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Determinants of COVID-19 vaccine acceptance among adults with diabetes and in the general population in Israel: A cross-sectional study

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ABSTRACT

Aims: To explore and compare key determinants of COVID-19 vaccine acceptance and willingness to get vaccinated among people with diabetes and the general population.
Methods: A cross-sectional survey study of 807 Israeli adults with and without diabetes was conducted prior to the first vaccination campaign in Israel in December 2020. Data was analyzed by population group and gender. A multinomial logistic regression determined the association between acceptance factors and willingness to get vaccinated.
Results: Diabetes patients had more anxiety about COVID-19, higher levels of confidence in vaccine safety, and greater willingness to get vaccinated than the general population. In both groups, women reported higher levels of anxiety toward COVID-19 but lower levels of confidence in vaccine safety and less willingness to get vaccinated than men. Vaccine safety had the largest contribution to diabetes patients' willingness to get vaccinated. For participants without diabetes, the perception that more than 50% of Israelis would get vaccinated had the largest contribution. Participants in both groups who had vaccinated against seasonal influenza were more likely to get vaccinated against COVID-19.
Conclusion: Policies aimed at improving vaccine acceptance should target vulnerable populations, particularly female diabetes patients, whose concerns must be addressed to increase their vaccination rates.

1. Introduction

By January 1st, 2022, close to 60% of the global population had received at least one dose of a COVID-19 vaccination and 50% were fully vaccinated [1]. However, when the vaccine was first introduced in Israel in December 2020, healthcare professionals and scientists debated its safety and efficacy, and people were hesitant about vaccinating. COVID-19 vaccines are now considered the most promising measure to manage the pandemic and reduce its spread [2]. Preventing infection through vaccination is also considered the best practice for mitigating the risks associated with COVID-19, especially in people with chronic diseases, such as diabetes [3]. Recent studies have shown that people with diabetes are more at risk for severe complications, intensive care unit admissions, and death from COVID-19 than people without diabetes [3,4]. However, vaccine hesitancy remains a barrier to universal immunization in countries where the vaccination is available to the public. Considering the severe health, social, and economic consequences of the COVID-19 pandemic understanding the factors that contribute to vaccine hesitancy, particularly among people with chronic conditions such as diabetes, is essential to effective vaccination campaigns in the current pandemic as it evolves and in future similar events.

Vaccine acceptance and hesitancy are complex in nature and vary across time, place, and culture [5-8]. However, some common factors were identified across studies conducted in 2020 in anticipation of and in the early days of the COVID-19 vaccine approval and implementation. A number of studies found that concerns about vaccine safety, adverse effects, and effectiveness negatively impacted its acceptance [e.g., 6, 9]. Several studies reported that women were more concerned about vaccination than men [6,7,10-17]. Further, as Joshi et al. [6] and El-Elimat et al. [18] have shown, having been vaccinated against the seasonal influenza was identified as a positive factor in vaccine acceptance. Though people with diabetes reported COVID-19 related fears [19,20], and some studies found a positive association between chronic conditions and COVID-19 vaccine acceptance [11,12]; little was known about vaccine acceptance among people with diabetes in comparison to the general public in the early days of the vaccine.

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In this paper, we examine the factors that affected the willingness of people with and without diabetes to get vaccinated in Israel immediately prior to the launch of the nationwide vaccine campaign. We consider the differences between the groups as well as gender-based differences within and between groups.

2. Subjects, materials and Methods

2.1. Study setting

The population in Israel is now over 9 million [21] and more than 550,000 people have diabetes [22]. According to the Israeli Ministry of Health, by the end of 2021, close to 70% of the population had received at least one dose of the COVID-19 vaccine; yet in May 2022, only approximately 50% had received the third (booster) shot [23]. Issues unique to the Israeli context have contributed to vaccine hesitancy in the population: Israel has been at the forefront of vaccination campaigns against COVID-19 from the start. In December 2020, Israel was one of the first countries to launch a nation-wide public vaccination campaign, when no real-world data about vaccine safety and efficacy was available and Pfizer's vaccine underwent emergency use authorization. At the time, Israeli physicians warned that the country was serving as Pfizer's "guinea pig" for the rest of the world, and some citizens were wary of the vaccine's new mRNA technology. Furthermore, the government's initial purchase agreement with Pfizer lacked transparency. The relatively rapid rollout of COVID-19 vaccinations subsequently slowed [24]. Israel continues to lead the way in vaccination against COVID; and in January 2022, when the fourth shot was introduced for people over the age of 60 years and medical staff [25], it had yet to be approved by the FDA and its efficacy had yet to be established. Public response was not enthusiastic.

2.2. Study design and population

This cross-sectional survey study was conducted in Israel from December 15–20, 2020 immediately prior to the introduction of the COVID-19 vaccination to the general population. The study sample included adults from the general population and adults with diabetes (Type 1 and Type 2). We employed a stratified random sample to compare the two groups. The sample was selected from among the registered panelists of an internet panel company, iPanel (https://www.ipanel.co.il/), which includes more than 100,000 panelists representing diverse demographic sectors in Israel. The company randomly selected participants based on our parameters (i.e., Hebrew speaking Internet users in Israel, aged 18 years and older from each of the two groups) and the requested sample size. Based on a confidence level of 95%, the minimal sample size required was 385 participants. However, the internet panel company employed to disseminate the survey was able to recruit only 304 participants with diabetes among its registered panelists. A total of 807 participants completed the study survey, 503 without diabetes and 304 with diabetes. Participants were invited by the company both via email and SMS to complete the study survey. iPanel, which has provided a variety of internet-based information collection services since 2006, adheres to the rigorous standards of the European Society for Opinion and Marketing Research (ESOMAR) [26].

2.3. Data collection

Data was collected using an online survey. The survey was developed based on existing research on the factors that influence vaccine acceptance and included five multiple choice questions regarding participants' attitudes toward the virus and vaccination against it, whether they were vaccinated against seasonal influenza in 2020, and their willingness to get vaccinated against COVID-19. The questions were as follows,

1. "To what extent are you afraid of contracting COVID-19?" Responses were given on a 5-point Likert scale (1 = Not at all to 5 = Very much) and were analysed as "Low" (1–2), "Medium" (3) and "High" (4–5) levels of anxiety.

2. "How safe do you think the COVID-19 vaccine is for use in people with chronic illnesses?" Responses were given on a 5-point Likert scale (1 = Not safe at all to 5 = Very safe) and were analysed as Low (1–2), Medium (3) and High (4–5) safety levels.

3. "What do you think the percentage is of Israelis who would be willing to get vaccinated against COVID-19?" Four potential responses were given: 1 = <25%, 2 = 25%–50%, 3 = 51%–75%, and 4 = More than 75%". Responses were analysed as: "<50%" (1–2) and "More than 50%" (3–4) willingness to get vaccinated. Drawing on Bandura's social learning theory [27], this question is based on the hypothesis that people's behavior will be influenced by their perception of the anticipated behavior of others.

4. "Did you get a seasonal flu vaccination this year [2020]?" with a Yes/No response.

5. "Do you intend to get vaccinated against COVID-19?" Three potential responses were given: Yes, immediately; Maybe later; and No.

2.4. Data analysis

All data was analysed using descriptive statistics. Chi-square tests were conducted to examine differences between groups (participants with diabetes and without diabetes, male and female participants). Finally, multinomial logistic regression modelling was conducted to understand the effect of the impact factors (i.e., fear of the virus, perceived willingness to get vaccinated in Israel, perceived safety of the vaccine, and vaccination against seasonal influenza) on participants' willingness to get vaccinated against COVID-19.

We first analyzed the data using a joint model of the complete sample in relation to the dependent variable "willingness to get vaccinated." In this analysis, population group (people with diabetes and the general population) had no significant influence. (See Supplemental Material for the results of the joint model analysis) At the same time, when conducting comparisons within each of the groups, we found significant differences in relation to the independent variables. As such, we decided to analyze the data using two separate models, one model for the diabetes group and one model for the general group. A comparison of the results of the two models is purely descriptive.

In addition, we examined the multicollinearity between the independent variables, and no exceptional values were found. Multicollinearity was measured using propriate symmetric indicators according to variable type: Cramer's V for categorical variables and Spearman correlation coefficient for ordinal variables. All correlation coefficients were below 0.7, which is considered moderate [28]. As such, all variables were included the analysis. All statistical analyses were performed using IBM SPSS Software, version 25. We considered p-values of 0.05 or less to be significant.

3. Results

3.1. Participants' sociodemographic characteristics

A total of 807 participants participated in the study, 62.33% of whom were from the general population and 37.67% of whom had diabetes. Of all participants in the diabetes group, 61.2% were female and 51.5% in the general population group were female. Participants in the diabetes group were generally older than participants in the general group: 51.1% of participants without diabetes were under the age of 40 years, while 80.3% of the participants with diabetes were 40 years old or older. The percentage of retired or unemployed participants with diabetes was approximately double that of participants without diabetes (33.2% compared to 16.3%). More than half of the participants were from northern and central Israel. See Table 1 for more information on the sociodemographic characteristics of the sample.

Table 1
Participants' Sociodemographic Characteristics by Population Type (N = 807).

		General population (n = 503)	People with diabetes (n = 304)
Gender	Male	48.5%	38.8%
	Female	51.5%	61.2%
Age (years)	18–29	29.4%	8.2%
	30–39	21.7%	10.5%
	40–49	17.7%	20.1%
	50–59	20.7%	25.3%
	60+	10.5%	35.9%
Family income	Below national average	38.6%	43.3%
	About national average	21.9%	19.0%
	Above national average	39.4%	37.6%
Education	Secondary or less	30.2%	28.6%
	Tertiary (post-secondary)	20.1%	29.9%
	Higher education	49.7%	41.4%
Employment status	Part- or full-time job	64.1%	55.0%
	Self employed	6.6%	8.6%
	Retired or unemployed	16.3%	33.2%
	Student	8.2%	2.6%
	Other	4.8%	0.6%
Family status	Single	34.2%	16.4%
	Married/Lives with a partner	57.9%	64.8%
	Divorced/ Separated/ Widowed	7.9%	18.8%
Area of residence	Haifa and Northern Israel	25.6%	30.3%
	HaSharon Region	8.9%	10.9%
	Tel Aviv and Central Israel	32.4%	29.6%
	Greater Jerusalem Area	11.1%	8.2%
	Southern Israel	21.9%	21.1%
Personal acquaintance with someone infected with COVID-19	Yes	78.9%	71.1%
	No	21.1%	28.9%

3.2. Differences between participants with and without diabetes

Results of the analysis of the differences between groups in terms of the determinants of vaccine acceptance and their willingness to get vaccinated against COVID-19 are presented in Table 2.

3.2.1. Determinants of vaccine acceptance

We found significant differences between participants with and without diabetes in their anxiety levels, perceptions of vaccine safety, and seasonal influenza vaccination: 69.5% of participants with diabetes had high levels of anxiety about contracting COVID-19 compared to 56.2% of the general population ($p < 0.001$); 41.1% of participants with diabetes believed the vaccine against COVID-19 has a high level of safety for people with chronic diseases compared to 30% of participants from the general population ($p < 0.001$); and 66.8% among people with diabetes had been vaccinated against the seasonal influenza in 2020 compared to only 36.6% in the general public group ($p < 0.001$). However, we found no significant differences between the groups regarding perceived vaccination rates in Israel. More than half of the respondents in both groups (50.3% in general population group and 57.2% in the diabetes group) thought that 50% of Israelis would get vaccinated against COVID-19 ($p = 0.056$).

3.2.2. Willingness to get vaccinated against COVID-19

Willingness to get vaccinated against COVID-19 was higher among participants with diabetes compared to participants from the general population: 41.8% of people with diabetes were willing to get vaccinated immediately compared to 31.8% of people without diabetes. In addition, only 10.2% of people with diabetes did not intend to get vaccinated compared to 16.7% of the general public group ($p = 0.003$).

Table 2
Determinants of Vaccine Acceptance and Willingness to Get Vaccinated by Population Type.

Variable		General population (n = 503)	People with diabetes (n = 304)	χ^2	*p*
Anxiety about developing COVID-19	Low	20.0%	17.8%	17.4	
	Medium*	23.9%	12.7%		<0.001
	High*	56.2%	69.5%		
Perceived safety of COVID-19 vaccine for people w/chronic illnesses	Low*	35.8%	23.4%	16.3	<0.001
	Medium	34.2%	35.5%		
	High*	30.0%	41.1%		
Perceived rate of Israelis willing to get vaccinated against COVID-19	<50%	49.7%	42.8%	4.5	0.056
	More than 50%	50.3%	57.2%		
Vaccinated against seasonal flu in 2020	Yes*	36.6%	66.8%	69.2	<0.001
	No*	63.4%	33.2%		
Willingness to get vaccinated against COVID-19	Yes, immediately*	31.8%	41.8%	11.4	0.003
	Maybe later	51.5%	48.0%		
	No*	16.7%	10.2%		

* Difference between general population and people with diabetes (using Bonferroni's method).

3.3. Gender differences among participants with and without diabetes

We found significant gender differences in participants' attitudes toward COVID-19 and its vaccine in both groups (see Table 3).

3.3.1. Determinants of vaccine acceptance

3.3.1.1. Fear of contracting the COVID-19 virus. Female participants in both groups (64.5% without diabetes and 75.6% with diabetes) reported higher anxiety levels about developing COVID-19 than male participants (47.2% without diabetes and 59.8% with diabetes) (general population $p < 0.001$; people with diabetes $p = 0.009$).

3.3.1.2. Perceived safety of the COVID-19 vaccine. Despite higher levels of concern regarding infection, female participants in both groups had less confidence in the safety of the vaccine for people with chronic diseases compared to male participants in both groups, though women with diabetes were more confident in the vaccine's safety than their counterparts (general population $p < 0.001$; people with diabetes $p = 0.022$): 41.3% of the women without diabetes considered the vaccine's safety level low (22.4% high) and 26.3% of the women with diabetes (34.9% high) compared to 29.9% of men in the general group (38.1% high) and 18.6% in the diabetes group (50.8% high).

3.3.1.3. Anticipated vaccination rates in Israel. We found significant gender differences in both groups regarding the perceived rate of Israelis who would be willing to get vaccinated against COVID-19 (general population $p = 0.001$; people with diabetes $p < 0.001$): 43.6% of female participants from the general population and 47.3% of women with diabetes thought that more than half of Israelis would be willing to get

Table 3
Determinants of Vaccine Acceptance and Willingness to Get Vaccinated by Gender and Population Type.

Variable		General population		χ^2	p-value	People with diabetes		χ^2	p-value
		M (n = 244)	F (n = 259)			M (n = 118)	F (n = 186)		
Anxiety about developing COVID-19	Low[ab]	25.5%	14.7%	15.71	<0.001	25.9%	12.8%	9.50	0.009
	Medium	27.2%	20.7%			14.3%	11.7%		
	High[ab]	47.2%	64.5%			59.8%	75.6%		
Perceived safety of COVID-19 vaccine for people w/chronic illnesses	Low[a]	29.9%	41.3%	15.59	<0.001	18.6%	26.3%	7.64	0.022
	Medium	32.0%	36.3%			30.5%	38.7%		
	High[ab]	38.1%	22.4%			50.8%	34.9%		
Perceived rate of Israelis willing to get vaccinated against COVID-19	<50 %[ab]	42.6%	56.4%	9.50	0.001	27.1%	52.7%	19.29	<0.001
	More than 50 %[ab]	57.4%	43.6%			72.9%	47.3%		
Vaccinated against seasonal flu in 2020	Yes	36.5%	36.7%		0.518	67.8%	66.1%	0.09	0.431
	No	63.5%	63.3%	0.00		32.2%	33.9%		
Willingness to get vaccinated against COVID-19	Yes, immediately[ab]	39.3%	24.7%	13.29	0.01	50.8%	36.0%	8.17	0.017
	Maybe later[a]	44.3%	58.3%			43.2%	51.1%		
	No	16.4%	17.0%			5.9%	12.9%		

[b] Difference between genders among People with diabetes (using Bonferroni's method).
[a] Difference between genders among General population (using Bonferroni's method).

vaccinated. Male participants, however, particularly men with diabetes, had much higher expectations: 57.4% of men in the general population and 72.9% among men with diabetes thought that more than half of Israelis would be willing to get vaccinated.

3.3.1.4. Vaccination against seasonal influenza. We found no significant gender differences in seasonal influenza vaccinating in either group (general population $p = 0.518$; people with diabetes $p = 0.431$).

3.3.2. Willingness to get vaccinated against COVID-19

Differences between the genders in both populations were also found in participants' willingness to get vaccinated against COVID-19 (general population $p = 0.01$; people with diabetes $p = 0.017$). Among participants without diabetes, only 24.7% of the female respondents were willing to get vaccinated immediately and 36% among women with diabetes compared to 39.3% of the male respondents without diabetes and 50.8% of men with diabetes.

3.4. Impact of acceptance factors and willingness to get vaccinated

To examine the impact of each factor on the decision to get vaccinated against COVID-19, we performed a multinomial regression analysis. The findings from this modelling are presented in Table 4. Of the four key determinants considered, three factors significantly influenced the participants' decision to get vaccinated to varying degrees: The perception that more than 50% of Israelis would be willing to get vaccinated, the perceived safety of the vaccine for people with chronic illnesses, and seasonal influenza vaccination in 2020. Anxiety about contracting COVID-19 was not correlated with participants' willingness to get vaccinated.

The perception that more than 50% of Israelis would be willing to get vaccinated was the largest contributor of the three factors in the general population group (OR = 7.14, $p < 0.001$) and the least in the diabetes group (OR = 4.76, $p = 0.037$). This factor was also the largest contributor associated with hesitancy among the general population (OR = 3.45, $p < 0.001$). On the other hand, the perceived safety of the vaccine for people with chronic illnesses was the largest contributor of the three in the diabetes group (OR = 21.78, $p < 0.001$) and the least in the general group (OR = 4.84, $p < 0.001$). This factor was also the largest contributor factor associated hesitancy among people with diabetes (OR = 6.39, $p < 0.001$). Seasonal influenza vaccination in 2020 was the second largest contributor correlated with willingness to vaccine in both the general population group (OR = 5.60, $p < 0.001$) and the diabetes group (OR = 8.47, $p = 0.002$).

Table 4
Determinants of Vaccine Acceptance Associated With Willingness to Get Vaccinated Against COVID-19 by Population Type.

Willingness to get vaccinated[†]	Variables	General population (n = 503)			People with diabetes (n = 304)		
		OR	CI (95%)	p-value	OR	CI (95%)	p-value
Yes, I will get vaccinated immediately	Gender (Female = 1)	0.87	(0.43–1.77)	0.699	0.17	(0.04–0.82)	0.027
	Age	1.02	(0.99–1.04)	0.242	1.06	(1.02–1.12)	0.009
	Apprehension level of developing COVID-19	1.36	(1.03–1.80)	0.032	1.60	(0.98–2.59)	0.048
	Perceived safety of COVID-19 vaccine for people w/ background illnesses	4.84	(3.28–7.13)	<0.001	21.78	(9.18–51.69)	<0.001
	Perceived rate of Israelis willing to get vaccinated against COVID-19 ("More than 50%"=1)	7.14	(3.33–16.67)	<0.001	4.76	(1.10–20.00)	0.037
	Vaccinated against seasonal flu in 2020 (Yes = 1)	5.60	(2.38–13.18)	<0.001	8.47	(2.20–32.56)	0.002
I may get vaccinated later	Gender (Female = 1)	1.32	(0.73–2.42)	0.361	0.24	(0.06–1.02)	0.054
	Age	1.01	(0.99–1.04)	0.244	1.04	(1.00–1.09)	0.046
	Anxiety about developing COVID-19	1.53	(1.22–1.93)	<0.001	1.72	(1.12–2.64)	0.013
	Perceived safety of COVID-19 vaccine for people w/chronic illnesses	2.20	(1.59–3.05)	<0.001	6.39	(2.95–13.85)	<0.001
	Perceived rate of Israelis willing to get vaccinated against COVID-19 (More than 50%=1)	3.45	(1.75–6.67)	<0.001	3.03	(0.79–11.11)	0.107
	Vaccinated against seasonal flu in 2020 (Yes = 1)	2.68	(1.2–5.83)	0.013	2.61	(0.80–8.50)	0.111
Nagelkerke pseudo R^2		0.44			0.59		

[†] "No" is a reference category.

In addition, when considering all factors together, we found an association between gender and willingness to get vaccinated immediately (compared to not getting vaccinated) among people with diabetes (OR = 0.17; p = 0.027). Men with diabetes were 5.88 times more willing get vaccinated than women with diabetes. No find significant correlation was found in the general population group in this regard.

4. Discussion

Overall, we found significant differences between participants from the general population and participants with diabetes in their perceptions of COVID-19 and its vaccination and their willingness to get vaccinated. In terms of the determinants of vaccine acceptance, participants with diabetes were more concerned about contracting COVID-19 and perceived the safety of the vaccine to be higher for people with chronic illnesses than participants from the general population. More among the participants with diabetes had vaccinated against the seasonal influenza in 2020 than in the general population group. This corresponds with the emphasis the Israeli Ministry of Health places on the importance of vaccination against seasonal influenza for people with diabetes, though the guideline includes the general population aged 6 months and older [29]. In addition, this guideline is among the quality measures for the treatment of people with diabetes by which all HMOs in Israel are annually evaluated [30].

This emphasis may help to explain why participants with diabetes were more willing to get vaccinated against COVID-19 than participants from the general population. In contrast, a study of diabetes acceptance in Malaysia found that people with diabetes were more hesitant to get vaccinated than the general population [31]. Finally, no significant differences were found between the groups in their perception of likely vaccination rates among Israelis.

In addition, we found significant gender-based differences in both groups across all study variables. In both groups, women reported higher levels of anxiety toward COVID-19, but lower levels of confidence in vaccine safety, and less willingness to get vaccinated than men. These findings are consistent with several studies that found a negative association between women and the intention to vaccine against COVID-19 in the general population of different countries (including China, France, Switzerland, Australia, Pakistan, the United States, and a number of countries in the Middle East, among others) [6,7,10-17,32-34]. However, when we evaluated the effect of all acceptance factors on willingness to get vaccinated, we found a significant association between gender and vaccination willingness only among people with diabetes. Men with diabetes were close to six times more likely than women with diabetes to get vaccinated. Similarly, a study of patients with diabetes in Uganda found an association between gender and willingness to get vaccinated [35].

Furthermore, participants with diabetes' perceived safety of the vaccine for people with chronic illnesses was the most significant factor in their willingness to get vaccinated. This finding is consistent with studies conducted in Italy and India that found vaccine safety was one of the main concerns among people with diabetes associated with intention to get vaccinated [36,37]. In contrast, vaccine safety was the least significant factor in the general population group; for them, the perception that more than 50% of Israeli citizens would be willing to get vaccinated against COVID-19 was the most significant. Finally, participants in both groups who had vaccinated against seasonal influenza in 2020 were more likely to get vaccinated against COVID-19. This association is consistent with the findings of studies of both the general population [6,18,27,38] and of diabetes patients [36]. Conversely, studies conducted in the United States found no such association [39] and even a negative association between seasonal influenza vaccination and willingness to get vaccinated against COVID-19 among diabetes patients [40]. These inconsistencies may, as Malik et al. argue, be explained by the influence of sociodemographic factors [13].

Our study has a number of limitations related to the study sample: A smaller number of participants completed the survey in the diabetes group than in the general public group. In addition, participants in the diabetes group were overall older than participants from the general population, and there were more female participants in the diabetes group than in the non-diabetes group. These imbalances may have skewed the results, though measures were taken in the analysis to overcome them. Further, due to the internet-based method employed to distribute our survey, computer skills were required to participate in the study. As such our results cannot be generalized beyond people with computer skills.

Furthermore, social determinants of vaccination acceptance, such as ethnic/religious, socioeconomic, and educational backgrounds, were not considered in this study and may have impacted results. A recent study of the pandemic in Israel found differences in vaccination rates between the Jewish and Arab populations and between the general Jewish population and the ultra-Orthodox Jewish population: Vaccination rates were lower in areas with predominantly Arab and ultra-Orthodox Jewish populations compared to the general Jewish population; and socioeconomic status was associated with vaccination [41]. Further research is required to examine the impact of socioeconomic factors on vaccine acceptance and uptake among people with and without diabetes in Israel. Finally, there is a gap of more than 2 years between our study and its publication. Some of the issues that beleaguered the vaccination campaign at the beginning of the pandemic may no longer be relevant at this time; however, the study findings continue to be relevant as the pandemic evolves and may inform future similar events.

In a recent conference on health policy, the Head of Public Health at the Israel Health Ministry spoke of the challenges we currently face in addressing the pandemic, including public fatigue with government restrictions; lack of trust in the health system and the government; disinformation regarding vaccinations in the media; and, as the pandemic progresses, it has become more and more difficult to motivate people to get vaccinated. She advocates for a nation-wide campaign through diverse media platforms to explain the rationale for the vaccines and the regulations, based on monitoring and analysis of current data [43]. Results of this study can inform campaigns such as these in targeting vulnerable groups and addressing gender differences.

In conclusion, the results of this study demonstrate the differences between people with diabetes and the general population in their attitudes toward COVID-19 vaccination, particularly with respect to gender. These findings can inform future vaccination campaign efforts in the current pandemic and in other similar events. Policies directed at cultivating vaccine acceptance should include targeted campaigns for vulnerable groups, such as diabetes patients. In particular, campaigns must address female diabetes patients' concerns about vaccine safety.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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