



Evaluation of vaccine perceptions in Israel's Elderly: A Comparative study of COVID-19 and influenza vaccination attitudes

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ABSTRACT

Purpose: This study aimed to evaluate the attitudes of Israeli elderly population towards COVID-19 and influenza vaccines, and to assess factors contributing to these attitudes.

Methods: Four-hundred and one participants exhibiting symptoms consistent with COVID-19 or influenza were enrolled and filled out a questionnaire. A second questionnaire was filled out for hospitalized patients at discharge. Nasopharyngeal samples were collected and detected for COVID-19 and influenza presence by reverse transcription PCR. Participants were divided into 3 groups according to their attitude towards vaccine- Pro-vaccine, Anti-vaccine and Dependent group, which represented participants whose stance depended on disease infection rate.

Results: Out of 401 participants, 11.2% (45/401) tested positive for COVID-19, 10.5% (42/401) were positive for Influenza A and one (0.2%) patient had Influenza B. The participants expressed varied beliefs about COVID-19 vaccine: 14.7% (59/401) agreed that it causes disease, 25.4% (102/401) doubted vaccine effectiveness and 22.9% (92/401) questioned vaccine safety. A higher percentage of individuals in Pro-Vaccine group (66.3%, 179/270) as compared to Anti-Vaccine (45.3%, 24/53) and to Dependent (60.3%, 47/78) groups had a COVID-19 history. Hospitalization history was significantly more common in Pro-Vaccine (11.1%, 30/270) and Dependent groups (16.7%, 13/78) than in Anti-Vaccine group (1.9%, 1/53).

Influenza vaccine effectiveness was doubted by 19.7% (79/401), 18% (72/401) participants questioned safety, and 18.7% (75/401) agreed that the vaccine causes disease. The majority of both Dependent (54.2%, 13/24) and Pro-Vaccine (56.2%, 167/297) groups believed they received sufficient information about the vaccine, while only 25% (20/80) of the Anti-Vaccine group has similar impressions.

Conclusions: This analysis reveals a notable disinclination towards vaccination among some of the elderly, reflecting their deep and ingrained hesitancy. These findings emphasize the need for customized approaches to improve vaccine acceptance in this vulnerable group. Such strategies should consider the various motivations and influences shaping elderly perspectives, from individual health experiences to wider social and cultural factors.

Introduction

Vaccines have been a cornerstone of public health, serving as a key factor in controlling the spread of numerous infectious diseases [1]. For example, the smallpox vaccine, introduced by Edward Jenner in 1796, was instrumental in eradicating the disease by 1980 [22], and the measles vaccination prevented 56 million deaths between 2000 and 2021 [3].

The eradication, near-elimination and high control of diseases' spread, are testaments to the critical role of vaccination in public health. However, despite their proven efficacy and safety, a segment of the population remains hesitant, questioning and sometimes refusing vaccines for political, scientific and religious reasons [4–6]. Vaccine hesitancy is described by the World Health Organization (WHO) as “the reluctance or refusal to vaccinate despite the availability of vaccines” and was classified as one of the top-ten global health threats in 2019 [7].

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Early opposition to vaccines, in the 18th century, centered around concerns about introducing foreign substances into the body, perceived violations of “the laws of God”, and a refusal to accept emerging scientific methodologies. Such opposition is not limited to religious figures, but constitutes a broader societal phenomenon [8]. Vaccine hesitancy among the elderly is a critical public health issue, as this population is at a higher risk of severe complications from infectious diseases compared to young individuals [9].

Influenza, an acute respiratory disease caused by influenza viruses, significantly affects the elderly, leading to severe complications, such as pneumonia, a high predisposition to bacterial sepsis and acute respiratory distress syndrome (ARDS) [10]. The Health Maintenance Organizations in Israel provides the annual Flu vaccine free-of-charge, for each citizen which agrees to get vaccinated. Despite the availability of annual influenza vaccines, there is notable hesitancy among older adults, usually driven by complacency (low perceived severity of disease) and distrust in authorities [11,12]. Similarly, COVID-19 caused by the novel SARS-CoV-2, poses significant health threats to the elderly. Contrary to the seasonal trends typically seen with certain viral infections, COVID-19 perpetuated continuous outbreaks since its emergence in 2019, leading to an ongoing global health crisis [13,14]. SARS-CoV-2 primarily infects the respiratory tract epithelial cells, similar to the influenza virus, but is associated with a higher risk for severe disease and complications [15].

The rapid development and implementation of COVID-19 vaccines were crucial in controlling the pandemic, significantly contributing to the reduction of hospitalizations and deaths [16]. When COVID-19 vaccines were first available in Israel, the ministry of health offered the vaccine free-of-charge to all citizen, with priority given to individuals above the age of 60, healthcare workers and vulnerable populations [17].

However, vaccine hesitancy remains a significant issue, fueled by anxiety and misconceptions about the safety and efficacy of vaccines, often due to a lack of exposure to reliable information or to concerns regarding potential vaccination side effects [18].

Given the unique challenges faced by the elderly in relation to vaccine hesitancy, it is essential to formulate targeted strategies to address these issues, such as improved access to accurate and comprehensible information about vaccines. Additionally, combating complacency demands a unified effort to raise awareness of the seriousness of diseases that vaccines can prevent. Considering the psychosocial factors associated with aging, it is also important to provide support networks that encourage health-related behaviors in this susceptible group.

This study aimed to evaluate the attitudes of the elderly towards COVID-19 and influenza vaccines, while also investigating the contributing factors behind these attitudes. To the best of our knowledge, no similar comprehensive study has been conducted in Israel to date.

Materials and methods

Research setting and methods for participant enrollment

The study was conducted at the Tzafon Medical Center, Israel, an academic medical center affiliated with the Azrieli Faculty of Medicine at Bar Ilan University and compliant with Joint Commission International (JCI) quality standards. This medical center serves population from a wide geographic area. This population is very diverse and includes ultra-orthodox, observant, and secular Jews, as well as Arabs, Muslims, Christians, Druze, and Circassians from rural and urban areas.

This study randomly recruited participants who received emergency room treatment at the medical center due to symptoms associated with Influenza and COVID-19. Some of these patients were subsequently hospitalized. Inclusion criteria included women aged ≥ 62 years and men aged ≥ 67 years (according to the local retirement age). Legally incompetent patients who were unable to sign an informed consent form were not eligible to participate in the study. All participants provided an

informed consent to participate in the study, which was approved by the medical center's Helsinki Committee (Approval number: POR-0033–22).

Sample collection and molecular testing

Skilled personnel collected nasopharyngeal samples from patients using flexible nylon flocked swabs (Lingen Precision Medical Products Cp. Ltd., Shanghai, China), which were then placed into sample tubes containing 2 mL universal transport medium (UTM) (Copan Diagnostics Inc., California, USA) and sent to the clinical microbiology laboratory of the medical center. Then, samples (200 μ L) were mixed with 150 μ L lysis buffer (Backman Coulter, Indianapolis, USA) and incubated for 30 min at room temperature. RNA and DNA extraction was conducted by a Biomek i7 Automated Workstation (Backman Coulter) according to the manufacturer's instructions. Then, RT-PCR was performed using the TaqPath RT-PCR COVID-19, Flu A, Flu B, Combo Kit (Applied Biosystems™, Thermo Fisher Scientific, Waltham, MA, USA) with a QuantStudio5 Detection System (Applied Biosystems™, Thermo Fisher Scientific). Reaction conditions were as follows: 1 cycle at 25 °C for 2 min, followed by 1 cycle at 53 °C for 10 min, 1 cycle at 85 °C for 10 min, 1 cycle at 95 °C for 2 min, 46 cycles at 95 °C for 3 s and 60 °C for 30 s.

A positive result for COVID-19 or Flu A/B was determined by the threshold cycle (Ct) values (range of 0–40), according to the RT-PCR kit instructions and the Israeli Ministry of Health guidelines.

Questionnaire

Each participant filled out a questionnaire ([supplementary file 1](#)) upon joining the study. The questionnaire was structured with closed-ended questions, enabling participants to select from a predefined set of responses, except for queries regarding age, weight and height. The questionnaire was available in Hebrew, Russian and Arabic. Assistance and the option to have the questionnaire read aloud were available to all participants. To ensure questionnaire effectiveness and clarity, 20 individuals representing both Arab and Jewish communities were randomly chosen to validate the questionnaire, ensuring its suitability and comprehensiveness.

A follow-up questionnaire

A follow-up questionnaire was given to patients who tested positive to COVID-19 or Influenza and were hospitalized. The purpose of the questionnaire was to assess factors related to their hospital stay, including duration of hospitalization, any complications experienced, and whether these factors influenced their perspectives on the relevant vaccination.

Statistical analysis

Based on χ^2 test for comparison of hesitancy proportions between groups, $\alpha = 0.05$, and 0.95 power, the minimum sample size needed for the study was 94. The calculation was conducted using RStudio® version 2021.09.0 Build 351.

Patient information was summarized using descriptive statistics. Summary tables for categorical variables include sample size and frequency, while those for continuous variables present sample size, mean, standard deviation and median.

The differences in categorical variables between groups were tested using the Fisher exact test and Pearson's Chi-squared test. The independent samples T test was used to compare the means of two separate groups to identify any significant statistical relationships. A $p < 0.05$ was defined as statistically significant. Analysis was conducted with RStudio® version 2021.09.0 Build 351.

Results

This study enrolled 401 patients, who were classified into three distinct groups based on their COVID-19 and influenza vaccination perspectives.

Prevalence of comorbidities among study participants

The majority of study participants (51.9 %, 208/401) were dealing with vascular diseases. Other common comorbidities included diabetes and renal failure, respectively affecting 39.2 % (157/401) and 27.2 % (109/401) of the participants. Chronic obstructive pulmonary disease (COPD) was identified in 15.2 % (61/401), and asthma in 9 % (36/401). A small proportion of the study participants, representing 8.2 % (33/401) and 5.7 % (23/401), reported tumors or autoimmune disorders, respectively.

Demographic and lifestyle characteristics of COVID-19 queries' respondents

The anti-vaccine group included 53 participants (13.2 %) and the pro-vaccine group included 270 participants (67.3 %). The third group included 78 participants (19.4 %) whose stance depended on the infection rate (called the "Dependent group").

The mean age of participants in the Anti-Vaccine group was 72.9 ± 8 years and slightly over half were females (50.9 %, 27/53) (Table 1). Individuals in the Dependent group were of an average age of 73.1 ± 7.6 years, and most were males (62.8 %, 49/78). The Pro-Vaccine group was generally older, with an average age of 76 ± 8.9 years, and had a slightly higher percentage of females (53.7 %, 145/270). The differences

Table 1

Demographics and lifestyle characteristics of COVID-19 patients, by vaccination attitude.

	Anti-vaccine (N = 53)	Dependent on infection rate (N = 78)	Pro-Vaccine (N = 270)	Total (N = 401)	p Value
Age (years)					0.005
Mean (SD)	72.9 (8)	73.1 (7.6)	76 (8.9)	75.1 (8.7)	
Range	57–86	59–92	57–96	57–96	
Gender, n (%)					0.036
Female	27 (50.9)	29 (37.2)	145 (53.7)	201 (50.1)	
Male	26 (49.1)	49 (62.8)	125 (46.3)	200 (49.9)	
Religion, n (%)					0.223
Arab	25 (47.2)	34 (43.6)	98 (36.3)	157 (39.2)	
Jew	28 (52.8)	44 (56.4)	172 (63.7)	244 (60.8)	
Housing, n (%)					0.279
Sheltered-housing	0 (0)	1 (1.3)	6 (2.2)	7 (1.7)	
Nursing home	1 (1.9)	4 (5.1)	23 (8.5)	28 (7)	
Private home	52 (98.1)	73 (93.6)	241 (89.3)	366 (91.3)	
Marital status, n (%)					0.128
Divorced	6 (11.3)	1 (1.3)	22 (8.1)	29 (7.2)	
Married	34 (64.2)	60 (76.9)	169 (62.6)	263 (65.6)	
Single	0 (0)	1 (1.3)	7 (2.6)	8 (2)	
Widower	13 (24.5)	16 (20.5)	72 (26.7)	101 (25.2)	

between the three groups in both age and gender were statistically significant ($p = 0.005$, $p = 0.036$, respectively). No significant differences were noted among the groups in other characteristics (Table 1).

Demographic and lifestyle characteristics of influenza queries' respondents

The classification of groups was as follows: 80 (20 %) participants belonged to the anti-vaccine group, 297 (70.1 %) participants belonged to the pro-vaccine group and 24 (5.9 %) participants were classified to the "Dependent" group.

Participants classified to the different groups differed in the mean age ($p = 0.030$) (Table 2). Patients in the Anti-Vaccine group had an average age of 75.9 ± 8 years. Similarly, the Pro-Vaccine cohort age was 75.2 ± 8.9 years. Participants in the Dependent group were a bit younger, with a mean age of 70.7 ± 6.8 years.

Perceptions on COVID-19 and influenza vaccine risks and necessity

COVID-19 vaccine-related perceptions

The majority of the Anti-Vaccine group were of the opinion that the COVID-19 vaccine causes disease (71.7 %, 38/53), while most of the Pro-Vaccine group (97 %, 262/270) and the Dependent group (65/78, 83.3 %) disagreed with this statement ($p < 0.001$) (Table 3). Almost the entire Anti-Vaccine group thought that the COVID-19 vaccine was ineffective (98.1 %, 52/53), contrasting with the Pro-Vaccine and the Dependent groups where 7.4 % (20/270) and 38.5 % (30/78) participants had such thoughts ($p < 0.001$). The vast majority of the Anti-Vaccine group agreed that the COVID-19 vaccine was unsafe (94.3 %, 50/53), whereas the Pro-Vaccine group largely disagreed (93.3 %, 252/270), as well as most of the Dependent group (69.2 %, 54/78) ($p < 0.001$).

Most participants that belonged to the Pro-vaccine (84.8 %) and

Table 2

Demographics and lifestyle characteristics of influenza patients.

	Anti-Vaccine (N = 80)	Dependent on infection rate (N = 24)	Pro-Vaccine (N = 297)	Total (N = 401)	p Value
Age (years)					0.030
Mean (SD)	75.9 (8)	70.7 (6.8)	75.2 (8.9)	75.1 (8.7)	
Range	57–92	59–83	57–96	57–96	
Gender, n (%)					0.201
Female	33 (41.2)	12 (50)	156 (52.5)	201 (50.1)	
Male	47 (58.8)	12 (50)	141 (47.5)	200 (49.9)	
Religion, n (%)					0.251
Arab	29 (36.2)	6 (25)	122 (41.1)	157 (39.2)	
Jew	51 (63.8)	18 (75)	175 (58.9)	244 (60.8)	
Housing, n (%)					0.572
Nursing home	7 (8.8)	0 (0)	21 (7.1)	28 (7.0)	
Private home	72 (90)	24 (100)	270 (90.9)	366 (91.3)	
Sheltered housing	1 (1.2)	0 (0)	6 (2)	7 (1.7)	
Marital status, n (%)					0.237
Divorced	5 (6.2)	0 (0)	24 (8.1)	29 (7.2)	
Married	51 (63.8)	20 (83.3)	192 (64.6)	263 (65.6)	
Single	0 (0)	1 (4.2)	7 (2.4)	8 (2)	
Widower	24 (30)	3 (12.5)	74 (24.9)	101 (25.2)	

Table 3
Perceptions on COVID-19 vaccine risks and necessity among the elderly.

	Anti-Vaccine (N = 53)	Dependent on infection rate (N = 78)	Pro-Vaccine (N = 270)	Total (N = 401)	p Value
COVID-19 vaccine causes disease, n (%)					< 0.001
Agree	38 (71.7)	13 (16.7)	8 (3)	59 (14.7)	
Disagree	15 (28.3)	65 (83.3)	262 (97)	342 (85.3)	
COVID-19 vaccine is ineffective, n (%)					< 0.001
Agree	52 (98.1)	30 (38.5)	20 (7.4)	102 (25.4)	
Disagree	1 (1.9)	48 (61.5)	250 (92.6)	299 (74.6)	
COVID-19 vaccine is unsafe, n (%)					< 0.001
Agree	50 (94.3)	24 (30.8)	18 (6.7)	92 (22.9)	
Disagree	3 (5.7)	54 (69.2)	252 (93.3)	309 (77.1)	
COVID-19 vaccine protects the environment, n (%)					< 0.001
Agree	1 (1.9)	48 (61.5)	229 (84.8)	278 (69.3)	
Disagree	52 (98.1)	30 (38.5)	41 (15.2)	123 (30.7)	
COVID-19 vaccine is unnecessary, n (%)					< 0.001
Agree	29 (54.7)	21 (26.9)	35 (13)	85 (21.2)	
Disagree	24 (45.3)	57 (73.1)	235 (87)	316 (78.8)	

Dependent groups (61.5 %) agreed with the statement that the vaccine protects the environment, in contrast to only one (1.9 %) participant from the Anti-vaccine group.

Influenza vaccine-related perceptions

The vast majority of the Anti-Vaccine group thought that the influenza vaccine causes disease (86.2 %, 69/80), as well as 87.5 % (21/24) of the dependent group; in contrast, most the Pro-Vaccine group disagreed (99 %, 294/297) ($p < 0.001$) (Table 4). Almost the entire Anti-Vaccine group had concerns regarding vaccine's ineffectiveness (93.8 %, 75/80), in contrast to the Pro-Vaccine and Dependent groups where only 1 % (3/297) and 4.2 % (1/24) of the participants, respectively, had these concerns ($p < 0.001$). Significant differences were noted in the groups opinions regarding vaccine safety, environment protection and necessity ($p < 0.001$ for each question).

Vaccination side effects among the influenza patients with different vaccination attitudes

Fever was more commonly reported in the Anti-Vaccine group (30 %, 24/80) compared to the Dependent (12.5 %, 3/24) and the Pro-Vaccine (5.7 %, 17/297) groups ($p < 0.001$). Cough was more prevalent in the Dependent group (12.5 %, 3/24) compared to the Anti-Vaccine (7.5 %, 6/80) and Pro-Vaccine (3 %, 9/297) groups ($p = 0.034$). No significant differences in the rates of weakness, dry mouth, injection site pain or muscle pain were found across groups.

Table 4
Perceptions on influenza vaccine risks and necessity among the elderly.

	Anti-Vaccine (N = 80)	Dependent on Infection Rate (N = 24)	Pro-Vaccine (N = 297)	Total (N = 401)	p Value
Influenza vaccine causes disease, n (%)					< 0.001
Agree	69 (86.2)	3 (12.5)	3 (1)	75 (18.7)	
Disagree	11 (13.8)	21 (87.5)	294 (99)	326 (81.3)	
Influenza vaccine is ineffective, n (%)					< 0.001
Agree	75 (93.8)	1 (4.2)	3 (1)	79 (19.7)	
Disagree	5 (6.2)	23 (95.8)	294 (99)	322 (80.3)	
Influenza vaccine is unsafe, n (%)					< 0.001
Agree	68 (85.1)	1 (4.2)	3 (1)	72 (18)	
Disagree	12 (15)	23 (95.8)	294 (99)	329 (82)	
Influenza vaccine protects the environment, n (%)					< 0.001
Agree	11 (13.8)	10 (41.7)	266 (89.6)	287 (71.6)	
Disagree	69 (86.2)	14 (58.3)	31 (10.4)	114 (28.4)	
Influenza vaccine is unnecessary, n (%)					< 0.001
Agree	61 (76.2)	14 (58.3)	45 (15.2)	120 (29.9)	
Disagree	19 (23.8)	10 (41.7)	252 (84.8)	281 (70.1)	

Vaccination side effects among the COVID-19 patients with different vaccination attitudes

Fever was more commonly reported in the Dependent group (24.4 %, 19/78) compared to the Anti-Vaccine (9.4 %, 5/53) and Pro-Vaccine (7.4 %, 20/270) groups ($p < 0.001$). Cough was also more prevalent in the Dependent group (11.5 %, 9/78) compared to the Anti-Vaccine (1.9 %, 1/53) and Pro-Vaccine (3 %, 8/270) groups ($p = 0.003$). No significant differences in the rates of weakness, dry mouth, injection site pain or muscle pain were found across groups.

Testing results, hospitalization and general vaccination attitudes

COVID-19 vaccine queries

A significantly higher percentage of individuals in the Anti-Vaccine group (17 %, 9/53) had a positive COVID-19 test as compared to the Dependent (23.1 %, 18/78) and the Pro-Vaccine (6.7 %, 18/270) groups ($p < 0.001$).

A higher proportion of the Pro-Vaccine group (66.3 %, 179/270) had a history of COVID-19 compared to 45.3 % (24/53) of the Anti-Vaccine group and 60.3 % (47/78) of the Dependent group ($p = 0.014$). Similar numbers of individuals who experienced quarantine were seen across the Anti-Vaccine, Dependent and Pro-Vaccine groups (98.1 % (52/53), 96.2 % (75/78) and 94.4 % (255/270) respectively), with no inter-group significant differences in the number of quarantine duration (mean 2.3, 2.5 and 2.4 times in the Anti-Vaccine, Dependent and Pro-Vaccine group, respectively).

Most of the Pro-Vaccine group (95.9 %, 259/270) were supportive of vaccinations in general; lower rates of participants supportive of general

vaccinations were noted in the Anti-Vaccine group (37.7 %,20/53) and in the Dependent group (51.3 %, 40/78) ($p < 0.001$). (Fig. 1A).

In the Anti-Vaccine and the Dependent groups, 39.6 % (21/53), and 48.7 % (38/78) participants, respectively, were supportive of childhood vaccinations ($p < 0.001$).

Hospitalization rates were higher in the Pro-Vaccine (11.1 %, 30/270) and Dependent (16.7 %, 13/78) groups compared to the Anti-Vaccine group (1.9 %, 1/53) (Fig. 1C, $p = 0.029$). All individuals in both the Pro-Vaccine and the Dependent groups were vaccinated for COVID-19 while 52.8 % (28/53) of the individuals in the Anti-Vaccine were vaccinated (Fig. 1E, $p = <0.001$).

All individuals in the Anti-Vaccine group were opposed to receiving a fourth or fifth anti-COVID-19 vaccine dose. In contrast, the majority of the Pro-Vaccine group (63 %, 170/270) were willing, while the Dependent group was more hesitant, with 47.4 % (37/78) unsure and

only 7.7 % (6/78) expressing their willingness ($p < 0.001$). When asked about their willingness to routinely receive COVID-19 shots, 98.1 % (52/53) of the Anti-Vaccine group answered “No”, compared to 37.2 % (29/78) of the Dependent group and 3 % (8/270) of the Pro-Vaccine group ($p < 0.001$).

Influenza vaccine queries

All individuals in the Anti-Vaccine and Dependent groups and 99.7 % (296/297) of the Pro-Vaccine group tested negative for influenza B. A smaller percentage of the Pro-Vaccine group (6.1 %, 18/297) as compared to the Anti-Vaccine group (28.8 %, 23/80) tested positive for influenza A. The Dependent group had the lowest positivity rate (4.2 %, 1/24; $p < 0.001$). Moreover, high rates of influenza illness during the past 5 years were reported in the Dependent group (37.5 %, 9/24), while 26.9 % (80/297) of the Pro-Vaccine group (26.9 %, 80/297) and only

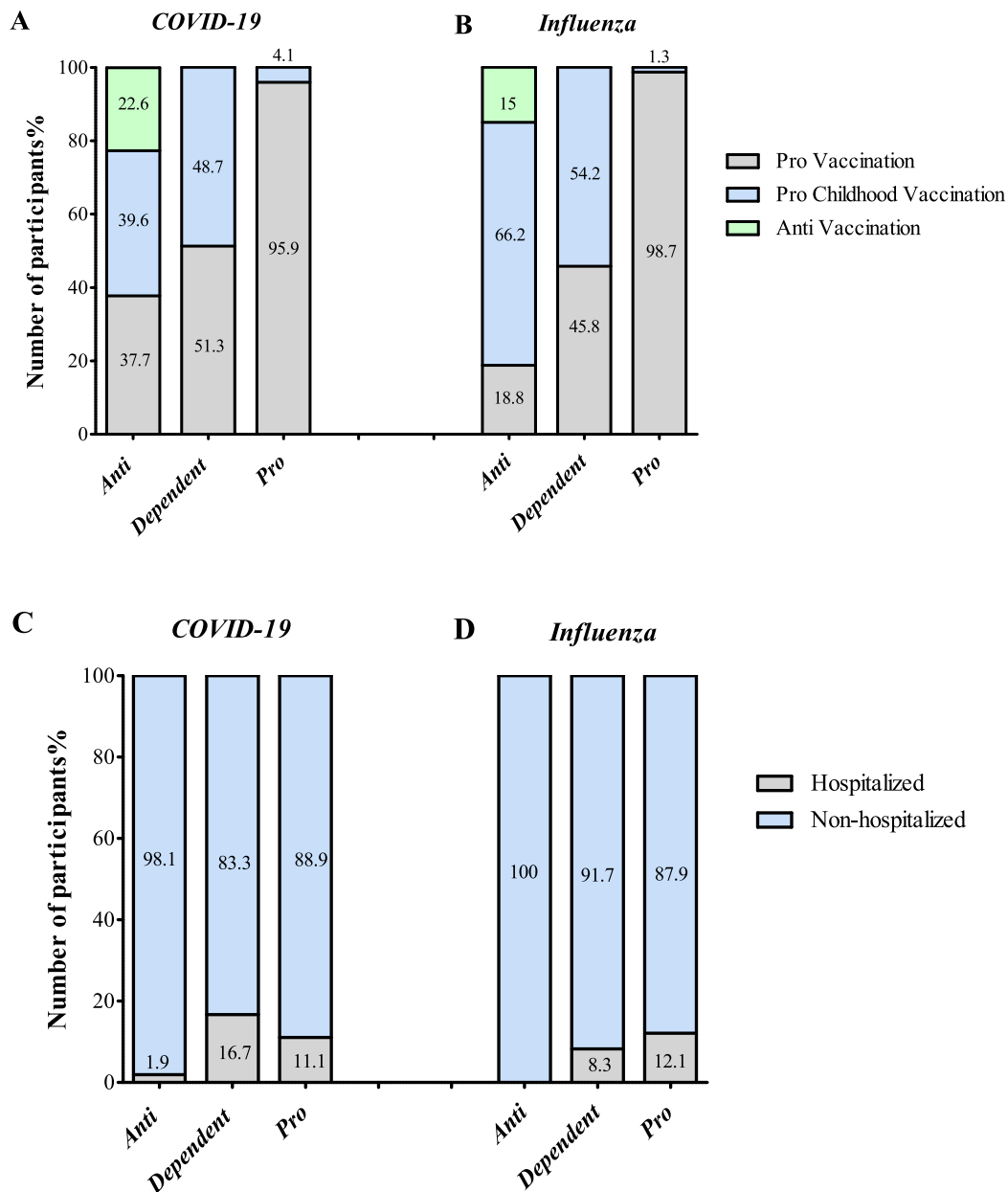


Fig. 1. Examination of associations between several factors to vaccination attitudes. Among the tested associations were the effect of general vaccination perspectives on (A) COVID-19 or (B) Influenza vaccine attitudes, the effect of hospitalization (C) due to COVID-19, or (D) due to influenza on COVID-19, or Influenza vaccine attitudes, respectively, and the effect of uptake of (E) COVID-19 vaccine or (F) Influenza vaccine on COVID-19 and Influenza vaccination attitudes, respectively.

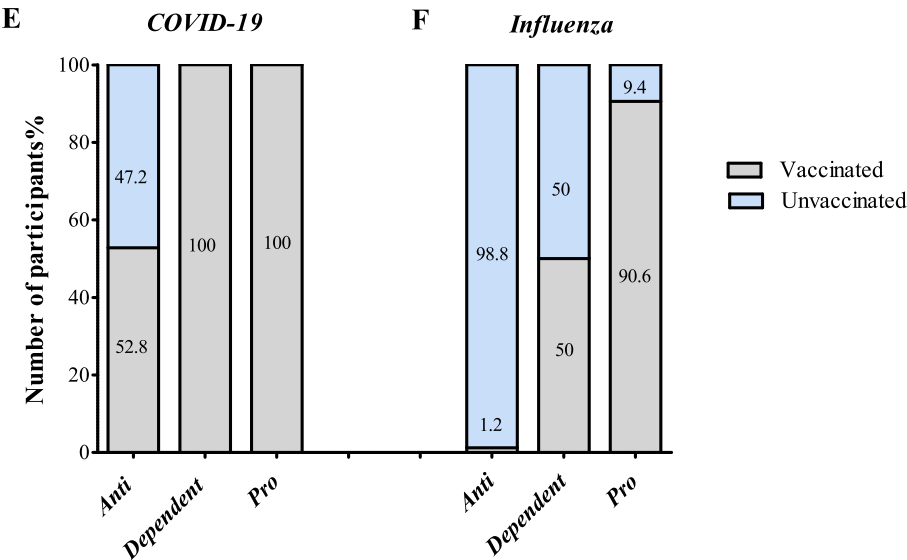


Fig. 1. (continued).

10 % (8/80) of the Anti-Vaccine group had recent history of influenza ($p < 0.001$). The majority of the Pro-Vaccine group had positive attitudes towards vaccination (98.7 %, 293/297), while 18.8 % of the Anti-Vaccine group was against it (15/80). The Dependent group showed mixed attitudes (p value < 0.001 , Fig. 1B). Hospitalization rates in the past 5 years were higher in the Pro-Vaccine (12.1 %, 36/297) compared to the Dependent group (8.3 %, 2/24); no hospitalizations were reported by individuals in the Anti-

Vaccine group ($p = 0.004$, Fig. 1D). Vaccination rate for influenza during the current year was 90.6 % (269/297) in the Pro-Vaccine group, while 50 % (12/24) and 1.2 % (1/80) of the individuals in the Dependent and the Anti-Vaccine groups, respectively, were vaccinated for influenza ($p < 0.001$, Fig. 1F).

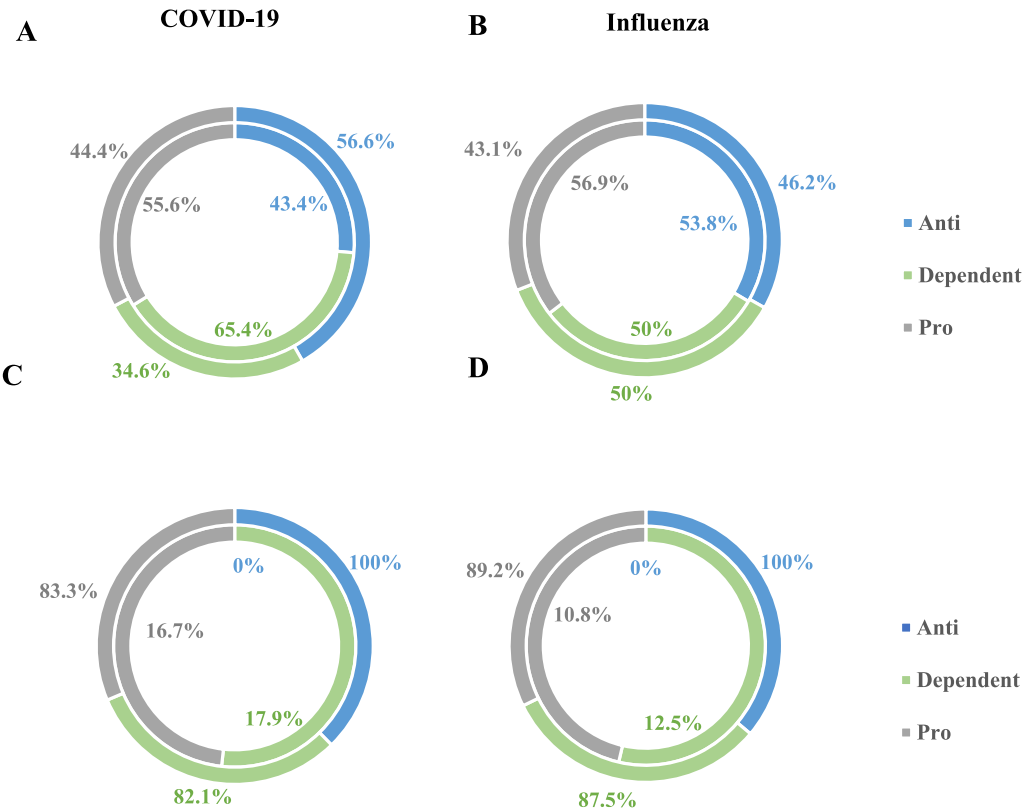


Fig. 2. Vaccination attitudes of participants, according to their experience with vaccine side effects and related deaths. In A-B, the inner circle represent the proportion of participants who reported they experienced side effects from the (A) COVID-19 vaccine or the (B) influenza vaccine. The outer circle represent the participants who reported they did not experienced side effects. In C-D, the inner circle represent the portion of participants who reported on a relative's death due to (C) COVID-19 or (D) Influenza, respectively. The outer circle represents participants that did not report on a relative death.

Perceptions of COVID-19/influenza vaccine side effects, related deaths, informational sufficiency, and vaccine endorsement

COVID-19 vaccine queries

The Anti-Vaccine group reported on a lower incidence of side effects (43.4 %, 23/53) compared to the Dependent (65.4 %, 51/78) and Pro-Vaccine groups (55.6 %, 150/270) ($p = 0.045$; Fig. 2A). All participants in the Anti-Vaccine group reported no COVID-19-related deaths among relatives, while a notable percentage of the Dependent (17.9 %, 14/78) and Pro-Vaccine (16.7 %, 45/270) groups reported on mortality among relatives ($p = 0.005$; Fig. 2C). The Anti-Vaccine group unanimously would not recommend the vaccine. In contrast, in the Dependent group, 37.2 % (29/78) were willing to recommend it, compared to 60.4 % (163/270) in the Pro group ($p < 0.001$). Lastly, the vast majority of both the Dependent (74.4 %, 58/78) and Pro-Vaccine (74.4 %, 201/270) groups believed they received sufficient information about the vaccine, while only 67.9 % (36/53) of the Anti-Vaccine group had similar impressions. A similar percentage of each group felt they had received partial information about the vaccine (20.5 %, 24.1 % and 24.5 % of the Dependent, Pro-Vaccine and Anti-Vaccine groups, respectively, while only a small fraction of each group reported receiving insufficient information (5.1 %, 1.5 % and 7.5 %, respectively; Fig. 3A).

Influenza vaccine queries

A 53.8 % (43/80) incidence of side effects was reported in the Anti-Vaccine group, compared to 50 % (12/24) and 56.9 % (169/297) in the Dependent and the Pro-Vaccine groups, respectively (Fig. 2B). All participants in the Anti-Vaccine group reported no deaths from influenza among relatives, while a small percentage of the Dependent (12.5 %, 3/24) and Pro-Vaccine (10.8 %, 32/297) groups had influenza-related mortality in their family ($p = 0.008$; Fig. 2D). Moreover, 98.8 % (79/

80) of the Anti-Vaccine group would not recommend the vaccine ($p < 0.001$). Lastly, the majority of both the Dependent (54.2 %, 13/24) and Pro-Vaccine (56.2 %, 167/297) groups believed they had received sufficient information about the vaccine, while only 25 % (20/80) of the Anti-Vaccine group had similar impressions. Receipt of partial information about the vaccine was reported by 33.3 % of the Dependent group (8/24), 35 % of the Pro-Vaccine group (104/297), and 18.8 % of the Anti-Vaccine group (15/80). The majority of the Anti-Vaccine group 56.2 % (45/80) felt it had received insufficient information about the vaccine, while only 12.5 % (3/24) of the Anti-Vaccine group and 8.8 % (26/297) of the Pro-Vaccine group felt this way ($p < 0.001$; Fig. 3B).

Sources of vaccine information

Sources of information regarding the COVID-19 vaccine varied (Fig. 4A). Nurses were the source for 85.8 % (344/401) of participants, the internet for 33.4 % (134 /401), television for 79.8 % (320 /401), radio for 45.4 % (182/401), physicians for 39.4 % (158 /401), and other sources for 64.6 % (259/401). The distribution of information sources was slightly different for the influenza vaccine (Fig. 4B). Nurses informed 88 % of the study population (353/401), the internet reached 23.7 % (95/401), television 25.7 % (103/401), radio 19.5 % (78/401), physicians 31.4 % (126/401), and other sources 58.6 % (235/401).

Hospitalization impact on vaccine attitudes in influenza and COVID-19 patients

According to the follow-up questionnaire, the majority of patients who changed their attitude towards the COVID-19 or the influenza vaccines were hospitalized for 3–5 days (68.2 %, 15/22). The majority of patients in both sub cohorts did not experience complications during hospitalization (Table 5).

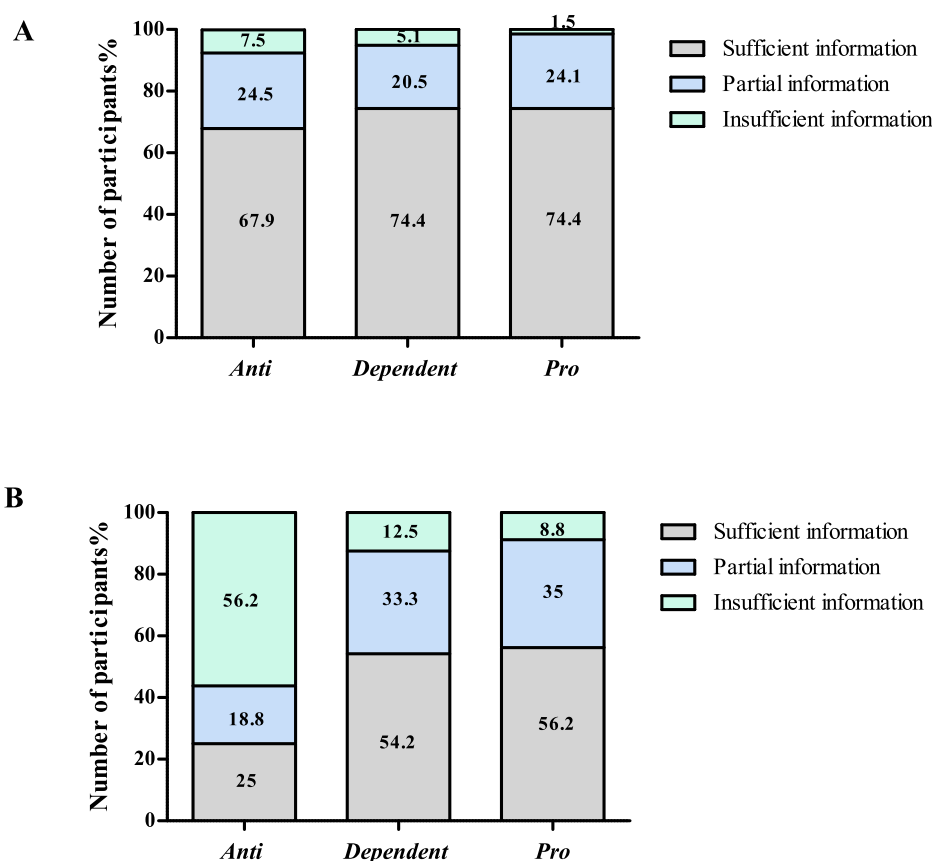


Fig. 3. Vaccination attitudes of participants, according to their perceptions of information regarding the vaccine. Participants were asked whether they got sufficient data regarding the (A) COVID-19 and (B) influenza vaccine, and categorized according to the different study group (Anti, Pro and dependent).

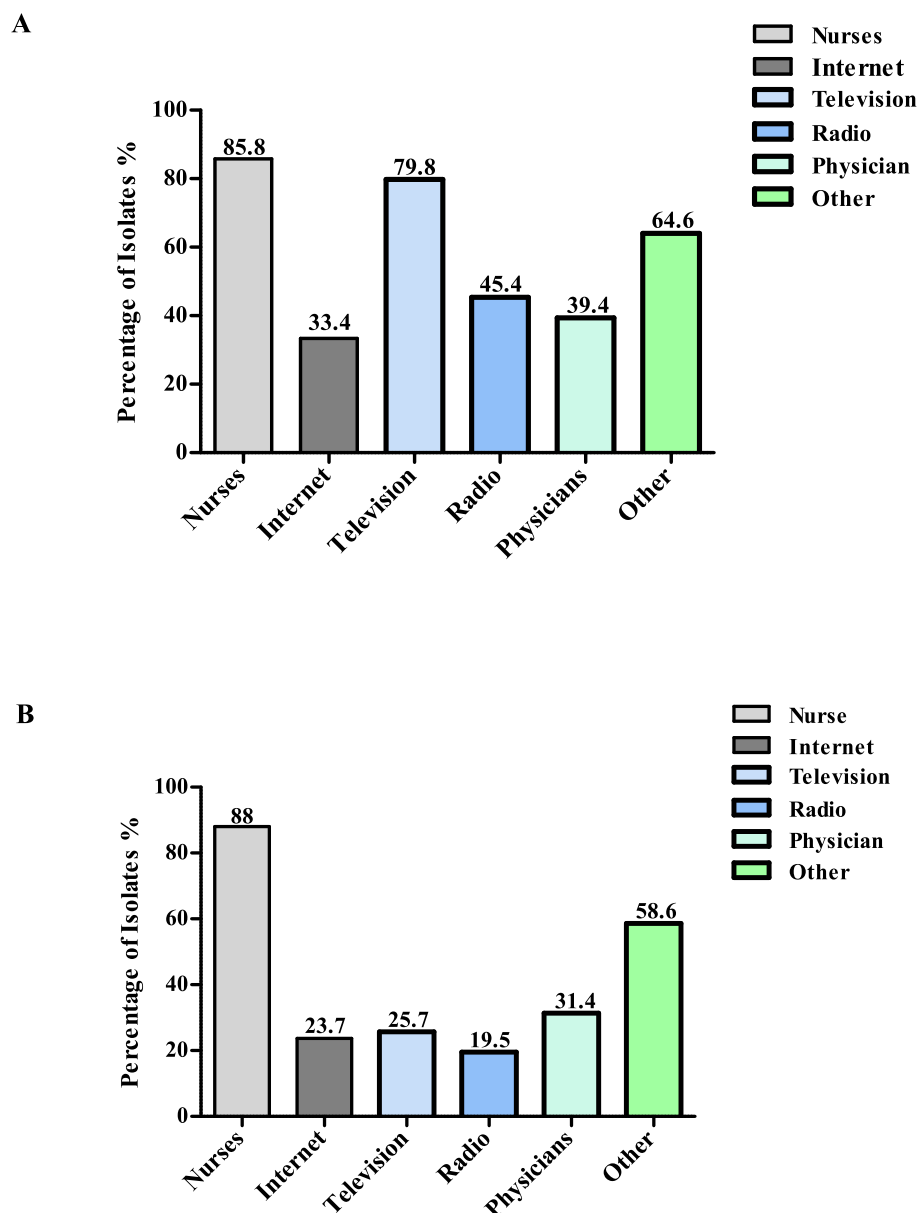


Fig. 4. Sources of vaccine information among (A) COVID-19 attitude groups, (B) influenza attitude groups.

Table 5

Impact of hospitalization on COVID-19 and influenza vaccine attitudes among elderly patients.

	Unchanged (N = 24)	Changed (N = 22)	Total (N = 46)	p
Complications, n (%)				0.775
No	20 (83.3)	19 (86.4)	39 (84.8)	
Yes	4 (16.7)	3 (13.6)	7 (15.2)	
Hospitalization time, n (%)				0.541
Less than 3 days	1 (4.2)	0 (0.0)	1 (2.2)	
3–5 days	17 (70.8)	15 (68.2)	32 (69.6)	
7 days	5 (20.8)	4 (18.2)	9 (19.6)	
More than 7 days	1 (4.2 %)	3 (13.6 %)	4 (8.7 %)	

Discussion

This study explored the attitudes of the elderly population in Israel towards the COVID-19 and influenza vaccines, and uncovered

significant insights that are crucial for public health strategies. The data indicated a varied response among the elderly, influenced by several factors such as prior health experiences and general perceptions of vaccine efficacy and safety.

Age is a significant risk factor for severe symptoms of COVID-19 [19]. Hence, the elderly and people with chronic health conditions were given priority for COVID-19 vaccination [20]. However, research on vaccine attitudes among older individuals has found that older people tend to be more hesitant and likely to refuse vaccines [21]. For example, a Hong Kong study [22] reported lower vaccine uptake in those over 80, contrasting with higher rates in younger seniors, suggesting increased hesitancy or access issues with advancing age. In contrast, the current work found that the average age of participants in the Pro-Vaccine was higher as compared to the Anti-Vaccine group (76 years vs. 72.9 years). Similarly, a study in southern Switzerland [23] revealed more positive attitudes toward vaccines among the elderly. Overall, these studies highlight the complexity of vaccine attitudes and the need for tailored public health strategies to address the varied concerns and needs of the older populations in different regions.

Our data suggest that there might be a correlation between comorbidities/chronic health conditions and the attitudes of elderly individuals towards the COVID-19 vaccine. The majority of study participants (51.9 %) were dealing with vascular diseases. Other common comorbidities included diabetes and renal failure, respectively affecting 39.2 % and 27.2 % of those surveyed. Hesitancy among respondents with comorbidities could be linked to a fear of vaccine-induced adverse effects, a sentiment echoed in research from Hong Kong where older adults with existing health issues feared potential fatal consequences from the vaccine, which affected their inclination to get vaccinated [24]. The present analysis also suggested that the experience of side effects plays a role in the stance of individuals in the Anti-Vaccine group against the COVID-19 vaccine. Furthermore, despite most of this group felt sufficiently informed, they were unanimously against recommending the vaccine. It was also notable that none of them had lost a relative to COVID-19, which might have influenced their perception of the risk of the disease and the need for vaccination. A systematic review studying factors influencing COVID-19 vaccine acceptance vs. refusal, suggested that safety concerns were the most significant factor, followed by worries about side effects and efficacy [25]. Similar conclusions were reached by Haeder and colleagues, in their study conducted in 2023 [26]. All these findings combined, underscore the complexity of vaccine hesitancy and acceptance, and highlight the need for tailored communication strategies that address specific health concerns, combat misinformation, and provide clear, evidence-based information on the benefits and risks of vaccination for vulnerable populations.

This research also demonstrated how personal experiences with COVID-19, such as associated illness or hospitalization, or death of a family member, significantly shape vaccination views. Individuals personally affected by the virus showed a heightened willingness to be vaccinated. A study by Zarębska-Michaluk and colleagues reported similar findings by showing that personal experience with severe COVID-19 and associated hospitalization influenced perceptions on vaccination, especially among previously unvaccinated individuals [27]. In light of these diverse perspectives, it is clear that understanding vaccine attitudes among the elderly requires a multifaceted approach, taking into account personal health histories and the influence of direct experiences with COVID-19. This complexity could be further compounded by the dynamic nature of the pandemic, where new variants and changing public health guidelines can shift perceptions and attitudes.

Regarding the influenza vaccine, the present work found that 19.95 % of the population was against the influenza vaccine (Anti-Vaccine) and an additional 6 % were hesitant (Dependent), reflecting widespread reservations among the elderly towards influenza vaccination. A Chinese national survey found that 37.18 % of elderly individuals were hesitant to receive influenza vaccine, with 19.3 % expressing reservations and 17.9 % outright refusal [28]. A research on elderly perceptions towards influenza vaccination in Ontario reported 21.2 % of the participants did not plan to get vaccinated [29]. These findings indicate a significant level of reservation among the elderly towards influenza vaccination.

While 67.3 % of the current study's participants were pro COVID-19 vaccine, 74.1 % were pro influenza vaccine, possibly due to its longer availability and resulting familiarity. Conversely, another Israeli study showed a preference for the COVID-19 vaccine, with concerns about the influenza vaccine's side effects and effectiveness [30]. In a study from Ontario, lower percentage of the participants accepted the importance of influenza vaccine, as compared to COVID-19 vaccine (75.8 % vs. 90.9 %). Similarly, influenza vaccine was thought to be effective by 72.7 % of the participants, as compared to the COVID-19 vaccine, that was perceived as effective by 93.9 % of the participants [29]. In the current study, the majority of the Anti-Vaccine group thought the influenza vaccine was ineffective and unsafe, while only few participants of the Pro-Vaccine group had such an opinion. Similarly, a previous study from Ontario found that higher percentage of the influenza-vaccinated

participants agreed on the vaccine's benefits and safety, as compared to the non-vaccinated group [29].

Another factor that may have affected participants' willingness to be vaccinated in the current cohort is a previous illness. Lower rates of infection with influenza during the last 5 years were noted in the group of Anti-Vaccine, as compared to the Pro-Vaccine group. Additionally, the Anti-Vaccine group had no hospitalizations during the past 5 years, while 12.1 % of the Pro-Vaccine group has been hospitalized. Furthermore, while participants of the Anti-Vaccine group had no experience with a relative death due to influenza, both the Dependent and Pro-Vaccine group reported on influenza-associated death among relatives. Similarly, a study that investigated factors associate with refusal to get COVID-19 vaccine among the Saudi Population, found that a previous diagnosis with COVID-19 was linked to a lesser extent of refusal to vaccination [31]. These findings suggest that personal experience of illness and/or mortality of a relative positively affect vaccination attitude.

Receipt of sufficient data regarding the vaccine is an important factor in vaccine attitudes, as higher percentage of participants from the Anti-Vaccine group felt they got insufficient information about the influenza vaccine, as opposed to participants in the two other groups. The impact of information on vaccination willingness was also recognized in a study from Ontario, which reported that vaccine uptake was positively affected from getting governmental information [29].

This factor is not limited to the elderly; a previous study among college students identified limited information as one of the 3 biggest effectors associated with COVID-19 and influenza vaccine hesitancy [32].

Information regarding vaccines can be received from various sources such as healthcare professionals and media. In the present study, nurses were found to be the most common source of information for the elderly. A cross-sectional survey among the elderly of North Dakota found a preference to rely on medical experts than informal sources or public outlets for vaccine-associated data [32]. Furthermore, a link was found between a greater reliance on medical experts and a more positive attitude towards vaccines [33].

A research in Hangzhou found that seniors were willing to accept influenza vaccines but lacked trust in health systems [34], underscoring the need for enhanced public health education. Correspondingly, over 85 % of the elderly depended on nurses, who are trusted by the public, for information on COVID-19 and influenza vaccines, underscoring crucial role played by healthcare professionals, particularly nurses, in disseminating vaccine-related information [35].

A significant difference in media consumption was found between groups seeking information on COVID-19 vs. influenza vaccines in the current cohort; 79.8 % of the COVID-19 group as opposed to only 25.7 % of the influenza group relied on television. There was also a notable disparity in radio source, with 45.4 % of the COVID-19 group depending on the radio for information compared to only 19.5 % in the influenza group. This disparity may stem from the more extensive coverage of COVID-19 vaccination programs by the media, reflecting its global impact and the perceived urgency and novelty of the pandemic, which likely led to a greater dependence on television and radio as real-time information sources. Taken together, mass media, along with digital inclusion, play a crucial role in effectively disseminating public health messages to the broader community, with the latter particularly enhancing the pursuit of health-related information [36,37].

Comparison of participants attitudes to COVID-19 and influenza vaccines in the current analysis showed that higher percentage of the influenza's Anti-Vaccine group thought the disease could cause a disease and is unnecessary (86.2 % and 76.2 %, respectively), as opposed to COVID-19's Anti-Vaccine group (71.7 %, and 54.7 %, respectively). Additionally, 85 % of the influenza's Anti-Vaccine group agreed the influenza vaccine is unsafe, as compared to 94.3 % of the COVID-19's Anti-Vaccine group. These findings may result from the more prolonged experience of people with influenza vaccine and its associated outcomes,

as opposed with the COVID-19 vaccine, which is new. Moreover, participants were familiar with influenza illness and outcomes, which are not always severe, as opposed to the acquaintance with COVID-19 infection, which has just recently emerged, and its pathogenesis have been evolved rapidly. Thus, it is possible that participants were more afraid of being infected with COVID-19, than with influenza. A previous study that investigated health beliefs and attitudes toward influenza and COVID-19 vaccination in Portugal indicated similar findings; both perception of COVID-19-associated severity and fear of the infection outcomes were high among participants. In contrast, influenza was less considered as health threat by the participants [38]. Interestingly, a recent systematic literature review indicated on increased influenza vaccination rates among adults during the COVID-19 pandemic, as compared to previous years [39]. Some of the factors that were associated with change in intention to be vaccinated were older age, fear of being infected with COVID-19, change in the perception of vaccine importance, and higher perception of susceptibility to COVID-19 [39].

Another interesting result in the current study was that although most of the COVID-19's Anti-Vaccine group had concerns regarding the vaccine's safety, 52.8 % were vaccinated, as opposed to 1.2 % of the influenza's Anti-Vaccine group, which were influenza- vaccinated. This may be linked to another result according to which 67.9 % of the COVID-19's Anti-Vaccine group thought they have received sufficient data regarding the vaccine, while only 25 % of the influenza's Anti-Vaccine group thought the same regarding the influenza vaccine. As mentioned earlier, due to the global impact and large extent of COVID-19 pandemic, COVID-19 vaccination programs were extensively covered by the media and healthcare providers, and this could have affect the participants opinion regarding receipt of sufficient data.

The present analysis noted a significant connection between past refusals of vaccines, including childhood vaccines, and reluctance to receive both the COVID-19 and influenza vaccines. Similarly, a previous study from Ontario associated general vaccination attitudes with the status of vaccination against influenza; positive thoughts regarding the vaccine's safety and effectiveness were more common among individuals, which received/ intended to receive the vaccine, as compared to the unvaccinated group [29]. This suggests that influenza vaccine hesitancy might reflect a broader mindset of opposition to vaccinations in general [39]. Understanding this link is crucial for developing targeted strategies to overcome vaccine hesitancy and encourage vaccine uptake, particularly among the elderly.

In examining the attitudes towards both vaccines, those holding an anti-vaccine stance for both COVID-19 and influenza exhibited skepticism, although the underlying reasons appeared to differ. For COVID-19, the majority of participants believed that they were well informed yet remained steadfast in their opposition, suggesting deeper reasons such as personal beliefs or concerns regarding vaccine efficacy and safety. Conversely, those opposing the influenza vaccine expressed a perceived inadequacy of information, indicating that improving communication might have a more substantial impact on their stance. Overall, the strong opposition to vaccination for both diseases highlights a deep-rooted resistance that needs to be addressed through specialized public health strategies.

Lastly, this research shed light on the impact of hospitalization on vaccine attitudes. Almost half of the participants who had been hospitalized due to COVID-19 or influenza shifted their stance on vaccination from opposing to supporting it, with most hospitalizations lasting between 3 and 5 days. Similarly, a study by Zarebska-Michaluk and colleagues [26] exploring the impact of hospitalization on COVID-19 vaccination attitudes, showed that a significant number of patients (66 %) regretted not getting vaccinated earlier, 64 % expressed a desire to advocate for COVID-19 vaccination following their discharge, and 69.5 % planned to get the COVID-19 vaccine as recommended for those recovering from the illness.

Conclusions

This study underscored the significant disinclination among the elderly for vaccination, reflecting a deep and ingrained hesitancy. However, the process of making a decision about vaccination is multifaceted, encompassing a variety of contextual and psychosocial elements and their interplay, which cannot be fully understood through questionnaire-based surveys. This highlights the importance of undertaking qualitative research to comprehensively investigate the factors influencing the vaccination decisions of older adults and to understand how these factors contribute to their ultimate choice regarding vaccination.

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CRediT authorship contribution statement

Odai Abu Aid: Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Hanan Rohana:** Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation, Formal analysis, Data curation. **Maya Azrad:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Project administration, Methodology, Investigation, Formal analysis, Data curation. **Avi Peretz:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Conceptualization.

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.

Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jvaxc.2024.100569>.

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