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COVID-19 vaccine hesitancy in Addis Ababa, Ethiopia: A mixed-methods study

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3 **1 COVID-19 vaccine hesitancy in Addis Ababa, Ethiopia: A mixed-methods study**
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12 Abstract

13 **Objective:** Data on COVID-19 vaccine hesitancy is limited in Ethiopia and other parts of
14 Africa. Therefore, the aim of this study was to determine the level of COVID-19 vaccine
15 hesitancy and its associated factors in Addis Ababa, Ethiopia.

16 **Design:** A community-based concurrent mixed-methods study

17 **Setting:** In a community setting

18 **Participants:** Adult residents (n = 422) of Akaki Kaliti sub-city who were recruited by a multi-
19 stage sampling technique were included for the quantitative part of the study and 24 adults who
20 were included purposively for the qualitative in-depth interview.

21 **Outcome Measures:** Data was collected by face-to-face interview by using a semi-structured
22 questionnaire. Factors associated with COVID-19 vaccine hesitancy were identified by
23 multivariable binary logistic regression model, as expressed by adjusted odds ratio (aOR).

24 **Results:** One out five (19.1%) participants was not willing to get vaccinated. In the
25 multivariable analysis, vaccine hesitancy was significantly associated with being female
26 (aOR=1.97; 95% CI: 1.10 - 3.89), negative attitude towards COVID-19 and its preventive
27 measures (aOR=1.75; 95% CI: 1.08 - 3.02), and primary information source being social media
28 (internet) (aOR=3.59; 95% CI: 1.75 - 7.37). Study participants have stated that they did not
29 have enough information about the vaccine, feared it would not be effective or have too many
30 side effects, and reflected their uncertainty towards the quality of the vaccine.

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3 31 **Conclusions:** A considerable proportion of the people in Addis Ababa have concerns on
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5 32 COVID-19 vaccine and unwilling to accept. This was mainly due to the misconceptions
6
7 33 distributed from the use of social media as source of information. Providing the community
8
9 34 with health education and consistent efforts to enhance the prevention measures are important,
10
11 35 particularly using different medias including social-medias.
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16 36 **Key Words:** COVID-19, knowledge, attitude, Vaccine, Hesitancy
17

18 37 **Article Summary**

19 38 **Strengths and limitations of this study**

- 20 39 • This is the first study from Ethiopia to determine the level of COVID-19 vaccine
21 40 hesitancy in the general population.
- 22 41 • A mixed-methods approach allows for triangulation of findings from different
23 42 perspectives.
- 24 43 • The study might be limited due to the recall bias and social desirability bias during the
25 44 data collection.

26 45 **Funding statement**

27 46 This study was funded by Myungsung Medical College. However, the funder had no role in the
28 47 design, conduct, analysis and interpretation of this study.
29 48

30 49 **Conflict of interest**

31 50 The authors declare that they have no conflict of interests.
32 51

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52 Introduction

53 Corona virus disease 2019 (COVID-19) is caused by severe acute respiratory syndrome corona
54 virus 2 (SARS-CoV-2) also known as Novel coronavirus (nCoV) [1]. The first case of COVID-
55 19 was discovered in Wuhan city, Hubei province of China with unexplained pneumonia on
56 December 12, 2019 [2]. The virus is transmitted through large droplets generated during
57 coughing or sneezing of symptomatic and asymptomatic patients [3]. Therefore, frequent hand-
58 washing with soap and water, using alcohol based hand rub or sanitizer, avoidance of hand
59 shaking/public gathering and use of face mask are crucial to halt the spread of COVID-19 [4].
60 COVID-19 was declared a pandemic by the World health organization on March 11, 2020 [5].
61 Since its emergence, this pandemic has shown its capability to spread rapidly in the world
62 causing the most dramatic global health crisis of our time resulting in devastating social,
63 economic and political crises [6].

64 Globally, more than 210 countries/territories have been affected by the virus, with more than
65 one hundred twenty six million people being infected and 2.7 million deaths reported as of
66 March 26, 2021. Ethiopia ranks 68th regarding COVID-19 with more than 194, 000 infected and
67 2,741 dead (March 26, 2021) [7]. Unfortunately, Ethiopia was found to be one of five African
68 countries with the highest case burden of COVID-19 [7]. Although, the government of Ethiopia
69 has been striving to spread information on COVID-19 preventive measures via television, radio
70 or social media outlets and declared a state of emergency, still the public is not consistently
71 adhering to the precautions [8].

72 Currently, COVID-19 vaccine has been made available but it is highly controversial. More than
73 seven billion doses have been pre-purchased by countries and organizations of the world, of

74 which more than half was sold-out to high income countries [9]. This figure is threatening to
75 the global health as may be an indication of the disparities on the health delivery globally.

76 Myths and conspiracy theories on vaccinations have been spreading and can easily be accepted
77 by the developing world. This may cause people to be reluctant and maleficent towards
78 vaccination, which has been demonstrated by a study in Nigeria by a low vaccine acceptability
79 rate [10]. WHO defined vaccine hesitancy as it is a difficulty in accepting or an outright refusal
80 of vaccines, despite their availability. In 2019, before the COVID-19 pandemic, the World
81 Health Organization listed vaccine hesitancy as one of the ten global threats to public health
82 [11].

83 Hence, it is crucial to understand the varying vaccine attitudes among the community to design
84 a strategy to overcome the vaccine hesitancy. Furthermore, unraveling the specific fears and
85 doubts of the community with regards to receiving the vaccine can help government and other
86 concerned officials to adequately address the misconceptions and various conspiracy theories in
87 their campaigns. Therefore, the aim of this study was to assess the level of COVID-19 vaccine
88 acceptability among the population in Addis Ababa; the capital city of Ethiopia.

90 **Methods and Materials**

91 **Study design and participants**

92 A concurrent mixed-methods study (QUAN + qual) was conducted from January 20 – 31, 2021
93 among adult population (≥ 18 years) currently residing in Akaki Kaliti sub city of Addis Ababa,
94 Ethiopia. The quantitative part of the study was addressed by a cross-sectional study design and
95 the qualitative part of the study was addressed by a phenomenological study design. The

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3 96 qualitative part was mainly intended to explain the reasons for COVID-19 vaccine hesitancy, as
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5 97 a supplementary of the quantitative study.
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8 98 A sample size for the quantitative part of the study ($n = 422$) was determined by using a single
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10 99 population proportion formula, by taking 95% confidence interval, 5% margin of error, 50%
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12 100 proportion of vaccine hesitancy and adding up 10% non-response rate. For the qualitative part,
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14 101 24 participants were included into the study based on the information saturation of the
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16 102 researchers.
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20 103 Multi-stage sampling technique was employed to recruit the participants for the quantitative part
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22 104 of the study. There were 13 districts in the sub-city; of which three of them were selected
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24 105 randomly (lottery method). The total sample was allocated proportionally to the districts. Then,
25
26 106 the households from each district were selected by employing a systematic random sampling
27
28 107 (sampling interval = every 4th house). From the specific selected households, only one randomly
29
30 108 selected eligible individual was interviewed. For the qualitative part of the study, purposive
31
32 109 sampling method was used to recruit participants who have reach information.
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36 37 110 **Patients and public involvement**

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39
40 111 Neither patients nor the public was involved in the study.
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43 112 **Data collection tools and procedures**

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45 113 Data was collected by using a semi-structured questionnaire which was adapted from reviewed
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47 114 literatures [10, 12, 13]. The questionnaire has 5 components: socio-demographic, knowledge
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49 115 towards COVID-19, attitude towards COVID-19, practice of COVID-19 prevention measures,
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51 116 and COVID-19 vaccine acceptance. The questionnaire was in English and translated into
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53 117 Amharic for the interview. The questionnaire was administered face-to-face by the medical
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3 118 interns. For the qualitative part of the study, in-depth interviews were made by the investigators
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5 119 by using an in-depth interview guide.
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8 120 **Data management and analysis**

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10 121 Data was coded and entered into SPSS-for windows version 25 for analysis. Frequency and
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12 122 proportions were used to summarize categorical variables, whereas mean and standard deviation
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14 123 were used to summarize continuous variables.
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18 124 The primary outcome variable of the study was COVID-19 vaccine hesitancy which was
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20 125 assessed by asking a question “Will you get vaccinated if you get COVID-19 vaccine?” then the
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22 126 response was dichotomized as “Yes” or “No”. Knowledge of COVID-19 was assessed by 15
23
24 127 yes or no knowledge-based questions. Then, the knowledge score was categorized in two as
25
26 128 below or above the mean score. The mean and below knowledge score was considered as poor
27
28 129 knowledge while above the mean was considered as good knowledge. Attitude towards
29
30 130 COVID-19 and its preventive measures was assessed by 11 questions which was in three Likert
31
32 131 scale (agree, neutral, disagree) then mean score was calculated. Then, the attitude score was
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34 132 categorized in two as below or above the mean score. The mean and below attitude score was
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36 133 considered as negative attitude while above the mean was considered as positive attitude [10,
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38 134 12, 13].
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44 135 Multivariable binary logistic regression analysis was carried out to identify factors associated
45
46 136 with vaccine hesitancy, as expressed by adjusted odds ratio (aOR) along with its respective 95%
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48 137 confidence interval (CI). Variables with <0.25 in bivariate analysis were considered for
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50 138 multivariable analysis. Variables having P value <0.05 were considered statistically significant.
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53 139 Multicollinearity was assessed by the collinearity diagnostics (Variance Inflation Factor and the
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55 140 tolerance test). Goodness of the model was checked by the Hosmer Lemshow goodness of fit
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3 141 test. The qualitative data analysis was initiated by transcription and translating of the interviews,
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5 142 then coded and analyzed by thematic analysis. The findings of the qualitative study were used to
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8 143 supplement the findings of quantitative data.
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10 11 144 **Ethical consideration**

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13 145 Ethical approval of this study was obtained from the Institutional Review Board (IRB) of
14
15 146 Myungsung Medical College. The participants of the study were informed about the purpose of
16
17 147 the study and provided their written consent. At the end of the interview, the data collectors
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19
20 148 have provided information with regard to the COVID-19 vaccine.
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23 24 149 **Results**

25 26 27 150 **Socio-demographic characteristics**

28
29 151 A total of 409 participants completed the questionnaire, with a response rate of 96.9%. Majority
30
31 152 of the participants 294 (71.9%) were females and married (62.3%) (Table 1). The mean age of
32
33 153 the participants was 34.1 years (± 12.9), ranging from 18 - 85 years.
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36 37 154 **Knowledge and attitude towards COVID-19 preventive measures**

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39 155 Almost all of the participants heard about COVID-19 from Mass-media. However, the average
40
41 156 knowledge score was 56.7 ± 3.7 , with 46.7% (n=191) exhibited poor level of knowledge. The
42
43 157 mean attitude score was found to be 20.3 ± 1.2 , with 51.8% of the participants have negative
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45 158 attitude towards COVID-19 and its preventive measures.
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49 159 This results were corroborated by the findings on the qualitative part of the study where the
50
51 160 majority of the participants stated that they were initially very concerned but now they were less
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53 161 so. Some participants stated that they did not believe the disease exists anymore since they have
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55 162 not personally encountered an infected person.
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3 163 Participants stated the following to show how they perceive about COVID-19:
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6 164 *“I am not scared because I expected this to happen; we brought this on ourselves and*
7
8 165 *we are paying for our sins. It has been long time coming.” [Female, 50 year old]*
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11 166 *“I have been through an outbreak before...I got sick and I had to be isolated from my*
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13 167 *family but I recovered easily and I don't believe this would be any different.” [Female,*
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15 168 *47 year old]*
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19 169 *“I was afraid that everyone in Ethiopia would die because even developed country*
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21 170 *people could not handle it. I think the only reason we have survived is because Ethiopia*
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23 171 *is God's country.” [Female, 70 year old]*
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26 27 172 **COVID-19 vaccine hesitancy**

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29 173 More than 90% of the participants heard about the COVID-19 vaccine mainly from Mass-
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31 174 media. However, 78 (19.1%) were not willing to get vaccinated when it becomes available
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33 175 (Figure 1). Out of them, 43.6% don't take the vaccine due to fear of side effects and 41.0% of
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35 176 them believe that the vaccine may be biological weapon (Figure 2).
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39 177 In the qualitative in-depth interview, some stated they did not have enough information about
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41 178 the vaccine and wanted to see other people take it first. Majority of the participants feared it
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43 179 would not be effective or have too many side effects. A few of the participants thought that the
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45 180 vaccine that will be distributed in Africa would be of lower quality. Others thought it would be
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47 181 used as a biological weapon by the developed nations to cause infertility and control the
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49 182 population of poor countries. Moreover, it was also mentioned that the vaccines might be used
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51 183 as a weapon to insert microchips into the body as the “mark of the beast” that would cause them
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184 to forsake their faith. A few others did not think they needed the vaccine because they had
185 God's protection.

186 *"I don't think the vaccine will come to this country and even if it does I don't need it;*
187 *God will be my vaccine." [Female, 45 year old]*

188 Close to 20% of the participants thought that children should not get vaccinated. Some of the
189 participants did not recommend the vaccine to children even though they would take it
190 themselves. These participants further expressed in the in depth interview that they thought the
191 virus did not affect children or it would be too dangerous for them.

192 **Factors associated with vaccine hesitancy**

193 In the multi-variable analysis (Table 2), COVID-19 vaccine hesitancy was associated with sex,
194 attitude and primary source of information about the vaccine. It was found that the odds of
195 vaccine hesitancy was 1.97 times (aOR=1.97; 95% CI: 1.10 - 3.89) higher among female
196 participants as compared to male participants. The odds of vaccine hesitancy was 1.75
197 (aOR=1.75; 95% CI:1.08 - 3.02) times higher in those participants who were found to have a
198 negative attitude towards COVID-19 and its preventive measures as compared to those who had
199 a positive attitude. Similarly, the odds of vaccine hesitancy was 3.6 times (aOR=3.59; 95% CI:
200 1.75 - 7.37) higher among those participants that received their information from social media
201 (internet) as compared to those who received information only from mass-media.

202 **Discussion**

203 For the COVID-19 battle, the population adherence to preventive measures is crucial; however,
204 it is mainly affected by their KAP toward the disease [1]. The findings of this study showed that
205 nearly half of the study participants demonstrated inadequate knowledge of COVID-19,

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3 206 indicating a great knowledge gap. This finding is higher than studies conducted in other parts of
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5 207 Ethiopia such as Arbaminch (23.5%) and Gedeo (39.5%), and other low income countries such
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8 208 as Ghana (34.9%), and Malaysia (22.7%) [14-17]. The discrepancies might be due to
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10 209 differences in the community awareness creation through mass media and social media. Further,
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12 210 in our study, more than half of the participants had negative attitude towards COVID-19 and its
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14 211 preventive measures, which is higher than the findings of studies conducted in Southern
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16 212 Ethiopia [15, 18] and lower than study done among Dessie and Kombolcha town residents in
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18 213 Ethiopia [19]. The discrepancy in the findings may be due to differences in the study period.
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20 214 The later studies were conducted earlier in the pandemic when the declaration and enforcement
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22 215 of state of emergency and other measures were still in place. Our findings show a significant
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24 216 decrease in the community's attitude towards COVID-19 and its prevention measures which can
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26 217 lead people to become discouraged to consistently adhere to the measures set forth by the
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28 218 government and the World Health Organization. These findings of the study has an implication
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30 219 on the public health and underscore the need for urgent concerted efforts to consistently
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32 220 promote the knowledge of the general public in Ethiopia towards COVID-19 preventive
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34 221 measures. If the current trend evidenced by this study continues in Ethiopia, COVID-19 will
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36 222 pose a devastating outcome on the medical, financial and social aspect of citizens besides the
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38 223 potential for new strains of disease developing.

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40 224 As COVID-19 continues to ravage the world, vaccination offers the most reliable hope for a
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42 225 permanent solution to controlling the pandemic. However, a vaccine must be accepted and used
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44 226 by a large majority of the population to create herd immunity [20]. The findings of this study
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46 227 showed that about one out of five participants are not willing to receive COVID-19 vaccine
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48 228 when it is available, which is higher than the findings reported from developed countries such as
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3 229 UK (3%) [9, 21, 22]. The discrepancies might be due to insufficient knowledge about the
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5 230 vaccine and difference in the perception of the seriousness of the pandemic. This implies that if
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8 231 the doubts and fears of the majority regarding the vaccine are not addressed properly, we may
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10 232 not be able to attain herd immunity. Surprisingly, the finding of this study was lower than a
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12 233 study conducted in the US (31%) and Nigeria (80%) [13, 20]. This might be due to difference in
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14 234 access to wide variety of conspiracy theories and doubts via internet.

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17 235 Consistent to the study conducted in China [23], vaccine hesitancy was more likely among
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19 236 females as compared to males in our study. This could be due to higher exposure of males for
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21 237 different media as compared to females in Ethiopia. In the present study, increased likelihood of
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23 238 vaccine hesitancy was also indicated among those with negative attitude towards COVID-19
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25 239 and its preventive measures. The qualitative aspects of this study also found that those
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27 240 participants who would not take the vaccine stated one of their reason to be their lack of implicit
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29 241 trust in the government and in health professionals. Thus, this lack of confidence in the
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31 242 government exhibited by 41.8% of our participants may be a potential hurdle we might face
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33 243 during the vaccination programs in Ethiopia.

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36 244 In our study, those participants who received their information from social media (internet)
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38 245 were more likely to have vaccine hesitancy as compared to those who got their information only
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40 246 from TV/radio. This finding of the study is in line with a study conducted to assess health
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42 247 protective behaviors and conspiracy theories during the pandemic found that there was
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44 248 significant association between holding a conspiracy belief and checking social media for news
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46 249 of COVID-19 [24]. As a result, this finding is justified by our findings on both the quantitative
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48 250 and qualitative aspects of our study which found that the majority of the reasons given for
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50 251 hesitancy towards the vaccine were the belief in the conspiracy theories. Thus, the spared of
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252 these conspiracy theories is a potential issue that can cause problems when vaccine distribution
253 starts in Ethiopia. Particularly, if these conspiracy theories start getting a wider audience thus
254 there may be a need to act in haste and find a solution before this issue worsens.

255 This study is the first community based study to assess the Ethiopian community's perception
256 towards COVID-19 vaccine and its level of acceptance. We employed a mixed methods design
257 which enables us to make the deep understanding of the issue. However, the study might be
258 limited due to the recall bias and social desirability bias during the data collection. In addition to
259 this, our sample over-represents female population because the majority of the study
260 participants that were found at home during data collection time were housewives. Therefore,
261 generalization of the study results needs to be cautious.

262 **Conclusions**

263 A considerable proportion of the people have concerns of the COVID-19 vaccine and unwilling
264 to accept once it is available. Several conspiracy theories were put forth to justify their stance
265 and this was mainly due to the misconceptions distributed from the use of social media as
266 primary source of information about the vaccine. These findings of the study underscore the
267 need to use social-media as a way to disseminate reliable information with regard to COVID-19
268 vaccination and the preventive measures, rather than only focusing on the mass-media
269 messages. Overall, providing the community with health education and consistent government
270 efforts in uphold the prevention measures are of paramount importance to tackle this pandemic.

271 **List of Abbreviations**

272 aOR: Adjusted Odds Ratio

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3 273 CI: Confidence Interval
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6 274 COR: Crude Odds Ratio
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9 275 SARS: Severe Acute Respiratory Syndrome
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12 276 UK: United Kingdom
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15 277 US: United States
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19 278 **Declarations**

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22 279 **Consent for publication**

23
24 280 Not applicable
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26
27 281 **Availability of data and material**

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29 282 Data are available upon reasonable request from the corresponding author.
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31

32
33 283 **Competing interests**

34
35 284 The authors declare that they have no competing interests.
36
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38
39 285 **Authors Contributions**

40 286 N.D., A.T., B.T., and D.A. conceptualized the study, designed the methodology, analyzed the
41
42 287 data, interpreted the results and drafted the initial manuscript and approved the final manuscript.

43
44 288 H.A., N.T., S.G., T.B., and Y.L. conceptualized the study, visualized the data, involved in data
45
46 289 analysis and interpretation and approved the final manuscript. All authors have read and
47
48 290 approved the manuscript.
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7
8 293 study. The authors are grateful to the study participants for their contributions.
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11 294 **Ethics approval statement**
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6 369 **Figure captions**
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9 370 Figure 1: COVID-19 vaccine acceptance
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11 371 Figure 2: Reasons of participant for refusing COVID-19 vaccination
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373 Table 1: Socio-demographic characteristics of the study participants

		Frequency (N)	Percent (%)
Sex	Male	115	28.1%
	Female	294	71.9%
Age	18-29	174	42.5%
	30-40	147	35.9%
	41-50	40	9.8%
	>50	48	11.7%
Marital status	Not married	123	30.1%
	Married	255	62.3%
	Widowed	20	4.9%
	Divorced	11	2.7%
Religion	Christian	349	85.3%
	Muslim	60	14.7%
Educational status	No formal education	39	9.5%
	Primary school	105	25.7%
	Secondary and above	265	64.8%
Occupation	Unemployed/housewife	190	46.5%
	Employed	219	53.5%
Monthly income*	≤3200 ETB (≤100 USD)	175	42.8%
	>3200 ETB (>100 USD)	228	57.2%

374 ETB: Ethiopian Birr USD: United States Dollar *6 participants' data missing

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376 Table 2: Factors associated with COVID-19 vaccine hesitancy in Addis Ababa, Ethiopia, 2021

Variables	Vaccine hesitancy		cOR (95% CI)	aOR(95% CI)	P value
	Yes (%)	No (%)			
Sex					
Male	17 (21.8%)	98 (29.6%)	1.00	1.00	0.03
Female	61 (78.2%)	233 (70.4%)	1.49 (0.83-2.69)	1.97 (1.10-3.89)	
Age					
18-29	34 (43.6%)	140 (42.3%)	1.00	1.00	0.934
30-40	24 (30.8%)	122 (36.9%)	0.81 (0.46-1.44)	1.03 (0.55-1.92)	
41-50	12 (15.4%)	29 (8.8%)	1.77 (0.82-3.82)	2.22 (0.94-5.21)	
>50	8 (10.2%)	40 (12.0%)	0.82 (0.35-1.92)	1.08 (0.39-2.97)	
Religion					
Christian	8 (10.3%)	52 (15.7%)	1.00	1.00	0.621
Muslim	70 (89.7%)	278 (84.3%)	1.64 (0.74-3.60)	1.23 (0.54-2.83)	
Educational status					
No formal education	9 (11.5%)	30 (9.1%)	1.11 (0.50-2.48)	1.11 (0.39-3.16)	0.840
Primary education	13 (16.7%)	93 (28.1%)	0.53 (0.27-1.01)	0.81 (0.40-1.63)	0.560
Secondary and above	56 (71.8%)	208 (62.8%)	1.00	1.00	
Attitude					
Positive attitude	28 (35.9%)	169 (51.1%)	1.00	1.00	

Negative attitude	50 (64.1%)	162 (48.9%)	1.87 (1.12-3.12)	1.75 (1.08-3.02)	0.04
Primary source of information					
TV/Radio	38 (48.7%)	255 (77.0%)	1.00	1.00	
Social media (internet)	40 (51.3%)	76 (23.0%)	3.53 (1.67-6.98)	3.59 (1.75-7.37)	0.0001

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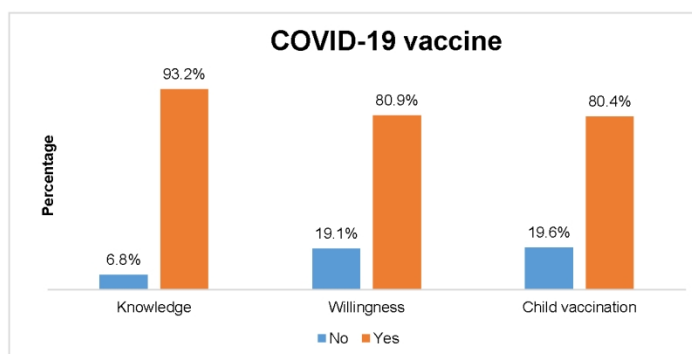


Figure 1: COVID-19 vaccine acceptance

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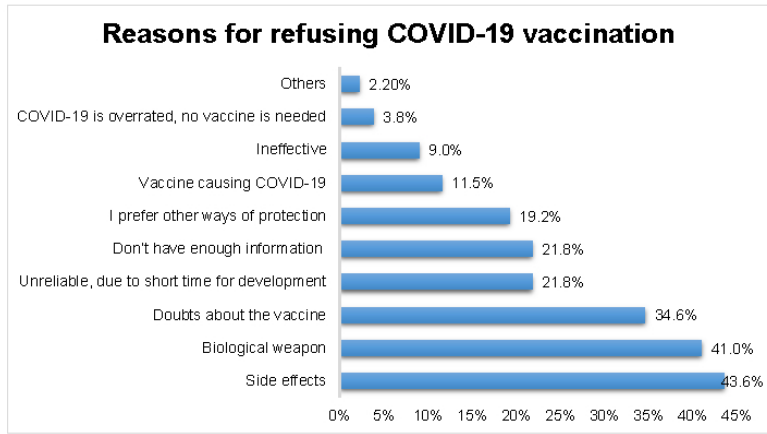


Figure 2: Reasons of participant for refusing COVID-19 vaccination
215x279mm (102 x 100 DPI)

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No.	Recommendation	Page No.	
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	Title page, Page No.1	
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	Abstract, Page No.2	
Introduction				
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Introduction, Page No. 4	
Objectives	3	State specific objectives, including any prespecified hypotheses	Introduction, Page No. 5	
Methods				
Study design	4	Present key elements of study design early in the paper	Methods, Page No. 6	
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Methods, Page No. 6	
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	Methods, Page No. 6	
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	N/A	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Methods, Data management and analysis, Page No. 7 and 8	
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Methods, Data tools and procedures, Page No. 7	
Bias	9	Describe any efforts to address potential sources of bias	Methods, Data tools and procedures, Page No. 7; Data management and analysis, Page No. 7 and 8	
Study size	10	Explain how the study size was arrived at	Methods, Page No. 5	
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Methods, Data management and analysis, Page No. 7 and 8	

Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	Methods, Data management and analysis, Page No. 7 and 8	
		(b) Describe any methods used to examine subgroups and interactions	Methods, Data management and analysis, Page No. 7 and 8	
		(c) Explain how missing data were addressed	N/A	
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	N/A	
		(e) Describe any sensitivity analyses	N/A	
Results				
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	N/A	
		(b) Give reasons for non-participation at each stage	N/A	
		(c) Consider use of a flow diagram	N/A	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Results, Page No. 9 and 10	
		(b) Indicate number of participants with missing data for each variable of interest	N/A	
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	N/A	
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	N/A	
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure		
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	Results, Page No. 9 and 10	
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Results, Page No. 9 and 10	
		(b) Report category boundaries when continuous variables were categorized	N/A	
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A	

Continued on next page

Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	Discussion, Page No. 10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Discussion, Page No. 12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Conclusions, Page No. 12
Generalisability	21	Discuss the generalisability (external validity) of the study results	Discussion, Page No. 12
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Source of funding, Page No. 14

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

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COVID-19 vaccine hesitancy in Addis Ababa, Ethiopia: A mixed-methods study

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Primary Subject Heading:	Public health
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3 **1 COVID-19 vaccine hesitancy in Addis Ababa, Ethiopia: A mixed-methods study**
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12 Abstract

13 **Objective:** Data on COVID-19 vaccine hesitancy is limited in Ethiopia and other parts of
14 Africa. Therefore, the aim of this study was to determine the level of COVID-19 vaccine
15 hesitancy and its associated factors in Addis Ababa, Ethiopia.

16 **Design:** A community-based concurrent mixed-methods study

17 **Setting:** In a community setting

18 **Participants:** Adult residents (n = 422) of Akaki Kaliti sub-city who were recruited by a multi-
19 stage sampling technique and 24 adults who were selected purposively were included for the
20 quantitative and qualitative part of the study respectively.

21 **Outcome Measures:** Data were collected by face-to-face interview using a semi-structured
22 questionnaire. Factors associated with COVID-19 vaccine hesitancy were identified by
23 multivariable binary logistic regression model.

24 **Results:** One out five (19.1%, 95% CI: 15.3% - 24.6%) participants were not willing to get
25 vaccinated. In the multivariable analysis, vaccine hesitancy was significantly associated with
26 being female (aOR=1.97; 95% CI: 1.10 - 3.89), having negative attitude towards COVID-19
27 and its preventive measures (aOR=1.75; 95% CI: 1.08 - 3.02), and primary information source
28 being social media (internet) (aOR=3.59; 95% CI: 1.75 - 7.37). Study participants have
29 predominantly stated that they did not have enough information about the vaccine, feared it
30 would not be effective or have too many side effects, and reflected their uncertainty towards the
31 quality of the vaccine.

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3 32 **Conclusions:** A considerable proportion of the people in Addis Ababa have concerns on
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5 33 COVID-19 vaccines and unwilling to accept them. This was due to the misconceptions,
6
7 34 negative attitudes, and use of social media as their primary source of information. Providing the
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9 35 community with health education and consistent efforts to enhance the prevention measures are
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11 36 important, particularly using different medias including social media.
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16 37 **Key Words:** COVID-19, knowledge, attitude, Vaccine, Hesitancy
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19 38 **Article Summary**

20 39 **Strengths and limitations of this study**

- 21 40 • We employed a community-based study which could reflect the prevailing COVID 19
22 41 vaccine hesitancy in the general population.
- 23 42 • A mixed-methods approach allows for triangulation of findings from different
24 43 perspectives.
- 25 44 • Factors associated with the outcome variable (vaccine hesitancy) were adjusted for the
26 45 known explanatory variables.
- 27 46 • The study might be limited due to the social desirability bias during the data collection.
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39 47 **Funding statement**

40 48 This study was funded by Myungsung Medical College. However, the funder had no role in the
41 49 design, conduct, analysis and interpretation of this study.
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50 50 **Conflict of interest**

51 51 The authors declare that they have no conflict of interests.
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55 52 **Word count** =2868
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54 **Introduction**

55 Corona virus disease 2019 (COVID-19) is caused by severe acute respiratory syndrome corona
56 virus 2 (SARS-CoV-2) also known as Novel coronavirus (nCov) [1]. Since its emergence, this
57 pandemic has shown its capability to spread rapidly in the world causing the most dramatic
58 global health crisis of our time resulting in devastating social, economic and political crises [2].
59 Therefore, on top of other preventive measures, it is crucial to receive COVID vaccines to halt
60 the spread of COVID-19 [3].

61 Globally, more than 210 countries/territories have been affected by the virus, and Ethiopia is
62 one of the five African countries with the highest case burden of COVID-19 [4]. Although, the
63 government of Ethiopia has been striving to spread information on COVID-19 preventive
64 measures, still the public is not consistently adhering to the precautions [5]. On the other hand,
65 although the COVID-19 vaccines have been made available, it is highly controversial, as they
66 are highly affected by disparities of access and distributions across the countries, where large
67 proportions of the vaccines have been already sold-out to high-income countries [6].

68 Moreover, myths and conspiracy theories on vaccinations have been spreading and can easily be
69 accepted by the developing world. This may cause people to be reluctant towards vaccination,
70 which has been demonstrated by a study in Nigeria by a low vaccine acceptability rate [7].
71 Furthermore, the World Health Organization listed vaccine hesitancy as one of the ten global
72 threats to public health [8].

73 Some recent studies have also reported the magnitude of vaccine hesitancy varying from 76.4%
74 to 3.0%, indicating variabilities across different countries [9 – 11]. This variability could be
75 partly due to varying perceptions and attitudes towards the efficacy, quality and safety of the

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3 76 COVID vaccines. Vaccine hesitancy could also be affected by the socio-demographic,
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5 77 psychological and cultural factors of the population. Therefore, it is imperative to understand
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7 78 the varying vaccine attitudes among the community to design strategies to overcome the
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9 79 vaccine hesitancy. Furthermore, unraveling the specific fears and doubts of the community with
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11 80 regards to receiving the vaccine can help government and other concerned officials to
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13 81 adequately address the misconceptions and various conspiracy theories in their campaigns.
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18 82 **Methods and Materials**

19 20 21 83 **Study design and participants**

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23 84 A concurrent mixed-methods study (QUAN + qual) was conducted from January 20 – 31, 2021
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25 85 among adult population (≥ 18 years) currently residing in Akaki Kality sub city of Addis Ababa,
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27 86 Ethiopia. The quantitative part of the study was addressed by a cross-sectional study design and
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29 87 the qualitative part of the study was addressed by a phenomenological study design. The
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31 88 qualitative part was mainly intended to explain the reasons for COVID-19 vaccine hesitancy, as
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33 89 a supplementary of the quantitative part.
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38 90 A sample size for the quantitative part of the study ($n = 422$) was determined by using a single
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40 91 population proportion formula, by taking 95% confidence interval, 5% margin of error, 50%
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42 92 proportion of vaccine hesitancy and adding up 10% non-response rate. For the qualitative part,
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44 93 24 participants were included into the study based on the information saturation of the
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46 94 researchers.
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50 95 Two-stage sampling technique was employed to recruit the participants for the quantitative part
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52 96 of the study. There were 13 districts in the sub-city; of which three of them were selected
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54 97 randomly (lottery method). The total sample was allocated proportionally to the districts. Then,
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3 98 the households from each district were selected by employing a systematic random sampling
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5 99 (sampling interval = every 4th house). From the specific selected households, only one randomly
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8 100 selected eligible individual was interviewed. For the qualitative part of the study, purposive
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10 101 sampling method was used to recruit participants who have reach information.

12 13 102 **Patients and public involvement**

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16 103 Neither patients nor the public was involved in the study.

18 19 104 **Data collection tools and procedures**

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21 105 Data was collected by using a semi-structured questionnaire which was adapted from reviewed
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23 106 literatures [7, 12, 13]. The contents of the questionnaire were validated by senior experts in the
24
25 107 field. The questionnaire has 4 components: socio-demographic, knowledge towards COVID-19,
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27 108 attitude towards COVID-19, and COVID-19 vaccine acceptance. The questionnaire was first
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29 109 prepared in English and translated into Amharic (local language) for the sake of interview. The
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31 110 questionnaire was administered face-to-face by trained medical interns. For the qualitative part
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33 111 of the study, in-depth interviews were made by the investigators by using an in-depth interview
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35 112 guide (supplementary file 1).

38 39 40 113 **Data management and analysis**

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42 114 Data was checked for completeness and consistency, coded and entered into SPSS-for windows
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44 115 version 25 for analysis. Frequency and proportions were used to summarize categorical
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46 116 variables, whereas mean and standard deviation were used to summarize continuous variables.

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50 117 The primary outcome variable of the study was COVID-19 vaccine hesitancy which was
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52 118 assessed by asking a question “Will you get vaccinated if you get COVID-19 vaccine?” then the
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54 119 response was dichotomized as “Yes” or “No”. Knowledge of COVID-19 was assessed by 15

120 yes or no knowledge-based questions. Then, the knowledge score was categorized in two as
121 below or above the mean score. The mean and below knowledge score was considered as poor
122 knowledge while above the mean was considered as good knowledge. Attitude towards
123 COVID-19 and its preventive measures was assessed by 11 questions which was in three Likert
124 scale (agree, neutral, disagree) then mean score was calculated. Then, the attitude score was
125 categorized in two as below or above the mean score. The mean and below attitude score was
126 considered as negative attitude while above the mean was considered as positive attitude [7, 12,
127 13].

128 Multivariable binary logistic regression analysis was carried out to identify factors associated
129 with vaccine hesitancy, as expressed by adjusted odds ratio (aOR) along with its respective 95%
130 confidence interval (CI). Variables with <0.25 in bivariate analysis were considered for
131 multivariable analysis. The explanatory variables entered into the multivariable model include
132 sex, age, educational status, religion, attitude and primary source of information. Variables
133 having P value <0.05 were considered statistically significant. Multicollinearity was assessed by
134 the collinearity diagnostics (Variance Inflation Factor (2.30) and the tolerance test (0.43)).
135 Goodness of the model was checked by the Hosmer Lemshow goodness of fit test, and it was
136 not significant (P value = 0.81). The qualitative data analysis was initiated by transcription and
137 translating of the interviews, then coded and analyzed by thematic analysis. The findings of the
138 qualitative study were used to supplement the findings of quantitative data.

139 **Ethical consideration**

140 Ethical approval of this study was obtained from the Institutional Review Board (IRB) of
141 Myungsung Medical College (MMC/IRB/067/21). The participants of the study were informed

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3 142 about the purpose of the study and provided their written consent. At the end of the interview,
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5 143 the data collectors have provided information regarding the COVID-19 vaccine.
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8 9 144 **Results**

10 11 12 145 **Socio-demographic characteristics**

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14 146 A total of 409 participants completed the questionnaire, with a response rate of 96.9%. Majority
15
16 147 of the participants 294 (71.9%) were females and married (62.3%) (Table 1). The mean (\pm SD)
17
18 148 age of the participants was 34.1 years (\pm 12.9), ranging from 18 - 85 years.

19 20 21 22 149 **Knowledge and attitude towards COVID-19 preventive measures**

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24 150 Almost all the participants heard about COVID-19 from Mass-media. However, the average (\pm
25
26 151 SD) knowledge score was 56.7 ± 3.7 , with 46.7% (n=191) exhibited poor level of knowledge.
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28 152 The mean (\pm SD) attitude score was found to be 20.3 ± 1.2 , with 51.8% of the participants had
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30 153 negative attitude towards COVID-19 and its preventive measures.
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34 154 These results were corroborated by the findings of the qualitative part of the study where
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36 155 participants stated that they were initially very concerned about getting infected with COVID-
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38 156 19. Paradoxically, participants also stated that they did not believe on the existence of the
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40 157 disease since they have not personally encountered an infected person. On the other hand,
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42 158 believing COVID-19 disease as if it was emanated because of the punishment of God was
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44 159 predominantly explained by the participants.
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49 160 Participants stated the following to show how they perceived about COVID-19:

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52 161 *“I am not scared because I expected this to happen; we brought this on ourselves, and*
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54 162 *we are paying for our sins. It has been long time coming.” [Female, 50-year-old]*
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3 163 *“I have been through an outbreak before...I got sick, and I had to be isolated from my*
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5 164 *family, but I recovered easily, and I don’t believe this would be any different.” [Female,*
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8 165 *47-year-old]*

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10 166 *“I was afraid that everyone in Ethiopia would die because even developed country*
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13 167 *people could not handle it. I think the only reason we have survived is because Ethiopia*
14
15 168 *is God’s country.” [Female, 70-year-old]*

169 **COVID-19 vaccine hesitancy and its associated factors**

170 More than 90% of the participants heard about the COVID-19 vaccine mainly from Mass-
171 media. However, 78 (19.1%, 95% CI: 15.3% - 24.6%) were not willing to get vaccinated. Out
172 of them, 43.6% don’t take the vaccine due to fear of side effects and 41.0% of them believe that
173 the vaccine may be biological weapon (Figure 1).

174 In the qualitative in-depth interview, participants stated that they did not have enough
175 information about the vaccine and wanted to see other people take it first. For instance, a young
176 man said that:

177 *“...frankly speaking, I do not have adequate information about the COVID vaccine,*
178 *and for sure I will not receive it until I see others take it first...” [Male, 32-year-old]*

179 Participants also described their concerns over the effectiveness and quality of the vaccines.

180 *“I fear that the vaccines might not be effective or of a lower quality, particularly*
181 *those vaccines distributed to Africa. They may also have serious side effects, as they did*
182 *not take longer time in laboratories or in trials before they are released for use.” [Male,*
183 *45-year-old]*

184

185 Other predominant thought expressed by the participants was the vaccines would be used by the
186 developed nations to cause infertility and control the population size of poor countries. For
187 example, participants stated that:

188 *“...I saw some videos circulating on social media stating that the vaccines are made
189 to reduce the population size of the poor countries...” [Female, 35-year-old]*

190 Moreover, it was also mentioned that the vaccines might be used as a weapon to insert
191 microchips into the body as the “mark of the beast” that would cause them to forsake their faith.

192 *“...it seems the end of the world is near...as it is stated in the Bible, during the end
193 times the mark of the beast will be labelled on the people...I fear these vaccines may be
194 associated to this...” [Male, 40-year-old]*

195 A few others did not think they needed the vaccine because they had God’s protection.

196 *“I don’t think the vaccine will come to this country and even if it does, I don’t need
197 it; God will be my vaccine.” [Female, 45-year-old]*

198 In the multi-variable analysis (Table 2), COVID-19 vaccine hesitancy was associated with
199 being female, having negative attitude towards the vaccine and primary source of information
200 about the vaccine being social media. The odds of vaccine hesitancy was 2 times (aOR=1.97;
201 95% CI: 1.10 - 3.89) higher among female participants as compared to male participants, 1.8
202 times (aOR=1.75; 95% CI: 1.08 - 3.02) higher among participants who have negative attitudes
203 towards COVID-19 as compared to those who had positive attitudes, and 4 times (aOR=3.59;

204 95% CI: 1.75 - 7.37) higher among those participants who got information from social media as
205 a primary source as compared to those who received information only from mass-media.

206 **Discussion**

207 For the COVID-19 battle, the population adherence to preventive measures and receiving
208 COVID vaccines is crucial; however, it is mainly affected by their knowledge and attitude
209 towards the disease and vaccination [1]. The findings of this study showed that nearly half of
210 the study participants demonstrated inadequate knowledge of COVID-19, indicating a great
211 knowledge gap. This finding is higher than studies conducted in other parts of Ethiopia such as
212 Arbaminch (23.5%) and Gedeo (39.5%), and other countries such as Ghana (34.9%), and
213 Malaysia (22.7%) [14-17]. The discrepancies might be due to differences in the community
214 awareness creation through mass media and social media. Further, in our study, more than half
215 of the participants had negative attitude towards COVID-19 and its preventive measures, which
216 is higher than the findings of studies conducted in Southern Ethiopia [15, 18] and lower than
217 study done among Dessie and Kombolcha town residents in Ethiopia [19]. The discrepancy in
218 the findings may be due to differences in the study period. The later studies were conducted
219 earlier in the pandemic when the declaration and enforcement of state of emergency and other
220 measures were still in place. Our findings show a significant decrease in the community's
221 attitude towards COVID-19 and its prevention measures which can lead people to become
222 discouraged to consistently adhere to the measures set forth by the government and the World
223 Health Organization. These findings of the study have an implication on the public health and
224 underscore the need for urgent concerted efforts to consistently promote the knowledge of the
225 public in Ethiopia towards COVID-19 preventive measures, including COVID vaccination. If
226 the current trend evidenced by this study continues in Ethiopia, COVID-19 will pose a

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3 227 devastating outcome on the medical, financial and social aspect of citizens besides the potential
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5 228 for new strains of disease developing.
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8 229 As COVID-19 continues to ravage the world, vaccination offers the most reliable hope for a
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10 230 permanent solution to controlling the pandemic. However, a vaccine must be accepted and used
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12 231 by a large majority of the population to create herd immunity [20]. The findings of this study
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14 232 showed that about one out of five participants are not willing to receive COVID-19 vaccine
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16 233 when it is available, which is higher than the findings reported from developed countries such as
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18 234 UK (3%) [6 21, 22]. The discrepancies might be due to insufficient knowledge about the
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20 235 vaccine and difference in the perception of the seriousness of the pandemic. This implies that if
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22 236 the doubts and fears of the majority regarding the vaccine are not addressed properly, we may
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24 237 not be able to attain herd immunity. Surprisingly, the finding of this study was lower than a
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26 238 study conducted in the US (31%) and Nigeria (80%) [13, 20]. This might be due to difference in
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28 239 access to wide variety of conspiracy theories and doubts via internet.
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34 240 Consistent to the study conducted in China [23], vaccine hesitancy was more likely among
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36 241 females as compared to males in our study. This could be due to higher exposure of males for
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38 242 different media as compared to females in Ethiopia. In the present study, increased likelihood of
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40 243 vaccine hesitancy was also indicated among those with negative attitude towards COVID-19
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42 244 and its preventive measures. The qualitative aspects of this study also found that those
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44 245 participants who would not take the vaccine stated one of their reasons to be their lack of
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46 246 implicit trust in the government and in health professionals. Thus, this lack of confidence in the
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48 247 government exhibited by 41.8% of our participants may be a potential hurdle we might face
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50 248 during the vaccination programs in Ethiopia.
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3 249 In our study, those participants who received their information from social media (internet)
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5 250 were more likely to have vaccine hesitancy as compared to those who got their information
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8 251 from mass media (TV/radio). This finding of the study is in line with a study conducted to
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10 252 assess health protective behaviors and conspiracy theories during the pandemic, which has
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12 253 found a significant association between holding conspiracy beliefs and checking social media
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14 254 for news of COVID-19 [24]. This finding of the study is justified by our findings on both the
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16 255 quantitative and qualitative aspects of our study, which revealed the predominant reasons given
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18 256 for vaccine hesitancy were associated with the participant's beliefs in the conspiracy theories.
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21 257 Thus, the spread of these conspiracy theories is a potential issue that needs attention during
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23 258 vaccination campaigns. It is critical to explicitly explain the details of the COVID vaccines
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25 259 including its effectiveness, safety and quality to address the information need of the community.
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29 260 This study is the first community-based study to assess the Ethiopian community's perception
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31 261 towards COVID-19 vaccine and its level of acceptance. We employed a mixed-methods design
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33 262 which enables us to make the deep understanding of the issue. However, the study might be
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35 263 limited due to social desirability bias during the data collection. However, to minimize this bias,
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37 264 the purpose of the study and assurance of the participant's anonymity were described to the
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39 265 participants prior to the administration of the interview. In addition to this, our sample over-
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41 266 represents female population because the majority of the study participants that were found at
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43 267 home during data collection time were housewives. Furthermore, the study was conducted in
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45 268 only one sub-city. Therefore, generalization of the study results needs to be cautious.
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269 **Conclusions**

270 A considerable proportion of the study participants in Addis Ababa have concerns on the
271 COVID-19 vaccines and unwilling to accept them. This was mainly due to the prevailing
272 misconceptions, negative attitudes, and use of social media as their primary source of
273 information. Several conspiracy theories were put forth to justify their stance and this was
274 mainly due to the misconceptions distributed from the use of social media as primary source of
275 information about the vaccines. These findings of the study underscore the need to use social-
276 media to disseminate reliable information regarding COVID-19 vaccination and the preventive
277 measures, rather than only focusing on the mass-media messages. Overall, providing the
278 community with health education and consistent government efforts in uphold the prevention
279 measures are of paramount importance to tackle this pandemic.

280 **List of Abbreviations**

281 aOR: Adjusted Odds Ratio

282 CI: Confidence Interval

283 COR: Crude Odds Ratio

284 SARS: Severe Acute Respiratory Syndrome

285 UK: United Kingdom

286 US: United States

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3 **287 Declarations**
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6 **288 Consent for publication**
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9 289 Not applicable
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12 **290 Availability of data and material**
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14 291 Data are available upon reasonable request from the corresponding author.
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16
17 **292 Competing interests**
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19 293 The authors declare that they have no competing interests.
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23 **294 Authors Contributions**
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25 295 N.D., A.T., B.T., and D.A. conceptualized the study, designed the methodology, analyzed the
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27 296 data, interpreted the results and drafted the initial manuscript and approved the final manuscript.
28

29 297 H.A., N.T., S.G., T.B., and Y.L. conceptualized the study, visualized the data, involved in data
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31 298 analysis and interpretation and approved the final manuscript. All authors have read and
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33 299 approved the manuscript.
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38

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41 302 study. The authors are grateful to the study participants for their contributions.
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45 **303 Ethics approval statement**
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47 304 Ethical approval of this study was obtained from the Institutional Review Board (IRB) of
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25 **Figure captions**
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28 384 Figure 1: Reasons of participants for refusing COVID-19 vaccination in Addis Ababa, Ethiopia
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386 Table 1: Socio-demographic characteristics of the study participants

		Frequency (N)	Percent (%)
Sex	Male	115	28.1%
	Female	294	71.9%
Age	18-29	174	42.5%
	30-40	147	35.9%
	41-50	40	9.8%
	>50	48	11.7%
Marital status	Not married	123	30.1%
	Married	255	62.3%
	Widowed	20	4.9%
	Divorced	11	2.7%
Religion	Christian	349	85.3%
	Muslim	60	14.7%
Educational status	No formal education	39	9.5%
	Primary school	105	25.7%
	Secondary and above	265	64.8%
Occupation	Unemployed/housewife	190	46.5%
	Employed	219	53.5%
Monthly income*	≤3200 ETB (≤100 USD)	175	42.8%
	>3200 ETB (>100 USD)	228	57.2%

387 ETB: Ethiopian Birr USD: United States Dollar *6 participants' data missing

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389 Table 2: Factors associated with COVID-19 vaccine hesitancy in Addis Ababa, Ethiopia, 2021

Variables	Vaccine hesitancy		cOR (95% CI)	aOR(95% CI)	P value
	Yes (%)	No (%)			
Sex					
Male	17 (21.8%)	98 (29.6%)	1.00	1.00	0.03
Female	61 (78.2%)	233 (70.4%)	1.49 (0.83-2.69)	1.97 (1.10-3.89)	
Age					
18-29	34 (43.6%)	140 (42.3%)	1.00	1.00	0.934
30-40	24 (30.8%)	122 (36.9%)	0.81 (0.46-1.44)	1.03 (0.55-1.92)	
41-50	12 (15.4%)	29 (8.8%)	1.77 (0.82-3.82)	2.22 (0.94-5.21)	
>50	8 (10.2%)	40 (12.0%)	0.82 (0.35-1.92)	1.08 (0.39-2.97)	
Religion					
Christian	8 (10.3%)	52 (15.7%)	1.00	1.00	0.621
Muslim	70 (89.7%)	278 (84.3%)	1.64 (0.74-3.60)	1.23 (0.54-2.83)	
Educational status					
No formal education	9 (11.5%)	30 (9.1%)	1.11 (0.50-2.48)	1.11 (0.39-3.16)	0.840
Primary education	13 (16.7%)	93 (28.1%)	0.53 (0.27-1.01)	0.81 (0.40-1.63)	0.560
Secondary and above	56 (71.8%)	208 (62.8%)	1.00	1.00	
Attitude					
Positive attitude	28 (35.9%)	169 (51.1%)	1.00	1.00	

Negative attitude	50 (64.1%)	162 (48.9%)	1.87 (1.12-3.12)	1.75 (1.08-3.02)	0.04
Primary source of information					
TV/Radio	38 (48.7%)	255 (77.0%)	1.00	1.00	
Social media (internet)	40 (51.3%)	76 (23.0%)	3.53 (1.67-6.98)	3.59 (1.75-7.37)	0.0001

390 cOR: Crude Odds Ratio

aOR: Adjusted Odds Ratio

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For peer review only

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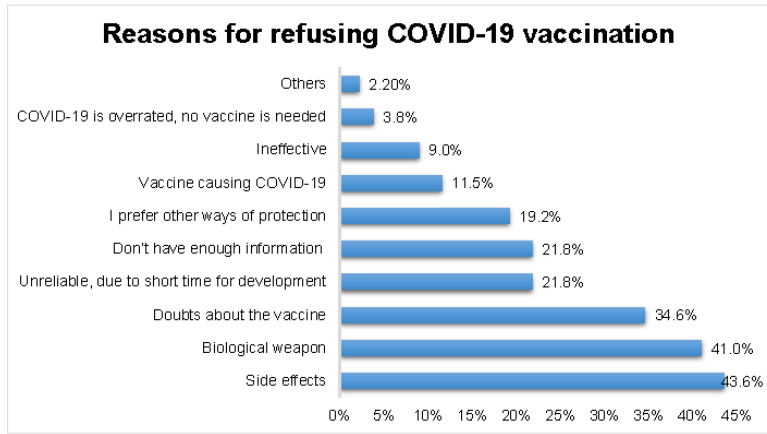


Figure 1: Reasons of participants for refusing COVID-19 vaccination in Addis Ababa, Ethiopia
215x279mm (102 x 100 DPI)

Questionnaire (English Version)

A. Sociodemographic		
1	Gender:	1. Male 2. Female
2	Age	----- in years
3	Marital status	1. Single 2. Married 3. Widowed 4. Divorced
4	Educational status	1. illiterate 2. can read and write 3. 1-8 th grade 4. 9-12 th grade 5. Technique 6. Higher education
5	Religion	1. Christian 2. Muslim 3. Other
	Occupation	1. Merchant 2. Gov't employee 3. Private employee 4. House wife 5. Daily laborer 6. Police/ Solidier 7. Unemployed 8. janitor 9. student 10. Other -----
6	Family monthly income	1. ≤1650 ETB 2. 1651 – 3200 ETB 3. 3201 – 5800 ETB 4. 5801 – 7800 ETB 5. 7801 – 10400 ETB 6. >10400 ETB
B. Source of information		

	What is the source of your information about COVID-19	<ol style="list-style-type: none"> 1. Social media (SNS) 2. TV/Radio (New Media) 3. Religious leaders 4. Friends/ Family/ Neighbors 5. Directly from healthcare workers 6. Others-----
C. Knowledge (please tick what is/are applicable)		
1	Mode of transmission:	<ol style="list-style-type: none"> 1. Respiratory droplets 2. Airborne 3. Fecal-Oral route 4. Blood transmission 5. Contact with contaminated surfaces 6. Contaminated food 7. Contact with a COVID-19 positive patient 8. Skin contact 9. Breast milk 10. Vertical transmission
2	Symptoms (that can be expected from a Covid-19 patient)	<ol style="list-style-type: none"> 1. Fever 2. Muscle pain 3. Fatigue 4. Diarrhea 5. Sneezing 6. Loss of smell 7. Vomiting 8. Runny nose 9. Shortness of Breath 10. Cough 11. Loss of taste 12. Stuffy nose 13. Conjunctivitis 14. Skin rash 15. No symptom
3	Are asymptomatic patients capable of transmitting the disease?	<ol style="list-style-type: none"> 1. Yes 2. No

4	Which group of population has likelihood of developing severe disease? (please tick what is/are applicable)	<ol style="list-style-type: none"> 1. Elderly 2. Pregnant women 3. Children 4. Smoker 5. People with co-morbid (DM, HTN, asthma) conditions 6. Obesity 7. I don't know
5	Prevention methods: Are you aware of that hand washing is one of the primary methods of preventing COVID-19 infection?	<ol style="list-style-type: none"> 1. Yes 2. No
6	What is/are the preferable methods of preventing COVID-19 transmission?	<ol style="list-style-type: none"> 1. Hand wash with soap & water 2. Hand wash with water only 3. Use of hand sanitizers
7	Duration of handwashing (minimum duration):	<ol style="list-style-type: none"> 1. 10 seconds 2. 20 seconds 3. 30 seconds 4. 40 seconds 5. I don't know
8	Do you think use of face masks can prevent COVID-19 transmission?	<ol style="list-style-type: none"> 1. Yes 2. No
9	Do you think double-mask use is effective in prevention?	<ol style="list-style-type: none"> 1. Yes 2. No
10	What is the recommended minimum distance to maintain adequate social distancing?	<ol style="list-style-type: none"> 1. <2 meter 2. >2 meter 3. I don't know
11	In order to prevent spread, do you think individuals should avoid going to crowded places and taking public transportation?	<ol style="list-style-type: none"> 1. Yes 2. No
12	Do you think you should stop to maintain social distancing if you are wearing a mask?	<ol style="list-style-type: none"> 1. Yes 2. No
13	Do you think you should avoid shaking hands and hugging while greeting people?	<ol style="list-style-type: none"> 1. Yes 2. No

14	Provided that your family member is COVID-19 positive, would you put yourself in self-quarantine?	1. Yes 2. No
15	How long should people in contact with COVID-19 positive put into self-quarantine?	()

D. Attitude		
1	Do you agree that COVID-19 will be successfully controlled?	1. Yes 2. No
2	I have no concern of being infected with COVID-19	1. Yes 2. No
3	Do you have confidence that Ethiopia will win the battle against COVID-19?	1. Yes 2. No
4	Is the Ethiopian government handling the COVID-19 health crisis well?	1. Yes 2. No
5	Do you think that wearing a face mask will effectively prevent COVID-19?	1. Yes 2. No
6	Do you think that adequate social distancing will effectively prevent COVID-19?	1. Yes 2. No
7	Do you think washing hands with soap and water helps to prevent COVID-19?	1. Yes 2. No
8	Would you be willing to tell people if you were having COVID-19 symptoms?	1. Yes 2. No
9	Would you inform the health authorities if a family member exhibits the symptoms?	1. Yes 2. No
10	Do you think traditional medicine can prevent or treat COVID-19?	1. Yes 2. No
11	Do you think COVID-19 doesn't affect youngsters?	1. Yes 2. No

E. Practice		
1	In recent days have you worn a mask leaving home?	<ol style="list-style-type: none"> 1. Always 2. Sometimes 3. Never
2	Do you wash your hands before putting your mask on?	<ol style="list-style-type: none"> 1. Yes 2. No
3	What kind of mask do you use?	<ol style="list-style-type: none"> 1. surgical 2. N-95 3. cloth
4	If cloth, how often do you wash and reuse it?	<ol style="list-style-type: none"> 1. Everyday 2. Weekly 3. monthly
5	-If surgical mask, how often do you change?	<ol style="list-style-type: none"> 1. Everyday 2. Weekly 3. monthly
6	If you reuse a mask, where/ how do you store it?	<ol style="list-style-type: none"> 1. In the pocket 2. plastic bag 3. Holding on hands
7	Do you touch your face while wearing a mask?	<ol style="list-style-type: none"> 1. Always 2. Sometimes 3. Never
8	Do you avoid touching your mask?	<ol style="list-style-type: none"> 1. Yes 2. No
9	How do you take off your mask?	<ol style="list-style-type: none"> 1. from the front of mask 2. from the string of mask
10	How do you greet your friends?	<ol style="list-style-type: none"> 1. hand shake 2. hugging 3. elbow touching 4. waving hand/without contact
11	In recent days have you practiced maintain your distance at 2m?	<ol style="list-style-type: none"> 1. Yes 2. No
12	When do you wash your hands?	<ol style="list-style-type: none"> 1. After I touch dirty materials such as Birr, door handles 2. After I touch my nose or ears or skin parts

6	If the answer is no, explain why?	
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Questions for the in-depth interview

1. How do you know about COVID-19? (Probe: transmission mechanisms, prevention strategies, vaccines availability, perceptions towards the vaccines)
2. What were your initial reactions towards COVID-19 when you first heard about it? How about now?
3. What are your thoughts on the COVID-19 vaccine? (Probe: availability, efficacy, perceptions on quality, side effects)
4. What factors do you think will hinder people from receiving COVID-19 vaccines?

SRQR Reporting checklist for qualitative study

	Reporting item	Page number
Title		
	Concise description of the nature and topic of the study identifying the study as qualitative or indicating the approach (e.g. ethnography, grounded theory) or data collection methods (e.g. interview, focus group) is recommended	Title
Abstract		
	Summary of the key elements of the study using the abstract format of the intended publication; typically includes background, purpose, methods, results and conclusions	Abstract
Introduction		
Problem formulation	Description and significance of the problem / phenomenon studied: review of relevant theory and empirical work; problem statement	Page # 4
Purpose or research question	Purpose of the study and specific objectives or questions	Page # 5
Methods		
Qualitative approach and research paradigm	Qualitative approach (e.g. ethnography, grounded theory, case study, phenomenology, narrative research) and guiding theory if appropriate; identifying the research paradigm (e.g. postpositivist, constructivist / interpretivist) is also recommended; rationale. The rationale should briefly discuss the justification for choosing that theory, approach, method or technique rather than other options available; the assumptions and limitations implicit in those choices and how those choices influence study conclusions and transferability. As appropriate the rationale for several items might be discussed together.	Page # 5
Researcher characteristics and reflexivity	Researchers' characteristics that may influence the research, including personal attributes, qualifications / experience, relationship with participants, assumptions and / or presuppositions; potential or actual interaction between	Page # 5

	researchers' characteristics and the research questions, approach, methods, results and / or transferability	
Context	Setting / site and salient contextual factors; rationale	Page # 5
Sampling strategy	How and why research participants, documents, or events were selected; criteria for deciding when no further sampling was necessary (e.g. sampling saturation); rationale	Page # 6
Ethical issues pertaining to human subjects	Documentation of approval by an appropriate ethics review board and participant consent, or explanation for lack thereof; other confidentiality and data security issues	Page # 7
Data collection methods	Types of data collected; details of data collection procedures including (as appropriate) start and stop dates of data collection and analysis, iterative process, triangulation of sources / methods, and modification of procedures in response to evolving study findings; rationale	Page # 6
Data collection instruments and technologies	Description of instruments (e.g. interview guides, questionnaires) and devices (e.g. audio recorders) used for data collection; if / how the instruments(s) changed over the course of the study	Page # 6
Units of study	Number and relevant characteristics of participants, documents, or events included in the study; level of participation (could be reported in results)	Page # 5
Data processing	Methods for processing data prior to and during analysis, including transcription, data entry, data management and security, verification of data integrity, data coding, and anonymisation / deidentification of excerpts	Page # 7
Data analysis	Process by which inferences, themes, etc. were identified and developed, including the researchers involved in data analysis; usually references a specific paradigm or approach; rationale	Page # 7
Techniques to enhance trustworthiness	Techniques to enhance trustworthiness and credibility of data analysis (e.g. member checking, audit trail, triangulation); rationale	Page # 7
Results/findings		
Syntheses and interpretation	Main findings (e.g. interpretations, inferences, and themes); might include development of a theory or model, or integration with prior research or theory	Page # 8 - 10
Links to empirical data	Evidence (e.g. quotes, field notes, text excerpts, photographs)	Page # 8 - 10

	to substantiate analytic findings	
Discussion		
Integration with prior work, implications, transferability and contribution(s) to the field	Short summary of main findings; explanation of how findings and conclusions connect to, support, elaborate on, or challenge conclusions of earlier scholarship; discussion of scope of application / generalizability; identification of unique contributions(s) to scholarship in a discipline or field	Page # 11 - 13
Limitations	Trustworthiness and limitations of findings	Page # 13
Other		
Conflicts of interest	Potential sources of influence of perceived influence on study conduct and conclusions; how these were managed	Page # 3
Funding	Sources of funding and other support; role of funders in data collection, interpretation and reporting	Page # 3