

Greek population's perceptions of non-pharmacological interventions towards the first wave of COVID-19 pandemic mitigation: A regression-based association analysis

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ABSTRACT

INTRODUCTION In the ongoing coronavirus disease 2019 (COVID-19) pandemic, even though vaccines have been rolled out and the vaccination campaigns in some countries have already been followed by a decline in number and severity of cases, non-pharmaceutical interventions (NPI) are still playing an important role on COVID-19 management (e.g. social distancing) that are imposed by the authorities and require the public's adherence and behavioral adjustment. This study aims to identify factors that affect the general public's attitudes towards the importance of NPI in Greece.

METHODS This prevalence study, enrolled 657 adults from the general Greek population in order to assess their beliefs and identify possible factors that influence their perceptions of NPI. All associations were assessed through multivariate logistic regression.

RESULTS Overall, Greeks considered NPI important for health protection. The participants who were less likely to consider NPI important were men compared to women (OR=1.64; 95% CI: 1.15–2.36, $p=0.007$), people aged <40 years compared to those ≥ 40 years (OR=0.48; 95% CI: 0.34–0.68, $p<0.001$), and people who did not choose the Hellenic National Public Health Organization (NPHO) to get informed about COVID-19 compared to other sources (OR=0.65; 95% CI: 0.46–0.92, $p=0.014$).

CONCLUSIONS This study profiled Greek people who do and do not consider NPI important, primarily on their demographic characteristics. Focused communicational strategies in certain population subgroups are recommended.

ABBREVIATIONS NPHO: Hellenic National Public Health Organization, NPI: non-pharmaceutical interventions, RO: basic reproduction number, STROBE: STrengthening the Reporting of OBservational Studies in Epidemiology.

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KEYWORDS

COVID-19, infectious diseases, non pharmacological intervention, public perception, Greece, knowledge gap hypothesis

Received: 2 March 2021

Revised: 1 August 2021

Accepted: 25 August 2021

INTRODUCTION

In December 2019, the first case of coronavirus disease 2019 (COVID-19) was reported in Wuhan, China, signifying the beginning of a pandemic caused by SARS-CoV-2, a virus subsumed in a large family of zoonotic RNA single stranded viruses, known as corona viruses¹. Within less than a year SARS-Cov-2 spread globally and by 23 July 2021 had caused more than 192 million confirmed cases and more than 4.1 million deaths worldwide². According to Ke et al.³ the median reproduction number (RO) of the virus was estimated to be close to 5.8 in the United

States and between 3.6 and 6.1 in eight European countries.

In the ongoing COVID-19 pandemic, even though vaccines have been rolled out and the vaccination campaigns in some countries have already been followed by a decline in number and severity of cases⁴, non-pharmaceutical interventions (NPI) are still playing an important role on COVID-19 management, such as social distancing through lockdown of institutional and professional facilities, and entertainment venues, or personal hygiene measures such as frequent hand washing^{5,6}. Existing literature provides strong evidence that

individuals' perception of NPI plays a major role in successful disease mitigation^{7,8}.

COVID-19 research is an extremely vibrant field as trials have begun since the beginning of 2020⁹ and a search for the term 'COVID-19' on PubMed on 13 July 2021, yielded more than 159086 publications that include the term 'COVID-19', a random search that suggests that most, if not all, are indeed relevant to COVID-19. This fact reveals the quick global reflexes on public health research, and although the vast majority of COVID-19 studies are of a general medical¹ and pharmacological interest^{10,11}, less research has been done on the role of the public's perception in this global emergency. This study aims to provide insights on the factors that influence the public's perception as regards the importance of NPI in health protection.

The aim of this study was to assess the public's beliefs and evaluate possible factors that influence the public's perceptions as regards NPI importance in personal and public health protection, in order to provide future recommendations that will enhance NPI effectiveness. The study was conducted in accordance with the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) statement¹².

METHODS

Study design

This study was an online prevalence survey which was conducted during the first national lockdown in Greece, between 25 March and the first week of May 2020. Ethical approval was granted by the University of West Attica, Athens, Greece (ID:29341). Participants were asked to provide informed consent in order to complete the survey questions and all procedures were conducted in line with the Declaration of Helsinki¹³.

Setting and recruitment

Respondents were recruited through social media (Facebook), where research assistants and research coordinators distributed the survey link in public groups and in people who had previously expressed interest in participating in the study. The online survey was hosted on Qualtrics¹⁴, a secure data collection platform.

Inclusion criteria

The participant inclusion criteria were: 1) able and willing to provide informed consent, 2) aged 18–85 years, 3) lives permanently in Greece, 4) social media user, and 5) can read and write Greek.

Exclusion criteria

The participant exclusion criteria were: 1) lives permanently outside Greece, 2) cannot or does not answer the survey questions (such as people who enter the survey but do not answer any questions at all), and 3) cannot understand Greek.

Data protection

This study was an anonymous online survey and participants were informed, before providing consent, that inclusion of personal information was discouraged. Data encryption was not deemed necessary or applicable, as data were completely anonymous. Data were kept in the online platform and only study investigators had access to them, while no paper-based files were utilized.

Form design

The study was based on the existing literature about perceptions of infectious disease control measures⁷ and it was undertaken through a self-developed structured completion form which was administered in the Greek language, adapted to assess the public's perceptions towards NPI. The form consisted of 24 questions divided into 3 sections related to demographic factors, knowledge questions, beliefs about the importance of NPI and self-reported adherence to home quarantine. Lastly, an open-ended field was provided for comments and feedback.

Certain epidemiological terms related to COVID-19 were assessed for their comprehensibility in awareness and belief section. These terms were 'incubation period' and 'contact with SARS-CoV-2', with the last being defined as one's contact with a symptomatic confirmed COVID-19 case or an asymptomatic SARS-CoV-2 carrier, followed or not by the individual's symptomatic manifestation. The term 'incubation' is included on the website of the Hellenic National Organization of Public Health (NPHO)¹⁵.

Bias

Bias associated with the verbal frame of surveys was avoided at the best possible degree. Simple and comprehensible language was used, the valid answers in the questions with 'right/wrong' design were the incorrect ones in order for the halo effect to be minimized¹⁶, while optimal recall periods were adjusted based on the domains of interest¹⁷.

Sample size calculation

In 2020, the Greek population was estimated to be about 10.4 million¹⁸, with more than 80% sustaining social media accounts¹⁹, thus social media users were considered a numerically representative source population. Sample size calculation based on the overall Greek population, with a confidence level of 95% and a 5% margin of error, determined that 385 respondents were required for the completion of the study, according to Cochran's formula²⁰.

Variables

All questions apart from demographic factors were *a posteriori* scored in order for the information to be combined and furtherly assessed. The section about knowledge and awareness of the NPI included 10 multiple choice questions, with each granted 1 point when answered correctly and 0 when answered incorrectly; thus the overall

section score ranged from 0 to 10. In the belief section, 11 NPI were given to be rated for their importance in public and personal health protection, through horizontal 11-point numeric unipolar gliding scales ranging from 0 to 10, where 0 was ‘not important at all’ and 10 was ‘extremely important’; thus the overall score of this section was from 0 to 110. Lastly, 4 questions relevant to self-reported adherence to home-quarantine were asked, where every answer relevant to reduced social contacts and self-motivated adherence to home quarantine was granted 1 point, and every other answer was given 0, with the overall score of the section ranging from 0 to 4. All details about the scoring methodology and the overall results are presented in Table 1.

The numeric variables that were used as predictors to perceived importance of NPI were the scores of knowledge and self-reported behavior in social distancing and home quarantine. Demographic factors were separated into two categories. Since the public’s perceptions were found different between post-secondary education and other education levels, as well as between areas with the most COVID-19 confirmed cases and the other areas of a country⁷, post-secondary education was assessed separately from other education levels, and Athens from other areas of Greece. There is evidence that ages >40 years are related to higher infection possibility²¹ and higher case-fatality rate in Europe²², thus it was assumed that age group could affect one’s beliefs, therefore it was categorized based on that cutoff point. As of cohabitation, people living with at least one infant or elderly person were considered a different subgroup from those who did not. Formal government announcements were studied separately from other sources of information, in accordance with previous studies²³.

Table 1. Scoring system

Score definition	Item scoring	Score range	Median
Knowledge score Row total of item scores in section of knowledge and awareness questions	1 = correct answer 0 = wrong answer	0–10	7
Perceived importance score Row total of item scores in section of belief questions	10 = every NPI rated as extremely important 0 = every NPI rated as not important at all	0–110	100
Self-reported adherence to home quarantine Row total of item scores in section of self-reported adherence to home-quarantine (4 questions)	1 = every question relevant to: a. Social contacts below normal. b. Home isolation more than 4 days/week. c. Voluntary adherence to home-quarantine according to the official guidelines. 0 = every question relevant to: a. Social contacts above normal b. Home isolation less than 4 days/week. c. Non adherence to home quarantine, or adherence due to change in other people’s behavior or entertainment venue closure.	0–4	3

Data analysis

The analysis included only submitted forms, and not partially completed ones, with and without missing values. Descriptive statistics and total responses were calculated for all variables, while absolute and relative frequencies are reported. Based on the results of the Shapiro-Wilk test²⁴ which assesses the normality assumption, the most appropriate correlation coefficient was chosen to test for collinearity amongst numeric variables²⁵. The outcome analyzed, namely the dependent variable, was the score of perceived importance of NPI, which was dichotomized according to the median split method²⁶.

Univariate analyses were initially performed and every variable with a p-value less than 0.2 was included in the multivariate analysis. A multivariate logistic regression model was used to evaluate relationships between the outcome and the aforementioned covariates, and odds ratios and their 95% confidence intervals were used to describe these associations. Logistic regression was performed with the ‘stepwise’ method²⁰, where the ratio of observations to the independent variables of the full model was kept above 5. Based on our study design, data were assumed to be independent and p<0.05 was considered as statistically significant for all comparisons in the multivariate level. The analyses were performed with the statistical package²⁷ STATA ©, version 16.0.

RESULTS

Demographic data

The survey was initially completed by 669 individuals. Of those, 12 were excluded because they stated a permanent residence outside Greece. Demographic characteristics of the remaining 657 participants are described in Table 2.

Knowledge of NPI

Overall, the participants had a high knowledge score (median=7, range: 1–10). Four hundred and thirty-seven participants (67.96%) were aware of the term ‘contact with the new coronavirus’, as well as of all the main symptoms of COVID-19 (n=507; 78.97%). The term ‘incubation’ though was understood by only 107 (16.56%) participants. Details about knowledge questions are provided in Table 3.

Perceived importance of NPI

The median overall score of all NPI as to their importance in personal and public health was 100 (range: 2–110). The lowest score amongst NPI both for public and for personal health protection was given to the use of mask and gloves (median=7, range: 1–10), whereas every other NPI was scored as highly important (median=10) with values ranging 1–10 for hand hygiene in public health protection, and 0–10 for the remaining NPI.

Self-reported behavior regarding social contacts

The score of self-reported adherence to home quarantine was found above average, with a median value of 3 (range:

Table 2. Demographics of study participants

Variable (total responses)	n (%)
Sex (645/657)	
Females	227 (35.19)
Males	418 (64.81)
Age (years) (608/657)	
≥40	330 (50.23)
<40	327 (49.77)
Household members below 18 or above 70 years (657/657)	
Yes	279 (42.72)
No	378 (57.53)
Education level (642/657)	
Undergraduate or postgraduate	544 (84.74)
Middle-High School or School	98 (15.26)
Area of permanent residence (641/657)	
Athens	478(74.57)
Other	163 (25.43)
Profession (644/657)	
Healthcare	187 (29.04)
Non-healthcare	457 (70.96)
Most trusted source of information about COVID-19 (635/657)	
NPHO or formal government announcements	348 (54.80)
Other (doctor, Greek or foreign medical associations)	287 (45.20)

Table 3. Description of knowledge and awareness section

Questions (total responses)	n (%)	Score
Which are the main symptoms of COVID-19? (642/657)		
Sore throat, dry cough, fever	110 (17.13)	0
Sore throat, dry cough, fever, fatigue, muscle and joint pain, dyspnea	507 (78.97)	1
Dry cough	14 (2.18)	0
None of the above	11 (1.71)	0
What does come ‘in contact with COVID-19’ mean? (643/657)		
Having contacted a COVID-19 positive person, or an asymptomatic carrier and having no symptoms	437 (67.96)	1
Having contacted a COVID-19 positive person and having manifested symptoms	66 (10.26)	0
Not aware	140 (21.77)	0
What does ‘incubation period’ mean? (646/657)		
The period from the first symptom to full recovery	503 (77.86)	0
The period from the infection to the first symptoms	107 (16.56)	1
Not aware	36 (5.57)	0
According to NPHO, the mean incubation period of SARS-CoV-2 is 5–6 days and the maximum is 14 days. If you contact a person who has the new coronavirus, how long should you stay at home? (643/657)		
5–6 days only upon symptom manifestation	2 (0.31)	0
14 days regardless of symptom manifestation	628 (97.67)	1
14 days only upon symptom manifestation	10 (1.56)	0
Not aware	3 (0.47)	0
If I have respiratory symptoms, I should go to the nearest hospital (628/657)		
Agree	197 (31.37)	0
Disagree	431 (68.63)	1

Continued

Table 3. Continued

Questions (total responses)	n (%)	Score
If my respiratory symptoms get worse, I should go to the nearest hospital (636/657)		
Agree	546 (85.85)	0
Disagree	90 (14.15)	1
Flu vaccine protects from COVID-19 (611/657)		
Agree	11 (1.80)	0
Disagree	600 (98.20)	1
If I cough/sneeze on a tissue, hand washing is not mandatory (609/657)		
Agree	18 (2.96)	0
Disagree	591 (97.04)	1
If I live alone, avoiding crowds is not mandatory (609/657)		
Agree	19 (3.12)	0
Disagree	590 (96.88)	1
Is it safe, as regards COVID-19 transmission, to use personal objects of asymptomatic people (612/657)		
Agree	23 (3.76)	0
Disagree	589 (96.24)	1

0–4). The majority of the participants (n=370; 58.92%) were capable of staying all day in the house from 0 to 4 days per week, while the remaining 258 (41.08%) could stay in the house from 5 to 7 days. The main barrier in one’s ability to apply home-quarantine proved to be work duties (n=317; 49.53%), while the main facilitator was the respondents’ sense of responsibility towards the NPI (n=547; 86.41%). Detailed description about perceived importance of NPI and self-reported adherence to social distancing are demonstrated in Table 4. Knowledge, perceived importance of NPI and self-reported adherence to social distancing by education level and profession are furtherly described in Table 5.

Multivariate logistic regression on public’s perceived importance of NPI

Spearman’s correlation coefficient, which was utilized since numeric variable distributions deviated from normal distribution, was found low amongst numeric variables, namely 0.12 between knowledge and self-reported adherence to home-quarantine scores, indicating negligible collinearity²⁸, thus both variables were included in the analysis.

According to multivariate logistic regression model, respondents who did not consider NPI important were more often males than females (OR=1.64; 95% CI: 1.15–2.36, p=0.007), among individuals aged <40 years than older (OR=0.48; 95% CI: 0.34–0.68, p<0.001), among residents of areas outside Athens than within (OR=0.57; 95% CI: 0.38–0.84, p=0.001) and among those who did not choose NPHO to get informed about COVID-19 compared to NPHO sources (OR=0.65; 95% CI 0.46–0.92, p=0.014). Lastly,

Table 4. Description of beliefs and social contact section

Questions	Median	Range	Score	Total responses
Rate the importance of the given NPI for public health				
Hand hygiene	10	1–10	1–10	647/657
Avoiding crowds	10	0–10	0–10	646/657
Use of mask and gloves	7	0–10	0–10	637/657
Avoiding people with clinical image compatible to COVID-19	10	0–10	0–10	645/657
Avoiding elderly or medically vulnerable people	10	0–10	0–10	630/657
Avoiding travelling	10	0–10	0–10	642/657
Rate the importance of the given NPI for personal health				
Hand hygiene	10	0–10	0–10	647/657
Avoiding crowds	10	0–10	0–10	647/657
Use of mask and gloves	7	0–10	0–10	647/657
Avoiding people with clinical image compatible to COVID-19	10	0–10	0–10	647/657
Avoiding travelling	10	0–10	0–10	647/657

Continued

Table 4. Continued

Questions	n	%	score	Total responses
How many days per week were you capable of staying in the house all day before national lockdown?				628/657
0	54	8.60	0	
1–2	209	33.28	0	
3–4	107	17.04	0	
5–6	116	18.47	1	
7	142	22.61	1	
Which was the biggest barrier in staying home before national lockdown?				640/657
My work duties	317	49.53	1	
First needs supply	177	27.66	1	
My psychology	103	16.09	0	
I didn't think something could change if I stayed home	43	6.72	0	
Which was the biggest facilitator in staying home before national lockdown?				633/657
I should follow the NPI	547	86.41	1	
My doctor recommended it	21	3.22	1	
Entertainment venues closed	18	2.84	0	
Other people's behavior changed	6	0.95	0	
I could work from home	41	6.48	1	
How would you characterize your social contacts before the national lockdown?				647/657
No	37	5.72	1	
Slight	122	18.86	1	
Too few	59	8.96	1	
Very few	44	6.80	1	
Few	51	7.88	1	
Normal	180	27.82	0	
Enough	51	7.88	0	
Many	44	6.80	0	
Too many	37	5.72	0	
Far too many	10	1.55	0	
Extreme	13	2.01	0	

self-reported adherence to home-quarantine demonstrated a strong positive correlation with positive perceived beliefs of NPI, as for every additional given answer relevant to home-quarantine adherence, the odds of considering NPI unimportant were multiplied by 0.77, therefore decreased (OR=0.77; 95% CI: 0.64–0.94, p=0.010). The overall p-value of the multivariate model was found highly statistically significant (p<0.0001). Regression analyses outcomes are demonstrated in Table 6.

DISCUSSION

This study aimed to identify the factors that affect the public's perception towards the importance of NPI. A unique aspect of this study was that it correlated the Greek population's perceptions with their demographic characteristics, depicting the profile of the people who do not acknowledge the significance of NPI in public and personal health. The main findings of this study showed that the participants who were less likely to consider NPI

Table 5. Knowledge, perceived importance of NPI and self-reported adherence to social distancing by education level and profession

Scores	Profession			Education level	
	Healthcare (n=187) n (%)	Non-healthcare (n=390) n (%)	Unemployed or retired (n=67) n (%)	Any level up to high school (n=98) n (%)	Undergraduate or postgraduate (n=544) n (%)
Knowledge score					
0	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
1	2 (1.07)	1 (0.26)	1 (1.49)	2 (2.04)	2 (0.37)
2	3 (1.60)	6 (1.54)	3 (4.48)	1 (1.02)	11 (2.02)
3	3 (1.60)	13 (3.33)	2 (2.99)	1 (1.02)	17 (3.13)
4	0 (0.00)	4 (1.03)	0 (0.00)	0 (0.00)	4 (0.74)
5	7 (3.74)	17 (4.36)	5 (7.46)	3 (3.06)	26 (4.78)
6	21 (11.23)	62 (15.88)	12 (17.91)	17 (17.35)	75 (13.79)
7	58 (31.02)	129 (33.08)	16 (23.88)	33 (33.67)	169 (31.06)
8	69 (36.90)	117 (30.00)	19 (28.36)	27 (27.55)	180 (33.08)
9	22 (11.76)	37 (9.49)	8 (11.94)	11 (11.23)	56 (10.29)
10	2 (1.07)	4 (1.03)	1 (1.49)	3 (3.06)	4 (0.74)
Belief score					
Above median	82 (43.85)	184 (47.18)	37 (55.22)	48 (48.98)	256 (47.06)
Below median	105 (56.15)	206 (52.82)	30 (44.78)	50 (51.02)	235 (52.94)
Compliance score					
0	2 (1.07)	3 (0.77)	1 (1.49)	2 (2.04)	4 (0.74)
1	15 (8.02)	29 (7.44)	11 (16.42)	8 (8.16)	46 (8.46)
2	85 (45.45)	133 (34.10)	22 (32.84)	36 (36.73)	202 (37.13)
3	70 (37.43)	149 (38.20)	24 (35.82)	32 (32.66)	213 (39.15%)
4	15 (8.02)	76 (19.49)	9 (13.43)	20 (20.41)	79 (14.52)

Table 6. Univariate and multivariate logistic regression models for the identification of factors that influence the public’s perceptions towards NPI importance (negative vs positive perceptions)

Independent predictors	OR (95% CI)	p	AOR (95% CI)	p
Sex				
Female	1		1	
Male	1.64 (1.18–2.28)	0.003	1.64 (1.15–2.36)	0.007
Age (years)				
<40	1		1	
≥40	0.50 (0.36–0.69)	<0.001	0.48 (0.34–0.68)	<0.001
Area				
Other	1		1	
Athens	0.53 (0.37–0.77)	0.001	0.57 (0.38–0.84)	0.005
Infants/elderly roommates				
0	1			
≥1	0.73 (0.53–1.00)	0.047	NI	-

Continued

Table 6. Continued

Independent predictors	OR (95% CI)	p	AOR (95% CI)	p
Education level				
Postgraduate	1			
University, Secondary or Primary	1.08 (0.70–1.66)	0.726	NI	-
Source of information				
Non NPHO/official sites	1		1	
NPHO/official sites	0.58 (0.42–0.80)	0.001	0.65 (0.46–0.92)	0.014
Profession				
Non medical/paramedical	1			
Medical/paramedical	1.19 (0.85–1.69)	0.298	NI	-
Knowledge score				
	0.98 (0.86–1.08)	0.693	NI	-
Self-reported adherence to home-quarantine				
	0.76 (0.64–0.91)	0.003	0.77 (0.64–0.94)	0.010

AOR: adjusted odds ratio. NI: Not important in univariate analysis, not included in multivariate analysis.

important were men, people aged <40 years, people who did not choose the Hellenic National Public Health Organization (NPHO) to get informed about COVID-19, and people who scored low in self-reported adherence to social distancing and home quarantine. Moreover, the majority (79%) of the Greek population correctly identified the main COVID-19 symptomatology, and respondents from Athens, the area with the most COVID-19 confirmed cases, demonstrated higher perceived importance of NPI.

The public’s positive perceptions were correlated with self-reported adherence to home-quarantine, acknowledging thus the relation between beliefs and behavior, in agreement with established findings²⁹. Similarly to previous research, females appeared more likely to consider NPI important, scored better in awareness questions⁸, held more positive attitudes³⁰ and adherence levels to COVID-19 mitigation strategies⁷. Also, respondents from Athens - demonstrated higher perceived importance of NPI, like the residents of Hubei when compared with people from other areas of China⁷. An interesting result was that participants did not consider the use of masks as being important. We believe that this is primarily due to the fact that refusal to wear masks is associated with a range of anti-mask attitudes, at the center of which are psychological reactance and beliefs that masks are ineffective and violated their civil liberties, as in a previous study³¹.

In contrast to previous evidence which found that only 35% of the Greek population correctly identified the main COVID-19 symptomatology³², the respective percentage in our study was 79%, indicating the respondents’ good knowledge of the most typical COVID-19 symptoms. Although previous studies did not correlate attitudes with age³⁰, in our study the public’s perceptions demonstrated strong correlation with age group. We consider that this is primarily due to the different approach in statistical analysis

that this study implemented, assessing age at the cutoff of 40 years. Furthermore, the majority of the participants (n=348; 54.80%) chose NPHO and formal government announcements as the most trusted source of information, a choice which presumably led to positive perceptions about the significance of NPI. The abovementioned result proved the public’s trust and receptivity towards the formal authorities, opposite to previous evidence where the individuals were not found to be positively influenced by formal communication strategies³³.

Greek community rated NPI as important, a fact that possibly played a major role in Greece’s success in prompt COVID-19 control and early flattening of the epidemic curve³⁴ in the first national lockdown. Despite the high overall score of belief and knowledge sections and the high education level that the sample demonstrated, ‘incubation’ appeared to be incomprehensible, since it was misinterpreted with the symptoms period by the majority of the respondents (77.86%). Thus, it is doubtful whether Greek people comprehend the transmission potential of asymptomatic individuals, estimate properly the importance of home quarantine during incubation period and apply it prior to symptom manifestation. Future research should investigate the ‘knowledge gap hypothesis’ in COVID-19, a phenomenon observed in other infectious diseases²³, in which highly educated individuals process faster and properly the available information from mass media, in sharp contrast to people of lower socioeconomic status. The fact that well educated Greek people failed to process the term ‘incubation’, which is of extreme importance, raises questions about the way that health-related terms are interpreted by less educated individuals.

Limitations

Limitations of this study lie primarily on bias inherent in

the study design^{16,17} since the sample was not random and sampling bias, according to which the lack of internet access or social media profile excluded certain population subgroups from participation, could not be taken into account. Furthermore, its cross-sectional design can only provide a picture of a consecutive sample within a given timeframe. Neither validated scales nor instruments were utilized, thus measurement precision or errors cannot be estimated, despite the fact that bias related to question forming was addressed. Also, this study did not assess the public's knowledge in the field of the routes of COVID-19 transmission or the public's trust towards authorities, as other studies undertaken in the general Greek population have done³⁵. These features suggest that generalization of our study findings should be carefully performed in other population subgroups, while it is not encouraged in elderly people who were not represented adequately in our sample.

CONCLUSIONS

Greeks considered NPI important for health protection during the first wave of COVID-19 pandemic, certain population subgroups with certain demographic characteristics though may have underestimated the importance of NPI. Future recommendations for COVID-19 research focus primarily on research orientation towards the link between the public's perceptions and adherence to NPI and towards COVID-19 spread by these asymptomatic individuals who fail to distinguish incubation from symptom onset and infectiousness. The verbal frame of NPI should probably be reassessed in order to ensure that it is comprehensible, thus effective, in COVID-19 or other communicable disease control. Lastly, communication programs about COVID-19 mitigation should not only be carefully designed in order to achieve proper and equable information of the population, but also targeted on the population subgroups that possibly underestimate the importance of NPI; men, aged <40 years, who choose informal sources to get informed about COVID-19, who reside outside Athens, and do not adhere well to home quarantine, should probably be considered as the main target population of the communication programs for COVID-19 mitigation. Since effective clinical management of COVID-19 is based on patients' clinical profile and risk of mortality³⁶, according to the same philosophy, communication programs for COVID-19 mitigation strategies should be based on populations' attitudes and characteristics that influence their adherence to NPI.

ACKNOWLEDGEMENTS

Our sincere gratitude is extended to all respondents for their contributions.

CONFLICTS OF INTEREST

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

FUNDING

This study is self-funded by the first author (ECB); no supplementary funding was provided for this study.

ETHICAL APPROVAL AND INFORMED CONSENT

Ethical approval was granted by the University of West Attica, Athens, Greece (ID:29341). Participants were asked to provide informed consent in order to complete the survey questions and all procedures were conducted in line with the Declaration of Helsinki.

DATA AVAILABILITY

The data supporting this research are available from the authors on reasonable request.

AUTHORS' CONTRIBUTIONS

ECB conceived the study, designed the form, was responsible for data management and data analysis, and funded the study. AC counseled on the form-design procedure and approved its final version. ME and IK contributed to the design of the form. NN, as a native English speaker, was responsible for the linguistic and grammatical editing of the manuscript. DK contributed to reporting and critical appraisal of the results, through her expertise in infectious diseases. CCB contributed to data curation. All authors contributed to manuscript composition and revision before submission. CT supervised all aspects of the planning and conduct of this epidemiological study and approved the final manuscript.

PROVENANCE AND PEER REVIEW

Not commissioned; externally peer reviewed.

REFERENCES

1. Zimmermann P, Curtis N. Coronavirus Infections in Children Including COVID-19: An Overview of the Epidemiology, Clinical Features, Diagnosis, Treatment and Prevention Options in Children. *Pediatr Infect Dis J*. 2020;39(5):355-368. doi:10.1097/INF.0000000000002660
2. COVID Live Update. Worldometer. Updated August 26, 2021. Accessed July 23, 2021. <https://www.worldometers.info/coronavirus/>
3. Ke R, Romero-Severson E, Sanche S, et al. Estimating the reproductive number R_0 of SARS-CoV-2 in the United States and eight European countries and implications for vaccination. *J Theor Biol*. 2021;517:110621. doi:10.1016/j.jtbi.2021.110621
4. Haas EJ, Angulo FJ, McLaughlin JM, et al. Impact and effectiveness of mRNA BNT162b2 vaccine against SARS-CoV-2 infections and COVID-19 cases, hospitalisations, and deaths following a nationwide vaccination campaign in Israel: an observational study using national surveillance data. *Lancet*. 2021;397(10287):1819-1829. doi:10.1016/S0140-6736(21)00947-8
5. Ferguson MN, Laydon D, Nedjati-Gilani G, et al. Report 9:

- Impact of non-pharmaceutical interventions (NPIs) to reduce COVID-19 mortality and healthcare demand. Imperial College London; 2020. doi:10.25561/77482
6. Torner N, Soldevila N, Garcia JJ, et al. Effectiveness of non-pharmaceutical measures in preventing pediatric influenza: a case-control study. *BMC Public Health*. 2015;15(1):543. doi:10.1186/s12889-015-1890-3
 7. Zhong BL, Luo W, Li HM, et al. Knowledge, attitudes, and practices towards COVID-19 among Chinese residents during the rapid rise period of the COVID-19 outbreak: a quick online cross-sectional survey. *Int J Biol Sci*. 2020;16(10):1745-1752. doi:10.7150/ijbs.45221
 8. Nwagbara UI, Osual EC, Chireshe R, et al. Knowledge, attitude, perception, and preventative practices towards COVID-19 in sub-Saharan Africa: A scoping review. *PLoS One*. 2021;16(4):e0249853. doi:10.1371/journal.pone.0249853
 9. Bourros D. BCG vaccination and Covid-19 protection. *Pneumon*. 2020;33(1):7-9. Accessed July 23, 2021. <http://www.pneumon.org/BCG-vaccination-and-Covid-19-protection,137291,0,2.html>
 10. Rodríguez-Morales AJ, Cardona-Ospina JA, Gutiérrez-Ocampo E, et al. Clinical, laboratory and imaging features of COVID-19: A systematic review and meta-analysis. *Travel Med Infect Dis*. 2020;34:101623. doi:10.1016/j.tmaid.2020.101623
 11. Gao J, Tian Z, Yang X. Breakthrough: Chloroquine phosphate has shown apparent efficacy in treatment of COVID-19 associated pneumonia in clinical studies. *Biosci Trends*. 2020;14:72-73. doi:10.5582/bst.2020.01047
 12. von Elm E, Altman DG, Egger M, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *Lancet*. 2007;370:1453-1457. doi:10.1016/S0140-6736(07)61602-X
 13. World Medical Association. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. *JAMA*. 2013;310(20):2191-2194. doi:10.1001/jama.2013.281053
 14. Qualtrics XM. Qualtrics; 2021. Accessed July 27, 2021. <https://www.qualtrics.com/>
 15. [Quarantine exclusion strategy and isolation close contacts & cases covid19]. National Organization of Public Health; 2020. Report in Greek. Accessed July 28, 2021. <https://eody.gov.gr/wp-content/uploads/2020/11/COVID19-lix-i-karantinas-apomonosis.pdf>
 16. Choi BCK, Pak AWP. A Catalog of Biases in Questionnaires. *Prev Chronic Dis*. 2005;2(1):A13. Accessed July 23, 2021. https://www.cdc.gov/pcd/issues/2005/jan/04_0050.htm
 17. Norquist JM, Girman C, Fehnel S, DeMuro-Mercon C, Santanello N. Choice of recall period for patient-reported outcome (PRO) measures: criteria for consideration. *Qual Life Res Int J Qual Life Asp Treat Care Rehabil*. 2012;21(6):1013-1020. doi:10.1007/s11136-011-0003-8
 18. Greece Population 2020. Worldometer. Accessed May 7, 2020. <https://www.worldometers.info/world-population/greece-population/>
 19. Social Media Stats Greece. StatCounter Global Stats. Accessed May 7, 2020. <https://gs.statcounter.com/social-media-stats/all/greece>
 20. Kotrlík JW, Higgins CC. Organizational research: Determining appropriate sample size in survey research appropriate sample size in survey research. *Information Technology, Learning, and Performance Journal*. 2001;19(1):43-50. Accessed July 23, 2021. <https://www.opalco.com/wp-content/uploads/2014/10/Reading-Sample-Size1.pdf>
 21. Chen N, Zhou M, Dong X, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. *Lancet*. 2020;395(10223):507-513. doi:10.1016/S0140-6736(20)30211-7
 22. Onder G, Rezza G, Brusaferro S. Case-Fatality Rate and Characteristics of Patients Dying in Relation to COVID-19 in Italy. *JAMA*. 2020;323:1775-1776. doi:10.1001/jama.2020.4683
 23. Kiviniemi MT, Orom H, Waters EA, McKillip M, Hay JL. Education-based disparities in knowledge of novel health risks: The case of knowledge gaps in HIV risk perceptions. *Br J Health Psychol*. 2018;23(2):420-435. doi:10.1111/bjhp.12297
 24. Mishra P, Pandey CM, Singh U, Gupta A, Sahu C, Keshri A. Descriptive Statistics and Normality Tests for Statistical Data. *Ann Card Anaesth*. 2019;22(1):67-72. doi:10.4103/aca.ACA_157_18
 25. Weaver KF, Morales VC, Dunn SL, Godde K, Weaver PF. An Introduction to Statistical Analysis in Research: With Applications in the Biological and Life Sciences. 1st ed. John Wiley & Sons, Inc; 2018:345. Accessed July 23, 2021. <https://onlinelibrary.wiley.com/doi/pdf/10.1002/9781119454205>
 26. MacCallum RC, Zhang S, Preacher KJ, Rucker DD. On the practice of dichotomization of quantitative variables. *Psychol Methods*. 2002;7(1):19-40. doi:10.1037/1082-989X.7.1.19
 27. Stata. Version 17. StataCorp; 2021. Accessed March 1, 2021. <https://www.stata.com/new-in-stata/>
 28. Myers L, Sirois MJ. Spearman Correlation Coefficients, Differences between. In: *Encyclopedia of Statistical Sciences*. American Cancer Society; 2006. Accessed July 23, 2021. doi:10.1002/0471667196.ess5050.pub2
 29. Russell D, Dowding DW, McDonald MV, et al. Factors for compliance with infection control practices in home healthcare: findings from a survey of nurses' knowledge and attitudes toward infection control. *Am J Infect Control*. 2018;46(11):1211-1217. doi:10.1016/j.ajic.2018.05.005
 30. Latiff LA, Parhizkar S, Zainuddin H, et al. Pandemic Influenza A (H1N1) and Its Prevention: A Cross Sectional Study on Patients' Knowledge, Attitude and Practice among Patients Attending Primary Health Care Clinic in Kuala Lumpur, Malaysia. *Glob J Health Sci*. 2012;4(2):95-102. doi:10.5539/gjhs.v4n2p95
 31. Taylor S, Asmundson GJG. Negative attitudes about

- facemasks during the COVID-19 pandemic: The dual importance of perceived ineffectiveness and psychological reactance. *PLoS One*. 2021;16(2):e0246317. doi:10.1371/journal.pone.0246317
32. 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.
33. Gerwin LE. The challenge of providing the public with actionable information during a pandemic. *J Law Med Ethics J Am Soc Law Med Ethics*. 2012;40(3):630-654. doi:10.1111/j.1748-720X.2012.00695.x
34. Greece COVID. Worldometer. Updated August 26, 2021. Accessed May 7, 2020. <https://ftp.worldometers.info/coronavirus/country/greece/>
35. Kanellopoulou A, Koskeridis F, Markozannes G, et al. Awareness, knowledge and trust in the Greek authorities towards COVID-19 pandemic: results from the Epirus Health Study cohort. *BMC Public Health*. 2021;21(1):1125. doi:10.1186/s12889-021-11193-x
36. Antoniou K, Bolaki M, Bibaki E, et al. COVID19 alert: Do we know our enemy? *Pneumon*. 2020;33(4):25-27. Accessed July 23, 2021. <http://www.pneumon.org/COVID19-alert-Do-we-know-our-enemy-,137296,0,2.html>