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A Crisis within a Crisis: COVID-19 Knowledge and Awareness among the Syrian Population - a national survey assessment

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4 1 **A Crisis within a Crisis: COVID-19 Knowledge and Awareness among the**
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6 2 **Syrian Population - a national survey assessment**
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12 4 **Authors: Fatema Mohsen¹, Batoul Bakkar¹, Humam Armashi¹, Nizar Daher^{2,3}**
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16
17 6 **Affiliations:**

18
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20
21 7 1Faculty of Medicine, Syrian Private University, Damascus, Syria.

22
23 8 2Professor in Infectious Diseases, Department of Internal Medicine, Faculty of Medicine,
24
25
26 9 Damascus University, Damascus, Syria.

27
28 10 3Professor in Infectious Diseases, Department of Internal Medicine, Faculty of Medicine,
29
30
31 11 Syrian Private University, Rif Dimashq, Syria.
32

33
34
35
36 13 **Corresponding Author:**

37
38 14 Fatema Mohsen

39
40
41
42 15 Faculty of medicine, Syrian Private University, Mazzeh Street, P.O. Box 36822, Damascus,

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44 16 Syrian Arab republic

45
46
47 17 Tel:00963936396590 Email: fatemamohsena@gmail.com
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54 19 **Abstract:**
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3 20 **Objectives:** To gauge specific knowledge around clinical features, transmission pathways,
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5 21 and prevention methods, and to identify factors associated with poor knowledge to help
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7 22 facilitate outbreak management in Syria during this rapid global rise of the COVID-19
8
9 23 pandemic. The aim of this study is to examine the Syrian public's awareness and knowledge
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11 24 regarding COVID-19.

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14 25 **Design:** Web-based cross-sectional survey.

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16
17 26 **Setting:** This study was distributed randomly in March 2020, nearly 10 years into the Syrian
18
19 27 war crisis. The Arabic-language survey was posted on various social media platforms
20
21 28 including WhatsApp, Telegram, Instagram, and Facebook targeting various social groups.

22
23
24 29 **Participants:** Of 4495 total participants who completed the survey, 3942 were in Syria. 356
25
26 30 participants outside of Syria were females and 1142(31.8%) males. The final sample of 3586
27
28 31 participants (completion rate=79.8%) consisted of 2444(68.2%) females and 1142(31.8%)
29
30 32 males. All participants residing in Syria with no known history of COVID-19 infection were
31
32 33 included in the study.

33
34 34 **Primary and secondary outcome measures:** The study revealed good awareness regarding
35
36 35 COVID-19. Poor knowledge was associated with male gender, education of secondary school
37
38 36 or lower, careers in government, private, business, military, and "other" sectors, as well as
39
40 37 unemployment, poor and moderate economic status, and over 5 household members.

41
42 38 **Results:** Of the 3586 participants, 68.2% were females, 50.8% were unemployed, and 79.2%
43
44 39 were at college-educated. The study revealed good awareness regarding COVID-19 (mean
45
46 40 75.6%, SD±9.4%). Multiple linear regression analysis correlated knowledge scores with
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48 41 gender, education level, occupation, economic status, and the number of household members.
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3 43 **Conclusion:** This study revealed some potentially troubling knowledge gaps which
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5 44 underscore the need for a vigorous public education campaign. This campaign must reinforce
6
7 45 the public's awareness, knowledge, and vigilance towards precautionary measures against
8
9 46 COVID-19 and, most importantly aid in controlling the worldwide spread of the disease. A
10
11 47 further assessment of attitudes and practice towards COVID-19 is needed.
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16
17 49 **Strengths and limitations of this study:**

18
19 50 This is the first study to measure the awareness and general knowledge of COVID-19 among
20
21 51 the Syrian population during a time of war. Our findings can be generalized regarding the
22
23 52 Syrian population; however, only for well-educated Syrians of good socio-economic status.
24
25 53 Syrians vulnerable to COVID-19 who represented a minority in the survey, such as the
26
27 54 elderly and rural residents, are more likely to exhibit poor knowledge and awareness due to
28
29 55 limited internet access. Even though all Syrian governorates were represented in this study,
30
31 56 the majority of participants lived in Damascus and Rural Damascus.

32
33 57 . This web-based cross-sectional survey was conducted between March 3rd and April 4th.

34
35 58 . The survey's designed questions were modelled after existing surveys.

36
37 59 . Participation was voluntary and confidentiality and anonymity of responses was assured.

38
39 60 . The first section of the survey covered socio-demographic information,

40
41 61 . The second section contained: general knowledge, transmission, symptoms, and prevention.
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49 63 **Keywords:** Awareness; Knowledge; COVID-19; Pandemic; Syria; War; Population.
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55 65 **Background:**
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3 66 Coronavirus disease 2019 (COVID-19), previously known as 2019 novel coronavirus
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5 67 disease,⁽³⁾ is a highly infectious respiratory disease that evolved into a worldwide pandemic
6
7 68 threatening a prolonged economic recession. The first incidence was reported at a local
8
9 69 seafood market in Wuhan, China (4). By April 20th 2020, the virus had reached 214 different
10
11 70 countries and territories and resulted in 3,517,345 cases and 243,401 deaths worldwide.⁽⁵⁾ On
12
13 71 January 30th 2020, the World Health Organization (WHO) declared for the sixth time that
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15 72 COVID-19 outbreak is a public health emergency of international concern (PHEIC),
16
17 73 prompting the organization to adopt and stipulate drastic global measures to stem the tide of
18
19 74 the pandemic.⁽⁶⁾

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24 75 The battle against COVID-19 in Syria is still in its infancy. The first confirmed case
25
26 76 was announced on March 22,⁽⁷⁾ and there had only been 44 cases and 3 death to date. These
27
28 77 figure are significantly lower than neighbouring countries such as Turkey (127,659 and
29
30 78 3,461), Iran (98,647 and 6,277), Iraq (2,346 and 98), Lebanon (740 and 25), and Jordan (465
31
32 79 and 9).⁽⁵⁾ The Syrian healthcare system is severely under-equipped and lacks the capacity to
33
34 80 contain such a crisis. The estimated number of intensive care unit (ICU) beds with ventilators
35
36 81 is mere 325, and the theoretical maximum number of cases that can be adequately treated is
37
38 82 only 6,500.⁽⁸⁾ Once this maximum threshold capacity is exceeded, drastic rationing decisions
39
40 83 will have to be made. Therefore, cooperation with and response to guidance from the WHO
41
42 84 are of utmost importance. Unprecedented measures have been adopted to control the spread
43
44 85 of COVID-19 in Syria including: partial closure of borders; suspension of public
45
46 86 transportation; closure of mosques, shops, parks, restaurants universities, and schools;
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48 87 isolation and care of suspected and infected individuals; curfews to limit social contact; and
49
50 88 awareness campaigns. The public's adherence to these control measures- which is largely
51
52 89 affected by their awareness, knowledge, and attitudes, towards COVID-19- is crucial to
53
54 90 mitigating the further spread of the disease.^(9, 10)

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3 91 The Syrian conflict, now in its 10th year, has resulted in the worst refugee crisis since
4
5 92 World War II.⁽¹¹⁾ The devastating impact of war has placed the public health system under
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7
8 93 constant strain; the numbers of casualties continues to rise, 70% of health care workers have
9
10 94 fled the country, the annihilation of healthcare facilities, and the “weaponization” of the
11
12 95 healthcare are ongoing challenges.^(8, 12) These challenges along with dense residential areas,
13
14 96 the growing prevalence of chronic illness, and 83% of the population living under the poverty
15
16 97 line make Syria highly vulnerable to a severe outbreak.^(8, 13)

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19 98 While some studies have been conducted to assess the knowledge, attitude, and
20
21 99 practices among populations during this pandemic, none have done so in Syria.^(1, 2, 14-19) To
22
23 100 our knowledge this first study that aims to measure the awareness and general knowledge of
24
25 101 COVID-19 among the Syrian population at a time where ambiguity and misinformation are
26
27 102 rampant. The objective of this study is to gauge specific knowledge around clinical features,
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29 103 transmission pathways, and prevention methods, and to identify factors associated with poor
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31 104 knowledge to help facilitate outbreak management in Syria during this rapid global rise of the
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33 105 COVID-19 pandemic.
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41 107 **Methods:**

42 43 44 108 **Study design, setting and participants:**

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47 109 This web-based cross-sectional survey was conducted between March 3rd and April
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49 110 4th. Ethical approval was obtained from the Institutional Review Board (IRB) of the Faculty
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51 111 of Medicine, Syrian Private University. All participants residing in Syria with no known
52
53 112 history of COVID-19 infection were included in the study. The authors designed questions
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55 113 that were modelled after existing surveys.^(1, 2) We conducted a pilot study on 20 people to
56
57 114 assess clarity, relevance, and the acceptability of the survey; these were excluded from the
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3 115 final sample to avoid bias. Modifications were made based on feedback received to facilitate
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5 116 better comprehension before distributing the final survey to the general population. The
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8 117 Arabic-language survey was posted on various social media platforms including WhatsApp,
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10 118 Telegram, Instagram, and Facebook targeting various social groups. Participants confirmed
11
12 119 their voluntarily participation by answering a yes-no question, were informed of the option to
13
14 120 opt-out of the survey at any time, and were assured of the confidentiality and anonymity of
15
16 121 their responses. After confirmation, participants were directed to the first part of the survey to
17
18 122 complete questions about socio-demographic information including, age, gender, residence,
19
20 123 education level, occupation, and economic status. Participants under the age of 18 required
21
22 124 informed parental consent, as well as submission of parent/guardian contact information. The
23
24 125 researchers were responsible for contacting the parents/guardians to obtain consent before the
25
26 126 child was given access to the survey. The self-administered survey contained 40 questions
27
28 127 divided into 4 sections: general knowledge (10 questions), transmission pathways (7
29
30 128 questions), clinical features (12 questions), and prevention methods (11 questions). The
31
32 129 survey is available in appendix 1.
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39 **Patient and public involvement:**

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42 131 The public's priorities, experience, and preferences were assessed through a pilot study
43
44 132 before administering the survey to the community. The public were involved in this study
45
46 133 through various social-media platforms. We encouraged the public to share the survey link
47
48 134 with family members and friends; however, participants were not involved in the conduct of
49
50 135 the study. The results of the survey were analyzed using Statistical Package for Social
51
52 136 Sciences version 25.0 (SPSS Inc., Chicago, IL, United States) to correlate mean knowledge
53
54 137 scores of participants with socio-demographic factors. We also identified participants factors
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3 138 associated with poor knowledge. Participant advisors including those in the pilot study were
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5 139 deeply thanked. Patients were not involved in this study.
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8 140 **Statistical analysis**

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12 141 Data was analyzed using the Statistical Package for Social Sciences version 25.0
13
14 142 (SPSS Inc., Chicago, IL, United States) and reported as frequencies and percentages (for
15
16 143 categorical variables) or means and standard deviations (SD) (for continuous variables). One-
17
18 144 way analysis of variance (ANOVA), t-test, or Chi-square test was applied to compare mean
19
20 145 knowledge scores against socio-demographic variables. Multivariable linear regression
21
22 146 analysis using the socio-demographic variables as independent variables and mean
23
24 147 knowledge score as the outcome variable was conducted to identify factors associated with
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26 148 knowledge. P-values<0.05 was considered statistically significant.
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32 33 34 150 **Results:**

35 36 37 151 **Socio-demographics characteristics:**

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40 152 Of 4495 total participants who completed the survey, 3942 were in Syria. 356
41
42 153 participants outside of Syria were excluded. The final sample of 3586 participants
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44 154 (completion rate=79.8%) consisted of 2444(68.2%) females and 1142(31.8%) males.
45
46 155 Participants aged 16-30 years were the majority 2789(77.8%) while participants under 16
47
48 156 were the minority 59(1.6%). Participant ages ranged from 12-78 years with the majority
49
50 157 being 19(mean=30 ±10 years), single 2279(63.6%), and unemployed 1822(50.8%).
51
52 158 1064(29.7%) participants were smokers, and 428(11.9%) were alcohol consumers (Table 1).
53
54 159 The majority of participants were residents of Damascus/Rural Damascus 2019(56.3%), and
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56 160 had attained college/university level education (Figure1).
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161 **General Knowledge regarding COVID-19:**

162 Participants showed a good level of awareness regarding COVID-19 (75.6%). An
163 adequate level of basic knowledge (67.0%) was found among participants (Table 2),
164 3383(94.3%) knew that a virus was the causative agent of COVID-19; 2535(70.7%) correctly
165 identified the incubation period as being between 2 days and 2 weeks. Only 1500(41.8%)
166 knew that an infection with COVID-19 does not confer lifelong immunity. The majority of
167 participants 3489(97.3%) were aware that COVID-19 infection in high risk groups can be
168 fatal. There is currently insufficient evidence on whether infertility is a complication of
169 COVID-19 infection; 461(12.9%) participants believed that COVID-19 can cause infertility
170 while 1903(53.0%) did not. 2986(83.3%), and 2597(72.4%) correctly answered that there are
171 currently no available vaccine or treatments; however, there were misconceptions about the
172 efficacy of antibiotics and Ibuprofen as treatments, 1228(34.2%) and 1268(35.3%)
173 respectively (Table 3).

174 **Transmission and Signs and Symptoms regarding COVID-19:**

175 There was a fair level of awareness (70.7%) regarding COVID-19 transmission
176 pathways (Table 2). A high level of awareness was demonstrated regarding common
177 transmission pathways: 3521(98.2%), 3387(94.4%), and 3330(92.9%) identified respiratory
178 droplets, touching an infected person's personal belongings, and handshaking respectively.
179 There is currently limited evidence on animal-to-human and sexual transmission; 703(19.6%)
180 did not know if transmission occurs between animals and humans, while 899(25.1%) did not
181 know if the virus is transmitted sexually (Table 4).

182 The data showed a good level of awareness (76.0%) regarding clinical features (Table
183 2). When asked about the main clinical features, participants correctly identified, fever
184 3563(99.4%), sore throat 3037(84.7%), headache 3186(88.8%), chest pain 3050(85.0%),

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3 185 general pain 3019(84.2%), fatigue 3405(95.0%), and dry cough 3466(96.7%), whereas only
4
5 186 1972(55.0%) knew that diarrhea can be a symptom. Only 2221(61.9%) were aware that
6
7 187 infected individuals may be asymptomatic (Table 4).
8
9

11 188 **Prevention Methods regarding COVID-19:**

13 189 The highest level of awareness was in the prevention section (88.8%) (Table 2).
14
15 190 Washing hands with soap, avoiding crowded areas, remaining at home, and wearing a face
16
17 191 mask outside are the principal preventative measures against COVID-19, 3574(99.7%),
18
19 192 3574(99.75%), 3554(99.1%), and 3204(89.3%), respectively. A minority 158(4.4%)
20
21 193 believed that cleaning with a mixture of Flash and bleach is a sound preventive measure.
22
23 194 Only 2482(69.2%) knew that the flu vaccine offers no protection against COVID-19 (Table
24
25 195 5).
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30 196 **Comparison Study:**

32 197 A series of one way ANOVA analyses revealed that mean knowledge differed
33
34 198 significantly across: gender (p-value=0.009) (Figure 2), age (p-value=0.003), social status (p-
35
36 199 value=0.042), education level (p-value=0.000), economic status (p-value=0.000), number of
37
38 200 household members (p-value=0.000) (Table 4). The data showed a significant correlation
39
40 201 between mean knowledge and place of residence (p-value=0.000). Participants living in
41
42 202 Lattakia (77.6%) exhibited the greatest awareness, whereas those in Ar-Raqqah (71.7%)
43
44 203 followed by Deir-ez-Zor (71.8%) exhibited the lowest (Figure 3).
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49 204 Participants acquired their information from the following source(s): Social media,
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51 205 1998(55.7%); health websites, 2823(78.7%); television/radio, 1572(43.8%); family
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53 206 members/friends, 528(14.7%); magazines/books, 266(7.4%); and lectures, 517(14.4%).
54
55 207 Participants with the lowest awareness acquired their information from family
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57 208 members/friends (74.0%), whereas those with the highest awareness acquired their
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3 209 information from lectures (78.2%), (p-value=0.000), (Figure 4). When participants were
4
5 210 asked if they were likely to share new information with friends and family, 3513(98.0%)
6
7 211 answered “yes”. There was a significant difference in mean knowledge between those who
8
9 212 were inclined to disseminate new information about COVID-19 to friends and family
10
11 213 (75.7%) compared with those who were not (72.3%) (p-value=0.002). On exclusive use of
12
13 214 personal belongings, 2692(75.1%) answered “yes”. We found no significant correlation
14
15 215 between mean knowledge and participant tendency to share personal belongings with others
16
17 216 (p-value=0.112). Participants who knew someone infected with COVID 19, 65(1.8%)
18
19 217 answered “yes”. There was no significant difference in mean knowledge between those who
20
21 218 knew an infected individual (75.9%) compared with those who did not (75.6%) (p-
22
23 219 value=0.816).

220 **Multiple linear regression:**

221 Multiple linear regression analysis results: male gender (vs. female, p=0.005);
222 education of secondary school or lower (vs. college/university and above, p=0.000); careers
223 in government, private, business, military, and “other” sectors, as well as unemployment
224 (vs. health care workers, p=0.000); poor and moderate economic status (vs. good and
225 excellent, p<0.040), and over 5 household members (vs. of 1-5, p=0.000) were associated
226 with significantly lower knowledge scores (Table 7). Careers in health care (vs. Unemployed,
227 p-value=0.000), and the 31-45 age group (vs. 16-30, p-value=0.005) were associated with
228 significantly higher knowledge scores.

230 **Discussion:**

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3 231 We found an overall mean knowledge score of 75.6%, indicating that most
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5 232 participants were relatively knowledgeable about COVID-19, though less so compared to
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8 233 their counterparts in China (90%).⁽¹⁾ This level of knowledge was unexpected given that
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10 234 when we carried out the survey, only 10 cases of COVID-19 had been confirmed in Syria.⁽²⁰⁾
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13 235 We found that poor knowledge was associated with males, non-post-secondary
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15 236 education, non-healthcare occupations, unemployment, poor and moderate economic status,
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18 237 and households exceeding 5 members (Table 5). Similar trends were observed in China.⁽¹⁾
19
20 238 Correlating socio-demographic variables with awareness is critical to public health efforts to
21
22 239 mitigate the spread of COVID-19. This data obtained can be leveraged by the Syrian Ministry
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24
25 240 of Health to tailor prevention and educational campaigns to populations with the widest
26
27 241 knowledge gaps.
28

29 242 In the general knowledge section (67%), the majority of the participants 3383(94.3%)
30
31 243 knew that COVID-19 is caused by a virus, similar to a Pakistani study (93.3%).⁽¹⁷⁾ Low
32
33 244 awareness of the 2 to 14 day incubation period was found,⁽²¹⁾ among dentists (36.1%), and
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35 245 health care workers (HCW) (36.4%).^(2, 19) Our study showed a higher level of awareness
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37
38 246 2535(70.7%) among the population. Syria has a relatively young population; 2018 showed
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40
41 247 that only 4.5% of the population was over 65.⁽²²⁾ 3489(97.3%) knew that COVID-19 infection
42
43 248 can be severe and lead to death in elderly, chronically ill, and immunodeficient patients. This
44
45 249 is higher than studies conducted in China (73.2%), and India (88.37%).^(1, 23) 40.6% of Syrians
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48 250 are hypertensive, yet a staggering 79.8% of them are unaware of their condition. Diabetes is
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50 251 also prevalent, affecting 11.9% of the population.^(24, 25) Such a rampant lack of awareness
51
52 252 about chronic disease in the population can be fatal, and underscores the need for targeted
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55 253 awareness campaigns.
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3 254 Only 2597(72.4%) participants knew that there is currently no available treatment;
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5 255 this is higher than a Kenyan study (40%) but significantly lower than a Chinese study
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7 256 (94%).^(1, 15) A minority 103(2.9%) participants thought there was a vaccine available against
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9 257 COVID-19; by contrast, Coimbatore District (18.6%) and Pakistan (11.6%) were
10
11 258 misinformed. In the absence of a vaccine or effective treatment protocol for COVID-19,
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13 259 controlling the spread of the disease is the best line of defense. We observed a considerable
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15 260 knowledge gap in 1268(35.3%) with regards to ibuprofen as a treatment option. There is no
16
17 261 available evidence to suggest that ibuprofen is effective against COVID-19.⁽²⁶⁾

18
19 262 Participants showed a fair level of awareness regarding transmission pathways
20
21 263 (70.7%), very similar to a Pakistani study (70.8%).⁽¹⁷⁾ The majority 3521(98.2%) of
22
23 264 participants were aware that respiratory droplets are common transmission vectors this is
24
25 265 similar to a Chinese study (97.8%), but much higher than an Indian study (29.5%).^(1, 16) WHO
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27 266 advise on physical distancing include: using greetings that replace physical contact with a
28
29 267 wave, nod, bow, peace sign, sign language, friendly words or smiles.^(27, 28) 3330(92.9%)
30
31 268 participants identified handshaking as a transmission pathway, higher than a study among
32
33 269 dentists (85.6%).⁽²⁾

34
35 270 A good level of awareness was found regarding the clinical features of COVID-19
36
37 271 (76.0%), similar to a Pakistani (77.7%).⁽¹⁷⁾ A very high level of awareness of the most
38
39 272 common symptoms was found: fever 3563(99.4%), dry cough 3466(96.7%), fatigue
40
41 273 3405(95.0%), and myalgia 3019(84.2%), similar to findings from Chinese (96.4%) and
42
43 274 Indian (95.4%) studies.^(1, 23) When asked about sore throat, a higher level of awareness
44
45 275 3037(84.7%) was found compared to studies from India (15.2%) and among dentists
46
47 276 (28.5%).^(2, 16) Knowledge about diarrhea as a symptom was lacking: only 1972(55.0%); a
48
49 277 study among dentists also showed low awareness (39.9%).^(2, 16) While infected individuals
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51 278 are frequently asymptomatic, or present with mild symptoms, around 1 in every 5 infections
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3 279 can be serious enough to require hospitalisation.^(6, 29) Only 2221(61.9%) participants were
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5 280 aware that infected individuals can be asymptomatic, while a study among dentists (34.5%)
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7 281 reported much lower awareness. “Silent spreaders” may significantly contribute to the
8
9 282 transmission of COVID-19, and so increasing public awareness of this particular point is
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11 283 crucial
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14 284 We found a high level of awareness in the preventive methods section (88.8%),
15
16 285 similar to a study in Pakistan (85%).⁽¹⁷⁾ Hand hygiene is considered an important element of
17
18 286 infection control dating back to the revolutionary work of Ignaz Semmelweis.⁽³⁰⁾
19
20 287 Implementing hand-washing techniques can break the transmission cycle and reduce the risk
21
22 288 of infection by 6%-44%.⁽³¹⁾ Almost all 3574(99.7%) participants were aware that washing
23
24 289 hands with soap and water is an important preventive measure against COVID-19. This
25
26 290 finding is in accordance with India (97.0%), and other studies (96.2%, and 87%).^(2, 16, 19)
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30 291 This year the WHO recommended that the following mitigation measures be
31
32 292 implemented during the holy month of Ramadan: cancelling social and religious gatherings,
33
34 293 holding events outdoors for adequate ventilation, physical distancing of at least 1 meter
35
36 294 between people, and the use of technology to broadcast ceremonies on television.^(27, 28) The
37
38 295 majority 3574(99.7%) identified avoiding mass gatherings as a preventive measure; studies in
39
40 296 China (98.6%) and Coimbatore District (97.7%) reported similar awareness.^(1, 23) Cheap and
41
42 297 efficient interventions such as N95 (filtration capacity=95%) have a 91% effectiveness of
43
44 298 blocking pathogen transmission.⁽³²⁾ 3204(89.3%) participants considered wearing a face mask
45
46 299 when leaving home as an effective prevention method, compared with a Coimbatore District
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48 300 study (93.02%).⁽²³⁾
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53 301 Since Syrian society is particularly vulnerable to COVID-19, this knowledge gap is
54
55 302 potentially dangerous and should be addressed to mitigate disease spread. Only 2482(69.2%)
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57 303 knew that the flu vaccine offers no protection against COVID-19; this is similar to a
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3 304 Coimbatore District study (67.4%), but lower than a study amongst HCWs (90.7%).^(19, 23)
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5 305 Mixing flash with bleach is highly toxic and caustic to the respiratory tract. Only a minority
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7
8 306 of participants 158(4.4%) believed that this method of cleaning is a sound
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10 307 preventive measure. 3305(92.2%) were aware that individuals showing symptoms should
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12 308 quarantine themselves, lower than in China (98.2%) and India (95.8%).^(1, 16)
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14
15 309 North-East Syria (NES) has a population of over 4 million people, 600,000 of whom
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17 310 are internally displaced refugees, 100,000 of whom live in overcrowded camps: only 2 of
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19 311 NES's 11 hospitals are currently functioning. NES consists of 3 governorates: Ar-Raqqah,
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21 312 Deir-ez-Zor and Al-Hasakah. With only 22 ICU beds, (18 in Al-Hasakah, 4 in Ar-Raqqah
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23 313 and none in Deir-ez-Zor), the maximum capacity threshold is only 80 COVID-19 cases. Ar-
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25 314 Raqqa and Deir-ez-Zor, the most vulnerable governorates, also showed the lowest awareness
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27 315 in the study (71.7%), and (71.8%). This is a potentially catastrophic situation, and a concern
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29 316 to the international community, as an unmonitored, uncontrolled outbreak in NES can
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31 317 prolong the global pandemic.
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39 **Limitations:**

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42 320 Our findings can only be generalized about well-educated Syrians of good socio-
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44 321 economic status. Syrians vulnerable to COVID-19, such as the elderly and rural residents, are
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46 322 more likely to exhibit poor knowledge and awareness due to limited internet access. As such,
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48 323 reaching out to these populations must be prioritized. Even though all Syrian governorates
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50 324 were represented in this study, the majority of participants lived in Damascus and Rural
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52 325 Damascus. Furthermore, assessment of attitudes and practice towards COVID-19 is needed,
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54 326 which should be developed as either a web-based survey, or phone interviews, and
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56 327 constructed using multi-dimensional scaling.
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67 **Conclusion:**
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10 330 COVID-19 has been a dire warning to humanity about the fragility of its social,
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12 331 economic, and healthcare institutions. Our study revealed good public awareness of clinical
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14 332 features and preventive measures. However general knowledge and knowledge about
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16 333 transmission pathways was suboptimal. Syrians of good socio-economic status, in particular
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18 334 young well-educated women, have shown good knowledge. Our national response must adapt
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20 335 to the growing threat of COVID-19 by adopting public awareness strategies and behaviours
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22 336 to contain the disease both within and beyond our borders.
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30 338 **Abbreviations:** COVID-19: Coronavirus Disease 2019; MERS: Middle East Respiratory
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32 339 Syndrome; SARS: Severe Acute Respiratory Syndrome; WHO: World Health Organization;
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34 340 PHEIC: Public Health Emergency of International Concern; ICU: Intensive care unit; IRB:
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36 341 Institutional Review Board; SPSS: Statistical Package for Social Sciences; SD: Standard
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38 342 Deviation; HCW: Health Care Worker.
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48

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50
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56 348
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58
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1
2
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4
5 351 public, commercial or non-profit sectors.
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12 353 **Availability of data and materials:**

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14 354 All data related to this paper's conclusion are available and stored by the authors. All
15
16 355 data are available from the corresponding author on a reasonable request.
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23 357 **Declarations:**

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25 358 **Ethics approval and consent to participate:**

26 359 This study was approved by the Institutional Review Board (IRB) at the Syrian
27
28 360 Private University (SPU). All Participants confirmed their written consent by answering a
29
30 361 yes-no question. Participants under the age of 18 required verbal informed parental consent,
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32 362 as well as submission of parent/guardian contact information. The researchers were
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34 363 responsible for contacting the parents/guardians to obtain verbal consent before the child was
35
36 364 given access to the survey. The verbal and written form of consent was approved by the IRB
37
38 365 at SPU. Participation in the study was voluntary and participants were assured that anyone
39
40 366 who was not inclined to participate or decided to withdraw after giving consent would not be
41
42 367 victimized. All information collected from this study was kept strictly confidential.
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48 368 **Consent for Publication:**

49 369 Not applicable.

50
51 370 **Competing interests:**

52 371 The authors declare that they have no competing interests.
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56 372 **Authors' contributions:**

57 373 FM conceptualized the study, participated in the design, wrote the study protocol,
58
59 374 performed the statistical analysis, did a literature search and drafted the manuscript. BB
60

375 participated in study design, did a literature search and drafted the manuscript. HA, and NA
 376 did a literature search, and revision of the draft. All authors read and approved the final draft.

377

378 **Tables and Figures:**

379 **Table 1.**

Table 1. Socio-demographic characteristics: (n=3586)

Gender (%)	Male	1142(31.8)	Education (%)	Primary School	25(0.7)
	Female	2444(68.2)		Intermediate School	166(4.6)
Age (%)	<16	59(1.6)		Secondary school	375(10.4)
	16-30	2789(77.8)		College/University	2839(79.2)
	31-45	503(14.0)		Master's degree	157(4.4)
	>45	235(6.6)		PhD	24(0.7)
Social Status (%)	Single	2279(63.5)		Occupation (%)	Health care worker
	In a relationship	286(8.0)	Government institution		283(7.9)
	Married	943(26.3)	Private institution		182(5.1)
	Divorced	46(1.3)	Business		198(5.5)
	Widowed	32(0.9)	Military		32(0.9)
Economic	¹ Poor	247(6.9)	Unemployed		1822(50.8)
			Other		435(12.1)

Status (%)	² Moderate	1247(34.8)	Household members (%)	0	46(1.3)
	³ Good	1761(49.1)		1-5	2751(76.7)
	⁴ Excellent	331(9.2)		>5	789(22)

380 ¹Poor: income does not provide essential needs for the family. ²Moderate: income provides essential
 381 needs for the family but no more. ³Good: income provides essential needs and some luxury
 382 requirements. ⁴Excellent: income provides luxury requirements.

383

384 **Table 2.**385 **Table 2. Mean knowledge score of participants by section**

	Mean Knowledge Score (%)	± Standard Deviation (%)
General Knowledge	67.0	18.9
Transmission Pathways	70.7	16.9
Signs and Symptoms	76.0	13.6
Prevention Methods	88.8	10.2
Overall knowledge	75.6	9.4

386

387 **Table 3.**388 **Table 3. General Knowledge around COVID-19: (n= 3586)**

	Virus	Bacteria	Parasite	Immune deficiency	Fungus	Inherited	Do Not Know
Causative Agent	3383(94.3)	39(1.1)	8(0.2)	46(1.3)	0(0.0)	2(0.1)	108(3.0)

N(%)						
	1 Minute to 1 Hour	1 Hour to 2 Days	2 Days to 2 Weeks	2 Weeks to 1 Month	>1 Month	
Incubation period	18(0.5)	58(1.6)	2535(70.7)	958(26.7)	17(0.5)	
N(%)						
		Yes(%)	No(%)	Do Not Know(%)		
Can infection with COVID-19 confer permanent immunity?		815(22.7)	1500(41.8)	1271(35.5)		
Can COVID-19 cause severe illness and lead to death in elderly, chronically ill, and immunodeficient patients?		3489(97.3)	28(0.8)	69(1.9)		
Can COVID-19 cause infertility?		461(12.9)	1222(34.1)	1903(53.0)		
Is COVID-19 teratogenic (i.e. cause malformations/abnormalities to an embryo/fetus)?		157(4.4)	1433(40.0)	1996(55.6)		
Treatment						
		Yes(%)	No(%)	Do Not Know(%)		
No treatment		2597(72.4)	515(14.4)	474(13.2)		

available			
Antibiotics	1228(34.3)	1790(49.9)	568(15.8)
Ibuprofen	1268(35.3)	1921(53.6)	397(11.1)
Vaccine	103(2.9)	2986(83.3)	497(13.8)

387

388 **Table 4.****Table 4. Transmission, Signs, and Symptoms of COVID-19: (n=3586)**

	YES(%)	NO(%)	DO NOT KNOW(%)
Transmission Pathways			
Respiratory droplets (from coughing or sneezing)	3521(98.2)	21(0.6)	44(1.2)
Handshaking	3330(92.9)	189(5.3)	67(1.8)
Touching an infected person's personal belongings	3387(94.4)	131(3.7)	68(1.9)
Animals-to-human	910(25.4)	1973(55.0)	703(19.6)
Undercooked food	1301(36.3)	1734(48.3)	551(15.4)
Sexual contact	1210(33.7)	1477(41.2)	899(25.1)
Horizontal transmission	1130(31.5)	1160(32.4)	1296(36.1)
Signs and Symptoms			
Fever	3563(99.4)	9(0.2)	14(0.4)
Sneezing	2353(65.6)	1000(27.9)	233(6.5)

Sore throat	3037(84.7)	358(10.0)	191(5.3)
Headache	3186(88.8)	190(5.3)	210(5.9)
Chest pain	3050(85.0)	254(7.1)	282(7.9)
Body aches (generalized pain)	3019(84.2)	260(7.2)	307(8.6)
Fatigue	3405(95.0)	72(2.0)	109(3.0)
Diarrhea	1972(55.0)	971(27.1)	643(17.9)
Dry cough	3466(96.7)	44(1.2)	76(2.1)
Productive cough	458(12.8)	2586(72.1)	542(15.1)
Bleeding	130(3.6)	2613(72.9)	843(23.5)
Asymptomatic	2221(61.9)	375(10.5)	990(27.6)

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390 **Table 5.****Table 5. Prevention Methods: (n= 3586)**

	YES(%)	NO(%)	DO NOT KNOW(%)
Does wearing a face mask outside the home offer protection from Covid-19?	3204(89.3)	314(8.8)	68(1.9)
Does washing hands with soap and water offer protection from Covid-19?	3574(99.7)	5(0.1)	7(0.2)

Does avoiding crowded places offer protection from Covid-19?	3574(99.7)	4(0.1)	8(0.2)
Does the flu vaccine offer protection from Covid-19?	331(9.2)	2482(69.2)	773(21.6)
Does staying at home offer protection from Covid-19?	3554(99.1)	15(0.4)	17(0.5)
Does using hand sanitizer offer protection from Covid-19?	3430(95.6)	104(2.9)	52(1.5)
Does cleaning house items with bleach offer protection from Covid-19?	3408(95.0)	110(3.1)	68(1.9)
Does cleaning fruits and vegetables with soap and water offer protection from Covid-19?	3262(90.9)	221(6.2)	103(2.9)
Does cleaning surfaces with a mixture of Flash and bleach offer protection from Covid-19?	158(4.4)	3301(92.1)	127(3.5)
Does the quarantine of symptomatic individuals protect others from Covid-19?	3305(92.2)	241(6.7)	40(1.1)
Do cumin, anise, and mint offer protection from Covid-19?	1041(29.0)	1934(53.9)	611(17.1)

391

392 **Table 6.**

Table 6. Mean knowledge score of participants by demographic variables (one way ANOVA), (n= 3586)

Characteristics	Number of participants (%)	Knowledge Score (%)	F-test	P-value	
Gender	Male	1142(31.8)	75.0	-2.625	0.009*
	Female	2444(68.2)	75.9		
Age-group (years)	<16	59(1.6)	71.5	4.770	0.003*
	16-30	2789(77.8)	75.8		
	31-45	503(14.0)	75.7		
	>45	23(6.6)	74.8		
Social status	Single	2279(63.5)	75.8	2.485	0.042*

	In a relationship	286(8.0)	76.6		
	Married	943(26.3)	75.1		
	Divorced	46(1.3)	73.9		
	Widowed	32(0.9)	73.4		
Residence	Urban	2426(67.7)	75.8	1.652	0.099
	Rural	1160(32.3)	75.3		
Education	Primary school	25(0.7)	66.5	26.176	0.000*
	Intermediate school	166(4.6)	73.2		
	Secondary school	375(10.4)	70.0		
	College/University	2839(79.2)	76.3		
	Master's degree	157(4.4)	77.2		

	PhD	24(0.7)	76.6		
Occupation	Health care worker	634(17.7)	78.6	16.379	0.000*
	Government institution	283(7.9)	75.7		
	Private institution	182(5.1)	75.5		
	Business	198(5.5)	73.4		
	Military	32(0.9)	71.2		
	Unemployed	1822(50.8)	75.3		
	Other	435(12.1)	74.0		

Economic status	Excellent	331(9.2)	76.6	7.108	0.000*
	Good	1761(49.1)	76.2		
	Moderate	1247(34.8)	74.9		
	Poor	247(6.9)	74.3		
Household members	0	46(1.3)	74.4	15.451	0.000*
	1-5	2751(76.7)	76.1		
	>5	789(22.0)	74.0		

393

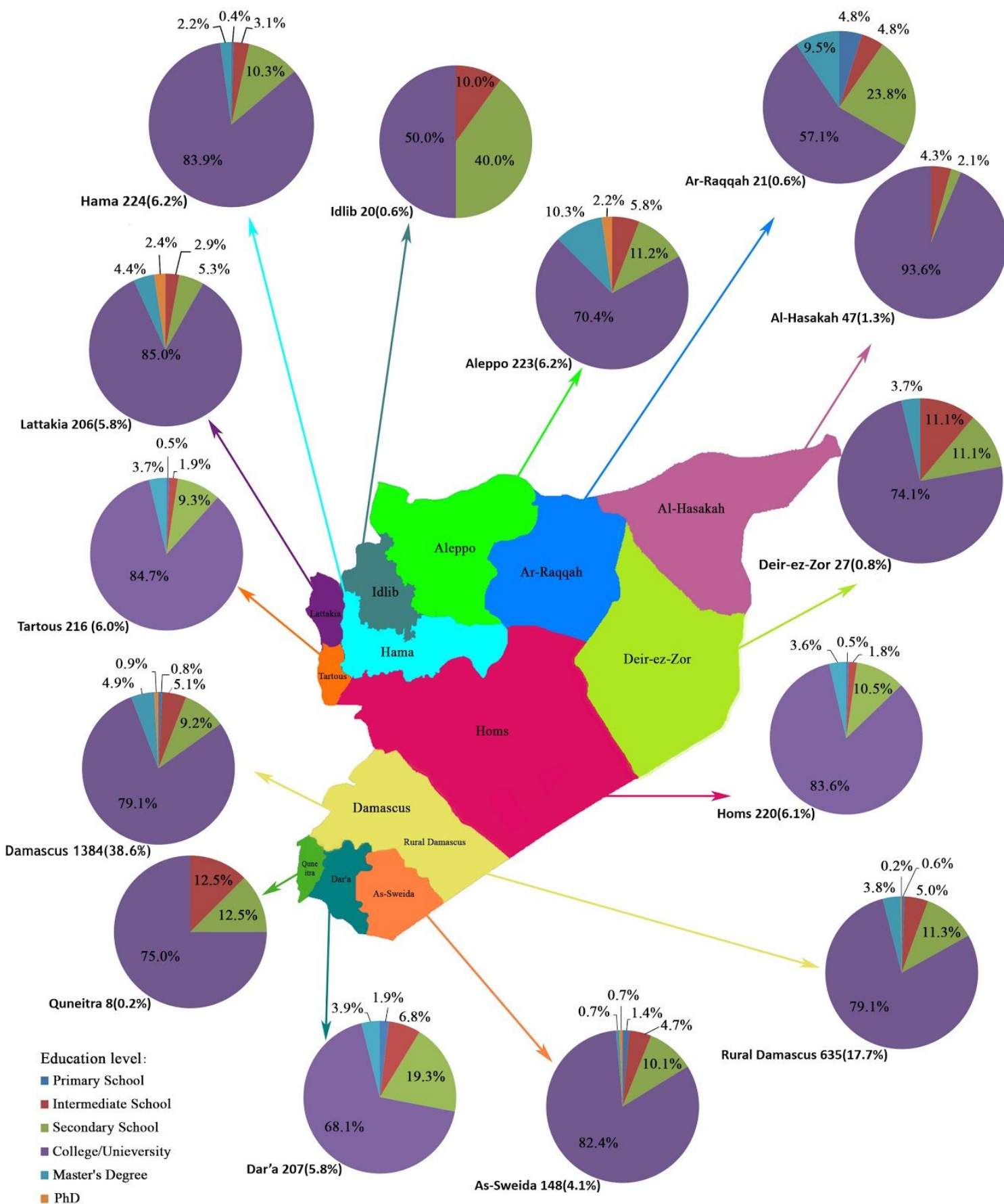
394 **Table 7.**

Table 7. Multiple linear regression on variables associated with poor COVID-19 knowledge

Variable	Coefficient	Standard error	t	P
Gender (male vs. female)	-0.933	0.334	-2.794	0.005*

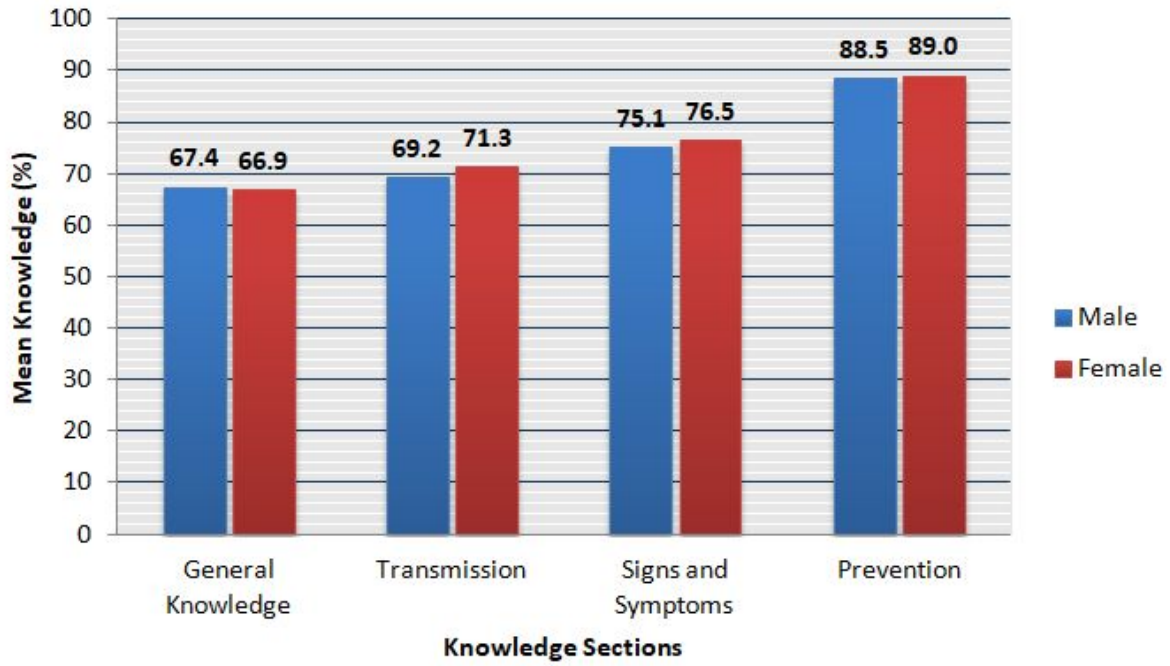
Education (primary, intermediate, secondary school vs. college/university, master, PhD)	-3.782	0.466	-8.125	0.000*
Occupation (government, private sector, business, military, unemployed, other vs. health care worker)	-3.592	0.474	-7.579	0.000*
Economic status (moderate, poor vs. excellent, good)	-0.669	0.325	-2.057	0.040*
Household members(>5 vs. 1-5)	-1.737	0.374	-4.648	0.000*

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396 **Figure 1.** Distribution of participants according to governorates and education level

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399 **Figure 2.** Relationship between both genders and mean knowledge.
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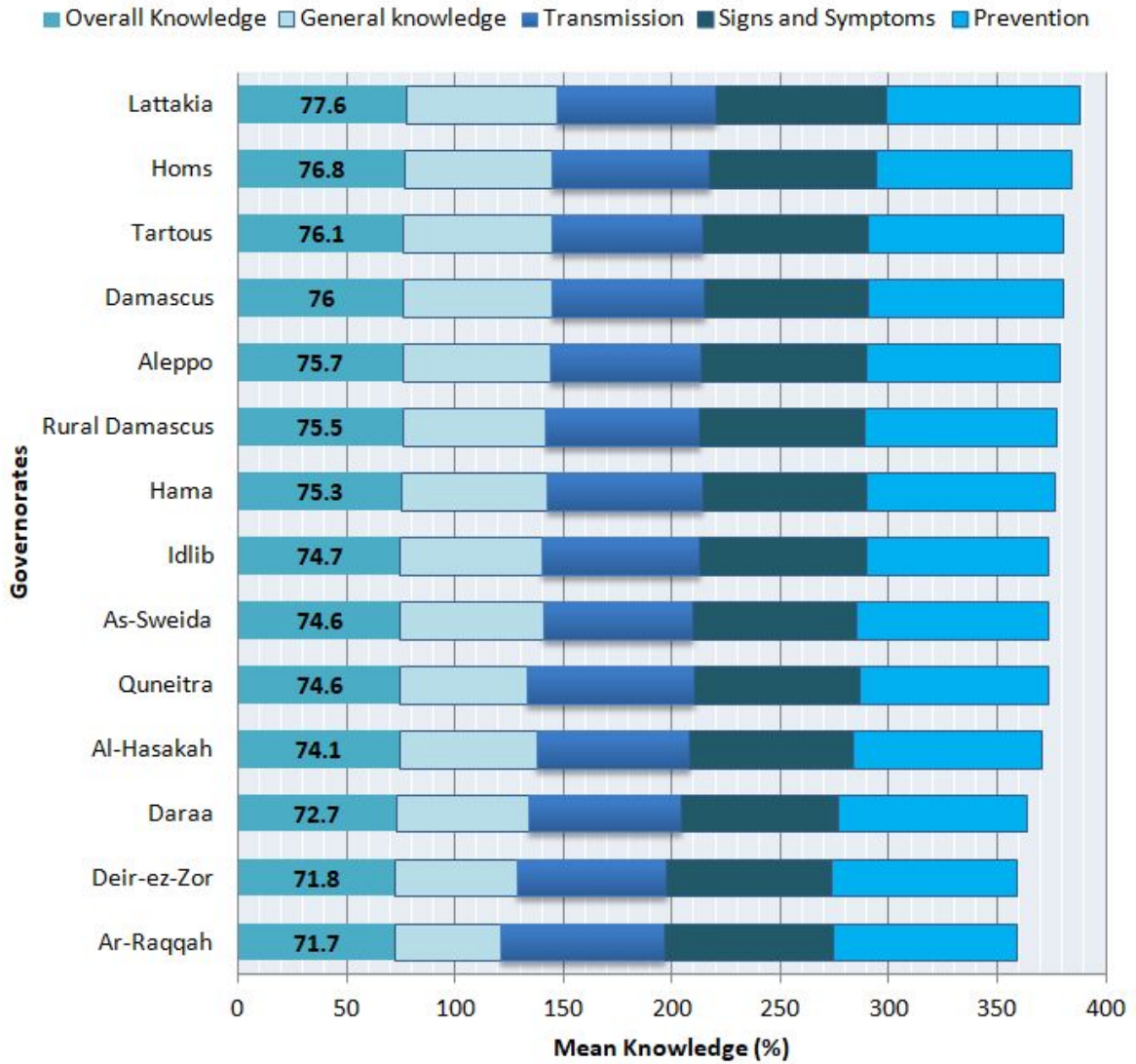


Figure 3. Relationship between place of residence and mean knowledge.

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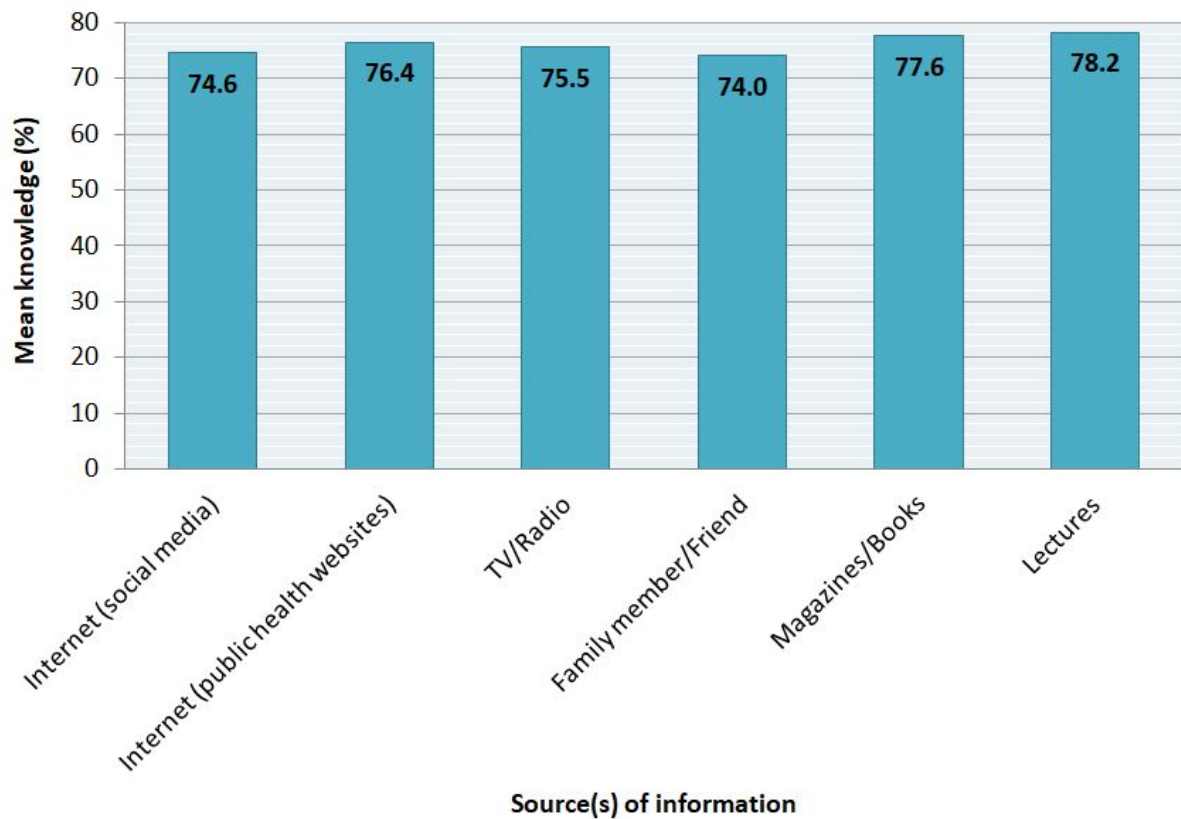


Figure 4. Relationship between different sources of information and mean knowledge.

Figures and tables legends:

Table 1. Sociodemographic characteristics

Table 2. Mean knowledge score of participants by section

Table 3. General Knowledge around COVID-19

Table 4. Transmission, Signs, and Symptoms of COVID-19

Table 5. Prevention Methods

Table 6. Mean knowledge score of participants by demographic variables

Table 7. Multiple linear regression on variables associated with poor COVID-19 knowledge

Figure 1. Distribution of participants according to governorates and education level

Figure 2. Relationships between both genders and mean knowledge.

Figure 3. Relationship between place of residence and mean knowledge.

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3 **418 Figure 4.** The relationship between different sources of information and mean knowledge.
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7 **420 References:**

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30 488

1 **Attached Survey:**2 **Appendix 1**

Socio-demographic Characteristics	
Age (years): <input type="checkbox"/> Below 15 <input type="checkbox"/> 15-20 <input type="checkbox"/> 20-30 <input type="checkbox"/> 30-50 <input type="checkbox"/> 40-50 <input type="checkbox"/> 50-60 <input type="checkbox"/> 60-70 <input type="checkbox"/> Above 70	Gender: <input type="checkbox"/> Male <input type="checkbox"/> Female
Marital status: <input type="checkbox"/> Single <input type="checkbox"/> Relationship <input type="checkbox"/> Married <input type="checkbox"/> Divorced <input type="checkbox"/> Widowed	Educational level: <input type="checkbox"/> Primary school <input type="checkbox"/> Intermediate school <input type="checkbox"/> Secondary school <input type="checkbox"/> University/College <input type="checkbox"/> Master's Degree <input type="checkbox"/> PHD Degree
Occupation: <input type="checkbox"/> Health care worker <input type="checkbox"/> Government institution <input type="checkbox"/> Private institution <input type="checkbox"/> Business <input type="checkbox"/> Military <input type="checkbox"/> Unemployed <input type="checkbox"/> Other	Residence: <input type="checkbox"/> Damascus/Rural Damascus <input type="checkbox"/> Hama <input type="checkbox"/> Aleppo <input type="checkbox"/> Homs <input type="checkbox"/> Tartous <input type="checkbox"/> Lattakia <input type="checkbox"/> Dara'a <input type="checkbox"/> As-Sweida <input type="checkbox"/> Al Hasakah <input type="checkbox"/> Deir-ez-Zor <input type="checkbox"/> Idlib <input type="checkbox"/> Ar-Raqqah <input type="checkbox"/> Quneitra
Area: <input type="checkbox"/> Rural <input type="checkbox"/> Urban	Economic Status: <input type="checkbox"/> Excellent <input type="checkbox"/> Good <input type="checkbox"/> Moderate <input type="checkbox"/> Poor
Do you smoke? <input type="checkbox"/> Yes <input type="checkbox"/> No	Do you drink alcohol? <input type="checkbox"/> Yes <input type="checkbox"/> No
How many people do you live with? <input type="checkbox"/> Alone <input type="checkbox"/> 1-5 <input type="checkbox"/> 6-10 <input type="checkbox"/> 11-15 <input type="checkbox"/> 16-20 <input type="checkbox"/> Above 20	
Do you share toiletries/personal care products with others? <input type="checkbox"/> Yes <input type="checkbox"/> No	
Do you know anyone infected with COVID-19? <input type="checkbox"/> Yes <input type="checkbox"/> No	

Table 2. General Knowledge about COVID-19

What is COVID-19? <input type="checkbox"/> Virus <input type="checkbox"/> Bacteria <input type="checkbox"/> Parasite <input type="checkbox"/> Fungus	Do you know how long after being infected with COVID-19 can a person suffer from signs and symptoms? <input type="checkbox"/> 1 Minute to 1 Hour <input type="checkbox"/> 1 Hour to 2 Days
-------------------------------------------------------------------------------------------------------------------------------------------------------------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

<input type="checkbox"/> Immunodeficiency <input type="checkbox"/> Do not know	<input type="checkbox"/> Inherited	<input type="checkbox"/> 2 Days to 2 weeks <input type="checkbox"/> Over a 1 month	<input type="checkbox"/> 2 Weeks to 1Month
<p>Can an infection with COVID-19 confer permanent immunity (once infected with COVID-19 you cannot contract another infection)?</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Do not know</p>			
<p>Can COVID-19 cause severe illness and lead to death in elderly, chronically ill (hypertension, diabetes, asthma . . .), and those who have compromised immune systems?</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Do not know</p>			
<p>Can COVID-19 cause infertility?</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Do not know</p>			
<p>Is COVID-19 teratogenic (i.e. cause malformations/abnormalities to an embryo/fetus)?</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Do not know</p>			
Treatment for COVID-19			
	Yes	No	Do Not Know
No treatment available			
Antibiotics			
Ibuprofen			
<p>Is there an available vaccine for COVID-19?</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Do not know</p>			

Table 3. Transmission Pathways			
	Yes	No	Do Not Know
Can COVID-19 be transmitted via respiratory droplets (coughing or sneezing) of infected individuals?			
Can COVID-19 be transmitted after shaking-hands with an infected individual?			
Can COVID-19 be transmitted after touching an infected individual's personal belongings?			
Can COVID-19 be transmitted from animals to humans?			
Can COVID-19 be transmitted via undercooked food?			

Can COVID-19 be transmitted via sexual contact?			
Can COVID-19 be transmitted via vertical transmission (mother to fetus)?			

Table 4. Signs and Symptoms of COVID-19

	True	False	Do Not Know
Is fever/temperature among the signs and symptoms of COVID-19?			
Is sneezing among the signs and symptoms of COVID-19?			
Is sore throat among the signs and symptoms of COVID-19?			
Is headache among the signs and symptoms of COVID-19?			
Is Chest pain among the signs and symptoms of COVID-19?			
Is body aches (generalized pain) among the signs and symptoms of COVID-19?			
Is fatigue among the signs and symptoms of COVID-19?			
Is diarrhea among the signs and symptoms of COVID-19?			
Is a runny nose among the signs and symptoms of COVID-19?			
Is dry cough among the signs and symptoms of COVID-19?			
Is productive cough among the signs and symptoms of COVID-19?			
Is bleeding among the signs and symptoms of COVID-19?			
Can a person be infected with COVID-19 and have no signs and symptoms?			

Table 5. Prevention Methods

	True	False	Do Not Know
Does wearing a face mask outside the home offer protection from Covid-19?			

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4	Does washing hands with soap and water offer protection from COVID-19?		
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7	Do avoiding crowded places offer protection from Covid-19?		
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9			
10	Does the flu vaccine offer protection from Covid-19?		
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12			
13	Does staying at home offer protection from Covid-19?		
14			
15			
16	Does using hand sanitizer offer protection from Covid-19?		
17			
18	Does using bleach to clean household surfaces prevent COVID-19 infection?		
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20			
21	Does cleaning surfaces with a mixture of Flash and bleach offer protection from Covid-19?		
22			
23			
24	Does the quarantine of symptomatic individuals protect others from Covid-19?		
25			
26			
27	Do cumin, anise, and mint offer protection from Covid-19?		
28			
29			
30			
31			
32	What is your main source of information about COVID-19? (You may choose more than one option)		
33	<input type="checkbox"/> Internet (social media platforms)		
34	<input type="checkbox"/> Internet (Official websites like world health organization)		
35	<input type="checkbox"/> TV/Radio		
36	<input type="checkbox"/> Friends/Member of family		
37	<input type="checkbox"/> Magazines/Books		
38	<input type="checkbox"/> Lectures		
39			
40			
41			
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43			
44	If you had new information about COVID-19 would you share it with friends and family to raise awareness?		
45			
46	<input type="checkbox"/> Yes <input type="checkbox"/> No		
47			

12

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A Crisis Within a Crisis: COVID-19 Knowledge and Awareness among the Syrian Population - a cross-sectional study

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4 1 **A Crisis Within a Crisis: COVID-19 Knowledge and Awareness among the**
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6 2 **Syrian Population - a cross-sectional study**
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12 4 **Authors: Fatema Mohsen¹, Batoul Bakkar¹, Humam Armashi¹, Nizar Daher^{2,3}**
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14 5
15
16

17 6 **Affiliations:**

18
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20
21 7 1Faculty of Medicine, Syrian Private University, Damascus, Syria.

22
23 8 2Professor in Infectious Diseases, Department of Internal Medicine, Faculty of Medicine,
24
25
26 9 Damascus University, Damascus, Syria.

27
28 10 3Professor in Infectious Diseases, Department of Internal Medicine, Faculty of Medicine,
29
30
31 11 Syrian Private University, Rif Dimashq, Syria.
32

33 12
34
35
36 13 **Corresponding Author:**

37
38 14 Fatema Mohsen

39
40
41
42 15 Faculty of Medicine, Syrian Private University, Mazzeh Street, P.O. Box 36822, Damascus,

43
44 16 Syrian Arab republic

45
46
47 17 Tel:00963936396590 Email: fatemamohsena@gmail.com
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54 19 **Abstract:**
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3 20 **Objectives:** To gauge specific knowledge around clinical features, transmission pathways, and
4
5 21 prevention methods, and to identify factors associated with poor knowledge to help facilitate
6
7 22 outbreak management in Syria during this rapid global rise of the COVID-19 pandemic.
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9

10 23 **Design:** Web-based cross-sectional survey.
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12

13 24 **Setting:** This study was conducted in March 2020, nearly 10 years into the Syrian war crisis.
14
15 25 The Arabic-language survey was posted on various social media platforms including
16
17 26 WhatsApp, Telegram, Instagram, and Facebook targeting various social groups.
18
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20
21 27 **Participants:** Of 4495 total participants who completed the survey, participants with no known
22
23 28 history of Covid-19 infection, residing outside Syria, and who did not fully complete the survey
24
25 29 were excluded. The final sample of 3586 participants (completion rate=79.8%) consisted of
26
27 30 2444(68.2%) females and 1142(31.8%) males.
28
29

30 31 **Primary and secondary outcome measures:** The First, knowledge of COVID-19 in 4 areas
31
32 32 (1. General knowledge 2. Transmission pathways 3. Signs and symptoms 4. Prevention
33
34 33 methods). The second, factors associated with poor knowledge.
35
36
37

38 34 **Results:** Of the 3586 participants, 2444(68.2%) were female, 1822(50.8%) were unemployed,
39
40 35 and 2839(79.2%) were college-educated. The study revealed good awareness regarding
41
42 36 COVID-19 (mean 75.6%, SD±9.4%). Multiple linear regression analysis correlated knowledge
43
44 37 scores with female gender ($\beta=-0.933$, $p=0.005$), education level ($\beta=-3.782$, $p<0.001$),
45
46 38 occupation ($\beta=-3.592$, $p<0.001$), economic status ($\beta=-0.669$, $p<0.040$), and the number of
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48 39 household members ($\beta=-1.737$, $p<0.001$).
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3 41 **Conclusion:** This study revealed some potentially troubling knowledge gaps which underscore
4
5 42 the need for a vigorous public education campaign. This campaign must reinforce the public's
6
7 43 awareness, knowledge, and vigilance towards precautionary measures against COVID-19, and
8
9 44 most importantly aid in controlling the worldwide spread of the disease.
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15 46 **Strengths and limitations of this study:**

16
17 47 . This study assesses COVID-19 knowledge and identifies poor knowledge factors
18
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20 48 . Data are derived from a large, national survey across Syria, during the lockdown period.
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23
24 49 . The survey covered socio-demographic information, general knowledge, transmission,
25
26 50 symptoms, and prevention.
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29 51 . Results have broad implications for public health programming and response to COVID-19
30
31 52 in Syria.
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35 53 . This web-based cross-sectional study cannot be generalized towards the Syrian population.
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41 55 **Keywords:** Awareness; Knowledge; COVID-19; Pandemic; Syria; War; Population.
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47 57 **Background:**

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51 58 Coronavirus disease 2019 (COVID-19) is a highly infectious respiratory disease that
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53 59 evolved into a worldwide pandemic threatening a prolonged economic recession. The first
54
55 60 incidence was reported at a local seafood market in Wuhan, China.¹ The virus continues to
56
57 61 spread resulting in growing morbidity and mortality cases, hitting the poorest and most
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3 62 vulnerable in the world. Many studies have assessed symptom clusters, transmission pathways,
4
5 63 and prevention methods; however, many aspects have yet to be proven.^{2,3} Sexual transmission,
6
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8 64 horizontal transmission, animal to human transmission, permanent immunity, and fetal
9
10 65 abnormalities as a result of maternal infection are unproven.

11
12 66 The battle against COVID-19 in Syria is still in its infancy. The first confirmed case
13
14 67 was announced on March 22,⁴ and there had only been 44 cases and 3 deaths to date. These
15
16 68 figures are significantly lower than neighbouring countries such as Turkey (127,659 and
17
18 69 3,461), Iran (98,647 and 6,277), Iraq (2,346 and 98), Lebanon (740 and 25), and Jordan (465
19
20 70 and 9).⁵ The Syrian healthcare system is severely under-equipped and lacks the capacity to
21
22 71 contain such a crisis. The estimated number of intensive care unit (ICU) beds with ventilators
23
24 72 is a mere 325, and the theoretical maximum number of cases that can be adequately treated is
25
26 73 only 6,500.⁶ Once this maximum threshold capacity is exceeded, drastic rationing decisions
27
28 74 will have to be made. Therefore, cooperation with and response to guidance from the WHO
29
30 75 are of utmost importance. Unprecedented measures have been adopted to control the spread of
31
32 76 COVID-19 in Syria.⁶ The public's adherence to these control measures- is largely affected by
33
34 77 their awareness, knowledge, and attitudes towards pandemics.^{7,8}

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38
39 78 The Syrian conflict, now in its 10th year, has resulted in the worst refugee crisis since
40
41 79 World War II.⁹ The devastating impact of war has placed the public health system under
42
43 80 constant strain; the numbers of casualties continue to rise, 70% of health care workers have
44
45 81 fled the country, the annihilation of healthcare facilities, and the "weaponization" of the
46
47 82 healthcare are ongoing challenges.^{6,10} These challenges along with dense residential areas, the
48
49 83 growing prevalence of chronic illness, and 83% of the population living under the poverty line
50
51 84 make Syria highly vulnerable to a severe outbreak.^{6,11}

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56 85 While some studies have been conducted to assess the knowledge, attitude, and
57
58 86 practices among populations during this pandemic, including one done in China, none have
59
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1
2
3 87 done so in Syria.¹²⁻¹⁹ To our knowledge this first study that aims to measure the awareness and
4
5 88 general knowledge of COVID-19 among the Syrian population at a time where ambiguity and
6
7 89 misinformation are rampant. The objective of this study is to gauge specific knowledge around
8
9 90 clinical features, transmission pathways, and prevention methods, and to identify factors
10
11 91 associated with poor knowledge to help facilitate outbreak management in Syria during this
12
13 92 rapid global rise of the COVID-19 pandemic. The information gleaned from this research will
14
15 93 help with public health programming and response to COVID-19 in Syria as the pandemic
16
17 94 continues to unfold.
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25 96 **Methods:**

26 27 28 97 **Study design, setting and, participants:**

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32 98 This web-based cross-sectional survey was conducted between March 31st and April
33
34 99 4th, during the lockdown period. Ethical approval was obtained from the Institutional Review
35
36 100 Board (IRB) of the Faculty of Medicine, Syrian Private University. All participants, who
37
38 101 completed the survey, and residing in Syria with no known history of COVID-19 infection
39
40 102 were included in the study. The authors designed questions that were modelled after existing
41
42 103 surveys.^{12 13} The survey was translated to Arabic and was reviewed by two dialectologists and
43
44 104 two infectious disease specialists, who evaluated whether the survey questions effectively
45
46 105 assessed COVID-19 knowledge, and checked for double-barrelled and confusing questions, to
47
48 106 ascertain the validity. We conducted a pilot study on 20 people to assess reliability clarity,
49
50 107 relevance, and the acceptability of the survey; these were excluded from the final sample to
51
52 108 avoid bias. Modifications were made based on feedback received to facilitate better
53
54 109 comprehension before distributing the final survey to the general population. The Arabic-
55
56 110 language survey was posted on various social media platforms including WhatsApp, Telegram,
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3 111 Instagram, and Facebook targeting various social groups. To avoid non-response bias the
4
5 112 survey was distributed during lockdown where the majority of the population were out of work
6
7
8 113 and at home, GIFs and posts were adapted to appeal to each social group, the questions were
9
10 114 made short and in the form of multiple choice questions that required no typing, and the ability
11
12 115 for viewers to comment on the link increased the popularity of the survey. Participants
13
14 116 confirmed their voluntary participation by answering a yes-no question, were informed of the
15
16 117 option to opt-out of the survey at any time, and were assured of the confidentiality and
17
18 118 anonymity of their responses. After confirmation, participants were directed to the first part of
19
20 119 the survey to complete questions about socio-demographic information including, age, gender,
21
22 120 residence, education level, occupation, and economic status. Participants under the age of 18
23
24 121 required informed parental consent, as well as submission of parent/guardian contact
25
26 122 information. The researchers were responsible for contacting the parents/guardians to obtain
27
28 123 consent before the child was given access to the survey. The sample size calculated was 2401
29
30 124 participants based on an error margin of 2%, and a confidence level of 95%, for a population
31
32 125 of 18284423 people using a sample size calculator (website:
33
34 126 <https://www.surveysystem.com/sscalc.htm>). The self-administered survey contained 40
35
36 127 questions divided into 4 sections: general knowledge (10 questions), transmission pathways (7
37
38 128 questions), clinical features (12 questions), and prevention methods (11 questions). The survey
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40 129 is available in appendix 1.
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48 **Patient and public involvement:**

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51 131 The public were not involved in the study design, conduct of the study, or plans to disseminate
52
53 132 the results to study participants.
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133 **Statistical analysis**

134 A scoring system was used to analyse the participants' knowledge: a score of "1" was
135 given for a correct answer and a score of "0" was given for an incorrect answer. The percentage
136 score for mean knowledge was calculated as follows: sum of scores obtained/maximum scores
137 that could be obtained \times 100. Participants' total mean knowledge in all the subsections, and
138 mean knowledge of each subsection were calculated. Data were analysed using the Statistical
139 Package for Social Sciences version 25.0 (SPSS Inc., Chicago, IL, United States) and reported
140 as frequencies and percentages (for categorical variables) or means and standard deviations
141 (SD) (for continuous variables). The t-test was applied to compare mean knowledge scores
142 against both genders, and 3 questions (knowing an infected individual, use of personal
143 belongings and dissemination of knowledge). The t-test was applied to compare mean
144 knowledge scores against age. One-way analysis of variance (ANOVA) was applied using f-
145 test to compare mean knowledge scores against socio-demographic variables (age, social
146 status, residence, education level, occupation, economic status, and number of household
147 members), and source of information. Multivariable linear regression analysis using the socio-
148 demographic variables as independent variables (categorical) and mean knowledge score as the
149 outcome variable (continuous) was conducted to identify factors associated with knowledge.
150 Factors were selected with a backward method and were analysed using unstandardized
151 coefficient (β), odds ratio (OR), and 95% confidence interval. P-values $<$ 0.05 were considered
152 statistically significant.

153

154 **Results:**

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3 155 **Socio-demographics characteristics:**
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6 156 Of 4495 total participants who completed the survey, participants with no known
7
8 157 history of Covid-19 infection, residing outside Syria, and who did not fully complete the survey
9
10 158 were excluded. The final sample of 3586 participants (completion rate= 79.8%) consisted of
11
12 159 2444(68.2%) females and 1142(31.8%) males. Participants aged >20 years were the majority
13
14 160 1204(33.6%) while participants between 35 and 39 were the minority 186(5.2). Participant ages
15
16 161 ranged from 12-78 years with a mean of 30 (± 10) years). 2279(63.6%) participants were single,
17
18 162 1822(50.8%) were unemployed, 1064(29.7%) were smokers, and 428(11.9%) were alcohol
19
20 163 consumers (Table 1). The majority of participants were residents of Damascus/ Rural
21
22 164 Damascus 2019(56.3%) and had attained college/university level education (Figure1).
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28 165 **General Knowledge regarding COVID-19:**
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31 166 Participants showed a good level of awareness regarding COVID-19 ($75.6 \pm 9.4\%$). An
32
33 167 adequate level of basic knowledge ($67.0 \pm 18.9\%$) was found among participants, 3383(94.3%)
34
35 168 knew that a virus was the causative agent of COVID-19; 2535(70.7%) correctly identified the
36
37 169 incubation period as being between 2 days and 2 weeks. Only 1500(41.8%) knew that an
38
39 170 infection with COVID-19 does not confer lifelong immunity. The majority of participants
40
41 171 3489(97.3%) were aware that COVID-19 infection in high-risk groups can be fatal. There is
42
43 172 currently insufficient evidence on whether infertility is a complication of COVID-19 infection;
44
45 173 461(12.9%) participants believed that COVID-19 can cause infertility while 1903(53.0%) did
46
47 174 not. 2986(83.3%), and 2597(72.4%) correctly answered that there are currently no available
48
49 175 vaccine or treatments; however, there were misconceptions about the efficacy of antibiotics
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51 176 and Ibuprofen as treatments, 1228(34.2%) and 1268(35.3%) respectively (Table 2).
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177 **Transmission and Signs and Symptoms regarding COVID-19:**

178 There was a fair level of awareness ($70.7 \pm 16.9\%$) regarding COVID-19 transmission
179 pathways. A high level of awareness was demonstrated regarding common transmission
180 pathways: 3521(98.2%), 3387(94.4%), and 3330(92.9%) identified respiratory droplets,
181 touching an infected person's personal belongings, and handshaking respectively. There is
182 currently limited evidence on animal-to-human and sexual transmission; 703(19.6%) did not
183 know if transmission occurs between animals and humans, while 899(25.1%) did not know if
184 the virus is transmitted sexually (Table 2).

185 The data showed a good level of awareness ($76.0 \pm 13.6\%$) regarding clinical features.
186 When asked about the main clinical features, participants correctly identified, fever
187 3563(99.4%), sore throat 3037(84.7%), headache 3186(88.8%), chest pain 3050(85.0%),
188 general pain 3019(84.2%), fatigue 3405(95.0%), and dry cough 3466(96.7%), whereas only
189 1972(55.0%) knew that diarrhea can be a symptom. Only 2221(61.9%) were aware that
190 infected individuals may be asymptomatic (Table 2).

191 **Prevention Methods regarding COVID-19:**

192 The highest level of awareness was in the prevention section ($88.8 \pm 10.2\%$). Washing
193 hands with soap, avoiding crowded areas, remaining at home, and wearing a face mask outside
194 are the principal preventative measures against COVID-19, 3574(99.7%), 3574(99.75%),
195 3554(99.1%), and 3204(89.3%), respectively. A minority 158(4.4%) believed that cleaning
196 with a mixture of Flash and bleach is a sound preventive measure. Only 2482(69.2%) knew
197 that the flu vaccine offers no protection against COVID-19 (Table 2).

198 **Statistical Analysis of the Data:**

199 A series of one way ANOVA analyses revealed that mean knowledge differed
200 significantly across: gender (p-value=0.009), age (p-value=0.003), social status (p-

201 value=0.042), education level (p-value<0.001<0.001), economic status (p-
202 value<0.001<0.001), number of household members (p-value<0.001<0.001), place of
203 residence (p-value<0.001), and source of information (p-value<0.001) (Table 3). Participants
204 living in Lattakia (77.6%) exhibited the greatest awareness, whereas those in Ar-Raqqah
205 (71.7%) followed by Deir-ez-Zor (71.8%) exhibited the lowest. The mean knowledge differed
206 across groups that acquired information from different sources, the lowest awareness was
207 among participants who chose family members/friends as one of their source(s) (74.0%),
208 whereas those with the highest awareness acquired their information from lectures as one of
209 their source(s) (78.2%) , (Table 3).

210 When participants were asked if they were likely to share new information with friends
211 and family, 3513(98.0%) answered “yes”. There was a significant difference in mean
212 knowledge between those who were inclined to disseminate new information about COVID-
213 19 to friends and family (75.7%) compared with those who were not (72.3%) (p-value=0.002).
214 On exclusive use of personal belongings, 2692(75.1%) answered “yes”. We found no
215 significant correlation between mean knowledge and participant tendency to share personal
216 belongings with others (p-value=0.112). Of participants who knew someone infected with
217 COVID-19, 65(1.8%) answered “yes”. There was no significant difference in mean knowledge
218 between those who knew an infected individual (75.9%) compared with those who did not
219 (75.6%) (p-value=0.816).

220 **Multiple linear regression:**

221 Multiple linear regression analysis results: male gender (vs. female, β =-0.933, p=0.005);
222 education of secondary school or lower (vs. college/university and above, β =-3.782, p<0.001);
223 careers in government, private, business, military, and “other” sectors, as well as
224 unemployment (vs. health care workers, β =-3.592, p<0.001); poor and moderate economic

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3 225 status (vs. good and excellent, $\beta=-0.669$, $p<0.040$); and over 5 household members (vs. of 1-
4
5 226 5, $\beta=-1.737$, $p<0.001$) were associated with significantly lower knowledge scores (Table 4).
6
7 227 Careers in health care (vs. Unemployed, $\beta=3.592$, $p\text{-value}=\leq 0.001$), and the 31-45 age
8
9 228 group (vs. 16-30, $\beta=1.511$, $p\text{-value}=0.005$) were associated with significantly higher
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12 229 knowledge scores.
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19 231 **Discussion:**

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22 232 During this time of Covid-19, the amount of ambiguity is larger than normal, we cannot
23
24 233 know for sure when there will be vaccines or treatments, neither provide sufficient evidence to
25
26 234 support Sexual transmission, horizontal transmission, animal to human transmission,
27
28 235 permanent immunity, and fetal abnormalities as a result of maternal infection. We found an
29
30 236 overall mean knowledge score of 75.6%, indicating that most participants were relatively
31
32 237 knowledgeable about COVID-19, though less so compared to their counterparts in China
33
34 238 (90%).¹² This level of knowledge was unexpected given that when we carried out the survey,
35
36 239 only 10 cases of COVID-19 had been confirmed in Syria.²⁰
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42 240 We found that poor knowledge was associated with males, non-post-secondary
43
44 241 education, non-healthcare occupations, unemployment, poor and moderate economic status,
45
46 242 and households exceeding 5 members. Similar trends were observed in China.¹² Correlating
47
48 243 socio-demographic variables with awareness is critical to public health efforts to mitigate the
49
50 244 spread of COVID-19. This data obtained can be leveraged by the Syrian Ministry of Health to
51
52 245 tailor prevention and educational campaigns to populations with the widest knowledge gaps.
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56 246 In the general knowledge section (67%), the majority of the participants 3383(94.3%)
57
58 247 knew that COVID-19 is caused by a virus, similar to a Pakistani study (93.3%).¹⁷ Low
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3 248 awareness of the 2 to 14 day incubation period was found,²¹ among dentists (36.1%), and health
4
5 249 care workers (HCW) (36.4%).^{13 19} Our study showed a higher level of awareness 2535(70.7%)
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8 250 among the population. Syria has a relatively young population; 2018 showed that only 4.5% of
9
10 251 the population was over 65.²² 3489(97.3%) knew that COVID-19 infection can be severe and
11
12 252 lead to death in elderly, chronically ill, and immunodeficient patients. This is higher than
13
14 253 studies conducted in China (73.2%), and India (88.37%).^{12 23} 40.6% of Syrians are
15
16 254 hypertensive, yet a staggering 79.8% of them are unaware of their condition. Diabetes is also
17
18 255 prevalent, affecting 11.9% of the population.^{24 25} Such a rampant lack of awareness about
19
20 256 chronic disease in the population can be fatal and underscores the need for targeted awareness
21
22 257 campaigns.

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27 258 Only 2597(72.4%) participants knew that there is currently no available treatment; this
28
29 259 is higher than a Kenyan study (40%) but significantly lower than a Chinese study (94%).^{12 15}
30
31 260 A minority 103(2.9%) participants thought there was a vaccine available against COVID-19;
32
33 261 by contrast, Coimbatore District (18.6%) and Pakistan (11.6%) were misinformed. In the
34
35 262 absence of a vaccine or effective treatment protocol for COVID-19, controlling the spread of
36
37 263 the disease is the best line of defence. We observed a considerable knowledge gap in
38
39 264 1268(35.3%) with regards to ibuprofen as a treatment option. There is no available evidence to
40
41 265 suggest that ibuprofen is effective against COVID-19.²⁶

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44
45 266 Participants showed a fair level of awareness regarding transmission pathways (70.7%),
46
47 267 very similar to a Pakistani study (70.8%).¹⁷ The majority 3521(98.2%) of participants were
48
49 268 aware that respiratory droplets are common transmission vectors this is similar to a Chinese
50
51 269 study (97.8%), but much higher than an Indian study (29.5%).^{12 16} WHO advice on physical
52
53 270 distancing include: using greetings that replace physical contact with a wave, nod, bow, peace
54
55 271 sign, sign language, friendly words or smiles.^{27 28} 3330(92.9%) participants identified
56
57 272 handshaking as a transmission pathway, higher than a study among dentists (85.6%).¹³
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2
3 273 A good level of awareness was found regarding the clinical features of COVID-19
4
5 274 (76.0%), similar to a Pakistani (77.7%).¹⁷ A very high level of awareness of the most common
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8 275 symptoms was found: fever 3563(99.4%), dry cough 3466(96.7%), fatigue 3405(95.0%), and
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10 276 myalgia 3019(84.2%), similar to findings from Chinese (96.4%) and Indian (95.4%) studies.¹²
11
12 277 ²³ When asked about sore throat, a higher level of awareness 3037(84.7%) was found compared
13
14 278 to studies from India (15.2%) and among dentists (28.5%).^{13 16} Knowledge about diarrhea as a
15
16 279 symptom was lacking: only 1972(55.0%); a study among dentists also showed low awareness
17
18 280 (39.9%).^{13 16} While infected individuals are frequently asymptomatic, or present with mild
19
20 281 symptoms, around 1 in every 5 infections can be serious enough to require hospitalisation.^{29 30}
21
22 282 Only 2221(61.9%) participants were aware that infected individuals can be asymptomatic,
23
24 283 while a study among dentists (34.5%) reported much lower awareness. “Silent spreaders” may
25
26 284 significantly contribute to the transmission of COVID-19, and so increasing public awareness
27
28 285 of this particular point is crucial
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33 286 We found a high level of awareness in the preventive methods section (88.8%), similar
34
35 287 to a study in Pakistan (85%).¹⁷ Hand hygiene is considered an important element of infection
36
37 288 control dating back to the revolutionary work of Ignaz Semmelweis.³¹ Implementing hand-
38
39 289 washing techniques can break the transmission cycle and reduce the risk of infection by 6%-
40
41 290 44%.³² Almost all 3574(99.7%) participants were aware that washing hands with soap and
42
43 291 water is an important preventive measure against COVID-19. This finding is in accordance
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45 292 with India (97.0%), and other studies (96.2%, and 87%).^{13 16 19}
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49 293 This year the WHO recommended that the following mitigation measures be
50
51 294 implemented during the holy month of Ramadan: cancelling social and religious gatherings,
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53 295 holding events outdoors for adequate ventilation, physical distancing of at least 1 meter
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55 296 between people, and the use of technology to broadcast ceremonies on television.^{27 28} The
56
57 297 majority 3574(99.7%) identified avoiding mass gatherings as a preventive measure; studies in
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3 298 China (98.6%) and Coimbatore District (97.7%) reported similar awareness.^{12 23} Cheap and
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5 299 efficient interventions such as N95 (filtration capacity=95%) have a 91% effectiveness of
6
7 300 blocking pathogen transmission.³³ 3204(89.3%) participants considered wearing a face mask
8
9 301 when leaving home as an effective prevention method, compared with a Coimbatore District
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11 302 study (93.02%).²³

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13
14 303 Since Syrian society is particularly vulnerable to COVID-19, this knowledge gap is
15
16 304 potentially dangerous and should be addressed to mitigate disease spread. Only 2482(69.2%)
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18 305 knew that the flu vaccine offers no protection against COVID-19; this is similar to a
19
20 306 Coimbatore District study (67.4%), but lower than a study amongst HCWs (90.7%).^{19 23} Mixing
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22 307 flash with bleach is highly toxic and caustic to the respiratory tract. Only a minority of
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24 308 participants 158(4.4%) believed that this method of cleaning is a sound preventive measure.
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26 309 3305(92.2%) were aware that individuals showing symptoms should quarantine themselves,
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28 310 lower than in China (98.2%) and India (95.8%).^{12 16}

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31 311 North-East Syria (NES) has a population of over 4 million people, 600,000 of whom
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33 312 are internally displaced refugees, 100,000 of whom live in overcrowded camps: only 2 of
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35 313 NES's 11 hospitals are currently functioning. NES consists of 3 governorates: Ar-Raqqah,
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37 314 Deir-ez-Zor, and Al-Hasakah. With only 22 ICU beds, (18 in Al-Hasakah, 4 in Ar-Raqqah, and
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39 315 none in Deir-ez-Zor), the maximum capacity threshold is only 80 COVID-19 cases. Ar-Raqqah
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41 316 and Deir-ez-Zor, the most vulnerable governorates, also showed the lowest awareness in the
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43 317 study (71.7%), and (71.8%). This is a potentially catastrophic situation, and a concern to the
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45 318 international community, as an unmonitored, uncontrolled outbreak in NES can prolong the
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47 319 global pandemic.

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57 321 **Limitations:**

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3 322 Our findings can only be generalized about online users of well-educated Syrians of
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5 323 good socio-economic status. Syrians vulnerable to COVID-19, such as the elderly and rural
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7 324 residents, are more likely to exhibit poor knowledge and awareness due to limited internet
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9 325 access. As such, reaching out to these populations must be prioritized. Even though all Syrian
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11 326 governorates were represented in this study, most participants lived in Damascus and Rural
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13 327 Damascus. Furthermore, an assessment of attitudes and practice towards COVID-19 is needed.
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20 329 **Conclusion:**
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24 330 COVID-19 has been a dire warning to humanity about the fragility of its social,
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26 331 economic, and healthcare institutions. Our study revealed good public awareness of clinical
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28 332 features and preventive measures. However general knowledge and knowledge about
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30 333 transmission pathways was suboptimal. Syrians of good socio-economic status, in particular
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32 334 young well-educated women, have shown good knowledge. Our national response must adapt
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34 335 to the growing threat of COVID-19 by adopting public awareness strategies and behaviours to
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36 336 contain the disease both within and beyond our borders.
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43 338 **Abbreviations:** COVID-19: Coronavirus Disease 2019; MERS: Middle East Respiratory
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45 339 Syndrome; SARS: Severe Acute Respiratory Syndrome; WHO: World Health Organization;
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47 340 PHEIC: Public Health Emergency of International Concern; ICU: Intensive care unit; IRB:
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49 341 Institutional Review Board; SPSS: Statistical Package for Social Sciences; SD: Standard
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51 342 Deviation; HCW: Health Care Worker.
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60 344 **Acknowledgments:**

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4
5 346 the field of medical training and research. We are thankful to everyone who participated in this
6
7
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9

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13
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15
16
17 350 This research received no specific grant from SPU or any other funding agency in the
18
19 351 public, commercial or non-profit sectors.
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25 353 **Availability of data and materials:**

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28 354 All data related to this paper's conclusion are available and stored by the authors. All
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30 355 data are available from the corresponding author on a reasonable request.
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36 357 **Declarations:**

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38 358 **Ethics approval and consent to participate:**

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40 359 This study was approved by the Institutional Review Board (IRB) at the Syrian Private
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42 360 University (SPU). All Participants confirmed their written consent by answering a yes-no
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44 361 question. Participants under the age of 18 required verbal informed parental consent, as well as
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46 362 submission of parent/guardian contact information. The researchers were responsible for
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48 363 contacting the parents/guardians to obtain verbal consent before the child was given access to
49
50 364 the survey. The verbal and written form of consent was approved by the IRB at SPU.
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52 365 Participation in the study was voluntary and participants were assured that anyone who was
53
54 366 not inclined to participate or decided to withdraw after giving consent would not be victimized.
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56 367 All information collected from this study was kept strictly confidential.
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368 **Consent for Publication:**

369 Not applicable.

370 **Competing interests:**

371 The authors declare that they have no competing interests.

372 **Authors' contributions:**

373 FM conceptualized the study, participated in the design, wrote the study protocol,
 374 performed the statistical analysis, did a literature search, and drafted the manuscript. BB
 375 participated in study design, did a literature search, and drafted the manuscript. HA, and ND
 376 did a literature search, and revision of the draft. All authors read and approved the final draft.

378 **Tables and Figures:**379 **Table 1.**380 **Table 1. Socio-demographic characteristics: (n=3586)**

Gender (%)	Male	1142(31.8)	Education (%)	Primary School	25(0.7)
	Female	2444(68.2)		Intermediate School	166(4.6)
Age (%)	<20	1204(33.6)		Secondary school	375(10.4)
	20-24	1104(30.8)		College/University	2839(79.2)
	25-29	446(12.4)		Master's degree	157(4.4)
	30-34	266(7.4)		PhD	24(0.7)

	35-39	186(5.2)	Occupation (%)	Health care worker	634(17.7)
	>39	380(10.6)		Government institution	283(7.9)
Social Status (%)	Single	2279(63.5)	Household members (%)	Private institution	182(5.1)
	In a relationship	286(8.0)		Business	198(5.5)
	Married	943(26.3)		Military	32(0.9)
	Divorced	46(1.3)		Unemployed	1822(50.8)
	Widowed	32(0.9)		Other	435(12.1)
Economic Status (%)	Poor	247(6.9)	0	46(1.3)	
	Moderate	1247(34.8)	1-5	2751(76.7)	
	Good	1761(49.1)	>5	789(22)	
	Excellent	331(9.2)			

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3 382 ¹Poor: income does not provide essential needs for the family. ²Moderate: income provides essential
4 383 needs for the family but no more. ³Good: income provides essential needs and some luxury
5 384 requirements. ⁴Excellent: income provides luxury requirements.
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11 386 **Table 2.**
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17 **Table 2. General Knowledge, Transmission, Signs and Symptoms, and Prevention of COVID-19:**
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19 **(n=3586)**
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General Knowledge					
Causative Agent N(%)	Virus	3383(94.3)	Incubation period N(%)	1 Minute to 1 Hour	18(0.5)
	Bacteria	39(1.1)		1 Hour to 2 Days	58(1.6)
	Parasite	8(0.2)		2 Days to 2 Weeks	2535(70.7)
	Immune deficiency	46(1.3)		2 Weeks to 1 Month	958(26.7)
	Fungus	0(0.0)		>1 Month	17(0.5)
	Inherited	2(0.1)			
	Do Not Know	108(3.0)			
YES(%)		NO(%)	DO NOT KNOW(%)		

1 2 3 4 5 6 7 8	Can infection with COVID-19 confer permanent immunity?	815(22.7)	1500(41.8)	1271(35.5)
9 10 11 12 13 14 15 16 17	Can COVID-19 cause severe illness and lead to death in elderly, chronically ill, and immunodeficient patients?	3489(97.3)	28(0.8)	69(1.9)
18 19 20	Can COVID-19 cause infertility?	461(12.9)	1222(34.1)	1903(53.0)
21 22 23 24 25 26 27 28 29	Is COVID-19 teratogenic (i.e. cause malformations/ abnormalities to an embryo/fetus)?	157(4.4)	1433(40.0)	1996(55.6)
30 31 32 33 34	Is there no available treatment against COVID-19?	2597(72.4)	515(14.4)	474(13.2)
35 36 37 38 39	Can COVID-19 be treated with antibiotics?	1228(34.3)	1790(49.9)	568(15.8)
40 41 42 43 44	Can COVID-19 be treated with Ibuprofen?	1268(35.3)	1921(53.6)	397(11.1)
45 46 47 48 49	Are there available COVID-19 vaccines?	103(2.9)	2986(83.3)	497(13.8)
50	Transmission Pathways			
51 52 53 54 55 56 57 58 59 60	Respiratory droplets (from coughing or sneezing)	3521(98.2)	21(0.6)	44(1.2)

Handshaking	3330(92.9)	189(5.3)	67(1.8)
Touching an infected person's personal belongings	3387(94.4)	131(3.7)	68(1.9)
Animals-to-human	910(25.4)	1973(55.0)	703(19.6)
Undercooked food	1301(36.3)	1734(48.3)	551(15.4)
Sexual contact	1210(33.7)	1477(41.2)	899(25.1)
Horizontal transmission	1130(31.5)	1160(32.4)	1296(36.1)
Signs and Symptoms			
Fever	3563(99.4)	9(0.2)	14(0.4)
Sneezing	2353(65.6)	1000(27.9)	233(6.5)
Sore throat	3037(84.7)	358(10.0)	191(5.3)
Headache	3186(88.8)	190(5.3)	210(5.9)
Chest pain	3050(85.0)	254(7.1)	282(7.9)
Body aches (generalized pain)	3019(84.2)	260(7.2)	307(8.6)
Fatigue	3405(95.0)	72(2.0)	109(3.0)
Diarrhea	1972(55.0)	971(27.1)	643(17.9)
Dry cough	3466(96.7)	44(1.2)	76(2.1)
Productive cough	458(12.8)	2586(72.1)	542(15.1)
Bleeding	130(3.6)	2613(72.9)	843(23.5)

Asymptomatic	2221(61.9)	375(10.5)	990(27.6)
Prevention Methods			
Does wearing a face mask outside the home offer protection from COVID-19?	3204(89.3)	314(8.8)	68(1.9)
Does washing hands with soap and water offer protection from COVID-19?	3574(99.7)	5(0.1)	7(0.2)
Does avoiding crowded places offer protection from COVID-19?	3574(99.7)	4(0.1)	8(0.2)
Does the flu vaccine offer protection from COVID-19?	331(9.2)	2482(69.2)	773(21.6)
Does staying at home offer protection from COVID-19?	3554(99.1)	15(0.4)	17(0.5)
Does using hand sanitizer offer protection from COVID-19?	3430(95.6)	104(2.9)	52(1.5)
Does cleaning house items with bleach offer protection from COVID-19?	3408(95.0)	110(3.1)	68(1.9)
Does cleaning fruits and vegetables with soap and water offer protection from COVID-19?	3262(90.9)	221(6.2)	103(2.9)

Does cleaning surfaces with a mixture of Flash and bleach offer a safe protection from COVID-19?	158(4.4)	3301(92.1)	127(3.5)
Does the quarantine of symptomatic individuals protect others from COVID-19?	3305(92.2)	241(6.7)	40(1.1)
Do cumin, anise, and mint offer protection from COVID-19?	1041(29.0)	1934(53.9)	611(17.1)

389 **Table 3.**

Table 3. Mean knowledge score of participants by demographic variables, and source of information (one way ANOVA), (n= 3586)

Characteristics		Number of participants (%)	Mean Knowledge Score (\pm SD%)	F-test/ T-test	P-value
Gender	Male	1142(31.8)	75.0(\pm 10.1)	-2.625	0.009*
	Female	2444(68.2)	75.9(\pm 9)		
Age-group	<20	1204(33.6)	75.0(\pm 9.9)	2.990	0.011*

(years)	20-24	1104(30.8)	76.4(±9.3)		
	25-29	446(12.4)	76.0(±9.4)		
	30-34	266(7.4)	75.4(±9.4)		
	35-39	186(5.2)	76.1(±7.6)		
	>39	380(10.6)	75.1(±8.6)		
	Social status	Single	2279(63.5)	75.8(±9.3)	2.485
In a relationship		286(8.0)	76.6(±8.6)		
Married		943(26.3)	75.1(±9.4)		
Divorced		46(1.3)	73.9(±8.8)		
Widowed		32(0.9)	73.4(±15.9)		
Residence	Urban	2426(67.7)	75.8(±9.3)	1.652	0.099

	Rural	1160(32.3)	75.3(±9.6)		
Education	Primary school	25(0.7)	66.5(±12.4)	26.176	<0.001*
	Intermediate school	166(4.6)	73.2(±9.3)		
	Secondary school	375(10.4)	70.0(±13)		
	College/University	2839(79.2)	76.3(±8.9)		
	Master's degree	157(4.4)	77.2(±9.7)		
	PhD	24(0.7)	76.6(±8.5)		
Occupation	Health care worker	634(17.7)	78.6(±8.6)	16.379	<0.001*
	Government institution	283(7.9)	75.7(±7.9)		

	Private institution	182(5.1)	75.5(±9)		
	Business	198(5.5)	73.4(±10.2)		
	Military	32(0.9)	71.2(±15.6)		
	Unemployed	1822(50.8)	75.3(±9.2)		
	Other	435(12.1)	74.0(±10.2)		
Economic status	Excellent	331(9.2)	76.6(±11.1)	7.108	<0.001*
	Good	1761(49.1)	76.2(±9.4)		
	Moderate	1247(34.8)	74.9(±9)		

	Poor	247(6.9)	74.3(±9.3)		
Household members	0	46(1.3)	74.4(±10.6)	15.451	<0.001*
	1-5	2751(76.7)	76.1(±9)		
	>5	789(22.0)	74.0(±10.2)		
Source of information	Health websites	2823(78.7%)	76.4(±8.7)	24.523	<0.001*
	Social media	1998(55.7%)	74.6(±9.6)		
	Television/ radio	1572(43.8%)	75.5(±9)		
	Family members/ friends	528(14.7%)	74.0(±10.3)		
	Lectures	517(14.4%)	78.2(±7.5)		
	Magazines/ books	266(7.4%)	77.6(±8.8)		

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391 **Table 4.**

Table 4. Multiple linear regression on variables associated with poor COVID-19 knowledge

Variable	Coefficient	Standard error	t	P
Male gender (reference: female)	-0.933	0.334	-2.794	0.005*
education of secondary school or lower (reference: college/university and above)	-3.782	0.466	-8.125	<0.001*
careers in government, private, business, military, and “other” sectors, as well as unemployment (reference: health care workers)	-3.592	0.474	-7.579	<0.001*
poor and moderate economic status (reference: good and excellent)	-0.669	0.325	-2.057	0.040*
>5 household members (reference: of 1-5)	-1.737	0.374	-4.648	<0.001*

392

393 **Figures and tables legends:**

394 **Table 1.** Sociodemographic characteristics

395 **Table 2.** General Knowledge, Transmission, Signs and Symptoms, and Prevention around
396 COVID-19 **Table 3.** Mean knowledge score of participants by demographic variables

397 **Table 4.** Multiple linear regression on variables associated with poor COVID-19 knowledge

398 **Figure 1.** Distribution of participants according to governorates and education level

399

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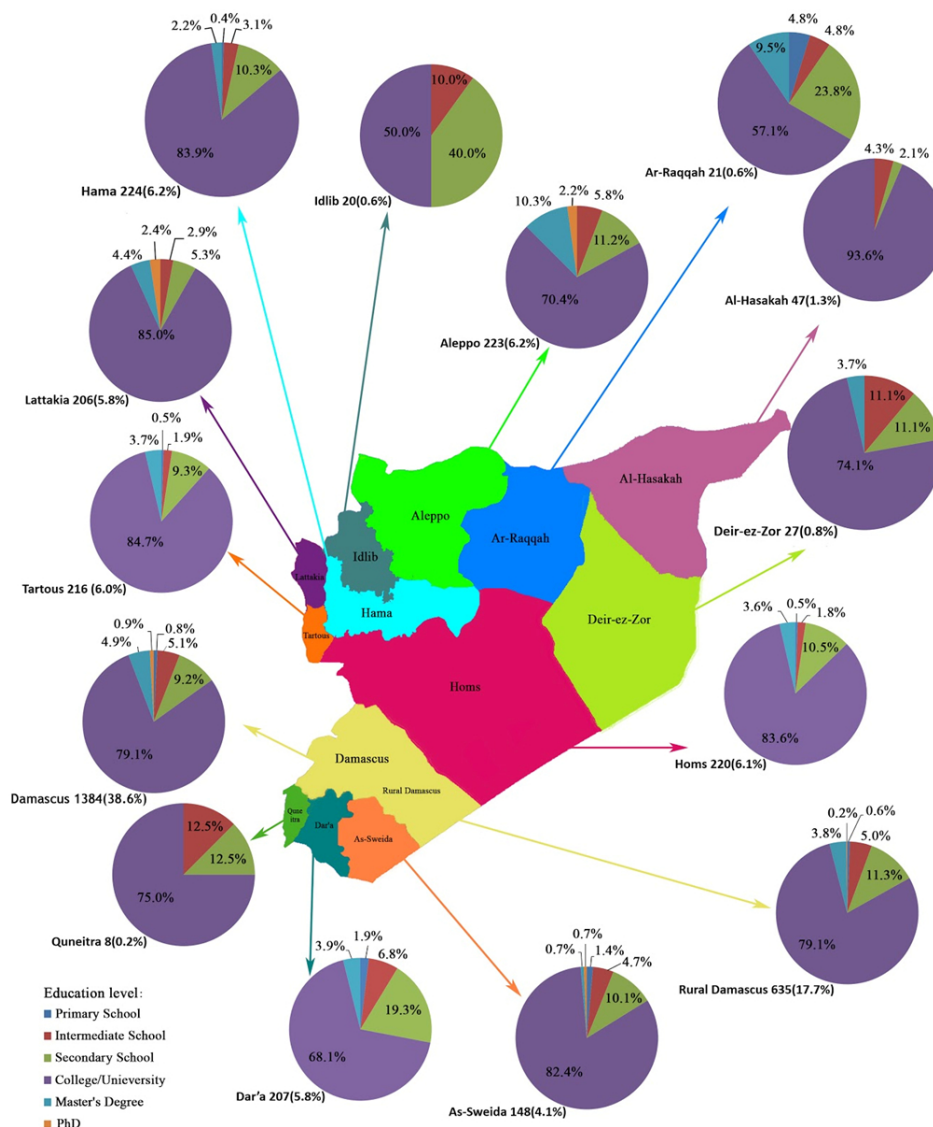


Figure 1. Distribution of participants according to governorates and education level

Attached Survey:

Appendix 1

Socio-demographic Characteristics	
Age (years): <input type="checkbox"/> Below 15 <input type="checkbox"/> 15-20 <input type="checkbox"/> 20-30 <input type="checkbox"/> 30-50 <input type="checkbox"/> 40-50 <input type="checkbox"/> 50-60 <input type="checkbox"/> 60-70 <input type="checkbox"/> Above 70	Gender: <input type="checkbox"/> Male <input type="checkbox"/> Female
Marital status: <input type="checkbox"/> Single <input type="checkbox"/> Relationship <input type="checkbox"/> Married <input type="checkbox"/> Divorced <input type="checkbox"/> Widowed	Educational level: <input type="checkbox"/> Primary school <input type="checkbox"/> Intermediate school <input type="checkbox"/> Secondary school <input type="checkbox"/> University/College <input type="checkbox"/> Master's Degree <input type="checkbox"/> PHD Degree
Occupation: <input type="checkbox"/> Health care worker <input type="checkbox"/> Government institution <input type="checkbox"/> Private institution <input type="checkbox"/> Business <input type="checkbox"/> Military <input type="checkbox"/> Unemployed <input type="checkbox"/> Other	Residence: <input type="checkbox"/> Damascus/Rural Damascus <input type="checkbox"/> Hama <input type="checkbox"/> Aleppo <input type="checkbox"/> Homs <input type="checkbox"/> Tartous <input type="checkbox"/> Lattakia <input type="checkbox"/> Dar'a <input type="checkbox"/> As-Sweida <input type="checkbox"/> Al Hasakah <input type="checkbox"/> Deir-ez-Zor <input type="checkbox"/> Idlib <input type="checkbox"/> Ar-Raqqah <input type="checkbox"/> Quneitra
Area: <input type="checkbox"/> Rural <input type="checkbox"/> Urban	Economic Status: <input type="checkbox"/> Excellent <input type="checkbox"/> Good <input type="checkbox"/> Moderate <input type="checkbox"/> Poor
Do you smoke? <input type="checkbox"/> Yes <input type="checkbox"/> No	Do you drink alcohol? <input type="checkbox"/> Yes <input type="checkbox"/> No
How many people do you live with? <input type="checkbox"/> Alone <input type="checkbox"/> 1-5 <input type="checkbox"/> 6-10 <input type="checkbox"/> 11-15 <input type="checkbox"/> 16-20 <input type="checkbox"/> Above 20	
Do you share toiletries/personal care products with others? <input type="checkbox"/> Yes <input type="checkbox"/> No	
Do you know anyone infected with COVID-19? <input type="checkbox"/> Yes <input type="checkbox"/> No	

Table 2. General Knowledge about COVID-19

What is COVID-19?				Do you know how long after being infected with COVID-19 can a person suffer from signs and symptoms?					
<input type="checkbox"/> Virus		<input type="checkbox"/> Bacteria		<input type="checkbox"/> 1 Minute to 1 Hour		<input type="checkbox"/> 1 Hour to 2 Days			
<input type="checkbox"/> Parasite		<input type="checkbox"/> Fungus		<input type="checkbox"/> 2 Days to 2 weeks		<input type="checkbox"/> 2 Weeks to 1Month			
<input type="checkbox"/> Immunodeficiency		<input type="checkbox"/> Inherited		<input type="checkbox"/> Over a 1 month					
<input type="checkbox"/> Do not know									
Can an infection with COVID-19 confer permanent immunity (once infected with COVID-19 you cannot contract another infection)?									
<input type="checkbox"/> Yes		<input type="checkbox"/> No		<input type="checkbox"/> Do not know					
Can COVID-19 cause severe illness and lead to death in elderly, chronically ill (hypertension, diabetes, asthma . . .), and those who have compromised immune systems?									
<input type="checkbox"/> Yes		<input type="checkbox"/> No		<input type="checkbox"/> Do not know					
Can COVID-19 cause infertility?									
<input type="checkbox"/> Yes		<input type="checkbox"/> No		<input type="checkbox"/> Do not know					
Is COVID-19 teratogenic (i.e. cause malformations/abnormalities to an embryo/fetus)?									
<input type="checkbox"/> Yes		<input type="checkbox"/> No		<input type="checkbox"/> Do not know					
Treatment for COVID-19									
				Yes		No		Do Not Know	
No treatment available									
Antibiotics									
Ibuprofen									
Is there an available vaccine for COVID-19?									
<input type="checkbox"/> Yes		<input type="checkbox"/> No		<input type="checkbox"/> Do not know					

Table 3. Transmission Pathways

	Yes	No	Do Not Know
Can COVID-19 be transmitted via respiratory droplets (coughing or sneezing) of infected individuals?			
Can COVID-19 be transmitted after shaking-hands with an infected individual?			
Can COVID-19 be transmitted after touching an infected individual's personal belongings?			
Can COVID-19 be transmitted from animals to humans?			
Can COVID-19 be transmitted via undercooked food?			
Can COVID-19 be transmitted via sexual contact?			
Can COVID-19 be transmitted via vertical transmission (mother to fetus)?			

Table 4. Signs and Symptoms of COVID-19

	True	False	Do Not Know
Is fever/temperature among the signs and symptoms of COVID-19?			
Is sneezing among the signs and symptoms of COVID-19?			
Is sore throat among the signs and symptoms of COVID-19?			
Is headache among the signs and symptoms of COVID-19?			
Is Chest pain among the signs and symptoms of COVID-19?			
Is body aches (generalized pain) among the signs and symptoms of COVID-19?			
Is fatigue among the signs and symptoms of COVID-19?			
Is diarrhea among the signs and symptoms of COVID-19?			
Is a runny nose among the signs and symptoms of COVID-19?			
Is dry cough among the signs and symptoms of COVID-19?			
Is productive cough among the signs and symptoms of COVID-19?			
Is bleeding among the signs and symptoms of COVID-19?			
Can a person be infected with COVID-19 and have no signs and symptoms?			

Table 5. Prevention Methods

	True	False	Do Not Know
Does wearing a face mask outside the home offer protection from Covid-19?			
Does washing hands with soap and water offer protection from COVID-19?			
Do avoiding crowded places offer protection from Covid-19?			
Does the flu vaccine offer protection from Covid-19?			
Does staying at home offer protection from Covid-19?			
Does using hand sanitizer offer protection from Covid-19?			
Does using bleach to clean household surfaces prevent COVID-19 infection?			
Does cleaning surfaces with a mixture of Flash and bleach offer protection from Covid-19?			
Does the quarantine of symptomatic individuals protect others from Covid-19?			
Do cumin, anise, and mint offer protection from Covid-19?			
What is your main source of information about COVID-19? (You may choose more than one option) <input type="checkbox"/> Internet (social media platforms) <input type="checkbox"/> Internet (Official websites like world health organization) <input type="checkbox"/> TV/Radio <input type="checkbox"/> Friends/Member of family <input type="checkbox"/> Magazines/Books <input type="checkbox"/> Lectures			
If you had new information about COVID-19 would you share it with friends and family to raise awareness? <input type="checkbox"/> Yes <input type="checkbox"/> No			

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	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2,3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5,6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	6,7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6,7
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	6,7
		<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	
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed	Not applicable
		<i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	-
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	Not applicable
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	8
		(b) Describe any methods used to examine subgroups and interactions	8
		(c) Explain how missing data were addressed	Not applicable (no missing data)
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up	8

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was addressed

Case-control study—If applicable, explain how matching of cases and controls was addressed

Cross-sectional study—If applicable, describe analytical methods taking account of sampling strategy

€ Describe any sensitivity analyses

-

Continued on next page

For peer review only

Results			Page No.
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	9
		(b) Give reasons for non-participation at each stage	-
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9
		(b) Indicate number of participants with missing data for each variable of interest	Not applicable
		© <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	Not applicable
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	-
		<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	29-35
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	34,35
		(b) Report category boundaries when continuous variables were categorized	29-33
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not applicable
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	13-15
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	16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	17
Generalisability	21	Discuss the generalisability (external validity) of the study results	16
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	17

*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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A Crisis Within a Crisis: COVID-19 Knowledge and Awareness among the Syrian Population - a cross-sectional study

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4 1 **A Crisis Within a Crisis: COVID-19 Knowledge and Awareness among the**
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6 2 **Syrian Population - a cross-sectional study**
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12 4 **Authors: Fatema Mohsen¹, Batoul Bakkar¹, Humam Armashi¹, Nizar Aldaher^{2,3}**
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14 5
15
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17 6 **Affiliations:**

18
19
20
21 7 1Faculty of Medicine, Syrian Private University, Damascus, Syria.
22

23 8 2Professor in Infectious Diseases, Department of Internal Medicine, Faculty of Medicine,
24
25
26 9 Damascus University, Damascus, Syria.
27

28 10 3Professor in Infectious Diseases, Department of Internal Medicine, Faculty of Medicine,
29
30
31 11 Syrian Private University, Rif Dimashq, Syria.
32

33 12
34
35
36 13 **Corresponding Author:**

37 14 Fatema Mohsen

38
39
40
41
42 15 Faculty of Medicine, Syrian Private University, Mazzeh Street, P.O. Box 36822, Damascus,
43

44 16 Syrian Arab republic
45

46
47 17 Tel:00963936396590 Email: fatemamohsena@gmail.com
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53 19 **Abstract:**
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3 20 **Objectives:** To gauge specific knowledge around clinical features, transmission pathways, and
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5 21 prevention methods, and to identify factors associated with poor knowledge to help facilitate
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7 22 outbreak management in Syria during this rapid global rise of the COVID-19 pandemic.
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10 23 **Design:** Web-based cross-sectional survey.
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13 24 **Setting:** This study was conducted in March 2020, nearly 10 years into the Syrian war crisis.
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15 25 The Arabic-language survey was posted on various social media platforms including
16
17 26 WhatsApp, Telegram, Instagram, and Facebook targeting various social groups.
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21 27 **Participants:** A total of 4495 participants completed the survey. Participants with a history of
22
23 28 COVID-19 infection, residing outside Syria, or who did not fully complete the survey were
24
25 29 excluded from the study. The final sample of 3586 participants (completion rate=79.8%)
26
27 30 consisted of 2444(68.2%) females and 1142(31.8%) males.
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30 31 **Primary and secondary outcome measures:** The first, knowledge of COVID-19 in 4 areas
31
32 32 (1. general knowledge 2. transmission pathways 3. signs and symptoms 4. prevention
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34 33 methods). The second, factors associated with poor knowledge.
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37
38 34 **Results:** Of the 3586 participants, 2444(68.2%) were female, 1822(50.8%) were unemployed,
39
40 35 and 2839(79.2%) were college-educated. The study revealed good awareness regarding
41
42 36 COVID-19 (mean 75.6%, SD±9.4%). Multiple linear regression analysis correlated poor mean
43
44 37 knowledge scores with male gender ($\beta=-0.933$, $p=0.005$), secondary school or lower education
45
46 38 level ($\beta=-3.782$, $p<0.001$), non-healthcare occupation ($\beta=-3.592$, $p<0.001$), low economic
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48 39 status ($\beta=-0.669$, $p<0.040$), and >5 household members ($\beta=-1.737$, $p<0.001$).
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4 41 **Conclusion:** This study revealed some potentially troubling knowledge gaps which underscore
5
6 42 the need for a vigorous public education campaign. This campaign must reinforce the public's
7
8 43 awareness, knowledge, and vigilance towards precautionary measures against COVID-19, and
9
10 44 most importantly aid in controlling the worldwide spread of the disease.
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15 46 **Strengths and limitations of this study:**

16
17 47 . Data are derived from a large, national survey across Syria, during the lockdown period.
18

19
20 48 . The survey covered socio-demographic information, general knowledge, transmission,
21
22 49 symptoms, and prevention.
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26 50 . Results have broad implications for public health programming and response to COVID-19
27
28 51 in Syria.
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32 52 . This web-based cross-sectional study cannot be generalized towards the Syrian population.
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37 54 **Keywords:** Awareness; Knowledge; COVID-19; Pandemic; Syria; War; Population.
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44 56 **Background:**

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48 57 Coronavirus disease 2019 (COVID-19) is a highly infectious respiratory disease that
49
50 58 evolved into a worldwide pandemic threatening a prolonged economic recession. The first
51
52 59 incidence was reported at a local seafood market in Wuhan, China.¹ The virus continues to
53
54 60 spread, with steadily increasing morbidity and mortality cases, hitting the poorest and most
55
56 61 vulnerable in the world. Many studies have assessed symptom clusters, transmission pathways,
57
58
59 62 and prevention methods; however, many aspects have yet to be studied.^{2 3} Sexual

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3 63 transmissions, horizontal transmission, animal to human transmission, permanent immunity,
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5 64 and fetal abnormalities as a result of maternal infection are as yet unproven.
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7

8 65 The battle against COVID-19 in Syria has just entered its third wave. The first
9
10 66 confirmed case was announced on 22 March 2020,⁴ and there had only been 44 cases and 3
11
12 67 deaths at the time of the study. These figures are significantly lower than neighbouring
13
14 68 countries such as Turkey (127,659 and 3,461), Iran (98,647 and 6,277), Iraq (2,346 and 98),
15
16 69 Lebanon (740 and 25), and Jordan (465 and 9).⁵ The Syrian healthcare system is severely
17
18 70 under-equipped and lacks the capacity to contain such a crisis. The estimated number of
19
20 71 intensive care unit (ICU) beds with ventilators is a mere 325, and the theoretical maximum
21
22 72 number of cases that can be adequately treated is only 6,500.⁶ Once this maximum threshold
23
24 73 capacity is exceeded, drastic rationing decisions will have to be made. Therefore, cooperation
25
26 74 with and response to guidance from the WHO are of utmost importance. Unprecedented
27
28 75 measures have been adopted to control the spread of COVID-19 in Syria.⁶ The public's
29
30 76 adherence to these control measures is largely affected by their awareness, knowledge, and
31
32 77 attitudes towards disease and outbreaks.^{7 8}
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37 78 The Syrian conflict, now in its 10th year, has resulted in the worst refugee crisis since
38
39 79 World War II.⁹ The devastating impact of war has placed the public health system under
40
41 80 constant strain; the numbers of casualties continue to rise, 70% of health care workers (HCW)
42
43 81 have fled the country, the annihilation of healthcare facilities, and the “weaponization” of
44
45 82 healthcare are ongoing challenges.^{6 10} These challenges along with dense residential areas, the
46
47 83 growing prevalence of chronic illness, and 83% of the population living under the poverty line
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49 84 make Syria highly vulnerable to a severe outbreak.^{6 11}
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54 85 While some studies have been conducted to assess the knowledge, attitude, and
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56 86 practices among populations during this pandemic, including one done in China, none have
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58 87 done so in Syria.¹²⁻¹⁹ To our knowledge this first study that aims to measure the awareness and
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3 88 general knowledge of COVID-19 among the Syrian population at a time where ambiguity and
4
5 89 misinformation are rampant. The objective of this study is to gauge specific knowledge around
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7 90 clinical features, transmission pathways, and prevention methods, and to identify factors
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9 91 associated with poor knowledge to help facilitate outbreak management in Syria during this
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11 92 rapid global rise of the COVID-19 pandemic. The information gleaned from this research will
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13 93 help with public health programming and response to COVID-19 in Syria as the pandemic
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15 94 continues to unfold.
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23 96 **Methods:**

24 25 26 97 **Study design, setting, and participants:**

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29 98 This web-based cross-sectional survey was conducted between March 31st and April 4th
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31 99 of 2020, during the lockdown period. Ethical approval was obtained from the Institutional
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33 100 Review Board (IRB) of the Faculty of Medicine, Syrian Private University. The inclusion
34
35 101 criteria for this study were participants residing in Syria who completed the survey and had no
36
37 102 known history of COVID-19 infection. The authors designed questions that were modelled
38
39 103 after existing awareness surveys, WHO course materials, technical briefs, and question and
40
41 104 answer bank on COVID-19 related topics.^{12 13 20-23} Questions from existing awareness surveys
42
43 105 that did not target community awareness regarding COVID-19 were excluded from the study.
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46 106 ^{12 13} The survey was translated to Arabic and was reviewed by two dialectologists and two
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48 107 infectious disease specialists, who evaluated whether the survey questions effectively assessed
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50 108 COVID-19 knowledge, and checked for double-barrelled and confusing questions, to ascertain
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52 109 the validity. We conducted a pilot study on 20 volunteers to assess reliability clarity, relevance,
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54 110 and the acceptability of the survey. These volunteers were excluded from the final sample to
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56 111 avoid bias. Modifications were made based on feedback received to facilitate better
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3 112 comprehension before distributing the final survey to the general population. The Arabic-
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5 113 language survey was posted on various social media platforms including WhatsApp, Telegram,
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7 114 Instagram, and Facebook targeting various social groups. To avoid non-response bias the
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9 115 survey was distributed during lockdown where the majority of the population were out of work
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11 116 and at home, GIFs and posts were adapted to appeal to each social group, the questions were
12
13 117 made short and in the form of multiple choice questions that required no typing, and the ability
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15 118 for viewers to comment on the link increased the popularity of the survey. Participants
16
17 119 confirmed their voluntary participation by answering a yes-no question, were informed of the
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19 120 option to opt-out of the survey at any time, and were assured of the confidentiality and
20
21 121 anonymity of their responses. After confirmation, participants were directed to the first part of
22
23 122 the survey to complete questions about socio-demographic information including, age, gender,
24
25 123 residence, education level, occupation, and economic status. Participants under the age of 18
26
27 124 required informed parental consent, as well as submission of parent/guardian contact
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29 125 information. The researchers were responsible for contacting the parents/guardians to obtain
30
31 126 consent before the child was given access to the survey. The sample size calculated was 2401
32
33 127 participants based on a margin of error of 2%, and a confidence interval of 95%, for a
34
35 128 population of 18,284,423 people using a sample size calculator (website:
36
37 129 <https://www.surveysystem.com/sscalc.htm>). The self-administered survey contained 40
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39 130 questions divided into 4 sections: general knowledge (10 questions), transmission pathways (7
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41 131 questions), clinical features (12 questions), and prevention methods (11 questions). The survey
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43 132 is available in appendix 1.
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52 **Patient and public involvement:**

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56 134 The public were not involved in the study design, conduct of the study, or plans to disseminate
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58 135 the results to study participants.
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136 **Statistical analysis**

137 A scoring system was used to analyse the participants' knowledge: a score of "1" was
138 given for a correct answer and a score of "0" was given for an incorrect answer. The correct
139 answers to the survey were determined from previous surveys and available WHO resources.
140 ^{12 13 20-23} The percentage score for mean knowledge was calculated as follows: sum of scores
141 obtained/maximum scores that could be obtained \times 100. Participants' total mean knowledge in
142 all the subsections, and mean knowledge of each subsection were calculated. Data were
143 analysed using the Statistical Package for Social Sciences version 25.0 (SPSS Inc., Chicago,
144 IL, United States) and reported as frequencies and percentages (for categorical variables) or
145 means and standard deviations (SD) (for continuous variables). The t-test was applied to
146 compare mean knowledge scores against both genders, and 3 questions (knowing an infected
147 individual, use of personal belongings, and dissemination of knowledge). The t-test was applied
148 to compare mean knowledge scores against gender. One-way analysis of variance (ANOVA)
149 was applied using f-test to compare mean knowledge scores against socio-demographic
150 variables (age, social status, residence, education level, occupation, economic status, and
151 number of household members), and source of information. Multivariable linear regression
152 analysis using the socio-demographic variables as independent variables (categorical) and
153 mean knowledge score as the outcome variable (continuous) was conducted to identify factors
154 associated with knowledge. Factors were selected with a backward method and were analysed
155 using the unstandardized coefficient (β), and 95% confidence interval. P-values $<$ 0.05 were
156 considered statistically significant.

157

158 **Results:**

159 **Socio-demographics characteristics:**

160 Of 4495 total participants who completed the survey, participants with a known history
161 of COVID-19 infection, residing outside Syria, and who did not fully complete the survey were
162 excluded. The final sample of 3586 participants (completion rate= 79.8%) consisted of
163 2444(68.2%) females and 1142(31.8%) males. Participants aged >20 years were the majority
164 1204(33.6%) while participants between 35 and 39 were the minority 186(5.2%). Participant
165 ages ranged from 12-78 years with a mean of 30 (± 10) years). 2279(63.6%) participants were
166 single, 1822(50.8%) were unemployed, 1064(29.7%) were smokers, and 428(11.9%) were
167 alcohol consumers (Table 1). The majority of participants were residents of Damascus/ Rural
168 Damascus 2019(56.3%) and had attained college/university level education (Figure1).

169 **General Knowledge regarding COVID-19:**

170 Participants showed a good level of awareness regarding COVID-19 ($75.6 \pm 9.4\%$). An
171 adequate level of basic knowledge ($67.0 \pm 18.9\%$) was found among participants, 3383(94.3%)
172 knew that a virus was the causative agent of COVID-19; 2535(70.7%) correctly identified the
173 incubation period as being between 2 days and 2 weeks. Only 1500(41.8%) believed that an
174 infection with COVID-19 does not confer lifelong immunity. The majority of participants
175 3489(97.3%) were aware that COVID-19 infection in high-risk groups can be fatal. There is
176 currently insufficient evidence on whether infertility is a complication of COVID-19 infection;
177 461(12.9%) participants believed that COVID-19 can cause infertility while 1903(53.0%) did
178 not. 2986(83.3%), and 2597(72.4%) correctly answered that there are currently no available
179 vaccine or treatments respectively; however, there were misconceptions about the efficacy of
180 antibiotics and Ibuprofen as treatments, 1228(34.2%) and 1268(35.3%) respectively (Table 2).

181 **Transmission, and Signs and Symptoms regarding COVID-19:**

182 There was a fair level of awareness ($70.7 \pm 16.9\%$) regarding COVID-19 transmission
183 pathways. A high level of awareness was demonstrated regarding common transmission
184 pathways: 3521(98.2%), 3387(94.4%), and 3330(92.9%) identified respiratory droplets,
185 touching an infected person's personal belongings, and handshaking respectively. There is
186 currently limited evidence on animal-to-human and sexual transmission; 703(19.6%) did not
187 know if transmission occurs between animals and humans, while 899(25.1%) did not know if
188 the virus is transmitted sexually (Table 2).

189 The data showed a good level of awareness ($76.0 \pm 13.6\%$) regarding clinical features.
190 When asked about the main clinical features, participants correctly identified, fever
191 3563(99.4%), sore throat 3037(84.7%), headache 3186(88.8%), chest pain 3050(85.0%),
192 general pain 3019(84.2%), fatigue 3405(95.0%), and dry cough 3466(96.7%), whereas only
193 1972(55.0%) knew that diarrhea can be a symptom. Only 2221(61.9%) were aware that
194 infected individuals may be asymptomatic (Table 2).

195 **Prevention Methods regarding COVID-19:**

196 The highest level of awareness was in the prevention section ($88.8 \pm 10.2\%$). Washing
197 hands with soap, avoiding crowded areas, remaining at home, and wearing a face mask outside
198 are the principal preventative measures against COVID-19, 3574(99.7%), 3574(99.75%),
199 3554(99.1%), and 3204(89.3%), respectively. A minority of 158(4.4%) believed that cleaning
200 with a mixture of Flash and bleach is a sound preventive measure. Only 2482(69.2%) knew
201 that the flu vaccine offers no protection against COVID-19 (Table 2).

202 **Statistical Analysis of the Data:**

203 A series of one way ANOVA analyses revealed that mean knowledge differed
204 significantly across: gender (p-value=0.009), age (p-value=0.003), social status (p-

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3 205 value=0.042), education level (p-value<0.001), economic status (p-value<0.001), number of
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5 206 household members (p-value<0.001), place of residence (p-value<0.001), and source of
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7 207 information (p-value<0.001) (Table 3). Participants living in Lattakia (77.6%) exhibited the
8
9 208 greatest awareness, whereas those in Ar-Raqqah (71.7%) followed by Deir-ez-Zor (71.8%)
10
11 209 exhibited the lowest. The mean knowledge differed across groups that acquired information
12
13 210 from different sources, the lowest awareness was among participants who chose family
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15 211 members/friends as one of their source(s) (74.0%), whereas those with the highest awareness
16
17 212 acquired their information from lectures as one of their source(s) (78.2%), (Table 3).
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22 213 When participants were asked if they were likely to share new information with friends
23
24 214 and family, 3513(98.0%) answered “yes”. There was a significant difference in mean
25
26 215 knowledge between those who were inclined to disseminate new information about COVID-
27
28 216 19 to friends and family (75.7%) compared with those who were not (72.3%) (p-value=0.002).
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30 217 On exclusive use of personal belongings, 2692(75.1%) answered “yes”. We found no
31
32 218 significant correlation between mean knowledge and participant tendency to share personal
33
34 219 belongings with others (p-value=0.112). Of participants who knew someone infected with
35
36 220 COVID-19, 65(1.8%) answered “yes”. There was no significant difference in mean knowledge
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38 221 between those who knew an infected individual (75.9%) compared with those who did not
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40 222 (75.6%) (p-value=0.816).
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45 223 **Multiple linear regression:**

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48 224 Multiple linear regression analysis results: male gender (vs. female, β =-0.933, p=0.005);
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50 225 education of secondary school or lower (vs. college/university and above, β =-3.782, p<0.001);
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52 226 careers in government, private, business, military, and “other” sectors, as well as
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54 227 unemployment (vs. health care workers, β =-3.592, p<0.001); poor and moderate economic
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56 228 status (vs. good and excellent, β =-0.669, p<0.040); and over 5 household members (vs. of 1-5,
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3 229 $\beta=-1.737$, $p<0.001$) were associated with significantly poorer knowledge scores (Table 4).
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6 230 Careers in health care (vs. Unemployed, $\beta=3.592$, $p\text{-value}=<0.001$), and the 31-45 age
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8 231 group (vs. 16-30, $\beta=1.511$, $p\text{-value}=0.005$) were associated with significantly higher
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10 232 knowledge scores.

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14 15 16 17 234 **Discussion:**

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20 235 We found an overall mean knowledge score of 75.6%, indicating that most participants
21
22 236 were relatively knowledgeable about COVID-19, though less so compared to their counterparts
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24 237 in China (90%).¹² This level of knowledge was unexpected given that only 10 cases of COVID-
25
26 238 19 had been confirmed in Syria at the time of the survey.²⁴

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30 239 Poor knowledge was associated with males, non-post-secondary education, non-
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32 240 healthcare occupations, unemployment, poor and moderate economic status, and households
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34 241 with more than 5 members; similar trends were observed in China.¹² Correlating socio-
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36 242 demographic variables with awareness is critical to public health efforts to mitigate the spread
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38 243 of COVID-19. The data obtained from this study can be leveraged by the Syrian Ministry of
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40 244 Health to tailor prevention and educational campaigns to populations with the widest
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42 245 knowledge gaps.

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46 246 Our study showed a relatively high level of awareness 2535(70.7%) among the
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48 247 population. In the general knowledge section (mean knowledge score 67%), the majority of the
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50 248 participants 3383(94.3%) knew that COVID-19 is caused by a virus, similar to a Pakistani
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52 249 study (93.3%).¹⁷ Low awareness of the 2-to-14 day incubation period was found²⁵ among
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54 250 dentists (36.1%) and HCW (36.4%) in similar studies.¹³ 19 Syria has a relatively young
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56 251 population; statistical data from 2018 showed that only an estimated 4.5% of the population
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3 252 was over the age of 65.²⁶ 3489(97.3%) knew that COVID-19 infection can be severe and
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5 253 potentially fatal in elderly, chronically ill, and immunodeficient patients. This is higher than in
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7 254 studies conducted in China (73.2%) and India (88.37%).^{12 27} 40.6% of Syrians are hypertensive,
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10 255 yet a staggering 79.8% of them are unaware of their condition. Diabetes is also prevalent,
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12 256 affecting 11.9% of the population.^{28 29} Such a rampant lack of awareness about chronic diseases
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14 257 associated with high mortality in COVID-19 patients underscores the need for targeted
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17 258 awareness campaigns.

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20 259 At the time of the survey, no standardized evidence-based protocols had yet been
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22 260 developed to treat COVID-19 infections; only 2597(72.4%) participants knew that there was
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24 261 no available treatment at that time; this is higher than a Kenyan study (40%) but significantly
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26 262 lower than a Chinese study (94%).^{12 15} A minority 103(2.9%) of participants thought there was
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28 263 a vaccine available against COVID-19, even though vaccines have only become commercially
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30 264 available in the past few months; by contrast, Coimbatore District and Pakistan were less
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32 265 informed, with (18.6%) and (11.6%) respectively believing that such a vaccine was available
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34 266 at the time. In the absence of a vaccine or effective treatment protocol for COVID-19 at the
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36 267 time of the survey, controlling the spread of the disease was the best line of defence, and
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38 268 remains so given the dire shortage of medication, ventilators, ICU capacity, and the continued
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40 269 lack of a vaccine widely available to the Syrian people. We observed a considerable knowledge
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42 270 gap in 1268(35.3%) with regards to ibuprofen as a treatment option. There is no available
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44 271 evidence to suggest that ibuprofen is effective against COVID-19.³⁰

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46 272 Participants showed a fair level of awareness regarding transmission pathways (70.7%),
47
48 273 very similar to a Pakistani study (70.8%).¹⁷ The majority 3521(98.2%) of participants were
49
50 274 aware that respiratory droplets are common transmission vectors; this is similar to a Chinese
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52 275 study (97.8%), but much higher than an Indian study (29.5%).^{12 16} 3330(92.9%) participants
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3 276 identified handshaking as a transmission pathway, higher than a study among Jordanian
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5 277 dentists (85.6%).¹³
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8 278 The majority of survey participants were sufficiently aware of the clinical features of
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10 279 COVID-19 (76.0%), similar to a Pakistani study (77.7%).¹⁷ A very high level of awareness of
11
12 280 the most common symptoms was found: fever 3563(99.4%), dry cough 3466(96.7%), fatigue
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14 281 3405(95.0%), and myalgia 3019(84.2%), similar to findings from Chinese (96.4%) and Indian
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16 282 (95.4%) studies.^{12 27} When asked about sore throat, a high level of awareness 3037(84.7%) was
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18 283 found compared to studies from India (15.2%) and among dentists in Jordan (28.5%).^{13 16}
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20 284 Knowledge about diarrhea as a symptom was lacking: only 1972(55.0%); a study among
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22 285 dentists also showed low awareness (39.9%).^{13 16} While infected individuals are frequently
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24 286 asymptomatic, or present with mild symptoms, around 1 in every 5 infections can be
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26 287 serious enough to require hospitalisation.^{31 32} Only 2221(61.9%) participants were aware that
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28 288 infected individuals can be asymptomatic, while a study among dentists (34.5%) reported much
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30 289 lower awareness. Increasing public awareness about the variability of symptoms is particularly
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32 290 important since those with mild or unreported symptoms may significantly contribute to the
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34 291 transmission of COVID-19; the lack of health insurance, paid sick leave, telecommuting, or
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36 292 other social and professional safety nets increase the likelihood that these “silent spreaders”
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38 293 will underreport symptoms for fear of being forced to miss work.
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44 294 We found a high level of awareness in the preventive methods section (88.8%), similar
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46 295 to a Pakistani study (85%).¹⁷ Hand hygiene has been known to be an important element of
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48 296 infection control since the 14th century.³³ Implementing hand-washing techniques can break
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50 297 the transmission cycle and reduce the risk of infection by 6%-44%.³⁴ Almost all 3574(99.7%)
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52 298 participants were aware that washing hands with soap and water is an important preventive
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54 299 measure against COVID-19. This finding is in accordance with studies from Joran (97.0%),
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56 300 and India (96.2%, and 87%).^{13 16 19}
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3 301 This year the WHO recommended that the following mitigation measures be
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5 302 implemented during the holy month of Ramadan: cancelling social and religious gatherings,
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8 303 holding events outdoors for adequate ventilation, physical distancing of at least 1 meter
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10 304 between people, and the use of technology to broadcast ceremonies on television.^{35 36} The
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12 305 majority 3574(99.7%) identified avoiding mass gatherings as a preventive measure; studies in
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14 306 China (98.6%) and Coimbatore District (97.7%) reported similar awareness.^{12 27} Cheap and
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16 307 efficient interventions such as N95 (filtration capacity=95%) have a 91% effectiveness of
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18 308 blocking pathogen transmission.³⁷ 3204(89.3%) participants considered wearing a face mask
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20 309 when leaving home as an effective prevention method, compared with a Coimbatore District
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24 310 study (93.02%).²⁷

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26 311 Since Syrian society is particularly vulnerable to COVID-19, this knowledge gap is
27
28 312 potentially dangerous and should be addressed to mitigate disease spread. Only 2482(69.2%)
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30 313 knew that the flu vaccine offers no protection against COVID-19; this is similar to a
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32 314 Coimbatore District study (67.4%), but lower than a study amongst HCWs (90.7%).^{19 27}
33
34 315 3305(92.2%) were aware that individuals showing symptoms should quarantine themselves,
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36 316 lower than in China (98.2%) and India (95.8%).^{12 16}

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39 317 North-East Syria (NES) has a population of over 4 million people, 600,000 of whom
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41 318 are internally displaced refugees, 100,000 of whom live in overcrowded camps: only 2 of
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43 319 NES's 11 hospitals are currently functioning. NES consists of 3 governorates: Ar-Raqqah,
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45 320 Deir-ez-Zor, and Al-Hasakah. With only 22 ICU beds, (18 in Al-Hasakah, 4 in Ar-Raqqah, and
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47 321 none in Deir-ez-Zor), the maximum capacity threshold is only 80 COVID-19 cases. Ar-Raqqah
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49 322 and Deir-ez-Zor, the most vulnerable governorates, also showed the lowest awareness in the
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51 323 study (71.7%), and (71.8%). This is a potentially catastrophic situation, and a concern to the
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53 324 international community, as an unmonitored, uncontrolled outbreak in NES can prolong the
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55 325 global pandemic.
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3 326 Since storming the international stage two years ago, COVID-19 caught the whole world off
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5 327 guard; ambiguity and uncertainly have been and continue to be defining features of this pandemic.
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7 328 Despite the emergence of effective vaccines and treatment protocols, timely global availability is a
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9 329 continuing challenge. We have yet to achieve a critical mass of vaccinations and herd immunity, as
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11 330 evidenced by the emergence of wave after wave of infection in both developed and developing
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13 331 countries.

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15 332 Further research is necessary to study transmission through sexual contact (body fluids other
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17 333 than respiratory droplets) and undercooked food. Numerous cases of animal infection, including house
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19 334 pets, apes, and even tigers, highlight the need for extensive studies into horizontal transmission.^{38 39}
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21 335 Long-term studies into permanent immunity, and fetal abnormalities as a result of maternal infection
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23 336 are also necessary.
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30 338 **Limitations:**

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33 339 Our findings can only be generalized about online users of well-educated Syrians of
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35 340 good socio-economic status. Syrians vulnerable to COVID-19, such as the elderly and rural
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37 341 residents, are more likely to exhibit poor knowledge and awareness due to limited internet
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39 342 access. As such, reaching out to these populations must be prioritized. Even though all Syrian
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41 343 governorates were represented in this study, most participants lived in Damascus and Rural
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43 344 Damascus. Credible published national data regarding the socio-demographic characteristics
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45 345 of Syrians are not available to evaluate the representativeness of our sample. Furthermore, an
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47 346 assessment of the Syrian population's practices relating to COVID-19 and the attitudes
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49 347 driving them is necessary to complete the picture.
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58 349 **Conclusion:**

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3 350 COVID-19 has been a dire warning to humanity about the fragility of its social,
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5 351 economic, and healthcare institutions. Our study revealed good public awareness of clinical
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7 352 features and preventive measures. However general knowledge and knowledge about
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9 353 transmission pathways was suboptimal. Syrians of good socio-economic status, in particular
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11 354 young well-educated women, have shown good knowledge. Our national response must adapt
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13 355 to the growing threat of COVID-19 by adopting public awareness strategies and behaviours to
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15 356 contain the disease both within and beyond our borders.
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23 358 **Abbreviations:** COVID-19: Coronavirus Disease 2019; MERS: Middle East Respiratory
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25 359 Syndrome; SARS: Severe Acute Respiratory Syndrome; WHO: World Health Organization;
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27 360 PHEIC: Public Health Emergency of International Concern; ICU: Intensive care unit; IRB:
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29 361 Institutional Review Board; SPSS: Statistical Package for Social Sciences; SD: Standard
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31 362 Deviation; HCW: Health Care Worker.
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44
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46
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52

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55
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58 371 public, commercial or non-profit sectors.
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67 **373 Availability of data and materials:**
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10 374 All data related to this paper's conclusion are available and stored by the authors. All
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12 375 data are available from the corresponding author on a reasonable request.
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18 **377 Declarations:**
1920 **378 Ethics approval and consent to participate:**

21 379 This study was approved by the Institutional Review Board (IRB) at the Syrian Private
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23
24 380 University (SPU). All Participants confirmed their written consent by answering a yes-no
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26 381 question. Participants under the age of 18 required verbal informed parental consent, as well as
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28 382 submission of parent/guardian contact information. The researchers were responsible for
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30 383 contacting the parents/guardians to obtain verbal consent before the child was given access to
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32 384 the survey. The verbal and written form of consent was approved by the IRB at SPU.
33
34 385 Participation in the study was voluntary and participants were assured that anyone who was
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36 386 not inclined to participate or decided to withdraw after giving consent would not be victimized.
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38 387 All information collected from this study was kept strictly confidential.
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43 **388 Consent for Publication:**

44 389 Not applicable.
45

46 **390 Competing interests:**

47 391 The authors declare that they have no competing interests.
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51 **392 Authors' contributions:**

52 393 FM conceptualized the study, participated in the design, wrote the study protocol,
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54 394 performed the statistical analysis, did a literature search, and drafted the manuscript. BB
55
56 395 participated in study design, did a literature search, and drafted the manuscript. HA, and NA
57
58 396 did a literature search and revision of the draft. All authors read and approved the final draft.
59
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398 **Tables and Figures:**399 **Table 1.**

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Table 1. Socio-demographic characteristics: (n=3586)

Gender (%)	Male	1142(31.8)	Education (%)	Primary School	25(0.7)
	Female	2444(68.2)		Intermediate School	166(4.6)
Age (%)	<20	1204(33.6)		Secondary school	375(10.4)
	20-24	1104(30.8)		College/University	2839(79.2)
	25-29	446(12.4)		Master's degree	157(4.4)
	30-34	266(7.4)		PhD	24(0.7)
	35-39	186(5.2)	Occupation (%)	Health care worker	634(17.7)
	>39	380(10.6)		Government institution	283(7.9)
Social	Single	2279(63.5)		Private institution	182(5.1)

Status (%)	In a relationship	286(8.0)		Business	198(5.5)
	Married	943(26.3)		Military	32(0.9)
	Divorced	46(1.3)		Unemployed	1822(50.8)
	Widowed	32(0.9)		Other	435(12.1)
Economic Status (%)	Poor	247(6.9)	Household members (%)	0	46(1.3)
	Moderate	1247(34.8)		1-5	2751(76.7)
	Good	1761(49.1)		>5	789(22)
	Excellent	331(9.2)			

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402 ¹Poor: income does not provide essential needs for the family. ²Moderate: income provides essential
 403 needs for the family but no more. ³Good: income provides essential needs and some luxury
 404 requirements. ⁴Excellent: income provides luxury requirements.

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406 **Table 2.**

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**Table 2. General Knowledge, Transmission, Signs and Symptoms, and Prevention of COVID-19:
 (n=3586)**

General Knowledge					
Causative Agent N(%)	Virus	3383(94.3)	Incubation period N(%)	1 Minute to 1 Hour	18(0.5)
	Bacteria	39(1.1)		1 Hour to 2 Days	58(1.6)
	Parasite	8(0.2)		2 Days to 2 Weeks	2535(70.7)
	Immune deficiency	46(1.3)		2 Weeks to 1 Month	958(26.7)
	Fungus	0(0.0)		>1 Month	17(0.5)
	Inherited	2(0.1)			
	Do Not Know	108(3.0)			
		YES(%)	NO(%)	DO NOT KNOW(%)	
Can infection with COVID-19 confer permanent immunity?		815(22.7)	1500(41.8)	1271(35.5)	
Can COVID-19 cause severe illness and lead to death in elderly, chronically ill, and immunodeficient patients?		3489(97.3)	28(0.8)	69(1.9)	
Can COVID-19 cause infertility?		461(12.9)	1222(34.1)	1903(53.0)	

Is COVID-19 teratogenic (i.e. cause malformations/ abnormalities to an embryo/fetus)?	157(4.4)	1433(40.0)	1996(55.6)
Is there no available treatment against COVID-19?	2597(72.4)	515(14.4)	474(13.2)
Can COVID-19 be treated with antibiotics?	1228(34.3)	1790(49.9)	568(15.8)
Can COVID-19 be treated with Ibuprofen?	1268(35.3)	1921(53.6)	397(11.1)
Are there available COVID-19 vaccines?	103(2.9)	2986(83.3)	497(13.8)
Transmission Pathways			
Respiratory droplets (from coughing or sneezing)	3521(98.2)	21(0.6)	44(1.2)
Handshaking	3330(92.9)	189(5.3)	67(1.8)
Touching an infected person's personal belongings	3387(94.4)	131(3.7)	68(1.9)
Animals-to-human	910(25.4)	1973(55.0)	703(19.6)
Undercooked food	1301(36.3)	1734(48.3)	551(15.4)
Sexual contact	1210(33.7)	1477(41.2)	899(25.1)
Horizontal transmission	1130(31.5)	1160(32.4)	1296(36.1)

Signs and Symptoms			
Fever	3563(99.4)	9(0.2)	14(0.4)
Sneezing	2353(65.6)	1000(27.9)	233(6.5)
Sore throat	3037(84.7)	358(10.0)	191(5.3)
Headache	3186(88.8)	190(5.3)	210(5.9)
Chest pain	3050(85.0)	254(7.1)	282(7.9)
Body aches (generalized pain)	3019(84.2)	260(7.2)	307(8.6)
Fatigue	3405(95.0)	72(2.0)	109(3.0)
Diarrhea	1972(55.0)	971(27.1)	643(17.9)
Dry cough	3466(96.7)	44(1.2)	76(2.1)
Productive cough	458(12.8)	2586(72.1)	542(15.1)
Bleeding	130(3.6)	2613(72.9)	843(23.5)
Asymptomatic	2221(61.9)	375(10.5)	990(27.6)
Prevention Methods			
Does wearing a face mask outside the home offer protection from COVID-19?	3204(89.3)	314(8.8)	68(1.9)
Does washing hands with soap and water offer protection from COVID-19?	3574(99.7)	5(0.1)	7(0.2)

Does avoiding crowded places offer protection from COVID-19?	3574(99.7)	4(0.1)	8(0.2)
Does the flu vaccine offer protection from COVID-19?	331(9.2)	2482(69.2)	773(21.6)
Does staying at home offer protection from COVID-19?	3554(99.1)	15(0.4)	17(0.5)
Does using hand sanitizer offer protection from COVID-19?	3430(95.6)	104(2.9)	52(1.5)
Does cleaning household surfaces with bleach offer protection from COVID-19?	3408(95.0)	110(3.1)	68(1.9)
Does cleaning fruits and vegetables with soap and water offer protection from COVID-19?	3262(90.9)	221(6.2)	103(2.9)
Does cleaning surfaces with a mixture of Flash and bleach offer a safe protection from COVID-19?	158(4.4)	3301(92.1)	127(3.5)
Does the quarantine of symptomatic individuals protect others from COVID-19?	3305(92.2)	241(6.7)	40(1.1)
Do cumin, anise, and mint offer protection from COVID-19?	1041(29.0)	1934(53.9)	611(17.1)

409 **Table 3.**

Table 3. Mean knowledge score of participants by demographic variables, and source of information (one way ANOVA), (n= 3586)

Characteristics		Number of participants (%)	Mean Knowledge Score (\pm SD%)	F-test/ T-test	P-value
Gender	Male	1142(31.8)	75.0(\pm 10.1)	-2.625	0.009*
	Female	2444(68.2)	75.9(\pm 9)		
Age-group (years)	<20	1204(33.6)	75.0(\pm 9.9)	2.990	0.011*
	20-24	1104(30.8)	76.4(\pm 9.3)		
	25-29	446(12.4)	76.0(\pm 9.4)		
	30-34	266(7.4)	75.4(\pm 9.4)		
	35-39	186(5.2)	76.1(\pm 7.6)		

	>39	380(10.6)	75.1(±8.6)		
Social status	Single	2279(63.5)	75.8(±9.3)	2.485	0.042*
	In a relationship	286(8.0)	76.6(±8.6)		
	Married	943(26.3)	75.1(±9.4)		
	Divorced	46(1.3)	73.9(±8.8)		
	Widowed	32(0.9)	73.4(±15.9)		
Residence	Urban	2426(67.7)	75.8(±9.3)	1.652	0.099
	Rural	1160(32.3)	75.3(±9.6)		
Education	Primary school	25(0.7)	66.5(±12.4)	26.176	<0.001*
	Intermediate school	166(4.6)	73.2(±9.3)		
	Secondary school	375(10.4)	70.0(±13)		

	College/University	2839(79.2)	76.3(±8.9)		
	Master's degree	157(4.4)	77.2(±9.7)		
	PhD	24(0.7)	76.6(±8.5)		
Occupation	Health care worker	634(17.7)	78.6(±8.6)	16.379	<0.001*
	Government institution	283(7.9)	75.7(±7.9)		
	Private institution	182(5.1)	75.5(±9)		
	Business	198(5.5)	73.4(±10.2)		

	Military	32(0.9)	71.2(±15.6)		
	Unemployed	1822(50.8)	75.3(±9.2)		
	Other	435(12.1)	74.0(±10.2)		
Economic status	Excellent	331(9.2)	76.6(±11.1)	7.108	<0.001*
	Good	1761(49.1)	76.2(±9.4)		
	Moderate	1247(34.8)	74.9(±9)		
	Poor	247(6.9)	74.3(±9.3)		
Household members	0	46(1.3)	74.4(±10.6)	15.451	<0.001*
	1-5	2751(76.7)	76.1(±9)		
	>5	789(22.0)	74.0(±10.2)		

Source of information	Health websites	2823(78.7%)	76.4(±8.7)	24.523	<0.001*
	Social media	1998(55.7%)	74.6(±9.6)		
	Television/ radio	1572(43.8%)	75.5(±9)		
	Family members/ friends	528(14.7%)	74.0(±10.3)		
	Lectures	517(14.4%)	78.2(±7.5)		
	Magazines/ books	266(7.4%)	77.6(±8.8)		

410

411 **Table 4.**

Table 4. Multiple linear regression on variables associated with poor COVID-19 knowledge

Variable	Coefficient	Standard error	t	P
Male gender (reference: female)	-0.933	0.334	-2.794	0.005*

education of secondary school or lower (reference: college/university and above)	-3.782	0.466	-8.125	<0.001*
careers in government, private, business, military, and “other” sectors, as well as unemployment (reference: health care workers)	-3.592	0.474	-7.579	<0.001*
poor and moderate economic status (reference: good and excellent)	-0.669	0.325	-2.057	0.040*
>5 household members (reference: of 1-5)	-1.737	0.374	-4.648	<0.001*

412

413 **Figures and tables legends:**414 **Table 1.** Sociodemographic characteristics415 **Table 2.** General Knowledge, Transmission, Signs and Symptoms, and Prevention around
416 COVID-19417 **Table 3.** Mean knowledge score of participants by demographic variables418 **Table 4.** Multiple linear regression on variables associated with poor COVID-19 knowledge419 **Figure 1.** Distribution of participants according to governorates and education level

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References:

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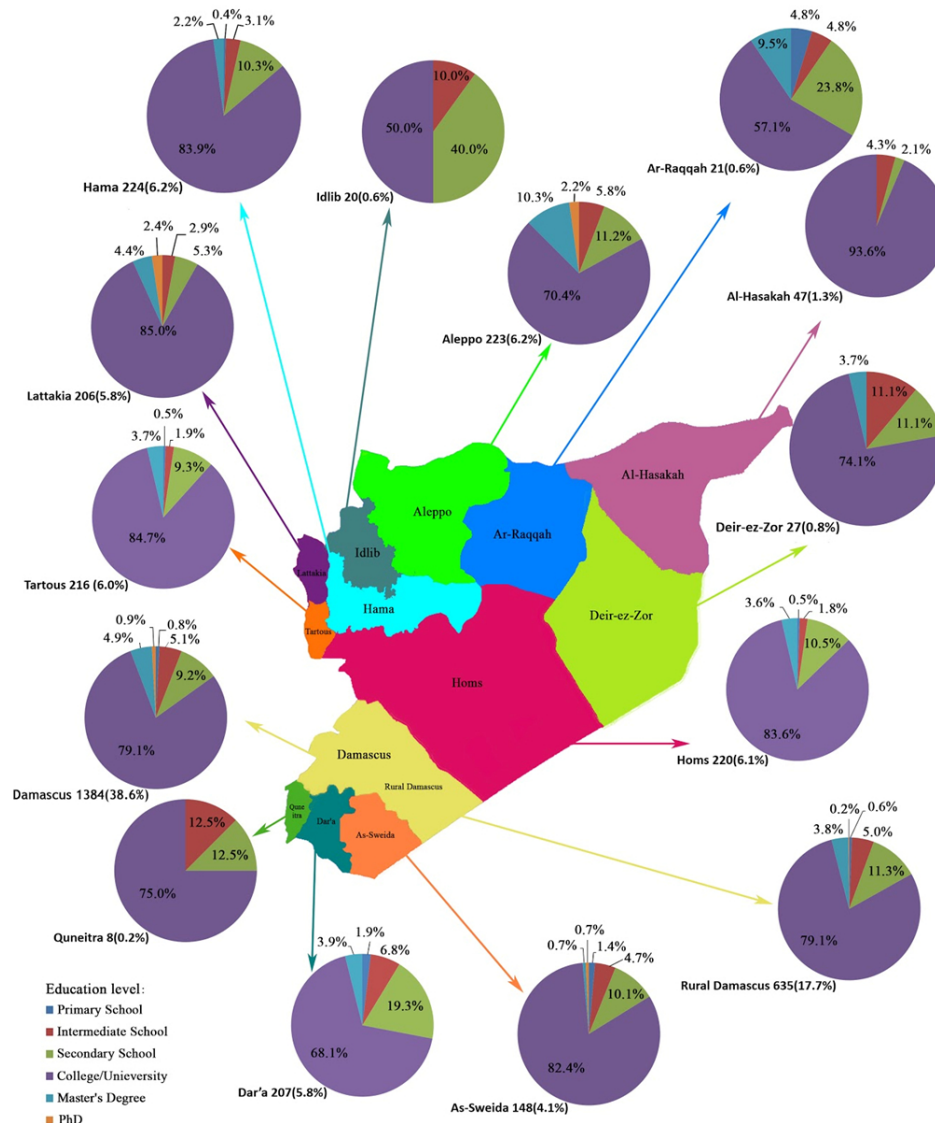


Figure 1. Distribution of participants according to governorates and education level

1 **Attached Survey:**2 **Appendix 1**

Socio-demographic Characteristics	
Age (years): <input type="checkbox"/> Below 15 <input type="checkbox"/> 15-20 <input type="checkbox"/> 20-30 <input type="checkbox"/> 30-50 <input type="checkbox"/> 40-50 <input type="checkbox"/> 50-60 <input type="checkbox"/> 60-70 <input type="checkbox"/> Above 70	Gender: <input type="checkbox"/> Male <input type="checkbox"/> Female
Marital status: <input type="checkbox"/> Single <input type="checkbox"/> Relationship <input type="checkbox"/> Married <input type="checkbox"/> Divorced <input type="checkbox"/> Widowed	Educational level: <input type="checkbox"/> Primary school <input type="checkbox"/> Intermediate school <input type="checkbox"/> Secondary school <input type="checkbox"/> University/College <input type="checkbox"/> Master's Degree <input type="checkbox"/> PHD Degree
Occupation: <input type="checkbox"/> Health care worker <input type="checkbox"/> Government institution <input type="checkbox"/> Private institution <input type="checkbox"/> Business <input type="checkbox"/> Military <input type="checkbox"/> Unemployed <input type="checkbox"/> Other	Residence: <input type="checkbox"/> Damascus/Rural Damascus <input type="checkbox"/> Hama <input type="checkbox"/> Aleppo <input type="checkbox"/> Homs <input type="checkbox"/> Tartous <input type="checkbox"/> Lattakia <input type="checkbox"/> Dara'a <input type="checkbox"/> As-Sweida <input type="checkbox"/> Al Hasakah <input type="checkbox"/> Deir-ez-Zor <input type="checkbox"/> Idlib <input type="checkbox"/> Ar-Raqqah <input type="checkbox"/> Quneitra
Area: <input type="checkbox"/> Rural <input type="checkbox"/> Urban	Economic Status: <input type="checkbox"/> Excellent <input type="checkbox"/> Good <input type="checkbox"/> Moderate <input type="checkbox"/> Poor
Do you smoke? <input type="checkbox"/> Yes <input type="checkbox"/> No	Do you drink alcohol? <input type="checkbox"/> Yes <input type="checkbox"/> No
How many people do you live with? <input type="checkbox"/> Alone <input type="checkbox"/> 1-5 <input type="checkbox"/> 6-10 <input type="checkbox"/> 11-15 <input type="checkbox"/> 16-20 <input type="checkbox"/> Above 20	
Do you share toiletries/personal care products with others? <input type="checkbox"/> Yes <input type="checkbox"/> No	
Do you know anyone infected with COVID-19? <input type="checkbox"/> Yes <input type="checkbox"/> No	

Table 2. General Knowledge about COVID-19

What is COVID-19? <input checked="" type="checkbox"/> Virus <input type="checkbox"/> Bacteria <input type="checkbox"/> Parasite <input type="checkbox"/> Fungus <input type="checkbox"/> Immunodeficiency <input type="checkbox"/> Inherited <input type="checkbox"/> Do not know	Do you know how long after being infected with COVID-19 can a person suffer from signs and symptoms? <input type="checkbox"/> 1 Minute to 1 Hour <input type="checkbox"/> 1 Hour to 2 Days <input checked="" type="checkbox"/> 2 Days to 2 weeks <input type="checkbox"/> 2 Weeks to 1Month <input type="checkbox"/> Over a 1 month		
Can an infection with COVID-19 confer permanent immunity (once infected with COVID-19 you cannot contract another infection)? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Do not know			
Can COVID-19 cause severe illness and lead to death in elderly, chronically ill (hypertension, diabetes, asthma . . .), and those who have compromised immune systems? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Do not know			
Can COVID-19 cause infertility? <input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Do not know			
Is COVID-19 teratogenic (i.e. cause malformations/abnormalities to an embryo/fetus)? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Do not know			
Treatment for COVID-19			
	Yes	No	Do Not Know
No treatment available	✓		
Antibiotics		✓	
Ibuprofen		✓	
Is there an available vaccine for COVID-19? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Do not know			

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Table 3. Transmission Pathways			
	Yes	No	Do Not Know
Can COVID-19 be transmitted via respiratory droplets (coughing or sneezing) of infected individuals?	✓		
Can COVID-19 be transmitted after shaking-hands with an infected individual?	✓		

Can COVID-19 be transmitted after touching an infected individual's personal belongings?	✓		
Can COVID-19 be transmitted from animals to humans?			✓
Can COVID-19 be transmitted via undercooked food?			✓
Can COVID-19 be transmitted via sexual contact?			✓
Can COVID-19 be transmitted via vertical transmission (mother to fetus)?	✓		

Table 4. Signs and Symptoms of COVID-19

	True	False	Do Not Know
Is fever/temperature among the signs and symptoms of COVID-19?	✓		
Is sneezing among the signs and symptoms of COVID-19?	✓		
Is sore throat among the signs and symptoms of COVID-19?	✓		
Is headache among the signs and symptoms of COVID-19?	✓		
Is Chest pain among the signs and symptoms of COVID-19?	✓		
Is body aches (generalized pain) among the signs and symptoms of COVID-19?	✓		
Is fatigue among the signs and symptoms of COVID-19?	✓		
Is diarrhea among the signs and symptoms of COVID-19?	✓		
Is a runny nose among the signs and symptoms of COVID-19?	✓		
Is dry cough among the signs and symptoms of COVID-19?	✓		
Is productive cough among the signs and symptoms of COVID-19?	✓		
Is bleeding among the signs and symptoms of COVID-19?		✓	
Can a person be infected with COVID-19 and have no signs and symptoms?	✓		

Table 5. Prevention Methods

	True	False	Do Not Know
Does wearing a face mask outside the home offer protection from COVID -19?	✓		
Does washing hands with soap and water offer protection from COVID-19?	✓		
Does avoiding crowded places offer protection from COVID -19?	✓		
Does the flu vaccine offer protection from COVID -19?		✓	
Does staying at home offer protection from COVID -19?	✓		
Does using hand sanitizer offer protection from COVID -19?	✓		
Does using bleach to clean household surfaces prevent COVID-19 infection?	✓		
Does cleaning fruits and vegetables with soap and water offer protection from COVID-19?	✓		
Does cleaning surfaces with a mixture of Flash and bleach offer protection from COVID -19?		✓	
Does the quarantine of symptomatic individuals protect others from COVID -19?	✓		
Do cumin, anise, and mint offer protection from COVID -19?		✓	
What is your main source of information about COVID-19? (You may choose more than one option) <input type="checkbox"/> Internet (social media platforms) <input type="checkbox"/> Internet (Official websites like world health organization) <input type="checkbox"/> TV/Radio <input type="checkbox"/> Friends/Member of family <input type="checkbox"/> Magazines/Books <input type="checkbox"/> Lectures			
If you had new information about COVID-19 would you share it with friends and family to raise awareness? <input type="checkbox"/> Yes <input type="checkbox"/> No			

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For peer review only

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	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2,3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5,6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	6,7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6,7
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	6,7
		(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	Not applicable
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	-
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	Not applicable
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	8
		(b) Describe any methods used to examine subgroups and interactions	8
		(c) Explain how missing data were addressed	Not applicable (no missing data)
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up	8

1
2 was addressed

3 *Case-control study*—If applicable, explain how matching of cases
4 and controls was addressed

5 *Cross-sectional study*—If applicable, describe analytical methods
6 taking account of sampling strategy

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8 € Describe any sensitivity analyses -
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10 Continued on next page
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Results			Page No.
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	9
		(b) Give reasons for non-participation at each stage	-
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9
		(b) Indicate number of participants with missing data for each variable of interest	Not applicable
		© <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	Not applicable
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	-
		<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	29-35
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	34,35
		(b) Report category boundaries when continuous variables were categorized	29-33
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not applicable
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	13-15
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	16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	17
Generalisability	21	Discuss the generalisability (external validity) of the study results	16
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	17

*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.

BMJ Open

A Crisis Within a Crisis: COVID-19 Knowledge and Awareness among the Syrian Population - a cross-sectional study

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2020-043305.R3
Article Type:	Original research
Date Submitted by the Author:	22-Mar-2021
Complete List of Authors:	Mohsen, Fatema; Syrian Private University Faculty of Medicine, Bakkar, Batoul; Syrian Private University Faculty of Medicine Armashi, Humam; Syrian Private University Faculty of Medicine Aldaher, Nizar; Syrian Private University Faculty of Medicine; Damascus University Faculty of Medicine
Primary Subject Heading:	Public health
Secondary Subject Heading:	Public health, Infectious diseases
Keywords:	Public health < INFECTIOUS DISEASES, PUBLIC HEALTH, COVID-19

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3 1 **A Crisis Within a Crisis: COVID-19 Knowledge and Awareness among the**
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6 2 **Syrian Population - a cross-sectional study**
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12 4 **Authors: Fatema Mohsen¹, Batoul Bakkar¹, Humam Armashi¹, Nizar Aldaher^{2,3}**
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17 6 **Affiliations:**

18
19
20
21 7 1 Faculty of Medicine, Syrian Private University, Damascus, Syria.
22

23 8 2 Professor in Infectious Diseases, Department of Internal Medicine, Faculty of Medicine,
24
25
26 9 Damascus University, Damascus, Syria.

27
28 10 3 Professor in Infectious Diseases, Department of Internal Medicine, Faculty of Medicine,
29
30
31 11 Syrian Private University, Rif Dimashq, Syria.
32

33 12
34
35
36 13 **Corresponding Author:**

37
38 14 Fatema Mohsen
39

40
41
42 15 Faculty of Medicine, Syrian Private University, Mazzeh Street, P.O. Box 36822, Damascus,
43

44 16 Syrian Arab Republic
45

46
47 17 Tel:00963936396590 Email: fatemamohsena@gmail.com
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50 18
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53 19 **Abstract:**
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3 20 **Objectives:** To gauge specific knowledge around clinical features, transmission pathways, and
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5 21 prevention methods, and to identify factors associated with poor knowledge to help facilitate
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7 22 outbreak management in Syria during this rapid global rise of the COVID-19 pandemic.
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10 23 **Design:** Web-based cross-sectional survey.
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13 24 **Setting:** This study was conducted in March 2020, nearly 10 years into the Syrian war crisis.
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15 25 The Arabic-language survey was posted on various social media platforms including
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17 26 WhatsApp, Telegram, Instagram, and Facebook targeting various social groups.
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21 27 **Participants:** A total of 4495 participants completed the survey. Participants with a history of
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23 28 COVID-19 infection, residing outside Syria, or who did not fully complete the survey were
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25 29 excluded from the study. The final sample of 3586 participants (completion rate=79.8%)
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27 30 consisted of 2444(68.2%) females and 1142(31.8%) males.
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30 31 **Primary and secondary outcome measures:** The first, knowledge of COVID-19 in 4 areas
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32 32 (1. general knowledge 2. transmission pathways 3. signs and symptoms 4. prevention
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34 33 methods). The second, factors associated with poor knowledge.
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38 34 **Results:** Of the 3586 participants, 2444(68.2%) were female, 1822(50.8%) were unemployed,
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40 35 and 2839(79.2%) were college-educated. The study revealed good awareness regarding
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42 36 COVID-19 (mean 75.6%, SD±9.4%). Multiple linear regression analysis correlated poor mean
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44 37 knowledge scores with male gender ($\beta=-0.933$, $p=0.005$), secondary school or lower education
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46 38 level ($\beta=-3.782$, $p<0.001$), non-healthcare occupation ($\beta=-3.592$, $p<0.001$), low economic
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48 39 status ($\beta=-0.669$, $p<0.040$), and >5 household members ($\beta=-1.737$, $p<0.001$).
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4 41 **Conclusion:** This study revealed some potentially troubling knowledge gaps which underscore
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6 42 the need for a vigorous public education campaign in Syria. This campaign must reinforce the
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8 43 public's awareness, knowledge, and vigilance towards precautionary measures against COVID-
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10 44 19, and most importantly aid in controlling the worldwide spread of the disease.
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15 46 **Strengths and limitations of this study:**

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17 47 . Data are derived from a large, national survey across Syria, during the lockdown period.
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21 48 . The survey covered socio-demographic information, general knowledge, transmission,
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23 49 symptoms, and prevention.
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27 50 . Results have broad implications for public health programming and response to COVID-19
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29 51 in Syria.
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33 52 . This web-based cross-sectional study cannot be generalized towards the Syrian population.
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37 54 **Keywords:** Awareness; Knowledge; COVID-19; Pandemic; Syria; War; Population.
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44 56 **Background:**

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48 57 Coronavirus disease 2019 (COVID-19) is a highly infectious respiratory disease that
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50 58 evolved into a worldwide pandemic, threatening a prolonged economic recession. The first
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52 59 incidence was reported at a local seafood market in Wuhan, China.¹ The virus continues to
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54 60 spread, with steadily increasing morbidity and mortality cases, hitting the poorest and most
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56 61 vulnerable in the world. Many studies have assessed symptomatic clusters, transmission
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58 62 pathways, and prevention methods; however, many aspects have yet to be studied.^{2 3} Sexual
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3 63 transmissions, horizontal transmission, animal to human transmission, permanent immunity,
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5 64 and fetal abnormalities as a result of maternal infection are as yet unproven.
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8 65 The battle against COVID-19 in Syria has just entered its third wave.^{4 5} The first
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10 66 confirmed case was announced on 22 March 2020,⁶ and there had only been 44 cases and 3
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12 67 deaths at the time of the study. These figures are significantly lower than neighbouring
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14 68 countries such as Turkey (127,659 cases and 3,461 deaths), Iran (98,647 and 6,277), Iraq (2,346
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16 69 and 98), Lebanon (740 and 25), and Jordan (465 and 9).⁷ The Syrian healthcare system is
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18 70 severely under-equipped and lacks the capacity to contain such a crisis. The estimated number
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20 71 of intensive care unit (ICU) beds with ventilators is a mere 325, and the theoretical maximum
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22 72 number of cases that can be adequately treated is only 6,500.⁸ Once this maximum threshold
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24 73 (capacity) is exceeded, drastic rationing decisions will have to be made. Therefore, cooperation
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26 74 with and response to guidance from the WHO are of utmost importance. Unprecedented
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28 75 measures have been adopted to control the spread of COVID-19 in Syria.⁸ The public's
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30 76 adherence to these control measures is largely affected by their awareness, knowledge, and
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32 77 attitudes towards disease and outbreaks.^{9 10}
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38 78 The Syrian conflict, now in its 10th year, has resulted in the worst refugee crisis since
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40 79 World War II.¹¹ The devastating impact of war has placed the public health system under
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42 80 constant strain; the numbers of casualties continue to rise, 70% of health care workers (HCW)
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44 81 have fled the country, the annihilation of healthcare facilities, and the “weaponization” of
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46 82 healthcare are ongoing challenges.^{8 12} These challenges along with dense residential areas, the
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48 83 growing prevalence of chronic illness, and 83% of the population living below the poverty line
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50 84 make Syria highly vulnerable to a severe outbreak.^{8 13}
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54 85 While some studies have been conducted to assess the knowledge, attitude, and
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56 86 practices among populations during this pandemic, including one done in China, none have
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58 87 been undertaken in Syria.¹⁴⁻²¹ To our knowledge this first study which aims to measure the
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3 88 awareness and general knowledge of COVID-19 among the Syrian population at a time where
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5 89 ambiguity and misinformation are rampant. The objective of this study is to gauge specific
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7 90 knowledge around clinical features, transmission pathways, and prevention methods, and to
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9 91 identify factors associated with poor knowledge to help facilitate outbreak management in
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11 92 Syria during this rapid global rise of the COVID-19 pandemic. The information gleaned from
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13 93 this research will help with public health programming and response to COVID-19 in Syria as
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15 94 the pandemic continues to unfold.
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23 96 **Methods:**

24 25 26 97 **Study design, setting, and participants:**

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29 98 This web-based cross-sectional survey was conducted between March 31st and April 4th
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31 99 of 2020, during the lockdown period. Ethical approval was obtained from the Institutional
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33 100 Review Board (IRB) of the Faculty of Medicine, Syrian Private University. The inclusion
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35 101 criteria for this study were participants residing in Syria who completed the survey and had no
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37 102 known history of COVID-19 infection. The authors designed questions were modelled after
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39 103 existing awareness surveys, WHO course materials, technical briefs, and question and answer
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41 104 bank on COVID-19 related topics.^{14 15 22-25} Questions from existing awareness surveys that did
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43 105 not target community awareness regarding COVID-19 were excluded from the study.^{14 15} The
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45 106 survey was translated into Arabic and was reviewed by two dialectologists and two infectious
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47 107 disease specialists, who evaluated whether the survey questions effectively assessed COVID-
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49 108 19 knowledge, and checked for double-barrelled and confusing questions, to ascertain validity.
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51 109 We conducted a pilot study on 20 volunteers to assess reliability, clarity, relevance, and the
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53 110 acceptability of the survey. These volunteers were excluded from the final sample to avoid
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55 111 bias. Modifications were made based on feedback received to facilitate better comprehension
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3 112 before distributing the final survey to the general population. The Arabic-language survey was
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5 113 posted on various social media platforms including WhatsApp, Telegram, Instagram, and
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8 114 Facebook targeting various social groups. To avoid non-response bias the survey was
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10 115 distributed during lockdown where the majority of the population were out of work and at
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12 116 home. GIFs and posts were adapted to appeal to each social group; the questions were made
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14 117 short and in the form of multiple choice questions that required no typing. The ability for
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17 118 viewers to comment on the link increased the popularity of the survey. Participants confirmed
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19 119 their voluntary participation by answering a yes-no question, were informed of the option to
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21 120 opt-out of the survey at any time, and were assured of the confidentiality and anonymity of
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24 121 their responses. After confirmation, participants were directed to the first part of the survey to
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26 122 complete questions about socio-demographic information including; age, gender, residence,
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28 123 education level, occupation, and economic status. Participants under the age of 18 required
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30 124 informed parental consent, as well as submission of parent/guardian contact information. The
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33 125 researchers were responsible for contacting the parents/guardians to obtain consent before the
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35 126 child was given access to the survey. The sample size calculated was 2401 participants based
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37 127 on a margin of error of 2%, and a confidence interval of 95%, for a population of 18,284,423
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40 128 people using a sample size calculator (website: <https://www.surveysystem.com/sscalc.htm>).
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42 129 The self-administered survey contained 40 questions divided into 4 sections: general
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44 130 knowledge (10 questions), transmission pathways (7 questions), clinical features (12
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46 131 questions), and prevention methods (11 questions). The survey is available in appendix 1.
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50 132 **Patient and public involvement:**

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53 133 The public were not involved in the study design, conduct of the study, or plans to disseminate
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55 134 the results to study participants.
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135 **Statistical analysis**

136 A scoring system was used to analyse the participants' knowledge: a score of "1" was
137 given for a correct answer and a score of "0" was given for an incorrect answer. The correct
138 answers to the survey were determined from previous surveys and available WHO resources.
139 ^{14 15 22-25} The percentage score for mean knowledge was calculated as follows: sum of scores
140 obtained/maximum scores that could be obtained $\times 100$. Participants' total mean knowledge in
141 all the subsections, and mean knowledge of each subsection were calculated. Data were
142 analysed using the Statistical Package for Social Sciences version 25.0 (SPSS Inc., Chicago,
143 IL, United States) and reported as frequencies and percentages (for categorical variables) or
144 means and standard deviations (SD) (for continuous variables). The t-test was applied to
145 compare mean knowledge scores against both genders, and 3 questions (knowing an infected
146 individual, use of personal belongings, and dissemination of knowledge). The t-test was applied
147 to compare mean knowledge scores against gender. One-way analysis of variance (ANOVA)
148 was applied using f-test to compare mean knowledge scores against socio-demographic
149 variables (age, social status, residence, education level, occupation, economic status, and
150 number of household members), and source of information. Multivariable linear regression
151 analysis using the socio-demographic variables as independent variables (categorical) and
152 mean knowledge score as the outcome variable (continuous) was conducted to identify factors
153 associated with knowledge. Factors were selected with a backward method and were analysed
154 using the unstandardized coefficient (β), and 95% confidence interval. P-values <0.05 were
155 considered statistically significant.

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157 **Results:**

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3 **158 Socio-demographics characteristics:**
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6 **159** Of 4495 total participants who completed the survey, participants with a known history
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8 **160** of COVID-19 infection, residing outside Syria, and who did not fully complete the survey were
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10 **161** excluded. The final sample of 3586 participants (completion rate= 79.8%) consisted of
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12 **162** 2444(68.2%) females and 1142(31.8%) males. Participants aged >20 years were the majority
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14 **163** 1204(33.6%) while participants between 35 and 39 were the minority 186(5.2%). Participant
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16 **164** ages ranged from 12-78 years with a mean of 30 (± 10) years). 2279(63.6%) participants were
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18 **165** single, 1822(50.8%) were unemployed, 1064(29.7%) were smokers, and 428(11.9%) were
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20 **166** alcohol consumers (Table 1). The majority of participants were residents of Damascus/ Rural
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22 **167** Damascus 2019(56.3%) and had attained college/university level education (Figure1).
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28 **168 General Knowledge regarding COVID-19:**
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31 **169** Participants showed a good level of awareness regarding COVID-19 ($75.6 \pm 9.4\%$). An
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33 **170** adequate level of basic knowledge ($67.0 \pm 18.9\%$) was found among participants, 3383(94.3%)
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35 **171** knew that a virus was the causative agent of COVID-19; 2535(70.7%) correctly identified the
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37 **172** incubation period as being between 2 days and 2 weeks. Only 1500(41.8%) believed that an
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39 **173** infection with COVID-19 does not confer lifelong immunity. The majority of participants
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41 **174** 3489(97.3%) were aware that COVID-19 infection in high-risk groups can be fatal. There is
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43 **175** currently insufficient evidence on whether infertility is a complication of COVID-19 infection;
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45 **176** 461(12.9%) participants believed that COVID-19 can cause infertility while 1903(53.0%) did
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47 **177** not. 2986(83.3%), and 2597(72.4%) correctly answered that there are currently no available
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49 **178** vaccine or treatments respectively; however, there were misconceptions about the efficacy of
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51 **179** antibiotics and Ibuprofen as treatments, 1228(34.2%) and 1268(35.3%) respectively (Table 2).
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180 **Transmission, and Signs and Symptoms regarding COVID-19:**

181 There was a fair level of awareness ($70.7 \pm 16.9\%$) regarding COVID-19 transmission
182 pathways. A high level of awareness was demonstrated regarding common transmission
183 pathways: 3521(98.2%), 3387(94.4%), and 3330(92.9%) identified respiratory droplets,
184 touching an infected person's personal belongings, and handshaking respectively. There is
185 currently limited evidence of animal-to-human and sexual transmission; 703(19.6%) did not
186 know if transmission occurs between animals and humans, while 899(25.1%) did not know if
187 the virus is transmitted sexually (Table 2).

188 The data showed a good level of awareness ($76.0 \pm 13.6\%$) regarding clinical features.
189 When asked about the main clinical features, participants correctly identified, fever
190 3563(99.4%), sore throat 3037(84.7%), headache 3186(88.8%), chest pain 3050(85.0%),
191 general pain 3019(84.2%), fatigue 3405(95.0%), and dry cough 3466(96.7%), whereas only
192 1972(55.0%) knew that diarrhea can be a symptom. Only 2221(61.9%) were aware that
193 infected individuals may be asymptomatic (Table 2).

194 **Prevention Methods regarding COVID-19:**

195 The highest level of awareness was in the prevention section ($88.8 \pm 10.2\%$). Washing
196 hands with soap, avoiding crowded areas, remaining at home, and wearing a face mask outside
197 are the principal preventative measures against COVID-19, 3574(99.7%), 3574(99.75%),
198 3554(99.1%), and 3204(89.3%), respectively. A minority of 158(4.4%) believed that cleaning
199 with a mixture of Flash and bleach is a sound preventive measure. Only 2482(69.2%) knew
200 that the flu vaccine offers no protection against COVID-19 (Table 2).

201 **Statistical Analysis of the Data:**

202 A series of one way ANOVA analyses revealed that mean knowledge differed
203 significantly across: gender (p-value=0.009), age (p-value=0.003), social status (p-

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3 204 value=0.042), education level (p-value<0.001), economic status (p-value<0.001), number of
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5 205 household members (p-value<0.001), place of residence (p-value<0.001), and source of
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7 206 information (p-value<0.001) (Table 3). Participants living in Lattakia (77.6%) exhibited the
8
9 207 greatest awareness, whereas those in Ar-Raqqah (71.7%) followed by Deir-ez-Zor (71.8%)
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11 208 exhibited the lowest. The mean knowledge differed across groups that acquired information
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13 209 from different sources, the lowest awareness was among participants who chose family
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15 210 members/friends as one of their source(s) (74.0%), whereas those with the highest awareness
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17 211 acquired their information from lectures as one of their source(s) (78.2%), (Table 3).
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22 212 When participants were asked if they were likely to share new information with friends
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24 213 and family, 3513(98.0%) answered “yes”. There was a significant difference in mean
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26 214 knowledge between those who were inclined to disseminate new information about COVID-
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28 215 19 to friends and family (75.7%) compared with those who were not (72.3%) (p-value=0.002).
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30 216 On exclusive use of personal belongings, 2692(75.1%) answered “yes”. We found no
31
32 217 significant correlation between mean knowledge and participant tendency to share personal
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34 218 belongings with others (p-value=0.112). Of participants who knew someone infected with
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36 219 COVID-19, 65(1.8%) answered “yes”. There was no significant difference in mean knowledge
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38 220 between those who knew an infected individual (75.9%) compared with those who did not
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40 221 (75.6%) (p-value=0.816).
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45 222 **Multiple linear regression:**

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48 223 Multiple linear regression analysis results: male gender (vs. female, β =-0.933, p=0.005);
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50 224 education of secondary school or lower (vs. college/university and above, β =-3.782, p<0.001);
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52 225 careers in government, private, business, military, and “other” sectors, as well as
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54 226 unemployment (vs. health care workers, β =-3.592, p<0.001); poor and moderate economic
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56 227 status (vs. good and excellent, β =-0.669, p<0.040); and over 5 household members (vs. of 1-5,
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3 228 $\beta=-1.737$, $p<0.001$) were associated with significantly poorer knowledge scores (Table 4).
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5 229 Careers in health care (vs. Unemployed, $\beta=3.592$, $p\text{-value}=<0.001$), and the 31-45 age
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7 230 group (vs. 16-30, $\beta=1.511$, $p\text{-value}=0.005$) were associated with significantly higher
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9 231 knowledge scores.
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17 233 **Discussion:**

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20 234 We found an overall mean knowledge score of 75.6%, indicating that most participants
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22 235 were relatively knowledgeable about COVID-19, though less so compared to their counterparts
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24 236 in China (90%).¹⁴ This level of knowledge was unexpected given that only 10 cases of COVID-
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26 237 19 had been confirmed in Syria at the time of the survey.²⁶
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30 238 Poor knowledge was associated with males, non-post-secondary education, non-
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32 239 healthcare occupations, unemployment, poor and moderate economic status, and households
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34 240 with more than 5 members. Similar trends were observed in China.¹⁴ Correlating socio-
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36 241 demographic variables with awareness is critical to public health efforts to mitigate the spread
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38 242 of COVID-19. The data obtained from this study can be leveraged by the Syrian Ministry of
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40 243 Health to tailor prevention and educational campaigns to populations with the widest
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42 244 knowledge gaps.
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46 245 Our study showed a relatively high level of awareness 2535(70.7%) among the
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48 246 population. In the general knowledge section (mean knowledge score 67%), the majority of the
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50 247 participants 3383(94.3%) knew that COVID-19 is caused by a virus. This was similar to a
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52 248 Pakistani study (93.3%).¹⁹ Low awareness of the 2-to-14 day incubation period was found²⁷
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54 249 among dentists (36.1%) and HCW (36.4%) in similar studies.^{15 21} Syria has a relatively young
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56 250 population. Statistical data from 2018 showed that only an estimated 4.5% of the population
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3 251 was over the age of 65.²⁸ 3489(97.3%) knew that COVID-19 infection can be severe and
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5 252 potentially fatal in elderly, chronically ill, and immunodeficient patients. This is higher than in
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7 253 studies conducted in China (73.2%) and India (88.37%).^{14 29} 40.6% of Syrians are hypertensive,
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10 254 yet a staggering 79.8% of them are unaware of their condition. Diabetes is also prevalent,
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12 255 affecting 11.9% of the population.^{30 31} Such a rampant lack of awareness about chronic diseases
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14 256 associated with high mortality in COVID-19 patients underscores the need for targeted
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17 257 awareness campaigns.

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20 258 At the time of the survey, no standardized evidence-based protocols had yet been
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22 259 developed to treat COVID-19 infections; only 2597(72.4%) participants knew that there was
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24 260 no available treatment at that time. This is higher than a Kenyan study (40%) but significantly
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26 261 lower than a Chinese study (94%).^{14 17} A minority 103(2.9%) of participants thought there was
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28 262 a vaccine available against COVID-19, even though vaccines have only become commercially
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30 263 available in the past few months. By contrast, Coimbatore District and Pakistan were less
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32 264 informed, with (18.6%) and (11.6%) respectively believing that such a vaccine was available
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34 265 at the time. In the absence of a vaccine or effective treatment protocol for COVID-19 at the
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36 266 time of the survey, controlling the spread of the disease was the best line of defence, and
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38 267 remains so given the dire shortage of medication, ventilators, ICU capacity, and the continued
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40 268 lack of a vaccine available to the Syrian people. We observed a considerable knowledge gap
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42 269 in 1268(35.3%) with regards to ibuprofen as a treatment option. There is no available evidence
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44 270 to suggest that ibuprofen is effective against COVID-19.³²

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50 271 Participants showed a fair level of awareness regarding transmission pathways (70.7%),
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52 272 very similar to a Pakistani study (70.8%).¹⁹ The majority 3521(98.2%) of participants were
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54 273 aware that respiratory droplets are common transmission vectors; this is similar to a Chinese
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56 274 study (97.8%), but much higher than an Indian study (29.5%).^{14 18} 3330(92.9%) participants

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3 275 identified handshaking as a transmission pathway, higher than a study among Jordanian
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5 276 dentists (85.6%).¹⁵
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8 277 The majority of survey participants were sufficiently aware of the clinical features of
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10 278 COVID-19 (76.0%), similar to a Pakistani study (77.7%).¹⁹ A very high level of awareness of
11
12 279 the most common symptoms was found: fever 3563(99.4%), dry cough 3466(96.7%), fatigue
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14 280 3405(95.0%), and myalgia 3019(84.2%), similar to findings from Chinese (96.4%) and Indian
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16 281 (95.4%) studies.^{14 29} When asked about sore throat, a high level of awareness 3037(84.7%) was
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18 282 found compared to studies from India (15.2%) and among dentists in Jordan (28.5%).^{15 18}
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20 283 Knowledge about diarrhea as a symptom was lacking: only 1972(55.0%); a study among
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22 284 dentists also showed low awareness (39.9%).^{15 18} While infected individuals are frequently
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24 285 asymptomatic, or present with mild symptoms, around 1 in every 5 infections can be
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26 286 serious enough to require hospitalisation.^{33 34} Only 2221(61.9%) participants were aware that
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28 287 infected individuals can be asymptomatic, while a study among dentists (34.5%) reported much
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30 288 lower awareness. Increasing public awareness about the variability of symptoms is particularly
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32 289 important since those with mild or unreported symptoms may significantly contribute to the
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34 290 transmission of COVID-19. The lack of health insurance, paid sick leave, telecommuting, or
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36 291 other social and professional safety nets increase the likelihood that these “silent spreaders”
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38 292 will underreport symptoms for fear of being forced to miss work.
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44 293 We found a high level of awareness in the preventive methods section (88.8%), similar
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46 294 to a Pakistani study (85%).¹⁹ Hand hygiene has been known to be an important element of
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48 295 infection control since the 14th century.³⁵ Implementing hand-washing techniques can break
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50 296 the transmission cycle and reduce the risk of infection by 6%-44%.³⁶ Almost all 3574(99.7%)
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52 297 participants were aware that washing hands with soap and water is an important preventive
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54 298 measure against COVID-19. This finding is in accordance with studies from Joran (97.0%),
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56 299 and India (96.2%, and 87%).^{15 18 21}
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3 300 This year the WHO recommended that the following mitigation measures be
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5 301 implemented during the holy month of Ramadan: cancelling social and religious gatherings,
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7 302 holding events outdoors for adequate ventilation, physical distancing of at least 1 meter
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9 303 between people, and the use of technology to broadcast ceremonies on television.^{37 38} The
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11 304 majority 3574(99.7%) identified avoiding mass gatherings as a preventive measure; studies in
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13 305 China (98.6%) and Coimbatore District (97.7%) reported similar awareness.^{14 29} Cheap and
14
15 306 efficient interventions such as N95 (filtration capacity=95%) have a 91% effectiveness of
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17 307 blocking pathogen transmission.³⁹ 3204(89.3%) participants considered wearing a face mask
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19 308 when leaving home as an effective prevention method, compared with a Coimbatore District
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21 309 study (93.02%).²⁹

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26 310 Since Syrian society is particularly vulnerable to COVID-19, this knowledge gap is
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28 311 potentially dangerous and should be addressed to mitigate disease spread. Only 2482(69.2%)
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30 312 knew that the flu vaccine offers no protection against COVID-19; this is similar to a
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32 313 Coimbatore District study (67.4%), but lower than a study amongst HCWs (90.7%).^{21 29}
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34 314 3305(92.2%) were aware that individuals showing symptoms should quarantine themselves,
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36 315 lower than in China (98.2%) and India (95.8%).^{14 18}

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40 316 North-East Syria (NES) has a population of over 4 million people, 600,000 of whom
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42 317 are internally displaced refugees, 100,000 of whom live in overcrowded camps: only 2 of
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44 318 NES's 11 hospitals are currently functioning. NES consists of 3 governorates: Ar-Raqqah,
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46 319 Deir-ez-Zor, and Al-Hasakah. With only 22 ICU beds, (18 in Al-Hasakah, 4 in Ar-Raqqah, and
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48 320 none in Deir-ez-Zor), the maximum capacity threshold is only 80 COVID-19 cases. Ar-Raqqah
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50 321 and Deir-ez-Zor, the most vulnerable governorates, also showed the lowest awareness in the
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52 322 study (71.7%), and (71.8%). This is a potentially catastrophic situation, and a concern to the
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54 323 international community, as an unmonitored, uncontrolled outbreak in NES can prolong the
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56 324 global pandemic.

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9 327 **Limitations:**

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12 328 Our findings may not be generalized to the wider Syrian population. The authors used
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14 329 a convenience sampling strategy involving various social media platforms. Credible
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16 330 published national data regarding the socio-demographic characteristics of Syrians are not
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18 331 available to evaluate the representativeness of our sample. Syrians vulnerable to COVID-19,
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20 332 such as the elderly and rural residents, are more likely to exhibit poor knowledge and
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22 333 awareness due to limited internet access. As such, reaching out to these populations must be
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24 334 prioritized. Even though all Syrian governorates were represented in this study, most
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26 335 participants lived in Damascus and Rural Damascus. Furthermore, an assessment of the
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28 336 Syrian population's practices relating to COVID-19 and the attitudes driving them is
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30 337 necessary to complete the picture.
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40 339 **Conclusion:**

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43 340 COVID-19 has been a dire warning to humanity about the fragility of its social,
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45 341 economic, and healthcare institutions. Our study revealed good public awareness of clinical
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47 342 features and preventive measures. However general knowledge and knowledge about
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49 343 transmission pathways was suboptimal. Syrians of good socio-economic status, in particular
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51 344 young well-educated women, have shown good knowledge. Our national response must adapt
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53 345 to the growing threat of COVID-19 by adopting public awareness strategies and behaviours to
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55 346 contain the disease both within and beyond our borders.
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3 348 **Abbreviations:** COVID-19: Coronavirus Disease 2019; MERS: Middle East Respiratory
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5 349 Syndrome; SARS: Severe Acute Respiratory Syndrome; WHO: World Health Organization;
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7 350 PHEIC: Public Health Emergency of International Concern; ICU: Intensive care unit; IRB:
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9 351 Institutional Review Board; SPSS: Statistical Package for Social Sciences; SD: Standard
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11 352 Deviation; HCW: Health Care Worker.
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20 354 **Acknowledgments:**
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22
23 355 We are thankful to the management of the Syrian Private University for the support in
24
25 356 the field of medical training and research. We are thankful to everyone who participated in this
26
27 357 study and to Mrs. Marah Marrawi for her statistical help. We would also like to thank Mr Rod
28
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38
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40
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47 364 **Availability of data and materials:**
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50 365 All data related to this paper's conclusion are available and stored by the authors. All
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52 366 data are available from the corresponding author on a reasonable request.
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58 368 **Declarations:**
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3 369 **Ethics approval and consent to participate:**

4 370 This study was approved by the Institutional Review Board (IRB) at the Syrian Private
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7 371 University (SPU). The IRB at SPU did not provide us with a number/ID. All Participants
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9 372 confirmed their written consent by answering a yes-no question. Participants under the age of
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11 373 18 required verbal informed parental consent, as well as submission of parent/guardian contact
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13 374 information. The researchers were responsible for contacting the parents/guardians to obtain
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15 375 verbal consent before the child was given access to the survey. The verbal and written form of
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17 376 consent was approved by the IRB at SPU. Participation in the study was voluntary and
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19 377 participants were assured that anyone who was not inclined to participate or decided to
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21 378 withdraw after giving consent would not be victimized. All information collected from this
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23 379 study was kept strictly confidential.

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28 380 **Consent for Publication:**

29 381 Not applicable.

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31 382 **Competing interests:**

32 383 The authors declare that they have no competing interests.

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35 384 **Authors' contributions:**

36 385 FM conceptualized the study, participated in the design, wrote the study protocol,
37
38 386 performed the statistical analysis, did a literature search, and drafted the manuscript. BB
39
40 387 participated in study design, did a literature search, and drafted the manuscript. HA, and NA
41
42 388 did a literature search and revision of the draft. All authors read and approved the final draft.
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50 390 **Tables and Figures:**

51
52 391 **Table 1.**

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57 **Table 1. Socio-demographic characteristics: (n=3586)**
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Gender (%)	Male	1142(31.8)	Education (%)	Primary School	25(0.7)	
	Female	2444(68.2)		Intermediate School	166(4.6)	
Age (%)	<20	1204(33.6)		Secondary school	375(10.4)	
	20-24	1104(30.8)		College/University	2839(79.2)	
	25-29	446(12.4)		Master's degree	157(4.4)	
	30-34	266(7.4)		PhD	24(0.7)	
	35-39	186(5.2)		Occupation (%)	Health care worker	634(17.7)
	>39	380(10.6)			Government institution	283(7.9)
Social Status (%)	Single	2279(63.5)			Private institution	182(5.1)
	In a relationship	286(8.0)		Business	198(5.5)	
	Married	943(26.3)		Military	32(0.9)	

	Divorced	46(1.3)		Unemployed	1822(50.8)
	Widowed	32(0.9)		Other	435(12.1)
Economic Status (%)	1Poor	247(6.9)	Household members (%)	0	46(1.3)
	2Moderate	1247(34.8)		1-5	2751(76.7)
	3Good	1761(49.1)		>5	789(22)
	4Excellent	331(9.2)			

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394 ¹Poor: income does not provide essential needs for the family. ²Moderate: income provides essential
 395 needs for the family but no more. ³Good: income provides essential needs and some luxury
 396 requirements. ⁴Excellent: income provides luxury requirements.

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398 **Table 2.**

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Table 2. General Knowledge, Transmission, Signs and Symptoms, and Prevention of COVID-19: (n=3586)

General Knowledge					
Causative Agent N(%)	Virus	3383(94.3)	Incubation period N(%)	1 Minute to 1 Hour	18(0.5)
	Bacteria	39(1.1)		1 Hour to	58(1.6)

				2 Days	
	Parasite	8(0.2)		2 Days to 2 Weeks	2535(70.7)
	Immune deficiency	46(1.3)			
	Fungus	0(0.0)		2 Weeks to 1 Month	958(26.7)
	Inherited	2(0.1)			
	Do Not Know	108(3.0)		>1 Month	17(0.5)
		YES(%)	NO(%)	DO NOT KNOW(%)	
Can infection with COVID-19 confer permanent immunity?		815(22.7)	1500(41.8)	1271(35.5)	
Can COVID-19 cause severe illness and lead to death in elderly, chronically ill, and immunodeficient patients?		3489(97.3)	28(0.8)	69(1.9)	
Can COVID-19 cause infertility?		461(12.9)	1222(34.1)	1903(53.0)	
Is COVID-19 teratogenic (i.e. cause malformations/ abnormalities to an embryo/fetus)?		157(4.4)	1433(40.0)	1996(55.6)	
Is there no available treatment against COVID-19?		2597(72.4)	515(14.4)	474(13.2)	

Can COVID-19 be treated with antibiotics?	1228(34.3)	1790(49.9)	568(15.8)
Can COVID-19 be treated with Ibuprofen?	1268(35.3)	1921(53.6)	397(11.1)
Are there available COVID-19 vaccines?	103(2.9)	2986(83.3)	497(13.8)
Transmission Pathways			
Respiratory droplets (from coughing or sneezing)	3521(98.2)	21(0.6)	44(1.2)
Handshaking	3330(92.9)	189(5.3)	67(1.8)
Touching an infected person's personal belongings	3387(94.4)	131(3.7)	68(1.9)
Animals-to-human	910(25.4)	1973(55.0)	703(19.6)
Undercooked food	1301(36.3)	1734(48.3)	551(15.4)
Sexual contact	1210(33.7)	1477(41.2)	899(25.1)
Horizontal transmission	1130(31.5)	1160(32.4)	1296(36.1)
Signs and Symptoms			
Fever	3563(99.4)	9(0.2)	14(0.4)
Sneezing	2353(65.6)	1000(27.9)	233(6.5)
Sore throat	3037(84.7)	358(10.0)	191(5.3)

Headache	3186(88.8)	190(5.3)	210(5.9)
Chest pain	3050(85.0)	254(7.1)	282(7.9)
Body aches (generalized pain)	3019(84.2)	260(7.2)	307(8.6)
Fatigue	3405(95.0)	72(2.0)	109(3.0)
Diarrhea	1972(55.0)	971(27.1)	643(17.9)
Dry cough	3466(96.7)	44(1.2)	76(2.1)
Productive cough	458(12.8)	2586(72.1)	542(15.1)
Bleeding	130(3.6)	2613(72.9)	843(23.5)
Asymptomatic	2221(61.9)	375(10.5)	990(27.6)
Prevention Methods			
Does wearing a face mask outside the home offer protection from COVID-19?	3204(89.3)	314(8.8)	68(1.9)
Does washing hands with soap and water offer protection from COVID-19?	3574(99.7)	5(0.1)	7(0.2)
Does avoiding crowded places offer protection from COVID-19?	3574(99.7)	4(0.1)	8(0.2)
Does the flu vaccine offer protection from COVID-19?	331(9.2)	2482(69.2)	773(21.6)

Does staying at home offer protection from COVID-19?	3554(99.1)	15(0.4)	17(0.5)
Does using hand sanitizer offer protection from COVID-19?	3430(95.6)	104(2.9)	52(1.5)
Does cleaning household surfaces with bleach offer protection from COVID-19?	3408(95.0)	110(3.1)	68(1.9)
Does cleaning fruits and vegetables with soap and water offer protection from COVID-19?	3262(90.9)	221(6.2)	103(2.9)
Does cleaning surfaces with a mixture of Flash and bleach offer a safe protection from COVID-19?	158(4.4)	3301(92.1)	127(3.5)
Does the quarantine of symptomatic individuals protect others from COVID-19?	3305(92.2)	241(6.7)	40(1.1)
Do cumin, anise, and mint offer protection from COVID-19?	1041(29.0)	1934(53.9)	611(17.1)

401 **Table 3.**

Table 3. Mean knowledge score of participants by demographic variables, and source of information (one way ANOVA), (n= 3586)

Characteristics		Number of participants (%)	Mean Knowledge Score (\pm SD%)	F-test/ T-test	P-value
Gender	Male	1142(31.8)	75.0(\pm 10.1)	-2.625	0.009*
	Female	2444(68.2)	75.9(\pm 9)		
Age-group (years)	<20	1204(33.6)	75.0(\pm 9.9)	2.990	0.011*
	20-24	1104(30.8)	76.4(\pm 9.3)		
	25-29	446(12.4)	76.0(\pm 9.4)		
	30-34	266(7.4)	75.4(\pm 9.4)		
	35-39	186(5.2)	76.1(\pm 7.6)		
	>39	380(10.6)	75.1(\pm 8.6)		
Social	Single	2279(63.5)	75.8(\pm 9.3)	2.485	0.042*

status	In a relationship	286(8.0)	76.6(±8.6)		
	Married	943(26.3)	75.1(±9.4)		
	Divorced	46(1.3)	73.9(±8.8)		
	Widowed	32(0.9)	73.4(±15.9)		
Residence	Urban	2426(67.7)	75.8(±9.3)	1.652	0.099
	Rural	1160(32.3)	75.3(±9.6)		
Education	Primary school	25(0.7)	66.5(±12.4)	26.176	<0.001*
	Intermediate school	166(4.6)	73.2(±9.3)		
	Secondary school	375(10.4)	70.0(±13)		
	College/University	2839(79.2)	76.3(±8.9)		

	Master's degree	157(4.4)	77.2(±9.7)		
	PhD	24(0.7)	76.6(±8.5)		
Occupation	Health care worker	634(17.7)	78.6(±8.6)	16.379	<0.001*
	Government institution	283(7.9)	75.7(±7.9)		
	Private institution	182(5.1)	75.5(±9)		
	Business	198(5.5)	73.4(±10.2)		
	Military	32(0.9)	71.2(±15.6)		
	Unemployed	1822(50.8)	75.3(±9.2)		

	Other	435(12.1)	74.0(±10.2)		
Economic status	Excellent	331(9.2)	76.6(±11.1)	7.108	<0.001*
	Good	1761(49.1)	76.2(±9.4)		
	Moderate	1247(34.8)	74.9(±9)		
	Poor	247(6.9)	74.3(±9.3)		
Household members	0	46(1.3)	74.4(±10.6)	15.451	<0.001*
	1-5	2751(76.7)	76.1(±9)		
	>5	789(22.0)	74.0(±10.2)		
Source of information	Health websites	2823(78.7%)	76.4(±8.7)	24.523	<0.001*
	Social media	1998(55.7%)	74.6(±9.6)		

	Television/ radio	1572(43.8%)	75.5(±9)		
	Family members/ friends	528(14.7%)	74.0(±10.3)		
	Lectures	517(14.4%)	78.2(±7.5)		
	Magazines/ books	266(7.4%)	77.6(±8.8)		

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Table 4.

Table 4. Multiple linear regression on variables associated with poor COVID-19 knowledge

Variable	Coefficient	Standard error	t	P
Male gender (reference: female)	-0.933	0.334	-2.794	0.005*
education of secondary school or lower (reference: college/university and above)	-3.782	0.466	-8.125	<0.001*

careers in government, private, business, military, and “other” sectors, as well as unemployment (reference: health care workers)	-3.592	0.474	-7.579	<0.001*
poor and moderate economic status (reference: good and excellent)	-0.669	0.325	-2.057	0.040*
>5 household members (reference: of 1-5)	-1.737	0.374	-4.648	<0.001*

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405 **Figures and tables legends:**

406 **Table 1.** Sociodemographic characteristics

407 **Table 2.** General Knowledge, Transmission, Signs and Symptoms, and Prevention around
408 COVID-19

409 **Table 3.** Mean knowledge score of participants by demographic variables

410 **Table 4.** Multiple linear regression on variables associated with poor COVID-19 knowledge

411 **Figure 1.** Distribution of participants according to governorates and education level

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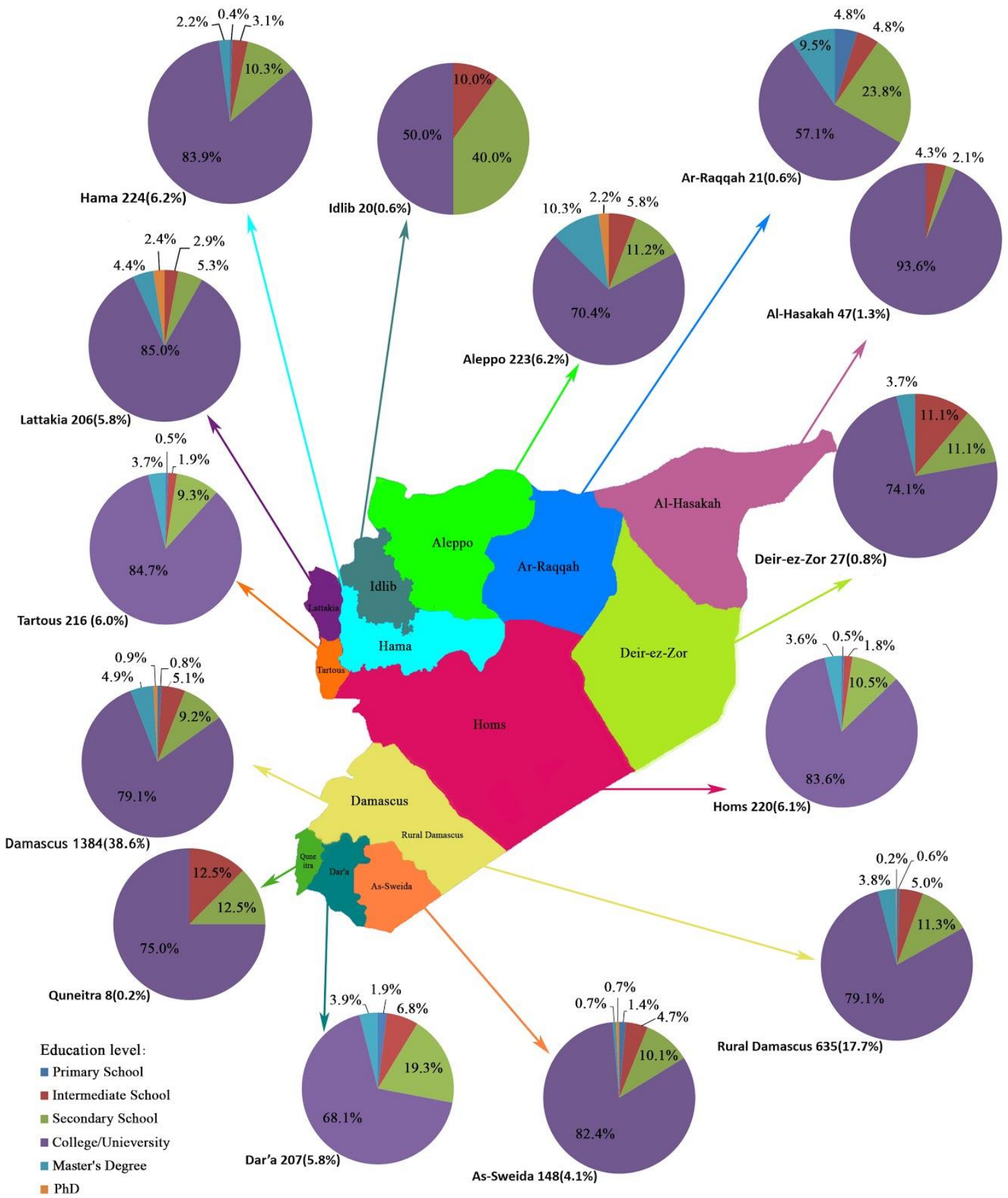


Figure 1. Distribution of participants according to governorates and education level

1 **Attached Survey:**

2 **Appendix 1**

Socio-demographic Characteristics	
Age (years): <input type="checkbox"/> Below 15 <input type="checkbox"/> 15-20 <input type="checkbox"/> 20-30 <input type="checkbox"/> 30-50 <input type="checkbox"/> 40-50 <input type="checkbox"/> 50-60 <input type="checkbox"/> 60-70 <input type="checkbox"/> Above 70	Gender: <input type="checkbox"/> Male <input type="checkbox"/> Female
Marital status: <input type="checkbox"/> Single <input type="checkbox"/> Relationship <input type="checkbox"/> Married <input type="checkbox"/> Divorced <input type="checkbox"/> Widowed	Educational level: <input type="checkbox"/> Primary school <input type="checkbox"/> Intermediate school <input type="checkbox"/> Secondary school <input type="checkbox"/> University/College <input type="checkbox"/> Master's Degree <input type="checkbox"/> PHD Degree
Occupation: <input type="checkbox"/> Health care worker <input type="checkbox"/> Government institution <input type="checkbox"/> Private institution <input type="checkbox"/> Business <input type="checkbox"/> Military <input type="checkbox"/> Unemployed <input type="checkbox"/> Other	Residence: <input type="checkbox"/> Damascus/Rural Damascus <input type="checkbox"/> Hama <input type="checkbox"/> Aleppo <input type="checkbox"/> Homs <input type="checkbox"/> Tartous <input type="checkbox"/> Lattakia <input type="checkbox"/> Dara'a <input type="checkbox"/> As-Sweida <input type="checkbox"/> Al Hasakah <input type="checkbox"/> Deir-ez-Zor <input type="checkbox"/> Idlib <input type="checkbox"/> Ar-Raqqah <input type="checkbox"/> Quneitra
Area: <input type="checkbox"/> Rural <input type="checkbox"/> Urban	Economic Status: <input type="checkbox"/> Excellent <input type="checkbox"/> Good <input type="checkbox"/> Moderate <input type="checkbox"/> Poor
Do you smoke? <input type="checkbox"/> Yes <input type="checkbox"/> No	Do you drink alcohol? <input type="checkbox"/> Yes <input type="checkbox"/> No
How many people do you live with? <input type="checkbox"/> Alone <input type="checkbox"/> 1-5 <input type="checkbox"/> 6-10 <input type="checkbox"/> 11-15 <input type="checkbox"/> 16-20 <input type="checkbox"/> Above 20	
Do you share toiletries/personal care products with others? <input type="checkbox"/> Yes <input type="checkbox"/> No	
Do you know anyone infected with COVID-19? <input type="checkbox"/> Yes <input type="checkbox"/> No	

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57 **Table 2. General Knowledge about COVID-19**

What is COVID-19? <input checked="" type="checkbox"/> Virus <input type="checkbox"/> Parasite <input type="checkbox"/> Immunodeficiency <input type="checkbox"/> Do not know <input type="checkbox"/> Bacteria <input type="checkbox"/> Fungus <input type="checkbox"/> Inherited	Do you know how long after being infected with COVID-19 can a person suffer from signs and symptoms? <input type="checkbox"/> 1 Minute to 1 Hour <input type="checkbox"/> 1 Hour to 2 Days <input checked="" type="checkbox"/> 2 Days to 2 weeks <input type="checkbox"/> 2 Weeks to 1Month <input type="checkbox"/> Over a 1 month		
Can an infection with COVID-19 confer permanent immunity (once infected with COVID-19 you cannot contract another infection)? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Do not know			
Can COVID-19 cause severe illness and lead to death in elderly, chronically ill (hypertension, diabetes, asthma . . .), and those who have compromised immune systems? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Do not know			
Can COVID-19 cause infertility? <input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Do not know			
Is COVID-19 teratogenic (i.e. cause malformations/abnormalities to an embryo/fetus)? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Do not know			
Treatment for COVID-19			
	Yes	No	Do Not Know
No treatment available	✓		
Antibiotics		✓	
Ibuprofen		✓	
Is there an available vaccine for COVID-19? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Do not know			

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Table 3. Transmission Pathways			
	Yes	No	Do Not Know
Can COVID-19 be transmitted via respiratory droplets (coughing or sneezing) of infected individuals?	✓		
Can COVID-19 be transmitted after shaking-hands with an infected individual?	✓		

Can COVID-19 be transmitted after touching an infected individual's personal belongings?	✓		
Can COVID-19 be transmitted from animals to humans?			✓
Can COVID-19 be transmitted via undercooked food?			✓
Can COVID-19 be transmitted via sexual contact?			✓
Can COVID-19 be transmitted via vertical transmission (mother to fetus)?	✓		

Table 4. Signs and Symptoms of COVID-19

	True	False	Do Not Know
Is fever/temperature among the signs and symptoms of COVID-19?	✓		
Is sneezing among the signs and symptoms of COVID-19?	✓		
Is sore throat among the signs and symptoms of COVID-19?	✓		
Is headache among the signs and symptoms of COVID-19?	✓		
Is Chest pain among the signs and symptoms of COVID-19?	✓		
Is body aches (generalized pain) among the signs and symptoms of COVID-19?	✓		
Is fatigue among the signs and symptoms of COVID-19?	✓		
Is diarrhea among the signs and symptoms of COVID-19?	✓		
Is a runny nose among the signs and symptoms of COVID-19?	✓		
Is dry cough among the signs and symptoms of COVID-19?	✓		
Is productive cough among the signs and symptoms of COVID-19?	✓		
Is bleeding among the signs and symptoms of COVID-19?		✓	
Can a person be infected with COVID-19 and have no signs and symptoms?	✓		

Table 5. Prevention Methods

	True	False	Do Not Know
Does wearing a face mask outside the home offer protection from COVID -19?	✓		
Does washing hands with soap and water offer protection from COVID-19?	✓		
Does avoiding crowded places offer protection from COVID -19?	✓		
Does the flu vaccine offer protection from COVID -19?		✓	
Does staying at home offer protection from COVID -19?	✓		
Does using hand sanitizer offer protection from COVID -19?	✓		
Does using bleach to clean household surfaces prevent COVID-19 infection?	✓		
Does cleaning fruits and vegetables with soap and water offer protection from COVID-19?	✓		
Does cleaning surfaces with a mixture of Flash and bleach offer protection from COVID -19?		✓	
Does the quarantine of symptomatic individuals protect others from COVID -19?	✓		
Do cumin, anise, and mint offer protection from COVID -19?		✓	
What is your main source of information about COVID-19? (You may choose more than one option) <input type="checkbox"/> Internet (social media platforms) <input type="checkbox"/> Internet (Official websites like world health organization) <input type="checkbox"/> TV/Radio <input type="checkbox"/> Friends/Member of family <input type="checkbox"/> Magazines/Books <input type="checkbox"/> Lectures			
If you had new information about COVID-19 would you share it with friends and family to raise awareness? <input type="checkbox"/> Yes <input type="checkbox"/> No			

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For peer review only

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	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2,3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5,6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	6,7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6,7
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	6,7
		(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	Not applicable
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	-
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	Not applicable
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	8
		(b) Describe any methods used to examine subgroups and interactions	8
		(c) Explain how missing data were addressed	Not applicable (no missing data)
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up	8

1
2 was addressed

3 *Case-control study*—If applicable, explain how matching of cases
4 and controls was addressed

5 *Cross-sectional study*—If applicable, describe analytical methods
6 taking account of sampling strategy

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8 € Describe any sensitivity analyses -
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Results			Page No.
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	9
		(b) Give reasons for non-participation at each stage	-
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9
		(b) Indicate number of participants with missing data for each variable of interest	Not applicable
		© <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	Not applicable
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	-
		<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	29-35
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	34,35
		(b) Report category boundaries when continuous variables were categorized	29-33
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not applicable
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	13-15
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	16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	17
Generalisability	21	Discuss the generalisability (external validity) of the study results	16
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	17

*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.