Covid-19 Vaccine Hesitancy immediately before the vaccine operation

Abstract

The successful development of vaccine to COVID-19 presented hope for a way out of the global crises caused by the virus. A potential barrier may be the vaccine hesitancy and identifying the factors that effect it are critical. The current research was performed three days before the vaccine operation started. The research represent a holistic approach which combines determinates previously discussed by the SAGE working group on vaccine hesitancy.

The results indicate that there are different sets of variables which affect the willingness to accept the vaccine for the whole spectrum and for the vaccine hesitancy spectrum. In the full sample men are significantly more willing to accept the vaccine than women, older age increase vaccine acceptancy, and higher level of income increase vaccine acceptance, respondent that currently vaccine against seasonal influenza have a higher tendency to accept the COVID-19 vaccine. Perceived trust has a positive association with the vaccine acceptancy. Perceived susceptibility, perceived benefits, perceived barriers are associated with vaccine acceptancy. The perceived level of suffer from COVID-19 is associated with willingness to vaccinate, when the religious level increase the intention to vaccinate decrease.

For the vaccine hesitancy subsample the set of significant factors includes only gender, flu vaccine, vaccine company trust, vaccine benefits and vaccine barriers.

The efforts of the government and health institutions should be focus on women and highlight the vaccine as opportunity to go back to normal without worries. In addition, official statements from the vaccine companies regarding safety, efficacy and side effects of the COVID-19 vaccine can help reduce vaccine hesitancy.

Keywords: Vaccine Hesitancy, Covid-19, HBM, demographic, trust, flu vaccine

The year 2020 has presented a health crises caused by the COVID-19 that has led to one of the worst economic crises the world have known and effected the life of billions of people. By December 27th over 80 million people had the virus and over 1.7 million died (<https://www.worldometers.info/coronavirus/>?). Due to the huge effect it had on everyday life and the risk it poses on people health including risk of death many researchers and companies has quickly started to develop a vaccine. Successful results of the vaccine tests lead to the FDA emergency approval for the use of the vaccine in December 2020. Countries all over the world are getting ready to start vaccinating the population by purchasing the vaccine, deciding priority in vaccine allocations and dealing with logistic issues. Addressing the supply issues is not enough. In order to get coverage and community immunity governments must address hesitancy and build vaccine literacy so that the public will accept immunization ([**Brewer, Chapman, Rothman, Leask, & Kempe, 2017**](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-2), Larson, et al 2014, Lane et al 2018). Concerning COVID-19, 67% of the population need to take the vaccine in order to get community immunity (**Graffigna et al 2020,** Feleszko **et al 2020 )**. Recent study found that nearly 26% of global participants would hesitate to take a COVID-19 vaccine when it is available (Neumann‑Bohme et al 2020). Vaccine hesitancy was defined by the World Health organization (WHO) as a delay in acceptance or refusal of vaccination, despite availability of vaccination services (MacDonald, N. E. & SAGE Working Group on Vaccine Hesitancy. 2015). The causes of vaccine hesitancy varied by countries and are vaccine specific, indicating a need to strengthen the capacity of national programs to identify the local casual factors and develop appropriate strategies. (Karafllakiset et al (2017) Cobos et al (2015)).

Theories concerning willingness to vaccine includes the Health Belief Model (HBM), Protection Motivation Theory (PMT), and Risk Perception Attitude (RPA) models ([**Janz & Becker, 1984**](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-12); [**Rogers, 1983**](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-28); [**Rimal & Real, 2003**](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-27), [**Paek & Hove, 2017**](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-21)).

 The research based on these theories is very extensive and cover variety of diseases, e.g. A/H1N1 (Teitler-Regev et al 2011), influenza (Wagner et al 2017) and flu (Xie 2019).

The SAGE working group on vaccine hesitancy developed the vaccine hesitancy determinate metrics with factors grouped into three categories (MacDonald, N. E. & SAGE Working Group on Vaccine Hesitancy. 2015)

Table 1: summary of research findings concerning COVID-19 vaccine hesitancy

|  |  |  |
| --- | --- | --- |
| Category | Findings | Source |
| The contextual influences | Respondents who said that they trusted their government were more likely to accept a vaccine | Lazarus (2020), Dodd el al 2020 |
| Cases and mortality per million of a nation’s population were associated with a higher likelihood of vaccine acceptance | Lazarus (2020), Reiter et al 2020 |
| Being moderate or liberal in their political leaning increased the willingness to get vaccinated  | Reiter et al 2020 |
| The willingness to get vaccinate is high among Respondent with chronic disease | Reiter et al 2020 |
| Age less than 25 years old decreased the willingness to get vaccinated  | Lazarus (2020), Neumann ‑Bohme et al 2020 |
| Younger ages or older ages increase vaccine acceptance | [Palamenghi et al., 2020](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-22), Reiter et al 2020 [Detoc et al., 2020](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-11),Neumann‑Bohme et al 2020 |
| Age do not effect vaccine acceptance  | Dror et al 2020 |
| men were slightly less likely to accept the vaccine | Lazarus (2020),  |
| Men were more likely to take the vaccine | Wong et al 2020, Qiao (2020), Dror et al 2020, [Harapan et al., 2020](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-11); Neumann ‑Bohme et al 2020 |
| having a child is a negative predictor for accepting future vaccination | [Dror et al., 2020](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-6) |
| Higher levels of education were associated positively with vaccine acceptance | Lazarus (2020), Qiao(2020)Dodd 2020 |
| Recent or upcoming travel outside of the country increase the willingness to take the vaccine | Reiter et al 2020 |
| People were less likely to accept the vaccine if the employer required it | Lazarus (2020) |
| being retired was associated with less acceptance compared to civil servants | [Harapan et al., 2020](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-11); |
| Those with a higher income were most likely to accept a vaccine than those with a lower income. | Lazarus (2020) |
| Individual and group influences | People currently vaccinated against seasonal influenza have a strong tendency to accept a future COVID-19 vaccine. | Dror et al 2020 |
| higher intended to get COVID-19 vaccine among responders who lost their job during the crisis | Dror et al 2020 |
| perceptions towards general vaccination are associated with COVID-19 acceptance | [Palamenghi et al., 2020](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-22) |
| trust in scientific research is associated with vaccine hesitancy | [**Palamenghi et al., 2020**](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-22) |
| Inadequate health literacy is associated with vaccine hesitancy | Dodd el al 2020 |
| higher levels of perceived likelihood to get a COVID-19 infection increase the willingness to get the vaccine | Reiter et al 2020. [Dror et al., 2020](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-6); [Graffigna et al ,2020 Palamenghi, et](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-8) al,2020, [Harapan et al., 2020](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-11); [Detoc et al., 2020](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-11); Wong et al 2020 |
| Perceived benefits have the highest significant odds of a definite intention to take the COVID-19 vaccine. | Wong et al 2020 |
| risk exposures were negatively associated with vaccine acceptance | Qiao (2020) |
| Perceived susceptibility was not significantly associated with vaccine acceptance among college students. | Qiao (2020) |
| perceived risk associated with COVID-19 vaccine acceptance | [Detoc et al., 2020](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-5) |
| perceived severity is predictor of intention to take a vaccine | Reiter et al 2020, [Dror et al., 2020](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-6); [Graffignaet al , 2020](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-8), Qiao (2020) |
| working in the health care system or taking care of COVID-19 patients is positively associated with COVID-19 vaccine acceptance | [Detoc et al., 2020](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-5);  [2020](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-6); [Harapan et al., 2020](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-11); [Wong et al., 2020](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-31) |
| higher level of fear about COVID-19 is related to higher vaccine acceptance | [Detoc et al., (2020](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-5)), Qiao(2020), [Harapan et al., 2020](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-11); |
| People who reported COVID-19 sickness in themselves or family members were no more likely to accept the vaccine | Lazarus(2020) |
| Respondent are more willing to take the vaccine if the doctor recommends it | Reiter et al 2020 |
| respondents who stated that they think COVID-19 is not dangerous totheir health are not willing to be vaccinated | Neumann ‑Bohme et al 2020 |
| Vaccine and Vaccination specific issues | Participants who had no worries about the possible side-effects of a COVID-19 vaccination had higher intention to get the vaccine | Wong et al 2020, Reiter et al 2020, Neumann ‑Bohme et al 2020 |
| Participants who are worried about the safety on the COVID-19 vaccine might had lower intention to get the vaccine | Neumann ‑Bohme et al 2020 |
| Perceived effectiveness of a COVID-19 vaccine increase the vaccine acceptance | Reiter et al 2020, [Harapan et al., 2020](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-11); |
| Respondent are more willing to take the vaccine if the doctor recommends it | Reiter et al 2020 |

1. The contextual influences: historical, religion, culture, gender, socio-economic, politics , leader and communication influences
2. Individual and group influences personal and family experience: beliefs about health and prevention, knowledge awareness, trust on the health system, perceived risks, severity of disease and benefits and social norms.
3. Vaccine and Vaccination specific issues: epidemiological risk and benefits, introduction of a new vaccine, mode of administration, vaccination schedule, reliability of the vaccine, recommendation/attitudes of health care professional

Table 1 summarize the recent findings concerning COVID-19 vaccine hesitancy according to the SAGE working group determinates matrix. The COVID-19 findings are in line with the findings of previous vaccine hesitancy research.

In contrast, the level of reluctance to vaccinate against COVID-19 in many countries is higher than with usual vaccine ([Feleszko, Lewulis, Czarnecki, & Waszkiewicz, 2020](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-7)). To increase the public willingness to receive the vaccine for COVID-19 and reduce vaccine hesitancy the governments and the public health officials must be prepared, and consider the rumors and fake news about the vaccine which are already spreading around (Enserink, et al 2020).

Several researchers claimed that the willingness to get vaccinated is not necessarily a good predictor of acceptance, as vaccine decisions are multifactorial and can change over time ( Lazarus 2020). Therefore, surveyed performed at the early stages of the vaccine development may not be a good predictor as survey which made when the vaccine is available. The current research is performed right before the vaccination process begins in Israel, after the FDA approval and after U.S, UK and Canada has started their vaccine operation. The vaccine is free, available to everybody and allocate according to a priority order. The study combine all the factors mentioned in the literature in order to get a holistic view and help in identifying the barriers to get vaccinated and the action that will enhance the willingness to get vaccinated. In order to capture the continuum between full acceptance and outright refusal, the willingness to accept the vaccine is measured by five levels. Most of the previous studies used 2 or 3 levels or analyzed the data by logistic regression which reduce the dimension of the acceptance variable to yes or no. If the purpose is to understand the vaccine hesitancy it is important to look at the different levels of it. The results can help the policy makers in developing and implementing effective strategies to promote the COVID -19 vaccine. It will also help by enhancing the understanding of people willingness to accept a newly developed vaccine against a life changing epidemic.

Methods:

The questionnaire is based on Reiter 2020, Teitler-Regev 2011, Wong 2020, Barakat, 2020, Narendran 2020 , Costa ,2020 and includes several sections: section 1: demographic data: age, gender, , number of kids, level of income and education, residence type, level of religiousness.

Section 2 included questions regarding the effects of COVID-19 on respondent economic status, health status, mental status, life routine and country welfare status on a scale of 0 – had no affect at all to 100 had a very strong affect. Section 3 : health record and behavior regarding willingness to get vaccinated against COVID-19, health situation of the respondent and close family, chronic diseases, health insurance, health behavior routine, exposure risk for COVID-19, being seek with COVID-19, having a family member sick with COVID-19, intention to get general vaccinated,. Section 4 included the perceived data concerning COVID 19: trust, knowledge and the four constructs of the HBM model: susceptibility, severity , benefits and barriers on a five –point Likert scale from 1 very much agree to 5 do not agree at all.

The questionnaire was distributed among 504 people over the age of 18 in Israel, between 14-16 of December after the vaccination has started in UK and U.S, and three days before it started in Israel. The Ethics Committee at the higher education institution with which the authors are affiliated approved this study. The study was conducted by a polling company using an Internet survey. The respondents received a link to a questionnaire and could choose whether or not to provide answers.

The analysis included three categories of variables: 1. the contextual influences (demographic variable like gender, age, income) 2. Health records (e.g.: insurance, health statues, exposure to COVID-19, previous vaccine acceptance) and behavior 3. Perceived health attitudes (e.g. knowledge, trust, HBM model construct, influence of COVID-19). A detailed list of the research independent variables appears in Appendix A. A separate linear regression model was performed for each categories. Afterwards a combined linear regression model based on the significant variables from the previous stages was performed. The dependent variable was the willingness to accept the vaccine: once for the whole spectrum (1-definitely yes, 2-probably yes, 3-have not decided, 4-probably not and 5-definitely not) and one for the hesitancy subsample (2-probably yes, 3-have not decided, 4-probably not). The correlations between the independent variables in each stage were checked in order to avoid multicollinearity issues.

Results

31.4 % of the sample declared that they are willing to get vaccine, and only 9.2% opt the vaccine. 59.4% are vaccine hesitant: with 21.6% which will probably get the vaccine, 25.8% who have not decided yet and 12% who will probably will not get the vaccine. The average sample age is 39.4 years old, and for the vaccine hesitancy subsample the average age is 38.55 years old.

Table 2 describes the demographic variables for the full sample and for those despondence that hesitant about taking the COVID-19 vaccine.

Table 2: descriptive statistics

|  |  |  |  |
| --- | --- | --- | --- |
| Variable |  | Full sampleN=504Percent | Vaccine hesitancy sample N=304Percent |
| Gender   | Male  |  49.3 | 44.7 |
| Female |  50.7 | 55.3 |
| religiousness | secular | 51.6 | 49.3 |
| conservative |  28.8 | 34.9 |
| Orthodox |  14 | 12.5 |
| Strict orthodox | 5.8 | 3.3 |
| Income | High above average | 4.5 | 3.3 |
| above average | 19.6 | 18.4 |
| average | 25.4 | 26.3 |
| Below average | 26.5 | 27.3 |
| Low below average | 24 | 24.7 |
| education | High school  | 32.5 | 35.5 |
| diploma | 19.1 | 18.4 |
| Bachler degree | 30.6 | 31.3 |
| Higher degrees | 17.8 | 14.8 |

Tables 3a, 3b and 3c describe the influence of the contextual variables, health record and behavior and perceived health attitudes on the willingness to accept vaccinated for the full sample and for the vaccine hesitancy subsample.

Table 3a: regression results for the contextual influences variables

|  |  |  |
| --- | --- | --- |
|  | Full sample | Vaccine hesitancy sample |
| Variable | B | Std. Error | Sig | B | Std. Error | Sig |
| (Constant) | -4418.43 | 1077.064 | .00 | -2656.96 | 854.82 | .00 |
| Gender   | .44 | .108 | .00 | .27 | .09 | .00 |
| Age | -.02 | .005 | .00 | -.00 | .00 | .37 |
| Income:     | .09 | .048 | .05 | .01 | .04 | .83 |
| Education    | -.06 | .034 | .10 | -.01 | .08 | .73 |
| Residence type | .16 | .137 | .24 | .07 | .10 | .48 |
| religiousness | .23 | .065 | .00 | .05 | .05 | .34 |
| kids   | .16 | .135 | .24 | .05 | .11 | .63 |
|  | Adjusted R Square = 0.143 P value=0.00 | Adjusted R Square =0.024 P value=0.046 |

The results for the full sample indicate that men are significantly more willing to accept the vaccine, the intention to get the vaccine increase with age and income, and decrease with level of religiousness. Those results except the gender difference does not hold for the subset of vaccine hesitancy respondent.

Table 3b: regression results for the health record and behavior variables

|  |  |  |
| --- | --- | --- |
|  | Full sample | Vaccine hesitancy sample |
| Variable | B | Std. Error | Sig | B | Std. Error | Sig |
| (Constant) | .29 | 1.07 | .79 | 1.89 | .99 | .06 |
| Basic health insurance  | .18 | .25 | .46 | .11 | .19 | .57 |
| Additional health insurance  | -.279 | .15 | .07 | -.12 | .12 | .36 |
| Health  statues | .06 | .12 | .65 | -.00 | .10 | .98 |
| Chronic disease | .42 | .19 | .03 | .19 | .17 | .24 |
| # of people  | .00 | .00 | .39 | .00 | .00 | .32 |
| # of people at risk  | -.00 | .01 | .74 | .01 | .09 | .54 |
| Follow instructions | .25 | .09 | .01 | .16 | .08 | .13 |
| Were you sick | -.57 | .33 | .09 | -.26 | .25 | .31 |
| surrounding Sick | .20 | .15 | .19 | .07 | .13 | .60 |
| Child Vaccine | .91 | .50 | .07 | .56 | .48 | .24 |
| Health behavior routine | .06 | .08 | .50 | -.06 | .07 | .39 |
| flu  vaccine | .19 | .04 | .00 | .12 | .04 | .00 |
|  | Adjusted R Square = 0.120 Pvalue=0.00 | Adjusted R Square =0.053 Pvalue=0.049 |

The results for the full sample indicate that those who suffer from chronic disease are more willing to accept the vaccine, being among people who follow the government instructions increase the willingness of accepting the vaccine, and those that took or plan to take the flu vaccine are more willing to accept the COVID-19 vaccine. Only the flu vaccine has a significant influence for the vaccine hesitancy subsample.

Table 3c: regression results for the perceived health attitudes variables

|  |  |  |
| --- | --- | --- |
|  | Full sample | Vaccine hesitancy sample |
| Variable | B | Std. Error | Sig | B | Std. Error | Sig |
| (Constant) | .99 | .37 | .00 | 1.71 | .32 | .00 |
| Knowledge | -.05 | .05 | .35 | -.07 | .05 | .18 |
| Update frequency | .01 | .03 | .71 | .02 | .03 | .46 |
|  fake news  | .03 | .04 | .51 | .08 | .04 | .05 |
| General trust | .20 | .08 | .01 | .15 | .08 | .05 |
| Vaccine company Trust  | .35 | .08 | .00 | .23 | .08 | .00 |
| susceptibility | .14 | .07 | .05 | .10 | .06 | .11 |
| severity | .06 | .07 | .37 | .03 | .07 | .67 |
| benefits | .41 | .06 | .00 | .23 | .05 | .00 |
| barriers | -.36 | .05 | .00 | -.19 | .05 | .00 |
| influence | -.00 | .00 | .05 | -.00 | .00 | .01 |
|  | Adjusted R Square = 0.584; Pvalue=0.00 | Adjusted R Square =0.324; Pvalue=0.00 |

The results for the full sample indicate that people who trust the information about the vaccine and those who trust the information from the companies that develop the vaccine are more willing to accept the vaccine. Those with higher perceived probability of getting COVID-19 (susceptibility) are more willing to accept the vaccine. The willingness to take the vaccine is higher for those who found the vaccine to be more beneficial (benefits) or with less limitations (barriers) .Those who perceived the suffer from COVID-19 to be higher are more willing to accept the vaccine. The influence of vaccine company trust, vaccine benefits and vaccine barriers hold for the vaccine hesitancy group as well.

The final models are based on the holistic approach, which combine the different influences into an extended model. Each one of the significant variables from the previous stages introduce into the extended models. The final model excluded the chronic disease and following government instruction variables since there contribution to the extended model is insufficient.

Table 4: final model of willingness to accept the COVID-19 vaccine.

|  |  |  |
| --- | --- | --- |
|  | Full sample | Vaccine hesitancy sample |
| Variable | B | Std. Error | Sig | B | Std. Error | Sig |
| (Constant) | -1776.17 | 746.22 | .02 | -1756.07 | 710.54 | .01 |
| Gender   | .18 | .08 | .02 | .17 | .07 | .01 |
| Age | -.09 | .00 | .00 |  |  |  |
| Income     | .08 | .03 | .02 |  |  |  |
| religiousness | .10 | .04 | .03 |  |  |  |
| flu  vaccine | .07 | .02 | .01 | .09 | .02 | .00 |
| General trust | .15 | .07 | .04 |  |  |  |
| Vaccine company Trust  | .37 | .08 | .00 | .24 | 4.48 | .00 |
| susceptibility | .14 | .06 | .01 |  |  |  |
| benefits | .38 | .05 | .00 | .26 | .05 | .00 |
| barriers | -.31 | .05 | .00 | -.12 | .05 | .01 |
| influence | -.01 | .00 | .01 |  |  |  |
|  | Adjusted R Square = 0.617; Pvalue=0.00 | Adjusted R Square =0.326; Pvalue=0.00 |

The final set of significant variables for the full sample includes: gender, age, income, level of religiousness, flu vaccine acceptance, trust, perceived susceptibility, perceived benefits, perceived barriers and the level of suffering from COVID-19. For the vaccine hesitancy subsample the set of significant variables include: gender, flu vaccine acceptance, perceived trust in Vaccine Company, perceived vaccine benefits and perceived vaccine barriers.

Discussion

The year 2020 presented the world with the worst health crises ever, which was caused by COVID-19. The health crises has led to a major economic crises and changed the life of billions of people all over the world. The successful development of vaccine to COVID-19 yield the wishful thinking of returning to routine life and stop the huge suffer and death caused by the epidemic. A potential barrier may be the vaccine hesitancy which has been identified by the world health organization as one of the top ten global health threats in 2019 (even before the COVID -19 outbreak). During the last months research analyzing COVID-19 vaccine acceptance from different disciplines: behavioral, sociology, psychology, communication and political found set of influencing variables depending on the specific location and time. These set of variables are in line with previous research about vaccine hesitancy regarding other diseases. The current research is unique because it was performed three days before the vaccine operation started in the country, after the FDA approval and after three other countries has started their vaccine operation. The research represent an holistic approach which combines all the factors previously found in the literature and distinguish between two populations: the whole spectrum (including those who are willing to accept the vaccine, those who are not willing to accept the vaccine, and those who are hesitance concerning the vaccine) and the vaccine hesitancy spectrum (including probably accept, have not decided yet and probably will not accept). There is a continuum between full acceptance and outright refusal of the vaccine. Previous research concern hesitancy, which measure the willingness to accept the vaccine by 2 or 3 levels or used logistic regression, ignore those variance and therefore yield limited results.

The results indicate that there are different sets of variables which affect the willingness to accept the vaccine for the whole spectrum and for the vaccine hesitancy spectrum. Considering the full sample this research confirms the previous results: men are significantly more willing to accept the vaccine than women (in line with Wong et al 2020, Qiao (2020), Dror et al 2020, [Harapan et al., 2020](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-11); Neumann ‑Bohme et al 2020). Older age increase vaccine acceptancy (in line with [Palamenghi et al., 2020](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-22), Reiter et al 2020 [Detoc et al., 2020](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-11),Neumann‑Bohme et al 2020), higher level of income increase vaccine acceptance (Lazarus 2020) , respondent that currently vaccine against seasonal influenza have a higher tendency to accept the COVID-19 vaccine (in line with Dror et al 2020). Perceived trust has a positive association with the vaccine acceptancy (in line with [Palamenghi et al., 2020](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-22)). Three constructs of the HBM model: perceived susceptibility, perceived benefits, perceived barriers are associated with vaccine acceptancy. Respondent with higher level of perceived likelihood to get the COVID-19 infection are more willing to get the vaccine ( in line with Reiter et al 2020, [Dror et al., 2020](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-6); [Graffignaet al , 2020](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-8), Qiao 2020, [Harapan et al., 2020](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-11); [Detoc et al., 2020](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-11); Wong et al 2020,  [Palamenghi, et](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-8) al,2020). Higher perceived benefits respondent have a higher vaccine acceptance (in line with Wong et al 2020). Higher vaccine barriers decrease the vaccine acceptancy (in line with Wong et al 2020, Reiter et al 2020, Neumann ‑Bohme et al 2020, [Harapan et al., 2020](https://www.medrxiv.org/content/10.1101/2020.11.26.20239483v1.full-text#ref-11);)

In addition, the perceived level of suffer from COVID-19 is associated with willingness to vaccinate. As the suffer level increased the willingness to vaccinate increase as well. On the other hand, when the religious level increase the intention to vaccinate decrease.

For the vaccine hesitancy subsample the set of significant factors includes only gender, flu vaccine, vaccine company trust, vaccine benefits and vaccine barriers.

The importance of the timing of the survey and the holistic approach is curtail as can be seen by comparing the results of the current study to the results of the study performed by Dror et al (2020) in March 2020 concerning the population in Israel. According to Dror (2020) the predictors for acceptance of COVID-19 vaccination are: gender, having children, severity. From this list, only gender remained a significant predictor and other predictors have been revealed.

Government and health institutions have to focus their efforts among women and highlight the vaccine as opportunity to go back to normal without worries (in the long run), and in the meantime decrease the infected probability and the disease severity. They may publish official statements from the vaccine companies (probably translate to Hebrew) regarding safety, efficacy and side effects of the COVID-19 vaccine. Comparing the COVID-19 vaccine to the flu vaccine may cause a negative effect since those who hesitance about the flu vaccine may hesitance about the COVID-19 vaccine as well. In addition, vaccine hesitancy may change during the period of vaccine operation and it is recommended to carry out updated and identify changes in the influencing factors.

The fact that the study was performed only in one country and on a relatively small sample is a limitations, however, the findings can shed light on what effect vaccine hesitancy in case of a life changing disease and the availability of a vaccine. Further research should examine this impact in other countries and compare various points in time.

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Appendix A

|  |  |  |
| --- | --- | --- |
| Variable name | Scale |  |
| Gender | 0=male1=female |  |
| Age |  |  |
| Income | 1= high above the average to 5 = low below average |  |
| Education | 1= High school2= diploma3= Bachler Degree4=Higher degree | Highest level of education |
| Residence type | 0=city1=non-city |  |
| religiousness | 1=Secular2= conservative3= Orthodox4= Strict orthodox | Level of religiousness |
| kids | 0=yes1=no | Do you have kids under 18 |
| Basic health insurance | 0=yes1=no |  |
| Additional health insurance | 0=yes1=no |  |
| Health statues | 1=excellent4= poor | Rate your general health statues |
| Chronic Disease  | 0=yes1=no | Do you have chronic disease |
| # people |  | Weekly average number of people you meet with  |
| # people at risk |  | Weekly average number of people with high risk for COVID-19 that you meet  |
| Follow instructions | 1= very much5= not at all | Degree of following the government instruction for COVID-19 by people around you |
| Where you sick | 0=yes1=no | Did you have COVID-19 |
| Surrounding sick | 0=yes1=no | Did anyone around you had COVID-19 |
| Child vaccine | 0=yes1=no | Do you give your children the routine childhood vaccine  |
| Health behavior routineCronbach’s alpha=0.74 | 1= health behavior, 5=non health behavior | Usually I eat according to a balance diet  |
| I follow medical instruction given to me since I believe it will improve my medical situation. |
| I look for new information regarding my medical situation |
| I practice regularly at least twice a week |
| I use to do periodical checkups. |
| Flu vaccine | 0=yes1=no | Did you take or plan to take the vaccine this year |
| Knowledge | 1=very much5= very little | How much do you know about COVID-19 |
| Update frequency  | 1=very much5= very little | How often do you read or hear news about COVID-19 |
| Fake news | 1=more than 10%, 2=5 to 10%, 3=1 to 5%, 4=less than 4% | What percentage of the news you classify as fake news |
| General trust | 1= fully trust to 4- do not trust at all | What is your level of trust in vaccine information |
| Vaccine company trust | 1= fully trust to 4- do not trust at all | what is your level of trust on data from the companies that develop the vaccine |
| SusceptibilityCronbach’s alpha=0.772 | 1=high probability, 5= low probability | The possibility I will get sick with COVID-19 is very frightening to me |
| Working with many people increase the option I will get COVID-19 |
| The possibility of getting sick with COVID-19 in the next few month is very high |
| I am very worried about getting COVID-19 |
| There is a chance I will get infected with COVID-19 |
| severity | 1=severe outcome; 5= no outcome | If I will get COVID-19 it will disturb my family |
| Cronbach’s alpha=0.809 | If I will get COVID-19 it will be hard for me to perform everyday activities |
| COVID-19 can be a serious disease that you can die from |
| If I will get COVID-19 I will be very sick |
| I am afraid from the results of the disease if I get COVID-19 |
| BenefitsCronbach’s alpha=0.877 | 1=vaccine has benefits, 5= vaccine has no benefit | The vaccine for COVID-19 decrease the chance of getting the disease and its effect in infected |
| The vaccine for COVID-19 make me less worried about getting the disease |
| BarriersCronbach’s alpha=0.853 | 1= worries, 5= no worries | I am afraid from the vaccine for COVID-19 efficiency |
| I am afraid from the vaccine for COVID-19 security |
| I am afraid that the vaccine for COVID-19 side effect will affect my daily activities |
| InfluenceCronbach’s alpha=0.703 | 1= no influence, 100 high influence | Rate the effect of COVID-19 on your life |
| Rate the effect of COVID-19 on your economic situation |
| Rate the effect of COVID-19 on your medical situation |
| Rate the effect of COVID-19 on your mental situation |
| Rate the effect of COVID-19 on the situation in the country |