Attitudes and intentions towards COVID-19 vaccines and associated factors among Egyptian adults

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A B S T R A C T

Background: Herd immunity through vaccination is the target of public health interventions against COVID-19, but vaccine refusal or hesitancy is one of the global threats that make achievement of community immunity very difficult. The aim of this study was to determine negative attitudes and intentions and their predictors towards COVID-19 vaccines.

Methods: This was cross sectional survey, that targeted 1011 Egyptians aged 18 years and above, from 24 governorates, during the period from 7 January 2021, to 30 March 2021. Using a convenient sampling technique, the data were collected through an online self-administered, structured questionnaire, which was composed of two main sections, that involved sociodemographic and health related factors, intentions, and attitudes towards COVID-19 vaccines.

Results: The mean age of participants was 29.35 ± 10.78 years, (16.6 %) of them had COVID-19. (54%) of respondents, reported COVID-19 vaccine hesitancy and 21% of them reported vaccine non-acceptance while (27.1%) of participants preferred receiving Pfizer vaccine. (51.8%) of the respondents expressed strong worries about unforeseen effects of the vaccine which was associated with younger age groups, married, females, absence of history of allergy to food or drugs, perceived susceptibility to COVID 19 and never having flu vaccination. Vaccine hesitancy was associated with female sex, urban residence, university/post graduate, married respondents, those never had flu vaccine, and those did not have confidence in the ability of health system to control the epidemic. Female sex, urban residence and having concerns about unforeseen effects were predictors for vaccine hesitancy and vaccine non-acceptance.

Conclusion: The observed high level of worries about unforeseen effects of COVID-19 vaccines and widespread vaccine hesitancy amongst Egyptians and its predictors should be considered during implementation of public health intervention campaigns to change negative attitudes and improve acceptance and uptake of COVID-19 vaccines in Egypt.

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Introduction

Herd immunity is the goal of the effective response of the public health interventions to coronavirus disease 2019 (COVID-19) pandemic. It is described as acquired community immunity in a sufficiently large proportion of the population, which is estimated to be 67% for COVID-19. If a large proportion of the population becomes infected, this would place immense pressure on healthcare infrastructure and could lead to up to 30 million deaths globally [1].

Widespread vaccination is important for COVID-19 transmission control [2]. However, despite the pandemic, there is a global distrust of vaccine safety and efficacy [3].

Planned behavior theory explains whether or not a person will adhere to a particular behavior. Regarding COVID-19 vaccine, it is dependent on three major factors: the individual's general attitudes toward vaccination in general and the COVID-19 vaccine in particular, the attitudes of 'significant others' toward the vaccine, and the perceived behavioral control, which refers to the perceived difficulty in doing the behavior [4].

In April 2020-, during the early stages of the pandemic, about one-quarter of adults in seven European countries, including the United Kingdom, were unaware or unable to receive a COVID-19 vaccine when it became available [5]. Concerns regarding the vaccine novelty and efficacy, as well as possible side effects, have been

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reported as reasons for not receiving the COVID-19 vaccine up to date [5,6]. According to a study explored the relationship between general vaccine attitudes and the intention to vaccinate against COVID-19, the belief in vaccine safety was the strongest predictor [7].

There is a critical need for a more updated understanding of public attitudes towards COVID 19 vaccines and associated factors in the light of the COVID-19 pandemic to tailor appropriate public health messages or actions. This research aimed to determine the prevalence of attitudes and intentions towards the COVID 19 vaccine and detect negative attitudes and intentions predictors.

Exploring the predictors of intentions towards the COVID-19 vaccine could help governments and policymakers identify and adopt appropriate interventions to eliminate worries and hesitancy and increase confidence in the vaccine.

Subjects and methods

Study design and participants

This web-based cross-sectional survey targeted Egyptian citizens aged 18 years and above all over the country. The study was conducted during the period from January to March 2021. The exclusion criteria included refusal to participate in the study, age below 18 years old, illiterate or internet non-user and Egyptian adult citizens living abroad during the study period.

Sample size

Sample size was estimated according to the following equation: $n = Z^2 P (1 − P)/d^2$ [8].

Due to limited data about the prevalence of COVID-19 anti-vaccine attitudes in Egypt, we assumed that 50% of the respondents would have anti-COVID-19 vaccine attitudes, 95% confidence level, and 80% power of the study, so the calculated sample size was 385 participants, and the sample was increased to be more representative.

Data collection

The data was collected using a convenient sampling method through an online self-administered, structured questionnaire. Participants completed and submitted the questionnaire after approval on participation in the study (informed consent). The questionnaire was distributed through the most famous platforms in Egypt (Facebook and What's App groups) or private Facebook & What's App accounts. To increase the response rate, continuous follow-up & reminder messages were used. Pilot testing was done and involved 20 participants in order to ensure readability & clarity, and results of the pilot were not included in the study.

The data collection tool
The questionnaire was composed of 3 main sections as follows;

1) Socio-demographic and health-related factors;
   - Age, sex, residence, educational level, occupation, marital status, smoking history and history of chronic diseases.
   - Current perceived state of health, as determined by a single item derived from the General Health Perception Scale [9].
   - Perceived susceptibility to potential adverse effects of the medication was assessed by a single item based on the Perceived Sensitivity to Medicines scale [10].
   - Prior Influenza vaccination behavior was assessed by one item.
   - Confidence in the Egyptian government to handle the pandemic.

   - Perceptions of governmental efforts to raise COVID 19 vaccine awareness.
2) Intentions and attitudes towards COVID-19 vaccination.
   - Intentions towards the COVID-19 vaccine were based on one item. Response options were vaccine acceptance, vaccine hesitancy, and vaccine non-acceptance.
   - Vaccine attitudes:

Using 12-items based on the Vaccination Attitudes Examination (VAX) Scale [11], general negative attitudes towards COVID 19 vaccines were assessed. Participants were asked to focus on COVID 19 specifically.

On a six-point scale, responses were scored from 1 (strongly agree) to 6 (strongly disagree). Four subscales were calculated; skepticism of vaccine benefit, fears regarding unexpected future consequences, commercial profiteering concerns, and natural immunity preference.

Each of the four subscales was classified as having a high level of negative attitudes toward COVID-19 vaccines (score of 5–6 on a scale of 1–6), an intermediate level (score of 3–4), or a low level (score of 1–2).

   - Type of vaccine preferred.

Statistical analysis
The data were analyzed using SPSS version 25 and significance level ($p < .05$). Qualitative data were presented as frequency and percent, while quantitative data were presented as mean $\pm$ SD. Chi^2 test was used to test the association between categorical variables. Pearson's correlation coefficient (r) was used to test the association between two continuous variables. Multinomial logistic regression analysis was used to identify the predictors.

Ethical issues
The study methodology was approved by the Ethical Committee of Scientific Research, Faculty of Medicine, Benha University, No (RC.3.1.2021). All participants provided electronic informed written consent after clarification of the goals, data confidentiality, voluntary participation, and withdrawal.

Results

One thousand eleven Egyptian citizens were recruited from 24 governorates and submitted the survey. Studied participants' sociodemographic characteristics were shown in Table 1. More than half of the participants (58.8%) were males. The mean age was 29.35 $\pm$ 10.78 years, and 55.5% of them were from the age group 18–28. More than half (54.3%) were from urban areas. The majority of them were university graduates. About one third (30.8%) worked in the governmental sector, 50% were single, and 86.6% were nonsmoker. The majority of the study participants did not have any chronic disease (77.5%) or any type of medication hypersensitivity (63.3%), and about 30.4%, 38.7% and 18.2% perceived their health as good, very good and excellent, respectively.

About two-thirds (65.6%) of participants had never received the flu vaccine. In this study, 16.6 % of the study participants had COVID-19, while 37.4% had a family member who had COVID-19. The majority of the study participants thought that the Ministry of Health did not provide adequate information about COVID-19 vaccines. Regarding intentions to receive the COVID19 vaccine, 54% of respondents were hesitant to take the vaccine, 21% were unwilling to take the vaccine, and only 25% were willing to take the vaccine. About 27.1% of the study participant preferred the Pfizer vaccine compared with 6.9%, 4.5%, who preferred the Chinese and AstraZeneca vaccine, respectively (Table 2).

Table 1
Distribution of socio-demographic, health characteristics and attitudes towards the vaccine.

Variables		Frequency	%
Age 29.35 ± 10.78	18–28	557	55.1
	29–39	280	27.7
	40–50	131	13.0
	50+	43	4.3
Gender	Male	417	41.2
	Female	594	58.8
Residence	Urban	549	54.3
	Rural	462	45.7
Education	Read and write/primary education	47	4.6
	Preparatory education	22	2.2
	Secondary education	232	22.9
	University education	500	49.5
	Post graduate	210	20.8
Occupation	Student	418	41.3
	Not working	24	2.4
	House wife	83	8.2
	Private sector	81	8.0
	Governmental sector	311	30.8
	Others	72	7.1
Marital status	Single	505	50.0
	Married	479	47.4
	Others (divorced–separated–widowed)	27	2.7
Smoking history	Current smoker	88	8.7
	Ex-smoker	47	4.6
	Non smoker	876	86.6
Chronic disease	No chronic disease	784	77.5
	Asthma or respiratory disease	55	5.4
	Cardiac disease	14	1.4
	Hypertension	27	2.7
	Diabetes	27	2.7
	Cancer	3	.3
	Kidney or liver disease	5	.5
	Autoimmune disease	15	1.5
	Overweight/obesity	38	3.8
Perceived health status	Poor health	22	2.2
	Medium	107	10.6
	Good	307	30.4
	Very good	391	38.7
	Excellent	184	18.2
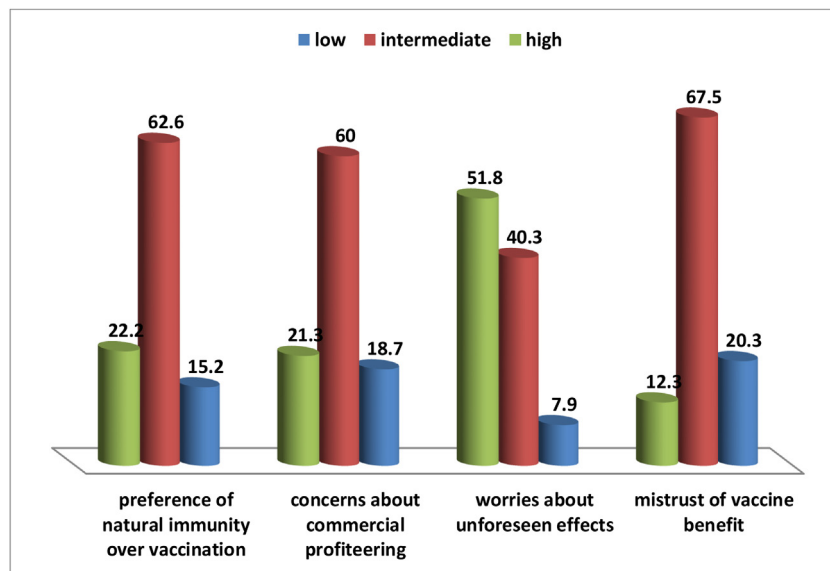
Fig. 1. Participants negative attitudes towards COVID-19 vaccines.

Overall, only 12.3% of respondents revealed high levels of mistrust regarding vaccines benefits and 67.5% reported moderate mistrust, and 20.3% showed low mistrust with a mean score of (2.98 ± 1.01). Half of the study participant (51.8%) showed strong worries about unexpected vaccine effects, while 40.3% showed moderate worries with a mean score of (4.02 ± 1.30). About one-quarter (21.3%) and two thirds (60%) expressed high and moderate concerns, respectively, regarding commercial profiteering with a mean score of (3.15 ± 1.13). About one-quarter (22.2%) revealed a high

Table 2

Distribution of socio-demographic, health characteristics and attitudes towards the vaccine.

Variables		Frequency	%
Hypersensitivity to drugs or foods	Yes	120	11.9
	No	640	63.3
	Don't know	245	24.2
Have had flu vaccination	Never	663	65.6
	Yes (long time ago)	225	22.3
	Yes last year	32	3.2
	Yes this year	61	6.0
	Yes every year	30	3.0
Had COVID 19	Yes	168	16.6
	No	601	59.4
	Don't know	242	23.9
Family member had COVID 19	Yes	378	37.4
	No	489	48.4
	Don't know	144	14.2
Does ministry of health provide adequate information about COVID-19 vaccines?	Yes	224	22.2
	No	584	57.8
	Don't know	203	20.1
Intentions towards COVID19 vaccine	Vaccine acceptance	259	25.6
	Vaccine hesitancy	543	53.7
	Vaccine non-acceptance	209	20.7
COVID 19 vaccine preferences	Chinese vaccine	70	6.9
	Pfizer vaccine	274	27.1
	Moderna vaccine	14	1.4
	AstraZeneca	46	4.5
	Russian vaccine	20	2.0
	don't know	587	58.1
Mistrust of vaccine benefit mean ± SD (2.98 ± 1.01)	Low	205	20.3
	Moderate	682	67.5
	High	124	12.3
Worries about unforeseen side effects mean ± SD (4.02 ± 1.30)	Low	80	7.9
	Moderate	407	40.3
	High	524	51.8
Concerns about commercial profiteering mean ± SD (3.15 ± 1.13)	Low	189	18.7
	Moderate	607	60.0
	High	215	21.3
Preference of natural immunity mean ± SD (3.26 ± 1.08)	Low	154	15.2
	Moderate	633	62.6
	High	224	22.2

natural immunity preference, while 62.6 % showed a moderate preference for natural immunity (Table 2 & Fig. 1).

The association between socio-demographic characteristics, health-related factors and worries about unforeseen effects of the vaccines is demonstrated in Table 3. There were a statistically significant associations between worries level and young age group (p = .006), female gender (p = .034), marriage (p < .001), urban residence (p < .001), university/post-graduate education level (p < .001), working in the governmental sector (p = .016), also with the absence of allergic history to foods or drugs (p = .004), perceived susceptibility to COVID 19 infection (p value <.001), perceived excellent health status (p < .001) and never received flu vaccination (p = .039) (Table 3).

Regarding the association between intentions towards COVID 19 vaccination and some socio-demographic and health-related factors, there was a statistically significant associations between vaccine hesitancy and female gender (p < .001), urban residence (p < .001), university/post-graduate education level (p = .041), working in the governmental sector (p < .001), marriage (p = .009), never received flu vaccine (p = .029), perceived excellent health status (p = .004), belief that The Egyptian Ministry of Health did not provide adequate information about COVID-19 vaccines (p < .001),and lake of confidence that the health system could have the ability to control the epidemic (p < .001) (Table 4).

Regarding the association between intentions towards COVID 19 vaccination and attitudes towards vaccines, vaccine hesitancy had highly significant associations with intermediate mistrust level of vaccine benefit (p < .001), high worries about unforeseen effects (p < .001), intermediate concerns about commercial profiteering (p

< .001), and intermediate preference of natural immunity (p < .001) (Table 5).

Multinomial logistic regression analysis for the predictors of the intentions towards COVID 19 vaccination showed that female gender, urban residence and having concerns about unforeseen effects were significant independent predictors for vaccine hesitancy and vaccine non-acceptance (p = .001, .001, .001, .000, .033, .000, respectively) (Table 6).

Discussion

Vaccination is one of the most important inventions in the field of public health in the 21st century. Vaccination hesitancy one of the world top ten health challenges. The high level of vaccine hesitancy emphasizes the fact that the availability of COVID-19 vaccines is not the only issue.

The current study found that the most often negative attitude towards COVID-19 vaccines was the concern about unforeseen effects of the vaccine in the future, more than half of participants (51.8%) expressed a high level of worries about unforeseen consequences of the vaccine, which is in line with a US study [12]. Additionally, a Chinese study discovered that 48% of respondents delayed vaccination until vaccine safety was confirmed [13], indicating their concerns about vaccine safety. The fast pace of vaccine production and some scientific and health professionals' skepticism can raise doubts about the COVID-19 vaccine [14].

According to the study, half of the participants expressed concerns about the vaccine safety once it became accessible, as demonstrated by their worries about potential side effects. This is in

Table 3
Association between socio-demographic, health related factors and worries about unforeseen effects of the vaccines.

Sociodemographic and health variables		Level of worries about unforeseen side effects			p
	Low	Intermediate	High		
Age groups 18–28		59(5.8%)	220(21.8%)	278(27.5%)	
29–39		13(1.3%)	116(11.5%)	151(14.9%)	
40–50		6(.6%)	60(5.9%)	65(6.4%)	.006**
50⁺		2(.2%)	11(1.1%)	30(.3%)	
Sex Male		42(4.2%)	175(17.3%)	200(19.8%)	
Female		38(3.8%)	232(22.9%)	324(32.0%)	.034*
Residence Urban		30(3.0%)	200(19.8%)	319(31.6%)	
Rural		50(4.9%)	207(20.5%)	205(20.3%)	.000**
Education Read and write/primary		7(.7%)	4(.4%)	36(3.6%)	
Preparatory/secondary		32(3.2%)	85(8.4%)	137(13.6%)	.000**
University/post graduate		41(4.1%)	318(31.5%)	351(34.7%)	
Student		49(4.8%)	177(17.5%)	192(19.0%)	
occupation Not working/house wife		7(.7%)	25(2.5%)	75(7.4%)	
Private sector		9(.9%)	38(3.8%)	34(3.4%)	.000**
Governmental sector		12(1.2%)	144(14.2%)	155(15.3%)	
Others		3(.3%)	23(2.3%)	68(6.7%)	
Marital status Single		52(5.1%)	212(21.0%)	241(23.8%)	
Married		26(2.6%)	187(18.5%)	266(26.3%)	.016**
Others (separated–divorced–widowed)		2(.2%)	8(.8%)	17(1.7%)	
Hypersensitivity to drugs or foods Yes		19(1.9%)	44(4.4%)	57(5.6%)	
No		44(4.4%)	275(27.2%)	327(32.3%)	.004**
Don't know		17(1.7%)	88(8.7%)	140(13.8%)	
Perceived susceptibility to COVID 19 infection Yes		39(3.9%)	258(25.5%)	404(40.0%)	
No		21(2.1%)	33(3.3%)	28(2.8%)	.000**
Don't know		20(2.0%)	116(11.5%)	92(9.1%)	
Had flu vaccination Never		46(4.5%)	268(26.5%)	349(34.5%)	
Long time ago		28(2.8%)	92(9.1%)	137(13.6%)	.039*
Recently		6(.6%)	47(4.6%)	38(3.8%)	
Perceived health status Poor to moderate		6(.6%)	33(3.3%)	90(8.9%)	
Good to very good		21(2.1%)	117(11.6%)	169(16.7%)	.000**
Excellent		53(5.2%)	257(25.4%)	265(26.2%)	

*Significant at the .05 level (2-tailed).
**Significant at the .01 level (2-tailed).

line in with Pogue et al., who stated that most participants (63%) in the United States of America expressed concerns about the COVID-19 vaccines side effects [15].

Additionally, the majority of respondents who picked preferred vaccine favored the US vaccine. This comes in accordance with a global study [15] and another one in the USA [16].

Regarding intentions to receive the COVID19 vaccine, 54% of respondents reported vaccine hesitancy, 21% reported vaccine non-acceptance, and only 25% decided on vaccine acceptance. An African study on 15 African countries found that intentions to accept a COVID-19 vaccine ranged from higher acceptance reported in Ethiopia and Niger to the lowest acceptance found in Senegal and DR Congo [17].

In the current study, the high level of vaccine hesitancy could be explained by the fact that more than half of the participants had concerns about future unexpected side effects of the vaccine and doubts about vaccine benefit, in addition to the lack of information about available COVID-19 vaccines and characteristics of everyone, which support the emergence of rumors and misleading information, creating negative attitudes, hesitancy, or even refusal of the vaccines. This in line with a study in Portugal, which found that more than one third (35%) of the participants would take the vaccine immediately, more than half (56%) would wait before taking the vaccine, and only 9% would not take the vaccine [18]. Also, this is consistent with an American study which reported that more than half of the participants (57.6%) intended to take the vaccine, about one-third (31.6%) were hesitant, and only 10.8% reported they did not intend to take the vaccine [19]. Also, a study by Tylor et al, stated that about one-quarter of Americans (25%) and Canadians (20%) would not receive the SARS-CoV2 vaccine. Due to the extent of non-adherence, achieving herd immunity would be extremely difficult [20]. In contrast, a Saudi study reported that 64.7% of participants

agreed to get the COVID-19 vaccine, 7.0% refused it, and 28.2% were hesitant about it. Additionally, Cordina's studies [21] demonstrated promising findings in terms of vaccine uptake willingness, with more than 50% of participants expressed a clear desire to take the vaccine, one-third (32.6%) expressed uncertainty, and only 15.6% expressed opposition, at the time when knowledge about the safety and effectiveness of the vaccine was scarce. Additionally, a European study recorded a willingness to take the vaccine in about three-quarters (73.9%). Another UK Oxford study reported 71.7%. In a global survey of 19 countries, 71.5% reported a willingness to take the vaccine, and in the United States, about half (52%) were quite likely, and one-quarters (27%) were very likely to take the vaccine [5,22].

The results of the current study indicated that Egyptians have a high degree of COVID-19 vaccine hesitancy, which is greater than that observed in previous research [5,13,23–25]. The differences between countries regarding COVID-19 vaccine acceptance, non-acceptance or hesitancy may be attributed to differences in socio-demographic characteristics, health characteristics, human behavior, the availability of knowledge about vaccines, control of rumors and misinformation, confidence in the health system, type of vaccines available, worries about side effects, and level of trust in vaccine benefits.

In this study, female gender was significantly associated with concerns about unforeseen effects of the COVID-19 vaccine and hesitancy towards COVID-19 vaccination. This comes in accordance with another study by Ref. [26], who reported that males were more likely to accept the vaccine. Furthermore, an African research on 15 African countries reported that women were more skeptical towards the COVID-19 vaccine [17]. This can be attributed to females' fears of the vaccine unforeseen and long term side effects on pregnancy and future generations, and a considerable portion

Table 4

Association between socio-demographic, health related factors and intentions towards COVID 19 vaccination.

Sociodemographic and health variables		Vaccine acceptance	Vaccine hesitancy	Vaccine non-acceptance	p
Age groups	18–28	151(14.9%)	293(29.0%)	113 (11.2%)	
	29–39	61(6.0%)	155(15.3%)	64(6.3%)	
	40–50	34(3.4%)	68(6.7%)	29(2.9%)	.225
	50+	13(1.3%)	27(2.7%)	3(.3%)	
Sex	Male	134(13.3%)	203(20.1%)	80(7.9%)	.000**
	Female	125(12.4%)	340(33.6%)	129(12.8%)	
Residence	Urban	105(10.4%)	309(30.6%)	135(13.4%)	.000**
	Rural	154(15.2%)	234(23.1%)	74(7.3%)	
Education	Read and write/primary	6(.6%)	33(3.3%)	8(.8%)	
	Preparatory/secondary	69(6.8%)	143(14.1%)	42(4.2%)	.041
	University/post graduate	184(18.2%)	367(36.3%)	159(15.7%)	
Occupation	Student	129(12.8%)	205(20.3%)	84(8.3%)	
	Not working/house wife	16(1.6%)	73(7.2%)	18(1.8%)	
	Private sector	18(1.8%)	39(3.9%)	24(2.4%)	.000**
	Governmental sector	81((.8%)	161(15.9%)	69(6.8%)	
	Others	15(1.5%)	65(6.4%)	14(1.4%)	
Marital status	Single	140(13.8%)	258(25.5%)	107(10.6%)	
	Married	115(11.4%)	274(27.1%)	90(8.9%)	.009**
	Others (separated–divorced–widowed)	4(.4%)	11(1.1%)	12(1.2%)	
Smoking	Current smoker	21(2.1%)	50(4.9%)	17(1.7%)	
	Ex-smoker	20(2.0%)	22(2.2%)	5(.5%)	.069*
	Non smoker	218(21.6%)	471(46.6%)	187(18.5%)	
Flu vaccination	Never	163(16.1%)	351(34.7%)	149(14.7%)	
	Long time ago	79(7.8%)	140(13.8%)	38(3.8%)	.029*
	Recent	17(1.7%)	52(5.1%)	22(2.2%)	
Perceived health status	Poor to moderate	22(2.2%)	83(8.2%)	24(2.4)	
	Good to very good	68(6.7%)	179(17.7%)	60(5.9%)	.004**
	Excellent	169(16.7%)	281(27.8%)	125(12.4%)	
Does ministry of health provide adequate information about COVID-19 vaccines?	Yes	93(9.2%)	97(7.6%)	34(3.4%)	
	No	105(10.4%)	335(33.1%)	144(14.2%)	.000**
	Don't know	61(6.0%)	111(11.0%)	31(3.1%)	
Confidence in health system ability to control the epidemic	Disagree	104 (10.3%)	245(24.2%)	126(12.5%)	
	Neutral	52(5.1%)	191(18.9%)	40(4.0%)	.000**
	Agree	103(10.2%)	107(10.6%)	43(4.3%)	

** Significant at the .01 level (2-tailed).
* Significant at the .05 level (2-tailed).

Table 5

Association between intentions towards COVID 19 vaccination and attitudes towards vaccines.

Variables	Vaccine acceptance	Vaccine hesitancy	Vaccine non-acceptance	p
Mistrust of vaccine benefit				
Low	24(2.4%)	76(7.5%)	105(10.4%)	
Intermediate	160(15.8%)	425(24.0%)	97(9.6%)	.000**
High	7(.7%)	42(4.2%)	75(7.4%)	
Worries about unforeseen effects				
Low	35(3.5%)	32(3.2%)	13(1.3%)	
Intermediate	122(12.1%)	211(20.9%)	74(7.3%)	.000**
High	102(10.1%)	300(29.7%)	122(12.1%)	
Concerns about commercial profiteering				
Low	83(8.2%)	76(7.5%)	30(3.0%)	
Intermediate	144(14.2%)	343(33.9%)	120(11.9%)	.000**
High	32(3.2%)	124(12.3%)	59(5.8%)	
Preference of natural immunity over vaccination				
Low	56(5.5%)	74(7.3%)	24(2.4%)	
Intermediate	167(16.5%)	341(33.7%)	125(12.4%)	.000**
High	36(3.6%)	128(12.7%)	60(5.9%)	

*Significant at the .05 level (2-tailed).
**Significant at the .01 level (2-tailed).

of females might be pregnant, lactating or planning to be pregnant in the near future. In contrast, other studies reported higher acceptance of the vaccine among females [27,28].

The current study results revealed vaccine hesitancy was higher among university/post-graduate education level, those working in the governmental sector, married respondents, and those never vaccinated with the flu vaccine. This finding agrees with another study, which reported that not receiving influenza vaccine in the prior year were among factors that were associated with vaccine hesitancy [19]. On the other side, a Saudi study reported that the future COVID-19 vaccine acceptance was relatively high among

married participants with a post-graduate degree or higher (68.8%) and governmental employees (68.9%) [28].

Higher odds for COVID-19 hesitancy were associated with the following factors: the presence of concerns about unforeseen effects, lower education level, and poor/moderate perceived health status. This could be explained by the fact that people who perceive their health status as poor are more fearful about health deterioration and vaccination adverse effects which is the major concern of the participants of this study. Participants with lower education level may have limited access to information about COVID-19 vaccines, so they are hesitant about it. In this study, more than one half

Table 6
Multinomial logistic regression for the predictors of the intentions towards COVID 19 vaccination.

Intentions			B	S.E.	Wald	Sig.	Exp(B)	95% CI
Vaccine hesitancy		Concerns about unforeseen effects	.197	.060	10.869	.001*	1.218	(1.083–1.370)
	Sex	Male	−.511	.158	10.496	.001*	.600	(.440–.817)
		Female (ref)	.	.	.	.	.	.
	Residence	Urban	.535	.165	10.529	.001*	1.707	(1.236–2.358)
		Rural (ref)	.	.	.	.	.	.
	Marital status	Single	.045	.621	.005	.942	1.046	(.310– 3.534)
		Married	.021	.617	.001	.973	1.021	(.305–3.421)
		Others (ref)	.	.	.	.	.	.
	Education	Read & write/primary	.837	.484	2.994	.084	2.310	(.895–5.963)
		Preparatory/secondary	.086	.183	.224	.636	1.090	(.762–1.559)
		University/post (ref)	.	.	.	.	.	.
	Chronic disease	No	.084	.208	.162	.687	1.088	(.723–1.637)
		Yes (ref)	.	.	.	.	.	.
	Perceived health	Poor/moderate	.462	.287	2.591	.107	1.588	(.904–2.789)
		Good/very good	.415	.180	5.293	.021*	1.514	(1.063–2.156)
		Excellent (ref)	.	.	.	.	.	.
Vaccine non-acceptance		Concerns about unforeseen effects	.329	.076	18.998	.000*	1.390	(1.199–1.612)
	Sex	Male	−.419	.197	4.540	.033*	.657	(.447–.967)
		Female (ref)	.	.	.	.	.	.
	Residence	Urban	.931	.206	20.418	.000*	2.538	(1.695–3.802)
		Rural (ref)	.	.	.	.	.	.
	Marital status	Single	−.814	.622	1.713	.191	.443	(.131–1.499)
		Married	−1.203	.618	3.786	.052*	.300	(.089–1.009)
		Others (ref)	.	.	.	.	.	.
	Education	Read& write/primary	.278	.594	.219	.640	1.321	(.412–4.234)
		Preparatory/secondary	−.265	.237	1.257	.262	.767	(.482–1.220)
		University/post (ref)	.	.	.	.	.	.
	Chronic dis	No	−.105	.252	.175	.676	.900	(.549–1.475)
		Yes (ref)	.	.	.	.	.	.
	Perceived health	Poor/moderate	.037	.358	.011	.917	1.038	(.514–2.096)
		Good/very good health	.160	.225	.503	.478	1.173	(.755–1.823)
		Excellent (ref)	.	.	.	.	.	.

The reference category is willing to take the vaccine.

* Significance at <.05 (B represents the estimated regression coefficients for the explanatory variables, with the standard error (S.E.) given. The Wald statistics is the ratio of B to S.E. of the regression coefficient squared. The significance of each explanatory variable (Sig.) is given by the p-value. Exp (B) is the predicted change in odds for a unit increase in the explanatory variable).

of participants (58.1%) could not decide on the type of preferred COVID-19 vaccine because they did not have enough knowledge about its types.

Also, higher odds for vaccine non-acceptance were linked to the presence of concerns about unforeseen effects. This comes in accordance with an American/Canadian, which stated that vaccine non-acceptance was most strongly associated with a distrust of vaccine value and also with a fear of unexpected potential consequences. These attitudes would make the achievement of herd immunity difficult or even impossible [20].

In addition, higher odds for vaccine non-acceptance were observed among those who perceived their health as good/very good. This could be explained by the fact that they believe they are not at risk of illness and can fight the infection, hence not needing vaccination that may have adverse consequences.

Although, there are those who support the COVID-19 vaccine without doubts, others absolutely reject it, and in the middle, there is a third hesitated group. These individuals often postpone vaccination or accept it but are uncertain. According to sociological and psychological theories, it is easier for people to adjust their behaviors if they are within the 'latitude of acceptance' [29].

Conclusions

The study findings indicated a high level of mistrust and worries about unforeseen effects of COVID-19 vaccines. Widespread COVID-19 vaccine hesitancy was associated with female gender, urban residence and lower educational levels. Policy makers should consider these findings in planning and implementing public health intervention campaigns to change negative vaccine attitudes and increase the acceptance and uptake of COVID-19 vaccines in Egypt in order to achieve herd immunity and control the pandemic.

Limitations of the study

One of the limitations of this study is the convenient non-probability sampling method. Being on-line survey that involved only internet-users and missed the opportunity of exploring the attitudes of internet non-users.

Funding

Conflict of interest

We have no conflict of interest.

Ethical approval

The study methodology was approved by the Ethical Committee of Scientific Research, Faculty of Medicine, Benha University, No (RC.3.1.2021). All participants provided electronic informed written consent after clarification of the goals, data confidentiality, voluntary participation, and withdrawal.

Authors contributions

The manuscript has been read and approved by all the authors, that the requirements for authorship have been met, and that each author has substantial contributions to each of the three components mentioned below:

Concept and design of study or acquisition of data or analysis and interpretation of data;

Drafting the article or revising it critically for important intellectual content; and

Final approval of the version to be published.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.jiph.2021.06.019.

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