COVID-19 pandemic impact on seasonal flu vaccination: A cross-sectional study

Ioannis Kopsidas[1], Evangelia Chorianopoulou[1], Eleni Kourkouni[1], Christos Triantafyllou[1], Nafsika-Maria Molocha[1], Markela Koniordou[1], Stefania Maistreli[1], Christina - Grammatiki Tsopela[1], Stefania Maroudi-Manta[1], Dimitrios Filippou[2], Theoklis E. Zaoutis[1,3], Georgia Kourlaba[1,4]

ABSTRACT

INTRODUCTION Vaccination against the flu is the best method for the prevention of illness by influenza viruses. The objective of this study was to assess the impact of the COVID-19 pandemic on the seasonal influenza vaccination attitudes in Greece and to identify factors associated with a positive change in participants' choice to vaccinate against the flu.

METHODS This is a sub-analysis of a cross-sectional nationwide survey (n=1004) that was conducted between 28 April and 3 May 2020 using a mixed methodology for data collection: computer assisted telephone interviewing (CATI) and computer assisted web interviewing (CAWI). Sampling followed a proportionate, stratified by region, systematic procedure to ensure a nationally representative sample of the urban/rural population. Data were collected using a structured questionnaire consisting of four parts: 1) demographics; 2) knowledge about COVID-19; 3) attitudes toward COVID-19; and 4) practices to control COVID-19 and vaccination against the flu.

RESULTS Of the respondents, 66.3% (n=665) had not been vaccinated for seasonal influenza during the 2019–2020 season, the period prior to the COVID-19 pandemic. However, of those, 21.8% showed willingness to receive the vaccine (n=145) the upcoming flu season 2020–2021. Factors independently associated with increased intention to vaccinate in those that had not been vaccinated the previous flu season included: age ≥65 years; the belief that vaccination against the flu is considered preventive against the spread of the coronavirus; not believing that coronavirus was man-made in a laboratory; and not believing that the pandemic will end once a large percentage of the population is infected.

CONCLUSIONS Factors that shift public opinion in favor of seasonal flu vaccination can be utilized to design effective strategies to increase vaccination uptake.

ABBREVIATIONS COVID-19: coronavirus disease 2019; CATI: computer assisted telephone interviewing; CAWI: computer assisted web interviewing; KAP: knowledge, attitudes, and practices.

AFFILIATION
1 Center Clinical Epidemiology and Outcomes Research (CLEO), Athens, Greece
2 Department of Anatomy and Surgical Anatomy, School of Medicine, National and Kapodistrian University of Athens, Athens, Greece
3 Department of Pediatrics, Division of Infectious Diseases at Children's Hospital of Philadelphia, Perelman School of Medicine at the University of Pennsylvania, Philadelphia, United States
4 ECONCARE - Health Research & Consulting, Athens, Greece

CORRESPONDENCE TO
Christos Triantafyllou. Center of Clinical Epidemiology and Outcomes Research (CLEO), Chatzigianni Mexi 5, 11528, Athens, Greece. E-mail: c.triantafyllou@cleoresearch.org

KEYWORDS
COVID-19, flu vaccination, infectious diseases, general population, Greece

Received: 10 March 2021
Revised: 8 April 2021
Accepted: 13 April 2021

INTRODUCTION

Seasonal influenza is an acute respiratory infection caused by influenza viruses[1]. It is considered one of the major global infectious disease challenges and is associated with high morbidity and mortality in the elderly, often resulting in months of hospitalization[2,3]. The World Health Organization (WHO) estimates that 0.29 million to 0.65 million people annually die due to flu-related causes worldwide[4] and it has been identified as the disease with the highest burden, with 81.8 DALYs per 100000 population[5].

Vaccination against the flu is the best tool for prevention against seasonal infection but remains inadequate[6,7]. In Europe, the last available data regarding vaccination coverage refers to the 2015–2016, 2016–2017 and 2017–2018 influenza seasons, and on average is 47.1% (range: 2.0–72.8) in the elderly, 30.2% (range: 15.6–63.2) in healthcare workers (HCWs), 44.9% (range: 15.7–57.1) in patients with chronic medical conditions, and 25% (range: 0.5–58.6) in pregnant women[8]. In general, a vaccine effectiveness of about 30–60% has been estimated for the three different influenza A (H1N1, H3N2) and B strains (Victoria or Yamagata lineages)[9]. However, the elderly may be insufficiently protected by vaccination due to the immunosenescence which accompanies aging[10]. The seasonal flu vaccine is changed every year to keep up with the three strains of the virus that research suggests will be most common in the upcoming flu season[9]. For this reason, it is necessary to get a new vaccine every year to stay safe.

Influenza vaccination coverage in the Greek population was 32.5% in 2013–2014[11], and 56.6% among the elderly in 2018[12]. Even among HCWs, vaccination uptake is low. Only 18% of HCWs in acute care hospitals and 34.6% in primary healthcare centers vaccinated for seasonal influenza in 2016–2017[13]. The national influenza vaccination program that is implemented in Greece is presented in Supplementary file A.

The recent COVID-19 pandemic has already affected the lives of millions of people worldwide. More than 76 million people have been diagnosed with COVID-19 worldwide with over 1.6 million related deaths since December 2020[14-16]. SARS-CoV-2 spreads easily, and the majority of the world population remains vulnerable due to the unavailability of vaccination and possible effective treatment[17-19]. Influenza vaccination could be an effective strategy to reduce the severity of the COVID-19 disease in the general population, but data is limited[20]. The aim of our study was to assess the impact of the SARS-CoV-2 pandemic on the seasonal influenza vaccination attitudes in Greece and to identify factors associated with a positive change in participants' choice to vaccinate against the flu.

METHODS

Study design and study participants

This is a sub-analysis of a cross-sectional survey that was conducted across Greece, between 28 April and 3 May 2020 (last week of lockdown) to assess the knowledge, attitudes and practices (KAP) of the Greek general adult population against COVID-19. In order to select a representative sample of the urban/rural population, a proportionate stratified by region systematic sampling procedure was used based on the distribution of the population according to the census of 2011 (www.statistics.gr). To ensure the external validity and the greater generalizability of the study, survey weights were used to adjust for differences in age and gender distribution between survey sample and country population as obtained from the census 2011 (www.statistics.gr). The survey weights were calculated with the rake method (also known as 'rim').

Data collection included both computer assisted telephone interviewing (CATI) and computer assisted web interviewing (CAWI). Participants reached 1004 adults (50% through CATI and 50% through CAWI). Respondents' consent was taken before the interview and participants were assured of confidentiality and anonymity. It was not deemed necessary to submit the study for an ethics approval as per Greek legislation (Association of Opinion Polls and Survey Organizations - www.sedea.gr).

Data collection

A structured questionnaire was developed consisting of four parts: 1) demographics (participants' sociodemographic information); 2) knowledge about COVID-19; 3) attitudes toward COVID-19; and 4) practices to control COVID-19 and vaccination against the flu. Completion time was approximately 9–12 minutes. Three independent reviewers pre-validated the questionnaire, and 6 individuals were used to pre-test the study (responses were not included in the analyzed data).

Knowledge about COVID-19 was assessed by 23 questions. Assigning 1 point to each correct answer led to a total knowledge score ranging from 0 to 23. The answers considered correct are presented in Supplementary file B. A higher score indicated better knowledge. Cronbach's alpha coefficient was used to assess the internal consistency of the questions used in the total score and it was found to be 0.580, indicating 'poor' internal reliability. Participants' source of information about COVID-19 was also stated.

Attitudes towards COVID-19 were measured through 8 questions and practices relevant to COVID-19 control were measured through 7 questions. Among the practices assessed was whether participants had received a flu vaccine the previous season (2019–2020) and their intention to vaccinate against the flu the next season (2020–2021) with responses options: 'yes', 'no' and 'don't know'.

Definitions

In this study, participants were considered to belong to a vulnerable group if they:

- were aged ≥65 years;
- were pregnant;
- had diabetes mellitus;
- had chronic respiratory disease;
- had chronic cardiac disease; and
- were immunocompromised.

Statistical analysis

Participant responses are presented with absolute and relative frequencies (%) as well as graphically with bar charts, whereas knowledge score is presented with median and interquartile range (IQR). The chi-squared test of independence was used to identify possible factors (demographics, knowledge, attitudes and practices against COVID-19) associated with participants' intention to get vaccinated against the flu next season, even though they had not vaccinated during the previous season.

Multiple logistic regression was performed to estimate the impact of those factors on the probability of the same group of participants' getting vaccinated against the flu. Results are presented with odds ratios (ORs) and 95% confidence intervals (CIs). The level of statistical significance was set to 5%. Analysis was conducted with SPSS statistical package v.25.

RESULTS

Characteristics of participants

In total, 1004 adults responded to the survey with mean age 41.7 years (SD: 17.7). Sociodemographic characteristics of the sample are presented in Supplementary file C. Indicatively, 51.0% were female, 59.8% had college or above education level, 63.8% were married or cohabiting, 31.6% had children, and 52.0% reported that they worked before COVID-19 measures were taken. Almost half of respondents reported that they belong to a vulnerable group or they were living with someone belonging to a vulnerable group. Of the participants, 4.1% (41) were healthcare professionals (9 doctors, 10 nurses, and 20 other healthcare professionals).

Participants' flu vaccination during the 2019–2020 season and intention to vaccinate in the upcoming season

Study participants stated that during the 2019–2020 flu season, 32.6% had received a flu vaccine (n=327) vs 66.3% that did not (n=665). However, the intention to get a flu vaccine the upcoming flu season (2020–2021) was higher at 45.3% (n=455), and the intention not to get vaccinated was lower at 40.6% (n=407).

Figure 1 presents the distribution of participants' decision on vaccination against the flu for the next season stratified by vaccination status of the previous season. Almost all (97.6%) previously vaccinated respondents were consistent in again being vaccinated against the flu and only 2.4% expressed uncertainty about what they would do next. In contrast, previously unvaccinated respondents seemed less adamant about not vaccinating again. Only 59.5% stated that they do not intend to vaccinate next season (n=396), while 21.8% expressed that they would be willing to vaccinate the next season after all (n=145). The remaining 18.8% (n=125) were 'unsure' about their decision to get vaccinated in the next season, at the time of the survey.

Factors associated with change in participants' intention to vaccinate against the flu

We examined the group of participants that intended to vaccinate the following season, despite not having been vaccinated during the previous season, in greater detail (N=665). Their sociodemographic characteristics are presented in Table 1. Elderly participants (aged ≥65 years) (OR=1.90; 95% CI: 1.12–3.22, p=0.017), those who were married/cohabiting (OR=1.64; 95% CI: 1.06–2.53, p=0.025) and divorced/widowed (OR=2.71; 95% CI: 1.38–5.33, p=0.004), were significantly more likely to have a positive change in their decision to vaccinate against the flu over their counterparts.

We also looked at this group's knowledge on symptoms, transmission routes and prevention /control measures against COVID-19 (Table 2). Participants who knew the symptoms of COVID-19 (OR=1.71; 95% CI: 1.17–2.50, p=0.005), those who think that vaccination against the flu is considered a preventative measure against the spread of the coronavirus (OR=2.84; 95% CI: 1.74–4.64, p=0.001) and those who knew the appropriate way of handwashing with soap and water (OR=1.46; 95% CI: 1.01–2.12, p=0.043) were also significantly more likely to upwardly change their intent to vaccinate against the flu.

Associations between the participants' attitudes and practices towards COVID-19 and their intention to get vaccinated against the flu the following season (while they had not in the previous season) are presented in Table 3. Participants believing that the SARS-CoV-2 virus was

Figure 1. Distribution of participants' decision for vaccination against the flu next season

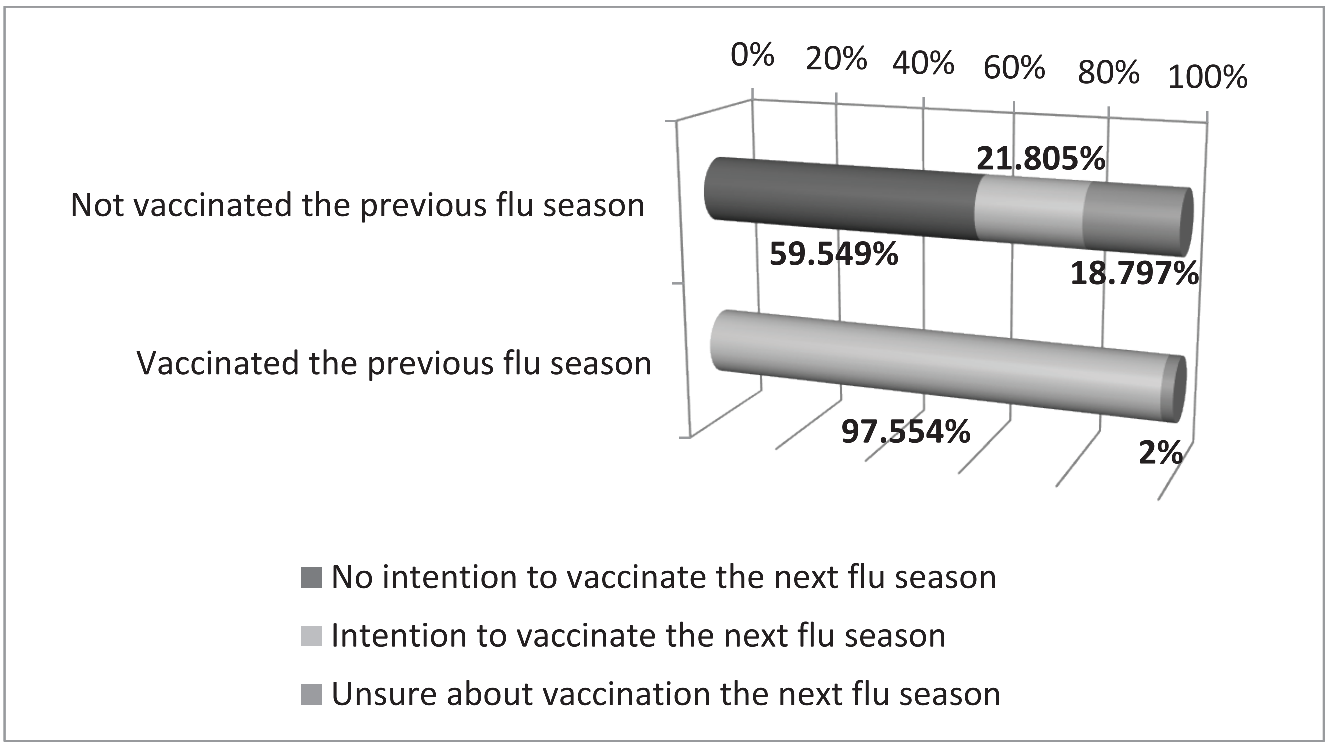

Table 1. Associations between demographic characteristics and flu vaccination for next season, for those who were not vaccinated during the 2019–2020 season (N=665)

Characteristics		Intension to vaccinate against the flu next season			
	Total n (%)	No/don't know (N=520) n (%)	Yes (N=145) n (%)	p	OR (95% CI)§
Gender				0.479	
Male	332 (49.8)	263 (79.3)	69 (20.7)		1.00
Female	334 (50.2)	257 (77.1)	77 (22.9)		1.14 (0.79–1.65)
Age (years)				**0.035**	
18–24	77 (11.5)	67 (87.3)	10 (12.7)		1.00
25–34	140 (21.0)	114 (81.4)	26 (18.6)		1.57 (0.71–3.49)
35–44	151 (22.7)	119 (78.7)	32 (21.3)		1.87 (0.86–4.05)
45–54	136 (20.4)	108 (79.4)	28 (20.6)		1.78 (0.81–3.93)
55–64	89 (13.3)	63 (71.7)	25 (28.3)		2.71 (1.20–6.14)*
≥65	73 (11.0)	49 (67.2)	24 (32.8)		3.36 (1.46–7.71)*
Age (years)				**0.015**	
<65	592 (89.0)	471 (79.5)	121 (20.5)		1.00
≥65	73 (11.0)	49 (67.2)	24 (32.8)		1.90 (1.12–3.22)*
Residence				0.370	
Athens	224 (33.7)	170 (75.9)	54 (24.1)		1.00
Thessaloniki	92 (13.9)	75 (81.6)	17 (18.4)		0.71 (0.39–1.30)
Urban area (>10000 inhabitants)	218 (32.7)	166 (76.5)	51 (23.5)		0.97 (0.62–1.50)
Semi-urban or agricultural area	131 (19.7)	109 (82.6)	23 (17.4)		0.66 (0.39–1.15)
Education level				0.370	
Primary school	28 (4.2)	20 (72.1)	8 (27.9)		1.00
Middle school	211 (31.7)	171 (80.9)	40 (19.1)		0.61 (0.25–1.49)
College and above	426 (64.0)	329 (77.3)	97 (22.7)		0.76 (0.32–1.78)
Marital status				**0.007**	
Single	215 (32.7)	181 (84.2)	34 (15.8)		1.00
Married/cohabiting	392 (59.3)	299 (76.4)	92 (23.6)		1.64 (1.06–2.53)*
Divorced/widowed	53 (8.0)	35 (66.2)	18 (33.8)		2.71 (1.38–5.33)*
Children				0.514	
No	429 (65.3)	333 (77.6)	96 (22.4)		1.00
Yes	229 (34.7)	182 (79.8)	46 (20.2)		0.88 (0.59–1.30)
Do you personally belong to a vulnerable group?				0.112	
No	517 (78.5)	410 (79.3)	107 (20.7)		1.00
Yes	141 (21.5)	103 (72.9)	38 (27.1)		1.42 (0.93–2.18)
Living with someone belonging to a vulnerable group?				0.528	
No	425 (64.6)	328 (77.2)	97 (22.8)		1.00
Yes	233 (35.4)	184 (79.2)	48 (20.8)		0.89 (0.60–1.32)
Belonging or living with someone belonging to a vulnerable group?				0.390	
No	361 (54.9)	286 (79.2)	75 (20.8)		1.00
Yes	297 (45.1)	227 (76.4)	70 (23.6)		1.17 (0.81–1.70)
Worked before coronavirus outbreak				0.278	
No	257 (38.9)	195 (75.8)	62 (24.2)		1.00
Yes	404 (61.1)	321 (79.5)	83 (20.5)		0.81 (0.55–1.17)

OR: odds ratio. CI: confidence interval. *p<0.05. § Results from univariate logistic regression models.

developed in laboratories by humans (OR=0.56; 95% CI: 0.37–0.86, p=0.008) and those believing that the spread of COVID-19 will be eliminated when a large percentage of the population has become infected (OR=0.37; 95% CI: 0.22–0.65, p<0.001) were less likely to have a positive change in their decision to vaccinate against the flu the following season. On the other hand, those believing that coronavirus is far more contagious (OR=2.06; 95% CI: 1.23–3.45, p=0.006) and lethal compared to the H1N1 virus (OR=2.03; 95% CI: 1.31–3.15, p=0.005), those believing that there will be consecutive epidemic COVID-19 waves in the future (OR=1.77; 95% CI: 1.13–2.79, p=0.012) and those who applied social distancing before government measures (OR=1.62; 95% CI: 1.12–2.36, p=0.010) were significantly more likely to have a positive change in their decision to vaccinate against the flu next season compared to their counterparts.

Multiple logistic regression model (Table 4) revealed that participants aged ≥65 years who had not been vaccinated the previous year were 1.92 times more likely to increase their intent to vaccinate against the flu the following season than participants <65 years (OR=1.92; 95% CI: 1.00–3.67, p=0.049). Those believing that vaccination against the flu is a measure to prevent the spread of SARS-CoV-2 were

Table 2. Associations between knowledge and attitudes against corona virus and flu vaccination for next season, for those who were not vaccinated during the 2019–2020 season (N=665)

		Intension to vaccinate against the flu next season			
	Total n (%)	No/don't know (N=520) n (%)	Yes (N=145) n (%)	p	OR (95% CI)[§]
Knowledge of symptoms[a]				**0.004**	
No	447 (67.1)	363 (81.3)	83 (18.7)		1.00
Yes	219 (32.9)	157 (71.8)	62 (28.2)		1.71 (1.17–2.50)*
Knowledge of transmission routes[a]				0.332	
No	528 (79.4)	418 (79.0)	111 (21.0)		1.00
Yes	137 (20.6)	103 (74.8)	34 (25.2)		1.27 (0.82–1.97)
Knowledge of prevention measures[a]				0.769	
No	552 (82.9)	433 (78.4)	119 (21.6)		1.00
Yes	114 (17.1)	88 (77.1)	26 (22.9)		1.08 (0.66–1.74)
Vaccination against flu is considered a measure to prevent the spread of coronavirus				**0.001**	
No	479 (72.0)	384 (80.1)	96 (19.9)		1.00
Yes	83 (12.4)	48 (58.6)	34 (41.4)		2.84 (1.74–4.64)*
Don't know	103 (15.5)	88 (85.2)	15 (14.8)		0.25 (0.12–0.49)*
Knowledge of correct first action in case of COVID-19 related symptoms[a]				0.388	
No	140 (21.3)	113 (80.5)	27 (19.5)		1.00
Yes	519 (78.7)	402 (77.3)	118 (22.7)		1.21 (0.76–1.92)
Knowledge of the appropriate way of hand washing with soap and water[a]				**0.037**	
No	394 (59.2)	319 (80.9)	75 (19.1)		1.00
Yes	271 (40.8)	201 (74.3)	70 (25.7)		1.46 (1.01–2.12)*
Is handwashing with antiseptic/ alcoholic solution better than soap and water?				0.379	
No	534 (80.2)	414 (77.5)	120 (22.5)		1.00
Yes	132 (19.8)	107 (80.8)	25 (19.2)		0.82 (0.51–1.33)
	Median (IQR)	Median (IQR)	Median (IQR)		
Total knowledge score[a]	18 (16–19)	18 (16–19)	18 (16–19)	0.103	1.07 (0.99–1.15)

OR: odds ratio. CI: confidence interval. IQR: interquartile range. *p<0.05. § Results from univariate logistic regression models. a As defined in Supplementary file B.

Table 3. Associations between attitudes and practices against corona virus and flu vaccination for next season, for those who were not vaccinated during the 2019–2020 season (N=665)

		Intension to vaccinate against the flu next season			
	Total n (%)	No/don't know (N=520) n (%)	Yes (N=145) n (%)	p	OR (95% CI)[§]
Do you believe that the novel coronavirus was developed by humans in laboratories?				**0.026**	
No	196 (29.5)	141 (71.7)	56 (28.3)		1.00
Yes	316 (47.5)	258 (81.8)	58 (18.2)		0.56 (0.37–0.86)*
Don't know	153 (23.0)	121 (79.2)	32 (20.8)		0.67 (0.40–1.10)
Coronavirus far more infectious compared to the flu virus H1N1				**0.005**	
No	145 (22.9)	125 (86.2)	20 (13.8)		1.00
Yes	485 (77.1)	365 (75.2)	121 (24.8)		2.06 (1.23–3.45)*
Coronavirus far more lethal compared to the flu virus H1N1				**0.001**	
No	211 (33.8)	179 (85.0)	32 (15.0)		1.00
Yes	412 (66.2)	303 (73.6)	109 (26.4)		2.03 (1.31–3.15)*
Do you think that the spread of the novel coronavirus will be mitigated when a large percentage of the population has become infected?				**0.001**	
No	463 (76.1)	342 (74.0)	120 (26.0)		1.00
Yes	145 (23.9)	128 (88.4)	17 (11.6)		0.37 (0.22–0.65)*
Very likely to have other waves of coronavirus outbreaks in our country				**0.012**	
No	180 (27.8)	151 (84.3)	28 (15.7)		1.00
Yes	467 (72.2)	351 (75.2)	116 (24.8)		1.77 (1.13–2.79)*
Where you in the process of social distancing before the government measures were applied?				**0.010**	
No	384 (58.7)	313 (81.6)	71 (18.4)		1.00
Yes	271 (41.3)	198 (73.2)	73 (26.8)		1.62 (1.12–2.36)*
On average how many times do you wash your hands on a daily basis?				0.252	
<10 times	405 (61.7)	322 (79.5)	83 (20.5)		1.00
≥10 times	252 (38.3)	190 (75.6)	61 (24.4)		1.25 (0.86–1.82)

OR: odds ratio. CI: confidence interval. *p<0.05. § Results from univariate logistic regression models.

Table 4. Impact of factors on participants' intension to vaccinate against the flu next season

	OR (95% CI)*	p
Age (years) (≥65 vs <65)	1.92 (1.00–3.67)	**0.049**
Knowledge of symptoms[a]	1.54 (0.97–2.30)	0.062
Vaccination against the flu is considered a measure to prevent the spread of coronavirus (Reference: No)		
Yes	2.37 (1.37–4.13)	**0.002**
Don't know	0.76 (0.37–1.54)	0.440

Continued

Table 4. Continued

	OR (95% CI)*	p
Knowledge of the appropriate way of hand washing with soap and water[a]	1.37 (0.90–2.07)	0.141
Belief that coronavirus was developed by humans in laboratories (Reference: No)		
Yes	0.67 (0.40–1.01)	**0.052**
Don't know	0.78 (0.44–1.40)	0.406
Belief that coronavirus is far more infectious compared to the flu virus H1N1	1.58 (0.87–2.88)	0.134
Belief that coronavirus is far more lethal compared to the flu virus H1N1	1.03 (0.61–1.75)	0.899
Belief that coronavirus will be eliminated when a large percentage of the population will be infected	0.44 (0.24–0.78)	**0.006**
Belief that a new coronavirus outbreak is very likely	1.34 (0.79–2.27)	0.271
Applying social distancing before government measures	1.50 (0.98–2.28)	0.066

OR: odds ratio. CI: confidence interval. a As defined in Supplementary file B. *Marital status was not added in the model as it was confounded with age.

2.4 times more likely to express a positive change in their intent to vaccinate against the flu next season than those who were not (OR=2.37; 95% CI: 1.37–4.13, p=0.002). In contrast, those believing that SARS-CoV-2 was developed by humans in laboratories and those believing that COVID-19 will disappear when a large percentage of the population will be infected were 33% less likely and 56% less likely, respectively, to change their decision to vaccinate against the flu the following season (OR=0.67; 95% CI: 0.40–1.01 and OR=0.44; 95% CI: 0.24–0.78; p=0.006, respectively).

DISCUSSION

The current study provides insights into the potential impact of the COVID-19 pandemic on the acceptance of influenza vaccination by the general population in Greece. We have identified several factors associated with a change of attitude towards the seasonal flu vaccination according to prior vaccination status and demographic characteristics and knowledge attitudes and practices against COVID-19.

According to our findings, a high percentage (66.3%) of respondents had not been vaccinated for seasonal influenza during the 2019–2020 season, the season prior to the COVID-19 pandemic, a percentage much lower than that in a previously conducted Greek study where 96.4% of the patients with idiopathic pulmonary fibrosis were immunized against influenza (530/550)[21]. Almost all (92.4%) of those that had been vaccinated were consistent in doing the same the upcoming flu season 2020–2021. However, this was not so for the non-vaccinated respondents, where 59.5% would not vaccinate again. In all, 21.8% were favorable in getting vaccinated the upcoming year and 18.8% were undecided at the time of the survey.

Factors independently associated with intention to vaccinate in the group of people that had not vaccinated the previous flu season were age ≥65 years (OR=1.92), belief that vaccination against the flu is considered preventive against the spread of the coronavirus (OR=2.37), not believing that coronavirus is lab-developed, and belief that the pandemic will come to an end when a large percentage of the population will be infected. A similar change in the intention to vaccinate for seasonal flu from refusal to acceptance or hesitancy has been shown in a study that was conducted in Italy[22]. In particular, 20.4% of the participants were highly influenced from the COVID-19 pandemic, which changed their willingness to be vaccinated in the 2020–2021 season.

As it has been shown that influenza vaccination can be an effective strategy to reduce the severity of the COVID-19 disease in the general population, it is imperative that flu vaccination promotion programs target specific populations and beliefs as presented above[20].

Considering that there is no effective treatment against seasonal influenza, flu vaccination is the only measure with positive impact on influenza-related mortality, medical visits, hospitalizations, and healthcare costs[23-25].

Limitations

A significant limitation of the results reported here is that the study was not originally designed to examine specifically the impact of the pandemic on flu vaccination, but was developed as a sub-analysis of a larger survey aiming to describe the knowledge, attitudes and practices of the general Greek public towards the virus and the pandemic. As such, we have missed out on questions that could explore the reasons for the observed change of intent and overall attitudes toward vaccination. Nevertheless, this analysis offers unique insights into factors that might influence seasonal flu vaccination uptake among the Greek population at the start of the global pandemic. It will be interesting to follow up how these may change over time and waves.

CONCLUSIONS

We have described how the COVID-19 pandemic can affect the intention of respondents to vaccinate against seasonal influenza among the Greek population. Factors associated with potentially shaping and increasing willingness to vaccinate against the flu can be used to design effective strategies to increase vaccination uptake in view of pandemics and independently.

CONFLICTS OF INTEREST

The authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest and none was reported.

FUNDING

There was no source of funding for this research.

ETHICAL APPROVAL AND INFORMED CONSENT

Respondents' consent was taken before interview and participants were assured of confidentiality and anonymity. It was not deemed necessary to submit the study for ethical approval as per Greek legislation (Association of Opinion Polls and Survey Organizations - www.sedea.gr).

PROVENANCE AND PEER REVIEW

Not commissioned; externally peer reviewed.

REFERENCES

1. Pleschka S. Overview of influenza viruses. In: Richt J, Webby RJ, eds. Swine Influenza. Springer; 2013:1-20. Current Topics in Microbiology and Immunology; vol 370. doi:10.1007/82_2012_272
2. Lu PJ, O'Halloran A, Ding H, Greby SM, Williams WW. Current status and uptake of influenza vaccination over time among senior adults in the United States. Hum Vaccin Immunother. 2015;11(12):2849-2851. doi:10.1080/21645515.2015.1075108
3. Clayville LR. Influenza Update: A Review of Currently Available Vaccines. P T. 2011;36(10):659-684. Accessed https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3278149/pdf/ptj3610659.pdf
4. Paget J, Spreeuwenberg P, Charu V, et al. Global mortality associated with seasonal influenza epidemics: New burden estimates and predictors from the GLaMOR Project. J Glob Health. 2019;9(2):020421. doi:10.7189/jogh.09.020421
5. Cassini A, Colzani E, Pini A, et al. Impact of infectious diseases on population health using incidence-based disability-adjusted life years (DALYs): results from the Burden of Communicable Diseases in Europe study, European Union and European Economic Area countries, 2009 to 2013. Euro Surveill. 2018;23(16):17-00454. doi:10.2807/1560-7917.ES.2018.23.16.17-00454
6. Ferguson NM, Cummings DA, Fraser C, Cajka JC, Cooley PC, Burke DS. Strategies for mitigating an influenza pandemic. Nature. 2006;442(7101):448-452. doi:10.1038/nature04795
7. Jefferson T, Rivetti A, Harnden A, Di Pietrantonj C, Demicheli V. Vaccines for preventing influenza in healthy children. Cochrane Database Syst Rev. 2008;(2):CD004879. doi:10.1002/14651858.CD004879.pub3
8. European Centre for Disease Prevention and Control. European Centre for Disease Prevention and Control. Seasonal influenza vaccination and antiviral use in EU/EEA Member States – Overview of vaccine recommendations for 2017–2018 and vaccination coverage rates for 2015–2016 and 2016–2017 influenza seasons. November 2018. Accessed https://www.ecdc.europa.eu/sites/default/files/documents/seasonal-influenza-antiviral-use-2018.pdf
9. Ferdinands JM, Patel MM, Foppa IM, Fry AM. Influenza Vaccine Effectiveness. Clin Infect Dis. 2019;69(1):190-191. doi:10.1093/cid/ciy1084
10. Smetana J, Chlibek R, Shaw J, Splino M, Prymula R. Influenza vaccination in the elderly. Hum Vaccin Immunother. 2018;14(3):540-549. doi:10.1080/21645515.2017.1343226
11. Teloniatis S, Tzortzi A, Behrakis P. Seasonal Influenza Vaccination Coverage in Greece in 2009 and 2014. Pneumon. 2017;30(1):41-48. Accessed http://www.pneumon.org/assets/files/789/file688_509.pdf
12. Dardalas I, Pourzitaki C, Manomenidis G, et al. Predictors of influenza vaccination among elderly: a cross-sectional survey in Greece. Aging Clin Exp Res. 2020;32(9):1821-1828. doi:10.1007/s40520-019-01367-4
13. Maltezou HC, Christophilea O, Tedoma A, Katerelos P, Dounias G. Vaccination of healthcare workers against influenza: does a day off make a difference? J Hosp Infect. 2018;99(2):181-184. doi:10.1016/j.jhin.2018.01.014
14. Antoniou K, Bolaki M, Bibaki E, et al. COVID19 alert: Do we know our enemy? Pneumon. 2020;33(1):25-27. Accessed http://pneumon.org/assets/files/789/file774_670.pdf
15. Johns Hopkins Coronavirus Resource Center. COVID-19 Dashboard. Accessed December 21, 2020. https://coronavirus.jhu.edu/map.html
16. World Health Organisation. Coronavirus disease 2019 (COVID-19): Situation Report – 51. 2020. Accessed December 21, 2020. https://apps.who.int/iris/bitstream/handle/10665/331475/nCoVsitrep11Mar2020-eng.pdf?sequence=1&isAllowed=y
17. Spernovasilis N, Markaki L, Tsioutis C. Challenges posed by COVID-19 to refugee camps on the Greek islands: We are all humans after all. Pneumon. 2020;33(2):7-8. Accessed http://www.pneumon.org/assets/files/789/file783_692.pdf
18. Kourlaba G, Triantafyllou C, Kourkouni E, et al. Knowledge, attitudes and practices regarding Covid-19 among the Greek general population. Pneumon. 2020;33(4):175-186. Accessed http://www.pneumon.org/assets/files/789/file820_770.pdf
19. Kourlaba G, Kourkouni E, Maistreli S, et al. Willingness of Greek general population to get a COVID-19 vaccine. Glob Health Res Policy. 2021;6(1):3. doi:10.1186/s41256-021-00188-1
20. Arokiaraj MC. Considering Interim Interventions to Control COVID-19 Associated Morbidity and Mortality—

Perspectives. Front Public Health. 2020;8:444. doi:10.3389/fpubh.2020.00444
21. Papiris SA, Bouros D, Markopoulou K, et al. Early COVID-19 Lockdown in Greece and IPF: A beneficial "impact" beyond any expectation. Eur Respir J. 2021;57(3):2003111. doi:10.1183/13993003.03111-2020
22. Domnich A, Cambiaggi M, Vasco A, et al. Attitudes and Beliefs on Influenza Vaccination during the COVID-19 Pandemic: Results from a Representative Italian Survey. Vaccines (Basel). 2020;8(4):711. doi:10.3390/vaccines8040711
23. Simonsen L, Reichert TA, Viboud C, Blackwelder WC, Taylor RJ, Miller MA. Impact of Influenza Vaccination on Seasonal Mortality in the US Elderly Population. Arch Intern Med. 2005;165(3):265-272. doi:10.1001/archinte.165.3.265
24. Rolfes MA, Flannery B, Chung JR, et al. Effects of Influenza Vaccination in the United States During the 2017–2018 Influenza Season. Clin Infect Dis. 2019;69(11):1845-1853. doi:10.1093/cid/ciz075
25. Machado A, Kislaya I, Larrauri A, Matias Dias C, Nunes B. Impact of national influenza vaccination strategy in severe influenza outcomes among the high-risk Portuguese population. BMC Public Health. 2019;19(1):1690. doi:10.1186/s12889-019-7958-8