5–10].

Annual influenza vaccination of people with T2DM is recommended by the World Health Organization, the Centers for Disease Control and Prevention, the European Union, and the main diabetes associations [3,11–13]. In Spain, the public health authorities recommend annual influenza vaccination for patients with T2DM, and the vaccine is free for vulnerable groups [14].

Despite the broad consensus on recommending influenza vaccination for people with T2DM, coverage varies across different geographical locations, and, in most cases, the percentage of those who receive the vaccine is below desirable levels [15–22]. In developed countries, coverage values are around 60–70%, with some studies showing decreasing proportions in recent years, mainly after the H1N1 influenza pandemic [15–22].

In Europe, very few countries reached the European Union Council recommendation set in 2009, which advises vaccination in 75% of at-risk populations [13].

In Spain, data from health records suggest that uptake is around 50%, rising to approximately 60% if health surveys are used [21,22].

The patient-related and health care–related factors associated with influenza vaccination in T2DM patients are very complex [17,20,22–27]. Predictors of uptake include sociodemographic characteristics, comorbid conditions, diabetes-related clinical variables, lifestyle, adherence to preventive practices, and use of health care services. Older age and comorbidity are the two factors most frequently associated with influenza vaccination. However, results are sometimes contradictory, thus necessitating further investigation in this population [17,20,22–27].

To our knowledge, no previous study has assessed perceptions of influenza vaccination among people with T2DM in Spain. The few studies conducted elsewhere show that the most common reasons for refusing the influenza vaccine are insufficient knowledge about the need for the vaccine, low perceived susceptibility to influenza, low perceived severity of infection, concerns about potential side effects, and doubts about the vaccine's effectiveness [23,24,26,27].

The objectives of the present study were as follows: (i) to assess the level of influenza vaccination among people with diabetes included in a primary care–based cohort (MADIABETES) in the year 2013; (ii) to identify predictors of vaccination uptake; and (iii) to analyze reasons for adherence and non-adherence to the recommendations.

2. Materials and methods

2.1. Study population and design

The Madrid Diabetes Study (MADIABETES Study) is a prospective cohort study of 3443 T2DM outpatients which has been described in detail elsewhere [28]. Briefly, patients were recruited from 56 primary care centers in the metropolitan area of Madrid (Spain). Data were collected by GPs at the baseline visit (2007) and annually during the follow-up period (2008–2013). These data were recorded using electronic case report forms. The last-observation-carried-forward method was used to impute missing values for patients with incomplete data during the follow-up period.

Using the MADIABETES Study database we conducted a retrospective case record form based study without controls.

The inclusion criteria were age $\geqslant$25 years and a confirmed diagnosis of T2DM. The exclusion criteria were T1DM and being homebound. Of the 3443 individuals followed-up until 2013, 553 died during 2007–2013, and information was missing for 602. The final sample comprised 2288 participants.

2.2. Information sources and study variables

Information was obtained from two sources, namely, computerized clinical records (CCR) and the results of a specific telephone survey conducted by trained interviewers from January to December 2013.

We used the latest available data in the computerized clinical record system and always for the year 2013. The variables collected from the CCR system were as follows:

1. Influenza vaccination uptake in the year 2013, influenza vaccination uptake during the previous six years, and pneumococcal vaccination at any time from 2007 to 2013.
2. Sociodemographic characteristics including age, gender, marital status (married vs. not) and educational level (primary education or below vs. secondary or over). Age was categorized into groups according to the age that the influenza vaccine recommendation becomes universal in Madrid ($\geqslant$60 years).
3. Duration of diabetes and diabetes-related complications including history of heart disease (myocardial infarction, angina, and congestive heart failure), cerebrovascular disease (stroke, transitory ischemic attack), nephropathy, neuropathy, retinopathy, amputations, peripheral vascular disease, and diabetic foot. The variable "any diabetes complications" included patients with none versus those with one or more complications.
4. History of other comorbid conditions such as obesity, high blood pressure, chronic respiratory diseases (asthma and COPD), depression, and cancer.
5. Pharmacological treatment prescribed, including insulin therapy, current blood pressure medications and lipid-lowering medications.
6. Clinical monitoring indicators including glycated haemoglobin (HbA1c), systolic blood pressure, diastolic blood pressure, total cholesterol, and body mass index. If these parameters were measured more than once in the year 2013, the mean was calculated and analyzed.
7. Number of visits to the GP in the year 2013.
8. A variable named "Indication for influenza vaccination other than T2DM" has been created and analyzed. This variable included those patients that suffer one or more of the following chronic conditions: heart diseases, cerebro-vascular disease, nephropathy, cancer and chronic respiratory disease.

The telephone survey included questions regarding influenza vaccination, lifestyle, mental health, and quality of life.

All patients were asked if they had been vaccinated against influenza in the latest campaign. The reasons for receiving the vaccination were as follows: (i) recommended by a physician because of age; (ii) recommended by a physician because of chronic conditions; (iii) vaccination in the workplace; (iv) own request; (v) other; and (vi) do not know.

The reason for not being vaccinated was requested with the following options: (i) not recommended by a health care worker (HCW) or health authorities; (ii) patient does not consider him/herself at risk; (iii) patient believes the vaccine is not effective; (iv) fear of adverse reactions; (v) belief that the vaccine can transmit the influenza virus; (vi) belief that influenza is a benign illness; (vii) access difficulties (lack of time, distance to the health centre); (viii) other; (ix) do not know. Only one option could be marked in both cases.

Lifestyle data included physical exercise (none, little, regular/high), usual alcohol consumption (none vs. any), and tobacco use (never smoker, ex-smoker, and current smoker).

Health status was measured using the SF-36 questionnaire, which yields two summary scores, namely, the Physical Component Summary (PCS) and the Mental Component Summary (MCS).

2.3. Statistical analysis

Descriptive data were expressed as mean and standard deviation. Normally distributed continuous variables were compared using the *t* test. Non-normally distributed variables were compared using the Mann-Whitney test. Categorical variables were compared using the chi-square test.

Multivariate logistic regression models were constructed to identify variables that were independently associated with vaccine uptake among patients with T2DM. We report adjusted odds ratios (ORs) with their respective 95% confidence intervals (95% CI). Variables that were statistically significant in the bivariate analysis and those shown to be predictors in previous studies were included in the multivariate analysis. Given the multiple testing the results of the multivariate regression should be interpreted for significance using the Bonferroni correction.

All calculations were performed using SPSS v.21.0 for Windows and STATA v11.1SE. Significance was set at $p < 0.05$ (two-tailed).

2.4. Ethical aspects

The study was approved by the Institutional Review Board of the Ramón y Cajal Hospital (Madrid) and conducted in accordance with the principles of the Declaration of Helsinki. All patients gave their written informed consent to participate in the study.

3. Results

Of the initial 3443 patients (January 2007), a total of 2890 were alive before the start of the survey (January 2013) and 2288 agreed to the interview (participation rate, 79.2%).

The computerized clinical records showed that nearly two-thirds of patients with T2DM (1504/2288, 65.7%) had received the influenza vaccine in the year 2013. Mean age was 70.3 years (SD 10.4) and 52% were men. Women were significantly (*T* student test = 7.76; $p < 0.001$) older than men (71.65 vs. 69.04 years).

The mean number of influenza vaccines received per individual in the period 2007–2013 was 3.24 (SD 1.15), and 23.3% had been vaccinated against pneumococcus. The proportion of diabetic patients who had not received any influenza vaccine over the seven-year follow-up period was 19.23%.

Table 1 shows the distribution of influenza vaccination in the year 2013 according to sociodemographic characteristics, lifestyle, comorbid conditions, previous vaccination, visits to the GP, and quality of life.

Patients who received the influenza vaccine tended to be older and married, with a lower educational level and more healthy behaviors (never smoked and not habitual consumers of alcohol). They also seemed to have more comorbid conditions (high blood pressure and chronic respiratory diseases) and reported a worse quality of life. Patients with T2DM who had received the pneumococcal vaccine and a higher number of influenza vaccines during previous years were vaccinated in a significantly higher proportion. Vaccinated patients had visited their GP during the previous year a mean of 2.5 times more than unvaccinated patients.

Table 2 shows the distribution of influenza vaccination according to complications of T2DM, pharmacological treatments, duration of diabetes, and clinical monitoring indicators. Vaccination coverage was higher among diabetic patients who had any chronic diabetic complication and, specifically, among those who had heart disease, neuropathy, retinopathy, amputations, or peripheral vascular disease. The mean time since diagnosis of diabetes was higher in vaccinated patients. Conversely, mean glycated haemoglobin, mean diastolic blood pressure, and mean total cholesterol were lower in vaccinated patients. As can be seen in Table 2 those with an indication for influenza vaccination other than T2DM were vaccinated in a higher proportion than those without it (68.79% vs. 62.41%; p value < 0.001).

The covariates independently associated with receiving the influenza vaccination in the final multivariate model are shown in Table 3. The variables that increased the probability of being vaccinated were inclusion in the age-based recommendation, that is, $\geqslant$60 years (OR, 2.50; 95%CI, 1.82–3.44), having a chronic respiratory disease (OR, 1.52; 95%CI, 1.02–2.30, p value = 0.011, alpha p value with Bonferroni correction = 0.007), previous pneumococcal vaccination (OR, 2.54; 95%CI, 1.83–3.55), higher number of visits to the GP in 2013 (OR, 1.05; 95%CI, 1.01–1.09), higher number of influenza vaccinations (OR, 1.29; 95%CI, 1.10–1.57), and longer time since diagnosis of diabetes (OR, 1.03; 95%CI, 1.01–1.06). Finally, a higher mean value of glycated haemoglobin in 2013 was associated with a reduced probability of vaccination that year (OR, 0.83; 95%CI, 0.75–0.93).

Table 4 shows the reasons for receiving or not receiving the influenza vaccination according to gender.

Most patients (both genders) received the vaccination following the advice of their primary care physician because of their age or because of their chronic conditions. Both reasons accounted for around 91% of vaccinations in men and over 95% in women. Patients requested the vaccination on their own account far less frequently (3.03% in men and 1.29% in women).

The reasons for refusal differed by gender ($p < 0.01$). In men, the most common reason was not considering oneself at risk (41.6% and 29.79% in women); in women, the most common reason was fear of adverse reactions (32.53% vs. 20.23% in men).

Other reasons that show insufficient knowledge about the vaccine were much less frequent and include belief that the vaccine is not effective (8.71%), belief that the vaccine can transmit influenza (2.18%), and belief that influenza is a benign illness (2.95%).

4. Discussion

The main result of our investigation is that one-third of T2DM patients included in the study population were not vaccinated against influenza in 2013. Furthermore, one-fifth of patients had not been vaccinated during the previous seven campaigns.

In Europe, the highest reported vaccination coverage was in the Netherlands, where an observational longitudinal study based on electronic medical records found that influenza vaccination coverage in persons with diabetes decreased significantly from 85.1% in the 2008 season to 74.7% in the 2013 season [15]. Other European countries such as France, the United Kingdom, and Ireland have coverages of around 60–70% in the diabetic population [16–18]. Similar rates have been reported in the US and Canada [19,20]. In a prospective cohort study performed in Alberta, Canada between

Table 1
Distribution and influenza vaccination in 2013 according to socio-demographic characteristics, lifestyles, comorbid conditions, previous vaccination, GP visits and quality of life.

		Influenza vaccine in 2013			
	N = 2288	No N (%)	Yes N (%)	Coverage%	p-value
Gender	Men	432(55.1)	758(50.4)	63.7	0.033
	Women	352(44.9)	746(49.6)	67.94	
Age groups	25–49 Years	46(5.87)	28(1.86)	37.84	<0.001
	50–59 Years	160(20.41)	145(9.64)	47.54	
	60–69 Years	253(32.27)	374(24.87)	59.65	
	70–79 Years	202(25.77)	611(40.63)	75.15	
	80 years and over	123(15.69)	346(23.01)	73.77	
Age recommendation (⩾60 years)	No	227(28.95)	193(12.83)	45.95	<0.001
	Yes	557(71.05)	1311(87.17)	70.18	
Marital status	Married	538(68.6)	1036(68.9)	65.8	0.006
	Other	246(31.4)	468(31.1)	65.3	
Educational level	Primary or less	471(60.38)	1016(68.23)	68.33	<0.001
	Secondary or over	309(39.62)	473(31.77)	60.49	
Physical exercise	None	100(12.94)	156(10.45)	60.94	0.025
	Little	598(77.36)	1226(82.12)	67.21	
	Regular/high	75(9.70)	111(7.47)	59.68	
Alcohol consumption	No	484(61.73)	999(66.42)	67.36	0.026
	Yes	300(38.27)	505(33.58)	62.73	
Tobacco use	Never smoker	299(38.14)	678(45.08)	69.4	<0.001
	Ex-smoker	356(45.41)	666(44.28)	65.17	
	Current smoker	129(16.45)	160(10.64)	55.36	
High blood pressure	No	204(26.02)	264(17.55)	56.41	<0.001
	Yes	580(73.98)	1240(82.45)	68.13	
Depression	No	700(89.29)	1354(90.03)	65.92	0.579
	Yes	84(10.71)	150(9.97)	64.1	
Cancer	No	677(87.02)	1272(84.57)	65.26	0.117
	Yes	101(12.98)	232(15.43)	69.67	
Chronic respiratory disease	No	716(91.33)	1291(85.84)	64.32	<0.001
	Yes	68(8.67)	213(14.16)	75.8	
Obesity	No	400(51.02)	758(50.4)	65.46	0.778
	Yes	384(48.98)	746(49.6)	66.02	
Previous pneumococcal vaccination	No	672(85.71)	1084(72.07)	61.73	<0.001
	Yes	112(14.29)	420(27.93)	78.95	
Number of influenza vaccines. Mean [SD][a]		1.31[1.81]	4.3[1.98]	NA	<0.001
Number of visits to the GP in 2013 Mean [SD]		10.89[6.94]	13.36[8.5]	NA	<0.001
SF-36 physical component summary Mean [SD]		41.23[11.22]	38.63[11.65]	NA	<0.001
SF-36 mental component summary. Mean [SD]		51.35[9.69]	52.13[8.95]	NA	0.071

NA. Not applicable.
[a] Number of influenza vaccines per person from 2007 to 2013.

2011 and 2013 (2040 adults with T2DM), 63% of patients reported having been vaccinated in the previous year [15]. According to the 2011 Behavioral Risk Factor Surveillance System survey in the US, the influenza vaccination coverage rate was 60.2% among persons with diabetes aged ⩾18 years and 66.3% in those aged ⩾65 years [25].

In 2011 in Spain, the estimated coverage among people with diabetes aged 15 or over was 57.1% when estimated using the 2011 Spanish National Health Survey and 51.4% when estimated using primary care electronic clinical records [21]. According to previous Spanish National Health Surveys, which have reported values of around 60% for all surveys conducted since the year 2003, vaccination uptake had not markedly improved [22].

In our study, the frequency of influenza vaccination increased sharply with age from only 37.8% in those aged 25–49 years to 75.2% in those aged 70–79 years. The positive association between vaccine coverage and age is almost constant in the diabetic population [17,21–27].

The results of the multivariate model showed that if we use 60 years as the cut point, persons aged ⩾60 years were 2.5 times more likely to be vaccinated than those under this age. In our opinion, such a large increase is a consequence of the fact that age-based strategies are more effective for increasing uptake than high-risk strategies [29,30].

Chronic respiratory conditions were a positive predictor of vaccine uptake among diabetic adults in the study, even if the p value was not significant if the Bonferroni correction is used. In Canada, respiratory disease was associated with a 1.39-fold (95%CI 1.07–1.81) greater coverage in patients with T2DM [20]. Previous investigations have found that patients that suffer a higher number of influenza vaccine indications have significantly higher vaccination coverage than those with only one condition. Possible explanations for this are that they visit more frequently the GP and therefore have a greater chance to be vaccinated, that patients with more chronic conditions make the GP, specialists and nurses be more aggressive recommending the vaccine or that patients with more chronic conditions are themselves more conscious of the necessity to be vaccinated [18–22].

As expected, previous pneumococcal vaccination was highly predictive of uptake (OR 2.54; 95%CI 1.83–3.55): in Madrid, vaccination is universally recommended for people aged ⩾60 years and people with T2DM regardless of their age [31]. Achtymichuk et al. [20] found that history of pneumococcal vaccination increased influenza vaccine uptake almost 12-fold (aOR 11.67, 95%CI 9.13–14.9).

Our results are consistent with those of studies suggesting that previous influenza vaccination was a predictor of subsequent vaccination [26,24]. It has been argued that once individuals have adopted a particular preventive health behavior, they are likely to adhere to that behavior over time [26,32,33].

The two clinical characteristics that were positively related to vaccination uptake in our study were longer duration of diabetes and lower mean glycated haemoglobin. Both variables have been reported in persons with T2DM [17,18,27].

Table 2
Distribution and influenza vaccination in 2013 according to diabetes complications, pharmacological treatments, duration of diabetes, and clinical monitoring indicators.

		Influenza vaccine in 2013			
	N = 2288	No N (%)	Yes N (%)	Coverage%	p-value
Heart diseases	No	595(75.89)	1081(71.88)	64.49	0.039
	Yes	189(24.11)	423(28.13)	69.11	
Cerebro-vascular disease	No	708(90.31)	1348(89.63)	65.56	0.610
	Yes	76(9.69)	156(10.37)	67.24	
Nephropathy	No	633(80.74)	1203(79.99)	65.52	0.668
	Yes	151(19.26)	301(20.01)	66.59	
Neuropathy	No	722(92.09)	1312(87.23)	64.5	<0.001
	Yes	62(7.91)	192(12.77)	75.59	
Retinopathy	No	678(86.48)	1241(82.51)	64.67	0.014
	Yes	106(13.52)	263(17.49)	71.27	
Amputations or peripheral vascular disease	No	725(92.47)	1314(87.37)	64.44	<0.001
	Yes	59(7.53)	190(12.63)	76.30	
Diabetic foot	No	678(86.48)	1268(84.31)	65.16	0.167
	Yes	106(13.52)	236(15.69)	69.01	
Any diabetes complications	No	391(49.87)	632(42.02)	61.78	<0.001
	Yes	393(50.13)	872(57.98)	68.93	
Indication for influenza vaccination other than T2DM	No	412(52.55)	684(45.48)	62.41	<0.001
	Yes	372(31.21)	820(68.79)	68.79	
Insulin therapy	No	413 (90.77)	842 (89.38)	67.09	0.422
	Yes	42 (9.23)	100 (10.62)	70.42	
Current blood pressure medications	No	278(61.1)	533(56.58)	65.72	0.109
	Yes	177(38.9)	409(43.42)	69.8	
Current cholesterol-lowering medication	No	316(69.45)	720(76.43)	69.5	0.005
	Yes	139(30.55)	222(23.57)	61.5	
Duration of diabetes in years. Mean [SD]		14.84[9.48]	16.95[10.32]	NA	<0.001
Glycated haemoglobin in 2013 Mean [SD]		7.16[1.35]	6.95[1.05]	NA	0.003
Systolic blood pressure in 2013. Mean [SD]		130.8[13.04]	131.4[11.21]	NA	0.256
Diastolic blood pressure in 2013. Mean [SD]		74.7[7.45]	73.3[7.19]	NA	<0.001
Total cholesterol in 2013. Mean [SD]		177.1[37.37]	170.9[32.22]	NA	<0.001
Body mass index in 2013. Mean [SD]		30.1[5.68]	29.8[5.17]	NA	0.263

NA. Not applicable.

Table 3
Logistic regression multivariable model showing covariates independently associated with receiving influenza vaccination in year 2013.

		Odds ratio	Confidence interval 95%	p-value
Age recommendation (⩾60 years)	No	1	–	
	Yes	2.50	1.82–3.44	<0.001[a]
Chronic respiratory disease	No	1	–	
	Yes	1.52	1.02–2.30	0.011
Previous pneumococcal vaccination	No	1	–	
	Yes	2.54	1.83–3.55	0.004[a]
Number of visits to the GP in 2013	Continuous	1.05	1.01–1.09	0.003[a]
Number of influenza vaccines	Continuous	1.29	1.10–1.57	<0.001[a]
Duration of diabetes in years	Continuous	1.03	1.01–1.06	0.005[a]
Mean glycated haemoglobin in 2013	Continuous	0.83	0.75–0.93	<0.001[a]

[a] Significant using Alpha Bonferroni correction (0.05/7 = 0.007).

Our results agree with those reported by other authors, who show the marked effect that visiting one's physician and the advice of HCWs have on adherence to recommendations for vaccination [17,18,20,21,23–28,33,34]. In our study, each visit to family physicians in 2013 increased the probability of uptake by 5%. Furthermore, when asked the reason for being vaccinated, over 90% of vaccinated persons replied that their physician had recommended it to them due to their age or chronic conditions.

Vaccination is more likely in patients who use the healthcare system more frequently. Lewis-Parmar and McCann [24] found that if vaccination is recommended by HCWs, the probability that a person with diabetes is vaccinated increases 14-fold, and that this was the only source of information that led to an increase in uptake [24].

The most common reasons given for not being vaccinated in the present study were not perceiving themselves at risk for influenza and concerns about adverse effects of the vaccine. These answers suggest insufficient knowledge of the need for and safety of influenza vaccine and are in line with results from both the general population and people with T2DM [23,26,27,34]. HCWs should take all available opportunities in their interactions with patients to provide objective information about the risks of influenza and the benefits of influenza vaccination and address all concerns that patients have.

Several factors associated with HCWs and the organization of healthcare services may also explain why too many diabetic patients are not vaccinated against influenza [24,27,32,35]. First, during daily routine diabetes care, the participating physicians may not be sufficiently concerned about preventive measures in patients with poor health outcomes owing to time constraints. Second, since physicians are mostly concerned with the treatment of presenting symptoms, they may forget to recommend preventive measures such as vaccinations in their busy daily practice. Third, physicians rarely track their patients' vaccinations, thus potentially

Table 4
Reasons for receiving and not receiving influenza vaccine in the last campaign according to gender.

		Gender					
		Male		Female		Total	
		n	%	n	%	n	%
Reason for receiving the vaccination p-value = 0.049	Recommended by a physician because of my age	373	49.21	352	50.29	725	49.73
	Recommended by a physician because of my chronic conditions	323	42.61	318	45.43	641	43.96
	Vaccination in the work place	18	2.37	5	0.71	23	1.58
	Own request	23	3.03	9	1.29	32	2.19
	Other or don't know	21	2.77	16	2.29	37	2.54
Reason for not being vaccinated p-value = 0.001	Not Recommended by a HCWs or health authorities	8	2.28	13	4.45	21	3.27
	Not consider myself at risk	146	41.60	87	29.79	233	36.24
	The vaccine is not effective.	36	10.26	20	6.85	56	8.71
	Fear of adverse reactions	71	20.23	95	32.53	166	25.82
	The vaccine can transmit the flu.	11	3.13	3	1.03	14	2.18
	Flu is a benign illness.	11	3.13	8	2.74	19	2.95
	Access difficulties (lack o time. distance to the health center).	22	6.27	14	4.79	36	5.60
	Others	42	11.97	47	16.10	89	13.84
	Don't know	4	1.14	5	1.71	9	1.40

P value comparing male vs. female.

resulting in low vaccination frequencies in the long term. Fourth, organizational systems that could help to increase vaccine uptake are not implemented.

Effective strategies for increasing influenza vaccination coverage in high-risk groups include the following: 1. Mass media publicity to promote vaccination. 2. Information for HCWs and persons with diabetes and their families about the risks of influenza and prevention strategies. 3. Expanding access to health care settings. 4. Use of computerized reminders at the GP's office. 5. Financial incentives for physicians [24,32,34,36–38].

Expanding access to healthcare settings implies that access to care must be acceptable to the patient, meaning services that are respectful of the patients' culture and values and promote patient understanding and involvement in treatment decisions [36–38]. Access must include the availability of care in the patient's community, with convenient hours to accommodate working families including offering more out-of-hours appointments, waiting times that do not discourage patients from seeking care, and appropriate accommodations for vulnerable populations, such as home-based services [36–38]. In home based programs, home visitors assess patients' vaccination status, discuss the importance of recommended vaccinations, and either provide vaccinations to patients in their homes or refer them to available immunization services [38].

Systematic reviews and meta-analysis suggest that clinician financial incentives are effective to improve influenza vaccination coverages [39,40]. In the UK the success of the pay for performance program has been demonstrated by high influenza vaccination coverages among the elderly population and high risk groups for suffering concomitant chronic conditions [41,42]. Norbury et al., using the general-practice population database in 15 general practices in Scotland analyzed the effectiveness of financial incentives to GPs for influenza immunisation from the 2003/4 to the 2006/7 seasons. Among people with diabetes the vaccination coverage raised significantly from 59.7–67.3% for those aged under 65 years and the coverage remained unchanged and over 86% for those aged 65 years and more [42].

However possible barriers to implementation of such programs would be ethical concerns about whether incentives constitute coercion and doubts if pay-for-performance systems can contribute to reduce health inequalities [43,44].

The Society of General Internal Medicine Ethics Committee advocate four major strategies to warranty high quality health care and ethical performance-based physician compensation. These are 1. Current pay-for-performance systems should rapidly adopt safeguards to protect vulnerable populations. 2. Key stakeholders should develop consensus regarding their responsibilities in improving health care quality. 3. Researchers and policy makers should develop valid and comprehensive quality measures for use in the next generation of compensation systems that reward genuine quality. 4. Researchers and policy makers should use a cautious evaluative approach to long-term development of compensation systems that reward quality [44].

Our study is subject to a series of limitations. First, the external validity of these results is limited because the study population may not be representative of the real population of patients with diabetes. Second, some of our information was self-reported and may therefore be prone to recall or social desirability biases. Third, accurate determination of the reasons for refusing vaccination is complicated, because the reasons can vary over time for the same person. Fourth, variables not collected during the study included the GP's beliefs about risk of influenza and effectiveness of vaccination, which may play a role in uptake and therefore prevent us from ruling out the possibility of residual confounding. Fifth, the telephone survey was conducted in year 2013 and no other survey has been done afterwards so we decided not to analyze vaccination coverages for years 2014 and 2015. Finally, as the participation rate for the survey was 79.2%, a potential selection bias must be taken into consideration.

In conclusion, the uptake of influenza vaccination among patients with T2DM in our population is below desirable levels. Older patients and those who follow preventive practices control their disease better and pay more visits to their GP are vaccinated more frequently. The main barrier to vaccination is the lack of knowledge regarding the need for and risks and the advantages of influenza vaccination. HCWs should make every effort to educate patients and encourage influenza vaccination among people with T2DM.

Author contributions

RJG. Researched data, contributed to the discussion, wrote the manuscript, and reviewed/edited the manuscript.

ALA. Contributed to the discussion and reviewed/edited the manuscript.

VHB. Researched data and reviewed/edited the manuscript

PGC. Contributed to the discussion and reviewed/edited the manuscript.

FJSAR. Contributed to the discussion and reviewed/edited the manuscript.

CBL. Contributed to the discussion and reviewed/edited the manuscript.

JCV. Contributed to the discussion and reviewed/edited the manuscript.

JCAH. Contributed to the discussion and reviewed/edited the manuscript.

MASF. Researched data, contributed to the discussion, wrote the manuscript, and reviewed/edited the manuscript.

All authors reviewed and gave their final approval of the version to be submitted.

Conflict of interest

The authors have no conflicts of interest to declare.

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