IJHS

Original Article

COVID-19 vaccine hesitancy in Sri Lanka: A national level survey

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WEBSITE: ijhs.org.sa
ISSN: 1658-3639
PUBLISHER: Qassim University

ABSTRACT

Objective: It is important to understand the factors associated with vaccination hesitancy for a given population for successful coronavirus disease-2019 (COVID-19) immunization program. This survey aimed to examine the prevalence of vaccine hesitancy and associated sociodemographic factors.

Methods: A cross-sectional online survey was undertaken by circulating through social media platforms. Survey questions included sociodemographics and vaccination acquisition-related questions.

Results: The study comprised a total of 3621 respondents. Over one-fifth of the unvaccinated population were identified as vaccine hesitancy group. Ethnicity and district indicated significant associations with vaccine hesitancy ($P < 0.05$). Indian Tamils (Odds Radio [OR] 2.222; 95%Confidence interval [CI], 1.150–4.294; $P = 0.018$), Sri Lankan Tamils (OR 1.714; 95% CI, 1.181–2.488; $P = 0.005$), and Sri Lankan Moors (OR 1.913; 95% CI, 1.316–2.781; $P = 0.001$) had significantly higher odds of vaccine hesitancy when compared to the Sinhalese. People in rural areas also had greater odds of vaccine hesitancy (OR 1.339; 95% CI, 1.000–1.793; $P = 0.05$) compared to municipal council areas.

Conclusion: Vaccine hesitancy was considerably high in this survey population. Our results emphasize the need of the Sri Lankan government taking appropriate efforts to establish a targeted COVID-19 vaccination campaign plan for rural and Colombo district residents. Attention should also be given to ethnic minority groups.

Keywords: COVID-19, pandemic, Sri Lanka, vaccine hesitancy

Introduction

The coronavirus disease-2019 (COVID-19) is a pandemic that poses grave health and economical challenges. It has affected all aspects of life and has imposed enormous costs on individuals, communities, health-care systems, and nations.[1] The world became aware of the dreadful reality of the situation as soon as the World Health Organization proclaimed COVID-19 a pandemic on March 11, 2020.[2] COVID-19 still shows no signs of being contained, resulting in an increased number of human deaths, destroyed livelihoods, and significant economic losses for countries.[3]

In addition to basic preventative measures such as social distancing, wearing a face mask, and washing hands,[4] many countries have taken rigorous precautions such as compulsory community lockdown and border restrictions in an effort to reduce the virus spread while minimizing the pandemic. However, vaccination is the ultimate strategy to prevent this infection.[5] The COVID-19 vaccines provide disease protection by activating an immunological reaction to the SARS-CoV-2 virus.[6] Therefore, it provides immunity, which decreases the probability of getting the illness and its consequences[6] and the pandemic may be controlled through herd immunity.[7,8] In addition, it was identified that a significant proportion must be vaccinated to develop effective herd immunity to halt the transmission of the COVID-19 virus.[9] Thus, universal vaccination is increasingly becoming a crucial approach in the growing COVID-19 pandemic. However, hesitation for the vaccine by the general public has been noticed as a key impediment to the successful handling of the present epidemic.[10] Vaccine hesitation is described by the strategic advisory group of experts on immunization as a "delay in accepting or refusing immunization notwithstanding the availability of vaccination services."[10] Vaccine hesitancy is a long-standing issue that poses a significant threat to world health, as seen by the resurgence of numerous infectious diseases, including measles and pertussis epidemics.[11,12] Conventionally, vaccination hesitancy is a widespread problem across the world with varying causes for the rejection of

vaccine uptake.[13] The most prevalent reasons were anticipated risk versus advantage, religious views, and insufficient awareness and understanding.[13] Furthermore, as proven by the previous vaccination research, the willingness to get vaccinated is highly impacted, particularly by suspicion of health experts.[14,15] In addition, because of the disease's novelty and worries about the safety of the vaccination and efficiency, a substantial number of the population have shown hesitate to get vaccinated against COVID-19.[16] The varied nature of vaccine hesitancy, including willingness to receive COVID-19 vaccinations, may hinder research into its worldwide impact. This implies that there are cognitive, psychologic, sociodemographic, and cultural aspects that contribute to vaccination hesitation. For instance, two recent reviews have discussed varying patterns of current COVID-19 vaccination acceptability in terms of proportion and associated factors such as gender, ethnicity, working status, education, age, religiosity, income, and working in health-care settings.[14,15] Following an evaluation of the extent and scale of this public health hazard, such variables must be examined to overcome COVID-19 vaccination hesitancy.[17] This can help in guiding interventional measures aimed at building and maintaining responses to tackle this threat.[18]

Sri Lanka is a low-to-middle income country with a population of more than 21 million people with diverse ethnic groups and different socioeconomic statuses. At present, the COVID-19 immunization program has been implemented in Sri Lanka and multiple types of vaccines were administrated.[19] The types of currently administered vaccines in Sri Lanka are CoviShield, Sinopharm, Sputnik-V, and Pfizer.[20] However, according to a small survey done in Sri Lanka, the majority of people were cautious about the brand of vaccine, its adverse reactions, allergy, and the period of immunity.[21] Therefore, the study was needed to collect reliable data on vaccination hesitancy when the vaccination is made accessible to the whole public. Considering a successful vaccination program, the government authorities must first accurately identify the target demographic factors and their nature in immunization concerns to develop effective intervention approaches such as implementing health education programs and then combat vaccine hesitancy accordingly. The purpose of this online survey was to investigate the prevalence of vaccine hesitancy and associated sociodemographic factors for vaccine hesitancy.

Materials and Methods

Study design and data collection

The target population of survey included Sri Lankan citizens who were residents in Sri Lanka at the time of survey distribution and who aged 16 years or older. The minimum sample size ($n = 482$) was calculated using the online Raosoft sample size calculator[22] designed specifically for population survey assuming the population size of 21 million in Sri Lanka,[23] with a response rate of 50%, confidence level of 95%, margin of error of 5%, and expecting 20% of incomplete forms. Using a pre-tested Google Form which covered the main points addressed in COVID-19 vaccination information published by the WHO[24] and Health Ministry of Sri Lanka,[25] a national-level cross-sectional online survey was performed. Questionnaires were distributed through the investigators' social network between the May 27, 2021 and the June 2, 2021, utilizing platforms such as WhatsApp, Facebook, Twitter, and Instagram. We also encouraged participants to recruit others using various methods such as forwarding the online questionnaire to their contact list and/or posting it on their personal Facebook wall and WhatsApp groups, allowing us to quickly reach a sufficiently large sample and a mixed population from different districts across the country during the lockdown period. An informed consent (electronic) was taken from the participants and ethical permission was waived for the current study because of the anonymous nature of the online survey and the inability of tracking sensitive personal data. This web-based poll was conducted in compliance with the World Medical Association's Helsinki Declaration's ethical guidelines (2000).[26] The detailed methodology is published previously and available online.[27]

Materials

The online poll was created with Google Forms and was available in all three main languages: English, Sinhala, and Tamil. The questionnaire was divided into two components. The first component comprised the sociodemographic data. Open-ended and multiple-choice questions were used to collect participants' birth year, gender, district, area of residence, ethnicity, educational status, current work status, and family monthly income. The second section of the questionnaire gathered information on vaccination acquisition and acceptability. Those who did not receive any dose of vaccine plus were not willing to be vaccinated due to another reason (other than the reason of contraindication to the vaccine as allergies and other diseases), was defined as the vaccine hesitancy group.

Statistical analysis

The demographic features of the research sample were investigated using descriptive statistics, which were given as mean and standard deviation (SD) for continuous variables and frequency and percentage (%) for categorical variables. To find the association between vaccine hesitancy and demographic variables, the Chi-square test was employed. Multivariate and univariate analysis was used to explore the relationship between dependent and independent variables. The analysis eliminated demographic variables that represented <1% of the sample. In addition, monthly family income categories of <10,000 Sri Lankan rupees (LKR) and 10,000–24,999 LKR were merged to form the 25,000 LKR category. Education level groups of no schooling, primary, and secondary education also were combined to a new one category as "secondary education

or below." The outcomes of logistic regression calculations were represented using the odds ratio (OR) and 95% confidence intervals (CI). $P \leq 0.05$ was deemed significant in all analyses. SPSS version 16.0 (IBM, Chicago, IL, USA) was utilized for data analysis.

Results

At the end of the survey period, a total of 3714 replies were received. After excluding incomplete responses and trivial groups (1% categories), 3621 respondents of ≥16 years old were included in the analysis. The sociodemographic characteristics of the participants are shown in Table 1. The participants' mean (SD) age was 32.98 (9.79) years, with the largest portion (24.6%) in the age range 26–30 years. About 60% of respondents were female. The current survey revealed from all 25 districts in Sri Lanka, with Colombo (38.0%, *n* = 1375), Gampaha (13.6%, *n* = 491), and Kandy (9.4%, *n* = 342) having the highest numbers. The majority (40.2 %, *n* = 1456) were in rural areas, with 32.6% (*n* = 1181) and 27.2% (*n* = 984) residing in municipal council and city regions, correspondingly. The study participants included people from all ethnic groups in Sri Lanka, with Sinhalese accounting for the majority portion (82.1 %, *n* = 2974). The majority of respondents held degree level (70.0%, *n* = 2533) or tertiary level (25.8%, *n* = 934) education. In terms of employment, 63.8% (*n* = 2311) were employed, 5.5% (*n* = 200) self-employed, 7.2% (*n* = 261) unemployed, and 16.6% (*n* = 602) were full time students. Nearly half of the participants (49%, *n* = 1785) had a gross monthly household income of far more than 100,000 LKR, while only 8.6% (*n* = 313) received an income less than monthly salary of 25,000 LKR.

In relation to the COVID-19 infection rate in this group, only 2.4% (*n* = 88) of those surveyed claimed to be infected with COVID-19. In addition, the majority of the respondents (65.3%, *n* = 2364) reported that they did not receive the vaccine. Among the vaccinated group (*n* = 1257), 54.0% got the first dose, while 47.9% received both doses. In relation to reasons for not having any dose of vaccine [Figure 1], the majority (75.7%, *n* = 1736) of them mentioned that they did not get the chance for vaccination, but expect to get the vaccine in the future and only 3.9% (*n* = 89) mentioned that they refused due to contraindication to the vaccine. However, over one-fifth of the study population (20.4%, *n* = 469) have mentioned that they were not willing to be vaccinated for other reasons.

Table 2 presents the distribution of the sociodemographic features by vaccine hesitancy due to acceptable reasons (unavailability of vaccine or contraindication to the vaccine) and other reasons. Across all the demographic variables, ethnicity and district indicated significant associations with vaccine hesitancy (hesitancy of accepting the vaccine due to other reasons) ($P < 0.05$). However, hesitancy of accepting the vaccine due to acceptable reason or other reason was not significantly associated with age, gender, area of residence, education level, employment status, and monthly family income.

Table 1: Demographic characteristics of the study population

Variables	Total (*n*=3621)	
	n	%
Age		
16–25 years	803	22.2
26–30 years	892	24.6
31–35 years	747	20.6
36–40 years	489	13.5
>40 years	690	19.1
Gender		
Male	1447	40.0
Female	2174	60.0
District		
Colombo	1375	38.0
Gampaha	491	13.6
Kandy	342	9.4
Others	1413	39.0
Area of residence		
Municipal council area	1181	32.6
City council area	984	27.3
Rural area	1456	40.2
Ethnicity		
Sinhala	2974	82.1
Sri Lankan Tamil	298	8.2
Indian Tamil	54	1.5
Sri Lankan Moors	250	6.9
Others	45	1.2
Education level		
Secondary education	154	4.3
Tertiary education	934	25.8
Degree or above	2533	70.0
Employment status		
Employed	2311	63.8
Self-employed	200	5.5
Unemployed	261	7.2
Engaged in home duties	110	3.0
Retired from employment	54	1.5
Full time student or pupil	602	16.6
Other	83	2.3
Monthly family income (in LKR)		
<25,000	313	8.6
25,000–49,999	591	16.3
50,000–99,999	942	26.0
100,000–199,999	876	24.2
>200000	899	24.8

LKR: Sri Lankan rupees

Table 2: Distribution of the Socio-Demographic features by vaccine hesitancy

Variable	Hesitancy of accepting the vaccine		
	Due to acceptable reasons	Due to other reasons[a]	*P*-value
Total (%)	1825 (79.6)	469 (20.4)	
Age			
16–25 years	497 (76.7)	151 (23.3)	0.185
26–30 years	547 (79.3)	143 (20.7)	
31–35 years	346 (81.0)	81 (19.0)	
36–40 years	202 (82.1)	44 (17.9)	
>40 years	233 (82.3)	50 (17.7)	
Gender			
Male	682 (80.5)	165 (19.5)	0.381
Female	1143 (79.0)	304 (21.0)	
District			
Colombo	549 (76.5)	169 (23.5)	**<0.001**
Gampaha	192 (72.2)	74 (27.8)	
Kandy	236 (79.5)	61 (20.5)	
Others	848 (83.7)	165 (16.3)	
Area of residence			
Municipal council area	530 (80.8)	126 (19.2)	0.550
City council area	458 (78.3)	127 (21.7)	
Rural area	837 (79.5)	216 (20.5)	
Ethnicity			
Sinhala	1521 (81.2)	353 (18.8)	**0.001**
Sri Lankan Tamil	141 (75.0)	47 (25.0)	
Indian Tamil	27 (64.3)	15 (35.7)	
Sri Lankan moors	117 (70.5)	49 (29.5)	
Others	19 (79.2)	5 (20.8)	
Education level			
Secondary education or below	102 (75.0)	34 (25.0)	0.398
Tertiary education	534 (79.8)	135 (20.2)	
Degree or above	1189 (79.9)	300 (20.1)	
Employment status			
Employed	1088 (80.5)	263 (19.5)	0.068
Self-employed	94 (72.3)	36 (27.7)	
Unemployed	166 (82.6)	35 (17.4)	
Engaged in home duties	56 (73.7)	20 (26.3)	
Retired from employment	18 (94.7)	1 (5.3)	
Full time student or pupil	355 (77.5)	103 (22.0)	
Other	48 (81.4)	11 (18.6)	
Monthly family income (in LKR)			
<25,000	189 (77.1)	56 (22.9)	0.264
25,000–49,999	348 (76.8)	105 (23.2)	
50,000–99,999	528 (79.9)	133 (20.1)	
100,000–199,999	415 (80.4)	101 (19.6)	
>200000	345 (82.3)	74 (17.7)	

P-probability value, LKR: Sri Lankan rupees, *P* value under 0.05 indicates a significant outcome. Values in bold indicate significance. [a]Those who considered as vaccine hesitancy group

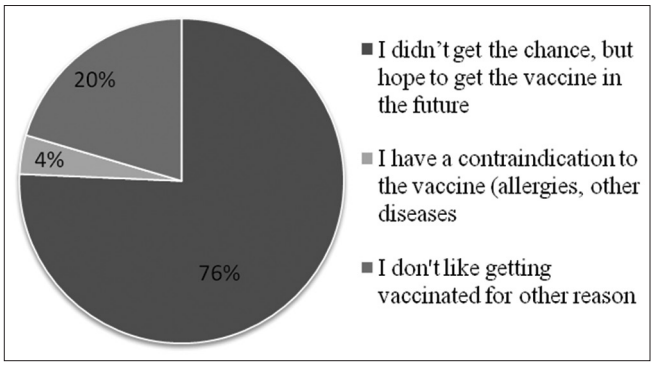

Figure 1: The reasons for not having COVID-19 vaccine

Table 3 shows the OR for the prevalence of vaccination hesitant by sociodemographic factors in both crude and adjusted regression analysis. According to the findings of the binary logistic regression analysis, age or gender had no significant impact on vaccination hesitancy in adjusted regression analysis. However, ages between 16 and 25 years were significantly less likely to hesitate vaccine compared to age >40 years (OR 0.66; 95% CI, 0.46–0.94; $P = 0.022$) in crude regression analysis. Respondents from other districts had significantly lower odds of vaccine hesitancy (OR 0.54; 95% CI, 0.41–0.71; $P < 0.001$) in comparison to Colombo in the adjusted model (multivariate analysis). In comparison to the municipal council area, people in rural areas were also more likely to be vaccination hesitant, only in the adjusted model (OR 1.34; 95% CI, 1.00–1.79; $P = 0.05$) which was almost significant, but not in the univariate analysis (OR 1.1; 95% CI, 0.86–1.40 $P = 0.46$). With regards to ethnicity, Indian Tamils (OR 2.22; 95% CI, 1.15–4.29; $P = 0.018$), Sri Lankan Tamils (OR 1.71; 95% CI, 1.18–2.49; $P = 0.005$) and Sri Lankan Moors (OR 1.91; 95% CI, 1.32–2.78; $P = 0.001$) had a significantly greater odds of vaccine hesitancy when compared to the Sinhalese in multivariate analysis. Moreover, all those categories had a significant greater odds of vaccine hesitancy compared to the Sinhalese in univariate analysis as well which was OR 1.46; 95% CI, 1.03–2.07; $P = 0.033$ in Sri Lankan Tamil, OR 2.44; 95% CI, 1.28–4.63; $P = 0.007$ in Indian Tamil, OR 1.83; 95% CI, 1.29–2.59; $P = 0.001$ in Sri Lankan moors. Any stratum of education and income level seems to have not significantly influenced the vaccine hesitancy both in univariate analysis and multivariate analysis. The employment status also had no influence on vaccine hesitancy in the adjusted model, but self-employed were significantly more likely to hesitate vaccine compared to the employed group (OR 1.57; 95% CI, 1.04–2.35; $P = 0.03$) in the crude regression analysis.

Discussion

To the best of our knowledge, The current study is the first largest national-level online surveys conducted in Sri Lanka to investigate the prevalence of vaccination hesitancy and its relationship to socioeconomic factors. Survey participants were primarily young people under age of 35 used social networking sites more actively than the elder population. Furthermore,

Table 3: The Odds Ratios (OR) for the likelihood of vaccine hesitancy by sociodemographic variables[a]

Variable	Vaccine hesitancy			
	Univariate analysis		Multivariate analysis	
	OR (95% CI) [x]	P-value [x]	OR (95% CI) [y]	*P*-value[y]
Age				
16–25 years*	1		1	
26–30 years	0.855 (0.660–1.107)	0.234	0.789 (0.550–1.131)	0.197
31–35 years	0.744 (0.550–1.006)	0.055	0.749 (0.499–1.124)	0.162
36–40 years	0.692 (0.477–1.004)	0.052	0.724 (0.456–1.148)	0.170
>40 years	0.662 (0.465–0.943)	**0.022**	0.712 (0.454–1.116)	0.138
Gender				
Male*	1		1	
Female	1.113 (0.901–1.375)	0.323	1.094 (0.873–1.370)	0.435
District				
Colombo*	1		1	
Gampaha	1.297 (0.945–1.781)	0.107	1.224 (0.867–1.728)	0.252
Kandy	0.872 (0.627–1.212)	0.415	0.719 (0.491–1.055)	0.092
Others	0.652 (0.513–0.828)	**<0.001**	0.538 (0.407–0.710)	**<0.001**
Area of residence				
Municipal Council Area*	1		1	
City Council Area	1.165 (0.885–1.536)	0.276	1.184 (0.888–1.577)	0.249
Rural Area	1.097 (0.859–1.401)	0.460	1.339 (1.000–1.793)	**0.050**
Ethnicity				
Sinhala*	1		1	
Sri Lankan Tamil	1.462 (1.030–2.074)	**0.033**	1.714 (1.181–2.488)	**0.005**
Indian Tamil	2.436 (1.282–4.628)	**0.007**	2.222 (1.150–4.294)	**0.018**
Sri Lankan Moors	1.827 (1.288–2.592)	**0.001**	1.913 (1.316–2.781)	**0.001**
Others	1.154 (0.428–3.112)	0.777	1.002 (0.365–2.748)	0.998
Education level				
Secondary Education*	1		1	
Tertiary Education	0.768 (0.499–1.180)	0.228	0.822 (0.520–1.297)	0.399
Degree or Above	0.759 (0.505–1.141)	0.185	0.933 (0.589–1.477)	0.766
Employment status				
Employed*	1		1	
Self-Employed	1.566 (1.044–2.350)	0.030	1.425 (0.931–2.180)	0.103
Unemployed	0.869 (0.590–1.281)	0.478	0.765 (0.499–1.174)	0.220
Engaged in Home Duties	1.507 (0.889–2.556)	0.128	1.306 (0.751–1.273)	0.345
Retired from Employment	0.222 (0.030–1.667)	0.143	0.240 (0.031–1.878)	0.174
Full time Student or Pupil	1.236 (0.957–1.598)	0.105	0.944 (0.638–1.396)	0.774
Other	0.967 (0.496–1.888)	0.922	0.819 (0.408–1.644)	0.575
Monthly family income (LKR)				
<25,000*	1		1	
25,000–49,999	1.025 (0.709–1.482)	0.897	1.072 (0.728–1.580)	0.724
50,000–99,999	0.843 (0.592–1.201)	0.345	0.884 (0.605–1.293)	0.526
100,000–199,999	0.806 (0.558–1.166)	0.252	0.802 (0.533–1.206)	0.289
>200000	0.709 (0.481–1.047)	0.084	0.702 (0.451–1.091)	0.116

*Reference variable, CI: Confidence interval, OR: Odds ratio, *P*-probability value, LKR: Sri Lankan rupees. *P*-value under 0.05 indicates a significant outcome. Values in bold indicate significance. [a]Those who declared not willing to take vaccine due to other reasons (reasons other than contraindication and unavailable of vaccine) were included in the analysis. [x]Results from univariate analysis. [y]Results from multivariate analysis

responders were mostly female and educated. During the survey period, the most of those who responded did not have the opportunity to be vaccinated but were expecting to acquire the vaccine when it becomes available. In Sri Lanka, 19/100 people

have been vaccinated (received at least one dose) as of 1st July 2021.[28] In other words, 13.62% of Sri Lankans have gotten at least one dose of any vaccination, while 5.3% have been fully vaccinated (received two doses).[28] Globally, over 3.16 billion immunization doses have been administered, equivalent to 41 doses for every 100 individuals.[28] However, there is already a significant disparity in immunization efforts in various nations, with some failing to record even a single dosage.[28] There is also a notable gap between regions. Africa has the lowest immunization rate of any region (3.8/100 people), while North America has the highest rate of vaccination (74/100 people).[28] Although high- and upper-middle-income nations accounted for 85% of all doses, in low-income nations, only 0.3% of dosages were delivered.[28] Although less-affluent nations are relying on COVAX, a vaccine-sharing agreement that intends to promptly supply two billion doses by the end of this year,[29] COVID-19 vaccination hesitancy was identified as a major obstacle worldwide in attempts to manage the present pandemic.[30] The most recent COVID-19 estimations indicated a range of 60–75 % vaccinated persons will be necessary for preventing the virus's further replication and community spread.[31] Therefore, public acceptability of vaccination should be high for this endeavor to be successful.

From the present study, over 20% of the respondents stated hesitation regarding vaccination while nearly 80% of people could not have the vaccine due to acceptable reasons. Similarly, a survey from our neighboring country, India revealed a vaccine hesitancy rate of 25.5%.[32] In East and South-east Asian countries, the general public's overall hesitancy rate was lower than in Sri Lanka. This includes two studies of the general people in China that revealed vaccination hesitancy rates of 8.7% and 16.5%,[33] with a further survey in South Korea reporting a rate of 20.2%.[32] In addition, other affluent countries such as Canada (20%), Denmark (20%), and the UK (as 17%; 21%; 10.9, and 28.3% with variability in different surveys) also reported lower vaccine hesitancy rates.[14] On the other hand, Middle East countries such as Jordan (71.6%) (34), Kuwait (76.4%),[34] and Saudi Arabia (35.3%)[35] have high rates of vaccine hesitancy.

Gender, income, level of education, and age appeared to have no significant effect on vaccination hesitancy based on the analysis in the present study. Association between vaccine hesitancy and gender is in conformity with the findings of a research done in Italy, which also had no significant association between gender and vaccine hesitancy,[36] otherwise, females had higher vaccine hesitancy than males in surveys done in many other countries such as the USA,[37] UK,[38] Turkey,[38] Italy,[39] Canada,[40] Japan,[40] and Switzerland.[40] Income had no association with the vaccine hesitancy in one survey done in the USA and Italy,[41] which was consistent with our result. However, other studies done in the USA, UK, Turkey, Italy, Canada, Japan showed that unemployed individuals as well as those with the lower incomes were more likely to be vaccination hesitant.[37-40] In addition, those studies have shown that individuals with a low level of education showed a greater prevalence of vaccination hesitancy.[37-40] The association of vaccine hesitancy and education level in our study is in accordance with the results observed in UK and Turkey,[38] which also showed no significant association. With regards to age, surveys done in the USA, UK, Turkey, Canada, Japan, and Switzerland have reported that the younger age group is linked with more vaccine hesitancy. In contrast, another study conducted in Italy discovered that people in the 40–50 years of age were more likely to hesitate vaccination than people in their 20–30 and >60 years of age.[39]

The district and area of residence have influenced the vaccine hesitancy in our study. Respondents from the Colombo district had significantly higher odds of vaccine-hesitant compared to "other" districts. One contributory reason for this might be that the vaccine was initially introduced to Colombo and when it came to the other districts; they already saw that it had been safely administered at Colombo and so it reduced their hesitancy due to concerns on safety. Moreover, people in rural areas also had substantially greater risk of vaccination hesitancy compared to people living in the municipal council areas. However, other surveys were done in countries with low- and middle-income (Brazil, Malaysia, Thailand, Bangladesh, and Africa) that has shown that residential setting (rural or sub-urban or urban) had no significant association with the vaccine hesitancy.[42] Although another study done in Bangladesh has revealed, the vaccine hesitancy is significant among rural residents compared to other living settings.[43]

Moreover, ethnicity has influenced the vaccine hesitancy reporting significantly lower odds in Sinhalese compared to both Tamil groups and Sri Lankan Moors, while Indian Tamils were more reluctant to be vaccinated among all ethnic groups. Similar to our finding, the vaccine hesitancy was significantly higher among the minor ethnic population in the USA[44] Great Britain.[45,46] Ethnic minorities indicated a higher vaccination hesitancy due to several reasons such as philosophical and religious issues, long history of distrust of the public medical services, and minority under-representation in health research and vaccination trials.[10] Our sample shows comparable proportions according to 2012 statistics,[47] demonstrating the country's well-balanced distribution of ethnic groupings, the association of ethnicity toward vaccine hesitancy will be a remarkable finding. The same population recorded in this study was assessed for the usage of nutritional supplements to improve immunity and found that ethnicity had a significant relationship with the frequency of supplement intake.[48] There might be close relationships between significant disparities in this vaccine hesitancy and intake of immune-nutrients among these ethnic groups.

Limitations

This study has certain limitations that must be noted when evaluating the results. Sampling was not undertaken

in the present study as sampling for online surveys has methodological challenges in developing countries due to the difficulty in reaching the poor people and lack of technology and IT literacy. Therefore, the use of an online survey might lead to sample bias, because of the lack of fair representation from all provinces. It is interesting to note that young individuals are over-represented in this survey sample, whereas elderly persons are under-represented. In addition to that, contribution from male and female for the survey was not equally distributed and predominant gender of the study sample was female. The generality and validity of the data are two of the significant drawbacks of web-based surveys, which necessitate careful interpretation of the study findings.[49] Furthermore, because the replies were self-reported, they may have been influenced by self-reporting bias and a desire to give a socially favorable response. The results of this survey should be evaluated in consideration of the restrictions indicated above. Given the above limitations, we consider our results contribute considerably to current understanding of public desire for COVID-19 immunization.

The government authorities must first accurately identify the target demographic factors and their nature in immunization concerns to develop effective intervention approaches and then combat vaccine hesitancy.[50] A study done in Bangladesh to understand the strategies to optimize vaccine coverage has recommended their government to establish specific vaccine campaigns for rural people, farmers, day laborers, and homemakers because of the high vaccination hesitancy prevalence among those groups.[43] The epidemiological triangle, which comprises environmental, agent (vaccine), and host (person) variables, can explain the underlying link on vaccination hesitancy.[50] This present study explored the host-vaccine hesitancy relationship, which includes ethnicity, education level, income, and area of living. Therefore, we believe that understanding these association present advantages for future immunization programs by implementing successful intervention strategies addressing the associated factors for vaccine hesitancy.

Future direction

As there are still insufficient vaccines to cover a considerable population in Sri Lanka, the assessment of vaccination hesitancy in real-world situations would represent genuine consumer acceptance. Therefore, further studies are needed to collect reliable data on vaccination hesitancy when the vaccination is made accessible to the whole public.

Conclusions

Vaccine hesitancy was considerably high in this survey population. Vaccine hesitancy was not related to age, gender, education level, or income. Sinhalese demonstrated significantly lower odds for vaccine hesitancy compared with other minority groups such as Sri Lankan Tamils, Indian Tamil, and Sri Lankan Moors, while Indian Tamil comprised significantly greater odds of vaccine hesitancy among other minority groups. Respondents from the rural area had increased odds of vaccine hesitancy compared with the municipal council area, and persons in the Colombo district were much more likely to be hesitant about getting the vaccination when compared to "other" districts. Our results emphasize the need of the Sri Lankan government taking appropriate efforts to establish a targeted COVID-19 vaccination campaign plan for rural and Colombo district residents. Attention should also be given to ethnic minority groups.

Author's Declaration Statement

Acknowledgments

The authors would express our gratitude towards every participant for their contribution in conducting this research study.

Source of funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not for-profit sectors.

Conflict of interest

The authors state that they have no conflicting financial interests or personal connections that may seem to have influenced the work presented in this publication.

Ethical approval

The ethical permission was waived. The survey did not require approval by the ethics committee because of the anonymous nature of the online survey and the inability of tracking sensitive personal data.

Consent to participate

An informed consent (electronic) was taken from the participants.

Consent to publication

Not applicable.

Availability of data and material

Not applicable.

Code availability

Not applicable.

Author contributions

RJ, PS, and TVF conceived, designed, and disseminated the questionnaire; HS was in responsible of data analysis,

interpretation, and manuscript writing. The manuscript was revised by RJ. The final manuscript was reviewed and approved by all writers.

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