Original Article

Acceptance Rate of Influenza Vaccination Among Patients with Type II Diabetes

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ABSTRACT

Background: It is well known that patients with diabetes are at increased risk of influenza infection and its serious complications. Our aim was to evaluate the attitude towards and prevalence of influenza vaccination among Saudi patients with diabetes. **Methodology:** Descriptive questionnaire-based cross-sectional survey of a sample of patients with diabetes attending a specialist diabetic centre in the Ministry of Health Hospital in Taif city in Saudi Arabia. We utilized a generalized logistic regression model analysis to evaluate the effect of background factors on influenza vaccine uptake. **Results:** The study included (n = 336) patients with diabetes. The prevalence of uptake of influenza vaccine was 43.5% (CI: 38.2% to 48.8%). Adjusted analysis of background effects revealed that uptake of influenza vaccine was improved with age, university education, and belief in the dangerousness of flu infection in patients with diabetes. Factors that deterred from the uptake of flu vaccines were longer in DM duration, getting health messages about flu vaccines, belief in vaccine effectiveness, health practitioner information, in addition to physician recommendation of the vaccine. **Conclusion:** The content of health messages about flu vaccine and the quality of practitioner-patient interaction requires considerable improvement and re-evaluation if the flu vaccine uptake rates among Saudi individuals with diabetes were to increase. Comprehensive therapeutic packages for patients with diabetes should include high quality education about influenza vaccine. Research into preventative measures among patients with diabetes should evaluate the effect of educational interventions using robust methodology.

Keywords: Diabetes mellitus, influenza, Saudi Arabia, Taif, vaccination.

Introduction

The prevalence of type-2 diabetes mellitus (T2DM) is rising all over the world and represents an important public health problem worldwide because of its health and economic burden.[1] T2DM affects about 46% of men and 44% of females aged over 50 years in the Kingdom of Saudi Arabia.[2] Influenza is an infectious respiratory illness that is caused by influenza viruses. These viruses can spread easily by direct contact with infected individuals, contact with contaminated objects, and by inhalation of virus-laden aerosols.[3] It can cause mild to very severe illness, characterized by a sudden onset of fever, headache, cough (usually dry), musculoskeletal and joint pain, severe malaise, sore throat and a runny nose. A cough can be severe and can last at least two weeks. Most people recover from these symptoms within a week without requiring medical attention. However, in high-risk people, it can cause severe illness or even death.[4] T2DM patients are considered a higher risk group to develop influenza infection, and this increases the risk of hospitalization.[5]

Seasonal influenza vaccination is a suitable tool to reduce the risk of hospitalization and death from complications of influenza in patients with T2DM patients.[6] According to the American Diabetic Association (ADA), annual influenza vaccination for all individuals with diabetes is recommended, because it

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is effective, safe, and reduces influenza-related complications, hospitalizations, and deaths in these patients.[7]

Despite the evidence of the effectiveness of the seasonal influenza vaccine, its coverage in general is still low, particularly for the vulnerable groups of patients including patients with diabetes in many parts of the world.[8] Numerous reasons have been identified in various studies for accepting seasonal influenza vaccination include the elderly, good knowledge on influenza and its vaccine, and presence of chronic disease, whereas reasons for refusing the vaccine included fear of vaccine's side effects and loss of confidence in the vaccine's efficacy.[6,7,9]

In Saudi Arabia, the Ministry of Health (MOH) recommends that international pilgrims be vaccinated against seasonal influenza with the most recently available vaccines before arrival. Particularly, those at increased risk of severe influenza disease including individuals with preexisting health conditions including DM.[10]

The primary aim of the current study was to explore the coverage status of seasonal influenza vaccination and its determinants among type 2 patients with diabetes in Taif, Saudi Arabia. The study also aimed to estimate the prevalence of seasonal influenza vaccination among patients with type II diabetes attending diabetes centre, MOH in Taif.

We also attempted to assess the factors associated with the uptake of influenza vaccination among patients with type II diabetes attending the diabetes center, MOH in Taif. Finally, we strove to identify the reasons of accepting and those of refusing of uptake of seasonal influenza vaccine among type II patients with diabetes attending the diabetes center, MOH in Taif.

Methodology

Study design: This study was a cross-sectional questionnaire-based descriptive study. The study included a systematic random sample of patients with diabetes attending Endocrinology Specialist Centre in Taif, Saudi Arabia. A standard questionnaire included seasonal influenza vaccination status and attitudes in addition to various socio-demographic factors.

Setting: The study included a systematic random sample of type II diabetes adult patients attending a Taif-based specialist endocrinology centre. Ethical approval was granted from the Ministry of Health Research and Ethics Committee.

Data analysis: Data was analysed using the R-Statistical Software version 3.4.1. Categorical data (such as educational level, sex, and income category) were summarised using frequencies and displayed using tables and bar graphs. Numerical continuous data, such as age in years and HbA1c levels, were summarized using means and standard deviations and displayed using box-and-whisker plots. The adjusted effect of categorical variables on the outcome variable (uptake of influenza vaccine) was determined using multiple logistic generalized linear regression modelling. The level of significance was set at $P < 0.05$.

Results

The study occurred between January 2019 and December 2019 on a systematic random sample from patients with diabetes in Taif, Saudi Arabia. The total number of subjects approached to participate in the study was (n = 336) patients with diabetes. All agreed to take part in the study (response rate = 100%). For a detailed account of demographic and clinical results, see Tables 1-3 below.

The uptake of seasonal influenza vaccine was reported by (n = 146, 43.5%) of the participating patients with diabetes. The confidence interval CI is: 38.2% to 48.8%. Women in our study were (n = 195, 58%) in contrast to men who were (n = 141, 42%).

To explore the effect of background factors (namely, demographic, clinical, and vaccine-related) on the probability of taking the vaccine, we modelled the data using multiple linear logistic regression.

Adjusted analysis of background effects revealed that age (estimate = 0.03271, P = 0.004767), University education (estimate = 0.94313) and illiterates (estimate = 0.85265, P = 0.035178) and preparatory education (estimate = 1.14790, P = 0.006288) were all impactful on increasing the flu vaccine uptake. See Table 4.

Adjusted analysis of background clinical effects revealed that longer DM duration (estimate = -0.089751, P = 0.0409805) and getting a health message about flu vaccine (estimate = -2.2044, P = 0.0003) were all negatively impactful on the flu vaccine uptake. See Table 5.

Adjusted analysis of background, attitudinal and knowledge factors' effects revealed that belief in the dangerousness of flu infection in patients with diabetes led to increased uptake in flu vaccine (estimate = 0.95866, P = 0.0339), as did ignorance about the correct frequency of flu vaccination (estimate = 1.90727, P = 0.000442). Factors that deterred from flu vaccine uptake was belief in vaccine effectiveness (estimate = -0.90115, P = 0.039093), health practitioner information (estimate = -1.3287, P = 0.002299), and planning vaccination (estimate = -1.19521, P = 0.00121), in addition to physician recommendation of the vaccine (estimate = -1.258, P = 0.009611). See Table 6.

We focused the analysis to examine the interaction effects between age of patients with diabetes and their duration of living with diabetes. This is to explore if the positive effect of age on the likelihood of getting the flu vaccine shot was an artefact of longer contact with services due to prolonged diabetes care. Clearly, the age effect disappeared (estimate = 0.017,

Table 1: Baseline Demographics of the Study Participants

Factor	Count (*n*)/mean	Percentage/SD	Mean Vaccination Status	*P*
Gender				
Males	141	42%	66 (46.8% got the vaccine)	0.3453
Females	195	58%	88 (41% got the vaccine)	
Age	58.1 years	12.83 years	61.5 (in the vaccinated) 55.5 (in the non-vaccinated)	2.321×10^{-5}
Marital Status				
Divorced	23	6.8%	8 (29.6% were vaccinated)	0.1847
Married	250	74.4%	105 (42% were vaccinated)	
Unmarried	18	5.4%	7 (38.9% were vaccinated)	
Widow	45	13.4%	26 (57.8% were vaccinated)	
Nationality				
Saudi	323	95.3%	141 (43.7% were vaccinated)	0.9323
Non-Saudi	13	3.8%	5 (38.5% were vaccinated)	
Education				
Illiterate	75	22.3%	16 (28.1% were vaccinated)	0.01785
Elementary	57	17%	41 (54.7% were vaccinated)	
Preparatory	55	16.4%	29 (52.7% were vaccinated)	
Secondary	54	16.1%	54 (38.9% were vaccinated)	
University	95	28.3%	39 (41.1% were vaccinated)	
Employment				
Employed	114	33.9%	40 (35.1% got vaccinated)	0.02813
Housewife	143	42.6%	63 (44.1% were vaccinated)	
Retired	79	23.5%	43 (54.4% were vaccinated)	
Income				
Not enough	45	13.4%	24 (53.3% were vaccinated)	0.3084
Enough	254	75.6%	108 (42.5% were vaccinated)	
Exceeds needs	37	11.0%	14 (37.8% were vaccinated)	

$P = 0.299$), and the negative effect of diabetes duration was more pronounced (estimate = -0.211, $P = 0.028$). The interaction effect was statistically significant (0.003, $P = 0.029$). See Table 7.

Discussion

Diabetes is a serious debilitating metabolic disorder that is listed by the Advisory Committee on Immunization Practices among the high-risk disorders requiring annual flu vaccination due to its susceptibility to higher rates of complications, morbidity, and mortality[11] and to the proven effectiveness of vaccination of patients with diabetes in prevention of such complications.[12] The findings from our current Saudi-based investigation show that the uptake of seasonal influenza vaccine was self-reported by 43.5% of the Saudi patients with diabetes. This is certainly far below the expectation of the 61% coverage reported in 2017[13] but mirrors the 47% Saudi-based prevalence of flu vaccine uptake reported in a recent past survey.[14] However, it is consistent with the low uptake of influenza vaccines worldwide. For instance, only 47% of over fifty American men reported receiving the influenza vaccine.[15] Although considerable variation exists among different ethnicities and age groups, particularly among minority communities.[16,17] Even among healthcare workers practicing in European countries, prevalence range for flu vaccination lies between 12% in Italy to 29% in Germany and France.[18] Flu vaccine uptake among Irish patients with diabetes was estimated as nearly 65%.[19] Among healthcare staff practicing in Saudi Arabia, the prevalence of flu vaccination was considerably higher, at a 55.9% figure.[20] This could likely be due to the requirement of vaccination in the annual recontacting process in several Saudi Arabian healthcare facilities.

Our results indicate that the uptake of the influenza vaccine was substantially more in older patients with diabetes. This correlates with findings from international studies, as flu vaccine recipients were noted to be substantially older than non-recipients.[21] This could be explained partially by the fact that older age is generally associated with higher rates of medical comorbidities and increased attendance at different health facilities, which would mean a higher likelihood to be advised to get a flu vaccine shot. This is reassuring as the flu vaccine is particularly effective in geriatric subjects in preventing influenza infection and its associated complications and mortality.[22]

In addition to older age, university and preparatory education improved the likelihood of vaccination among our participants compared to secondary education. We also noted that illiteracy was far better in terms of getting the flu shot than secondary education. This conundrum illustrates the complexity of trust in flu immunization, an issue that arises in the international literature quite frequently.[23] One clear and consistent finding is that better education correlates with better knowledge about influenza vaccine.[24]

Rates of reported hospitalization were quite high among our participants, exceeding 75%. This reflects the reliance in Saudi Arabia on hospital-based medical services due to

Table 2: Clinical Characteristics of Participants

Factor	Count (*n*)/mean	Percentage/SD	Mean Vaccination Status	*P*
Duration of DM	10.1 years	8.0 years	11.2 (in the vaccinated) 9.3 (in the non-vaccinated)	0.05584
HbA1c	8,0%	2.1%	8.1% (in the vaccinated) 7.8% (in the non-vaccinated)	0.4081
Glucose Check at work				
Yes	223	66.4%	94 (42.2% got vaccinated)	0.5763
No	113	33.6%	52 (46% got vaccinated)	
Kidney Disease	65	19.3%	33 (50.3% were vaccinated)	0.2357
Visual Impairment	Yes=169	50.3%	86 (50.1% got the vaccine)	0.007912
	No=167	49.7%	60 (35.9% were vaccinated)	
PVD	47	14%	23 (48.9% were vaccinated)	0.5098
Diabetic Foot	19	5.7%	10 (52.6% were vaccinated)	0.5533
Hypertension	Yes=170	50.6%	86 (50.6% got vaccinated)	Chi=6.5552
	No=166	49.4%	60 (36.1% got vaccinated)	0.01046
Bronchial Asthma	54	16.1%	23 (42.6% were vaccinated)	0.999
IHD	37	11%	22 (59.5% were vaccinated)	0.05659
Family History	216	64.3%	95 (44% were vaccinated)	0.346
DM Treatment	Oral=140	41.7%	60 (42.9% were vaccinated)	0.9454
	Insulin=59	17.6%	25 (42.4% got vaccinated)	
	Both=137	40.8%	61 (44.5% reported vaccination)	
Commitment to treatment				
Weak	39	11.6%	26 (66.7% were vaccinated)	0.005803
Good	196	58.3%	76 (38.8% got vaccinated)	
Average	101	30.1%	44 (43.6% got vaccinated)	
Commitment to OPD visit				
Weak	48	14.3%	28 (58.3% got vaccinated)	0.03688
Good	176	52.4%	67 (38.1% got vaccinated)	
Average	112	33.3%	51 (45.5% were vaccinated)	
Commitment to diet				
Weak	100	29.8%	60 (60% got vaccinated)	3.172×10^{-5}
Good	108	32.1%	31 (28.7% got vaccinated)	
Average	128	38.1%	55 (43% were vaccinated)	
Commitment to sports				
diet	190	56.5%	88 (46.3% got vaccinated)	0.430
Weak	41	12.2%	15 (36.6% got vaccinated)	
Good	105	31.3%	43 (41% were vaccinated)	
Average				
Hospitalization	266	79.2%	115 (43.2% got vaccinated)	*P*=0.9284
Smoking status				
Smoker	47	14%	22 (46.8% got the vaccine)	0.7435
Ex-smoker	34	10.1%	13 (38.2% were vaccinated)	
Non-smoker	255	75.9%	111 (43.5% got vaccinated)	
Health Education				
Yes	259	77.1%	96 (37.1% were vaccinated)	4.471×10^{-5}
No	74	22%	49 (66.2% got vaccinated)	
Don't know	3	0.9%	1 (33.3% got the vaccine)	
Flu vaccine message				
Yes	203	60.4%	58 (28.6% were vaccinated)	8.837×10^{-11}
No	128	38.1%	85 (66.4% got vaccinated)	
Don't know	5	1.5%	3 (60% got the vaccine)	

underdeveloped family medicine practices,[25] and to some extent the increased rates of complications among Saudi patients with type two diabetes.[26] Uptake of influenza vaccine among our participants did not differ substantially between those patients with diabetes who were hospitalized and those who were not. This contradicts results from international surveys. A recent retrospective investigation of over half a million patients with diabetes' records showed clearly that flu vaccination reduced the rates of hospitalization for major medical emergencies, such as cerebrovascular accidents and heart failure.[21] Furthermore, flu vaccination was associated with a reduction in all-cause mortality.[27] Recently, influenza vaccination was found to protect against the risk of cognitive decline and dementia.[28]

We found, in our sample, that general health messages and longer DM duration substantially improved vaccine uptake.

Table 3: Flu Vaccine Knowledge and Attitudes Factors

Factor	Count (*n*)/mean	Percentage/SD	Mean Vaccination Status	*P*
DM increases vulnerability to flu				
Yes	174	51.8%	51 (29.3% got the vaccine)	3.987×10^{-7}
No	51	15.2%	29 (56.9% got the vaccine)	
Don't know	111	33.0%	66 (59.5% were vaccinated)	
Flu vaccine efficacy				
Yes	169	50.3%	41 (24.3% took the vaccine)	8.301×10^{-12}
No	34	10.1%	22 (64.7% got the vaccine)	
Don't know	133	39.6%	83 (62.4% were vaccinated)	
Flu vaccine complications				
Yes	134	39.9%	29 (21.6% were vaccinated)	4.263×10^{-10}
No	57	17%	33 (57.9% were vaccinated)	
Don't know	145	43.2%	84 (57.9% were vaccinated)	
Flu vaccine dangerousness				
Yes	153	45.5%	40 (26.1% vaccinated)	1.344×10^{-8}
No	53	15.8%	35 (66% vaccinated)	
Don't know	130	38.7%	71 (54.6% vaccinated)	
Flu vaccine timing				
6-monthly	35	10.4%	7 (20% got vaccinated)	$<2.2\times10^{-16}$
yearly	148	44%	33 (22.3% vaccinated)	
Don't know	135	40.2%	93 (68.9% vaccinated)	
Once in a lifetime	18	5.4%	13 (72.2% vaccinated)	
Flu vaccine intending				
Yes	251	74.7%	79 (31.5% were vaccinated)	7.152×10^{-14}
No	85	25.3%	67 (78.8% vaccinated)	

Table 4: Estimates for the Effects of Background Demographic Factors on Flu Vaccination

Factor	Estimate	SE	*t*	*P*
Age	0.03271	0.01159	2.8223	0.004767**
Gender: Male	0.14908	0.38006	0.3923	0.694873
Marital: Married	0.11805	0.49037	0.2407	0.809754
Marital: Unmarried	0.14767	0.68877	0.2144	0.830241
Marital: widow	0.65192	0.57173	1.1403	0.254178
Nationality: Saudi	-0.13981	0.64985	-0.2151	0.829656
Education: illiterate	0.85265	0.40481	2.1063	0.035178 *
Education: Preparatory	1.14790	0.42011	2.7324	0.006288 **
Education: Secondary	0.76679	0.43677	1.7556	0.079157 .
Education: University	0.94313	0.42879	2.1995	0.027843 *
Occupation: Housewife	0.23377	0.43711	0.5348	0.592790
Occupation: Retired	0.46577	0.34303	1.3578	0.174531
Income: Exceedingly Enough	-0.25099	0.40181	-0.6246	0.532207
Income: Not enough	0.39978	0.35246	1.1342	0.256690

*significant at 0.05 level, **significant at 0.01 level

Living longer with diabetes and older age, together with frequent primary care use were shown to collectively increase the probability of flu vaccination among patients with diabetes.[19] However, we noted a substantial interaction between age and duration. As DM duration increases, the positive effect of age on flu vaccine uptake was more pronounced. This further enforces the theoretical framework of higher propensity for older patients with diabetes to take the vaccine as a result of increased contact among geriatric patients with health services rather than a dependent effect on older age per se. Notably, in younger patients living longer with diabetes reduced the likelihood of taking the flu shot. This is clearly difficult to rationalize. Further research should focus on younger patients with diabetes to explore their attitudes towards health services and vaccination.

We found the currently employed were the least likely to be vaccinated, compared to the retired patients. This consistent with the theory that patients with stable employment are likely to be financially better and more educated and knowledgeable about the vaccine than their unemployed counterparts. Such factors are substantially associated with higher uptake of vaccination, as shown by a series of past surveys.[29]

Our results also indicate that the visually impaired are more likely to get their flu vaccination. To our knowledge, we are the first to examine the effects of diabetic-induced retinal impairment on flu vaccine uptake. Past research confirmed that compliance with the annual retinal checks was associated with higher uptake of influenza shots.[30] Having comorbid hypertension was associated with higher influenza vaccine uptake in half of the patients, however, being normotensive meant only a third would get vaccinated. Medical comorbidities were shown to improve vaccination rates in general.[31] Patients living with hypertension were keener to get the flu shot than the general public.[32] Moreover, hypertensive patients were more susceptible to educational and organizational interventions that promote flu vaccination.[33] Better accessibility to diabetic services were shown to improve adherence to preventive and therapeutic measurements in patients with type two diabetes.[34] Clearly, adhering to annual influenza vaccination among patients with diabetes was effective in reducing mortality in the long run.[35]

We found, from the unadjusted analysis, that a weak commitment to dietary and pharmacological treatment of diabetes and

Table 5: Estimates for the Effects of Background Clinical Factors on Flu Vaccination

Factor	Estimate	SE	*t*	*P*
HbA1c	0.0349407	0.1395639	0.2504	0.8023120
DM Duration	-0.0897540	0.0439168	-2.0437	0.0409805*
Sugar Check at work	-0.2570196	0.6411084	-0.4009	0.6884947
Kidney disease	0.1216961	0.8338793	0.1459	0.8839690
Vision problems	0.1126849	0.5996413	0.1879	0.8509390
PVD	-1.1509260	0.9376479	-1.2275	0.2196495
Diabetic Foot	1.0097953	1.0399688	0.9710	0.3315551
BP	-0.2808119	0.6425402	-0.4370	0.6620867
asthma	-1.3153747	0.7488820	-1.7565	0.0790114
IHD	0.9219385	0.7621666	1.2096	0.2264215
FH	1.7209624	1.0650377	1.6159	0.1061224
Treatment: Insulin	0.0357436	0.8138171	0.0439	0.9649674
Treatment: Oral tablets	-0.0067214	0.6085636	-0.0110	0.9911878
Treatment commitment	-0.0666332	0.7684742	-0.0867	0.9309033
OPD commitment	0.4940806	0.8627382	0.5727	0.5668553
Diet Commitment	0.3738130	0.7195100	0.5195	0.6033854
Sports Diet commitment	-0.4180073	0.9201929	-0.4543	0.6496413
Admission	-0.4972654	0.6942998	-0.7162	0.4738608
Smoking	-0.7558894	0.9287574	-0.8139	0.4157184
Any Health Education	-0.5065951	1.7551708	-0.2886	0.7728645
Flu Health Message	-2.2044208	0.6209478	-3.5501	0.0003851*

*significant at 0.05 level

Table 6: Estimates for the Effects of Background Attitude and Knowledge Factors on Flu Vaccination

Factor	Estimate	SE	*t*	*P*
Diabetic vulnerability	-0.33528	0.38877	-0.8624	0.388462
Vaccine effectiveness	-0.90115	0.43677	-2.0632	0.039093*
complication seriousness	-0.44713	0.45661	-0.9792	0.327458
dangerousness in diabetes	0.95866	0.45192	2.1213	0.033896*
Frequency: Every year	0.31038	0.52941	0.5863	0.557686
Frequency: I do not know	1.90727	0.54282	3.5137	0.000442***
Frequency: Once in life	2.15917	0.78467	2.7517	0.005929**
Info: Health practitioner	-1.32872	0.43585	-3.0486	0.002299**
Info: Social media	-0.20060	0.43491	-0.4613	0.644618
Info: Relatives & friends	-0.72155	0.42906	-1.6817	0.092627
Info: Various media	-0.45834	0.51112	-0.8967	0.369862
Planning vaccination	-1.19521	0.36930	-3.2365	0.001210**
Doctor didn't recommend	17.35687	1770.71966	0.0098	0.99218
Vaccine ineffectiveness	0.41443	0.65975	0.6282	0.52989
Fear of Side Effects	-0.15382	0.60758	-0.2532	0.80014
Fear of Needle	-0.10350	0.90571	-0.1143	0.90902
Infection By Needle	0.39340	1.16422	0.3379	0.73543
Difficulty getting it	16.81228	3445.11932	0.0049	0.99611
Belief vaccine importance	-0.49119	0.48797	-1.0066	0.314131
Physician recommendation	-1.25834	0.48594	-2.5895	0.009611**
Other's recommendation	-0.10471	0.56379	-0.1857	0.852657
Health awareness	-0.24210	0.55086	-0.4395	0.660298

*significant at 0.05 level, **significant at 0.01 level, ***significant at 0.001 level

OPD visits was associated more with vaccination uptake than average commitment and good commitment. This is difficult to explain, as one would expect that patients with diabetes reporting increased adherence to their management plan to be more proactive in getting the vaccine shot against seasonal flu.

We also found that those who got health education about diabetes were far less in terms of uptake of vaccination than those who did not get diabetic health education. This clearly points towards the inconclusiveness of diabetic education of the importance of flu vaccination. In terms of preventive health behaviour among patients with diabetes, education effective.[36] Additionally, vaccine education was shown to improve rates of uptake of flu vaccine among high-risk patient groups that include patients with diabetes.[31] Globally, rates of education about the importance of flu vaccination remained low among patients with diabetes, as more than half of patients received no such educative intervention.[37] In Saudi Arabia, well-constructed message about the importance of flu vaccination was shown to improve rates of vaccine uptake.[13] Health messages about flu vaccination should be well-constructed and tailored to the level of understanding off laying patients with diabetes in Saudi Arabia.

We found that better knowledge about and attitude towards seasonal influenza vaccines are not necessarily associated with better uptake. Poor uptake was observed in those who reported a belief in the increased vulnerability for flu among patients with diabetes. Those who believed in the effectiveness of the vaccine constituted only a third of those who took the vaccine and did not believe in its effectiveness. The uptake was poor in those who were knowledgeable of serious flu-related complications, more so in patients with diabetes. Only one in five of those who knew the annual nature of the vaccine did actually take it. Only a third of those planning to get the flu shot next year took it this year.

Counterintuitively, we found a worrying association between getting health messages about flu vaccination and not taking it. Two thirds of whoever reported not getting the health message did take the flu vaccine compared to just over a quarter of those who got the message and went on to get the flu vaccine. Clearly, the current health message about flu vaccine is ineffective. Worse, the current health message about flu vaccine is a proven deterrent for the vaccine uptake! Current literature indicates that better education leads to better diabetes management outcomes.[38] The issue with our findings could be more with the content of education rather than the process of education itself. Many of the material could be out-of-date or even incorrect. All education material delivered to patients with diabetes in Saudi Arabia about flu vaccination requires specialist revision and re-evaluation.

We also demonstrated that getting information from health practitioners was quite harmful, compared to getting information from relatives and friends. This contradicts the established research that physicians are more influential in promoting flu vaccination.[39] However, emerging studies did not find an improvement in flu vaccine uptake among patients with diabetes with more increased number of visits to physicians.[40] This indicates that the efficiency of clinical services could be more related to the quality of physician-patient interaction, far more than the quantity of visits. This is supported by the higher rates of flu vaccine uptake among patients with comorbid medical conditions[41] as they visit their physicians

Table 7: Estimates for the Interaction Effects of Age and DM Duration on Flu Vaccination

Factor	Estimate	SE	*t*	*P*
Age	0.0169873	0.0163628	1.0382	0.29920
Duration	-0.2105566	0.0958083	-2.1977	0.02797*
Age × Duration	0.0031522	0.0014440	2.1830	0.02904*

*significant at 0.05 level

more frequently and likely to have better quality interventions. Certainly, future research in Saudi Arabia should examine the quality of practitioner-patient interaction as well as the frequency of consultations on rates of flu vaccine uptake among patients with diabetes.

Our findings demonstrate that the belief in the dangerousness of flu infection in patients with diabetes led to increased uptake in flu vaccines. In addition, underperformance in terms of knowledge about the correct frequency of flu vaccination was associated with increased uptake. Clearly, this is at odds with past findings that better knowledge and education help promote flu vaccination.[42] Again, perhaps the main message to be highlighted, the quality of health messaging could be the principal player in terms of effect on flu vaccination among the patients with diabetes' population. Health practitioners' information in our sample and the recommendation did not improve vaccine uptake. Belief in vaccine effectiveness did not improve its uptake also. Recent innovations in electronic health messaging were utilized in promoting flu vaccination for subjects with diabetes.[43] This could be an important avenue to explore in Saudi Arabia. Misinformation is a recognized factor in the vaccine under coverage.[44] The only way is to provide correct and reliable information to patients with diabetes on what existing technological advances can offer.

Needle phobia and fear of vaccine-related complications were not that impactful in flu vaccine uptake among our participants. These were found to be minor issues in recent investigations.[29,45]

The current study has numerous strengths. We evaluated a large sample of patients with diabetes in Saudi Arabia. We adopted robust modelling of the data to come up with reliable results. One limitation of the current survey is the reliance on self-report in the estimation of the prevalence of flu vaccine uptake. Future research should adopt extra-objectivity by examining preventive health records. Social desirability bias is unavoidable in this type of cross-sectional survey of attitudes.[46]

Further research should be of longitudinal design to explore the causative effects between background factors and uptake of flu vaccine. Furthermore, it could establish the causative effect between flu vaccine and reduction in mortality and morbidity among patients with diabetes. Furthermore, future research should examine details of medical disorder-specific rates of hospitalization and outcome in terms of mortality and morbidity. In addition, qualitative research into the desired health messaging techniques preferred by patients with diabetes would be quite helpful in improving the effectiveness of public health campaigns directed towards improving flu vaccination. Additionally, future research in Saudi Arabia should examine the quality of practitioner-patient interaction as well as the frequency of consultations on rates of flu vaccine uptake among patients with diabetes.

Conclusion

To sum up, the content of health messages about flu vaccine and the quality of practitioner-patient interaction requires considerable improvement and re-evaluation if the flu vaccine uptake rates among Saudi individuals with diabetes were to increase. Comprehensive therapeutic packages for patients with diabetes should include high quality education about influenza vaccine. Research into preventive measures among patients with diabetes should evaluate the effect of educational interventions using robust methodologies.

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Conflicts of interest

There are no conflicts of interest.

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