

# A Global Map of COVID-19 Vaccine Acceptance Rates per Country: An Updated Concise Narrative Review

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**Abstract:** The delay or refusal of vaccination, which defines vaccine hesitancy, is a major challenge to successful control of COVID-19 epidemic. The huge number of publications addressing COVID-19 vaccine hesitancy necessitates periodic review to provide a concise summary of COVID-19 vaccine acceptance rates worldwide. In the current narrative review, data on COVID-19 vaccine acceptance rates were retrieved from surveys in 114 countries/territories. In East and Southern Africa (n = 9), the highest COVID-19 vaccine acceptance rate was reported in Ethiopia (92%), while the lowest rate was reported in Zimbabwe (50%). In West/Central Africa (n = 13), the highest rate was reported in Niger (93%), while the lowest rate was reported in Cameroon (15%). In Asia and the Pacific (n = 16), the highest rates were reported in Nepal and Vietnam (97%), while the lowest rate was reported in Hong Kong (42%). In Eastern Europe/Central Asia (n = 7), the highest rates were reported in Montenegro (69%) and Kazakhstan (64%), while the lowest rate was reported in Russia (30%). In Latin America and the Caribbean (n = 20), the highest rate was reported in Mexico (88%), while the lowest rate was reported in Haiti (43%). In the Middle East/North Africa (MENA, n = 22), the highest rate was reported in Tunisia (92%), while the lowest rate was reported in Iraq (13%). In Western/Central Europe and North America (n = 27), the highest rates were reported in Canada (91%) and Norway (89%), while the lowest rates were reported in Cyprus and Portugal (35%). COVID-19 vaccine acceptance rates  $\geq 60\%$  were seen in 72/114 countries/territories, compared to 42 countries/territories with rates between 13% and 59%. The phenomenon of COVID-19 vaccine hesitancy appeared more pronounced in the MENA, Europe and Central Asia, and Western/Central Africa. More studies are recommended in Africa, Eastern Europe and Central Asia to address intentions of the general public to get COVID-19 vaccination.

**Keywords:** SARS-CoV-2, vaccine hesitance, vaccine resistance, vaccine rejection, willingness to vaccinate, intention to vaccinate

## Introduction

The prevention of infectious diseases through vaccination can be considered as one of the most important achievements of modern science.<sup>1</sup> However, the availability of vaccines and vaccination services per se does not guarantee achieving the desired effect of alleviating the burden of infectious diseases.<sup>2,3</sup> One major challenge to vaccination success is the phenomenon of vaccine hesitancy, which can be defined as “the reluctance or rejection of getting the vaccines despite the availability of vaccination services”.<sup>4,5</sup> Vaccine hesitancy accompanied the early days of vaccination modern inception in the 1800s, as reviewed comprehensively by Eve Dubé et al.<sup>6</sup>

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Vaccine hesitancy is time, place and context-specific phenomenon that can be addressed with multicomponent and dialogue-based interventions, carefully tailored according to the target population.<sup>4,7,8</sup> The potential factors that can drive vaccine hesitancy are mostly related to lack of confidence in safety and effectiveness of vaccination; inconvenience (difficulty in affordability and accessibility to vaccination); and complacency (entailing low perception of disease risks).<sup>4,5,9</sup>

The manifestations of vaccine hesitancy appeared to be more pronounced amid the ongoing coronavirus disease 2019 (COVID-19) pandemic, considering the relatively rapid spread of misinformation/disinformation with embrace of conspiracy beliefs associated with the pandemic.<sup>10–13</sup> The issue of COVID-19 vaccine hesitancy/rejection requires a special attention in the global collaborative efforts aiming to control the ongoing serious pandemic.<sup>14–16</sup>

Several vaccines based on different technologies have been approved for use to prevent severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection.<sup>17,18</sup> The currently approved COVID-19 vaccines have been shown to display excellent safety and efficacy profiles in various settings.<sup>19,20</sup> A majority of these vaccines (eg, Pfizer-BioNTech COVID-19 vaccine (tozinameran), Moderna COVID-19 vaccine, Oxford-AstraZeneca COVID-19 vaccine) helped to reduce the incidence and severity of SARS-CoV-2 infection.<sup>21</sup> Possible challenges to successful COVID-19 vaccination campaigns include unequal distribution globally, and continued emergence of SARS-CoV-2 lineages (variants) with immune escape capability.<sup>22,23</sup> Furthermore, COVID-19 vaccine hesitancy continues to present a serious threat to the efforts aimed to control the ongoing pandemic.<sup>24</sup>

A previous systematic review had investigated COVID-19 vaccine acceptance rates worldwide based on survey studies by December 2020.<sup>25</sup> This review showed the large scope of the problem, particularly in the Middle East and North Africa (MENA), with a lack of studies in Africa, the Caribbean and Latin America.<sup>25</sup>

In this narrative review, the aim was to provide an updated concise perspective on the status of COVID-19 vaccine acceptance rates worldwide. This objective appears crucial, considering the huge number of publications investigating COVID-19 vaccine acceptance/hesitancy from different countries/territories and regions of the world. Thus, an updated review appears necessary to describe the patterns of this phenomenon which may

threaten the efforts needed to lessen the devastating effect of COVID-19 pandemic.

## Materials and Methods

In this review, a total of 175 different countries/territories were classified into seven regions as follows (for convenience, this classification was based on The Joint United Nations Programme on HIV/AIDS (UNAIDS) regional classification with minor modifications; <https://www.unaids.org/en/regionscountries/regions>): Eastern and Southern Africa (21 countries), Western and Central Africa (25 countries), Asia and the Pacific (29 countries), Eastern Europe and Central Asia (17 countries), Latin America and the Caribbean (27 countries), Middle East and North Africa (23 countries), and Western/Central Europe and North America (33 countries, Figure 1).

Then, the search for the literature investigating COVID-19 vaccine acceptance/hesitancy rates in each country/region was based mainly on MEDLINE/PubMed and Google Scholar, besides a Google search for published reports on the review topic.

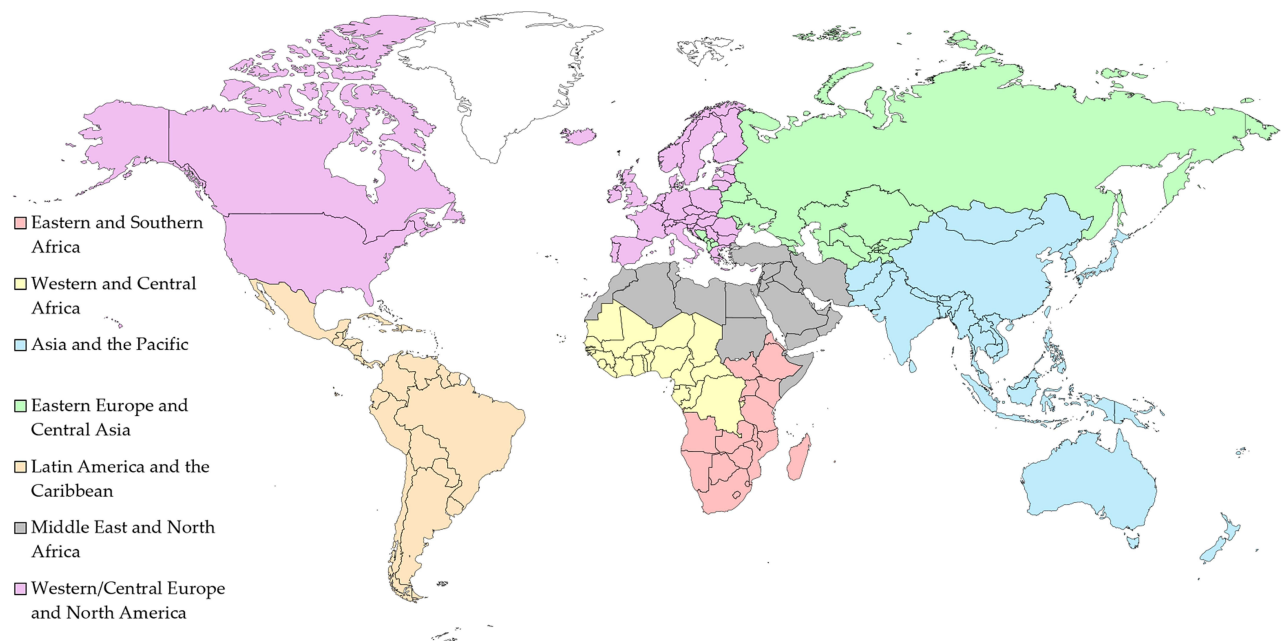
The inclusion criteria were as follows: 1) peer-reviewed published articles, preprints or reports reporting the results of surveys, or research studies among the general population, health-care workers, students, or parents/guardians, with the major aim being the investigation of COVID-19 vaccine acceptance/hesitancy; and 2) English as the publication language.

For the final assignment in the global map of COVID-19 vaccine acceptance rates per country, if multiple studies were found from a single country, the priority was given to surveys conducted at a country level (rather than a city or region). The priority was also given to surveys conducted among the general population; however, if no studies from the general population were found, then we opted to use the results of surveys conducted among healthcare workers or students.

## Results

### Eastern and Southern Africa

Out of 21 countries in Eastern and Southern Africa region, COVID-19 vaccine acceptance rates were found only in nine countries (Figure 2). Data were found from Ethiopia, Kenya, Malawi, Mozambique, Rwanda, South Africa, Uganda, Zambia, and Zimbabwe, while no data were found from Angola, Botswana, Comoros, Eritrea, Eswatini, Lesotho,



**Figure 1** The classification of countries into seven world regions which formed the basis for this narrative review. Countries/territories in white color were not screened in the review. The map was generated in Microsoft Excel, powered by Bing. © GeoNames, Microsoft, Navinfo, TomTom, Wikipedia. We are neutral with regard to jurisdictional claims in this map.

Madagascar, Mauritius, Namibia, Seychelles, South Sudan, and Tanzania.

### Ethiopia

A comprehensive phone survey of households with 2178 participants was conducted in February 2021 at the country level.<sup>26</sup> This study indicated a very high rate of COVID-19 vaccine acceptance (92.3%), if vaccination was available for free.<sup>26</sup> Another interviewer-administered questionnaire that was conducted in March 2021, among 492 participants in Gurage zone, Ethiopia, showed a lower intention to get COVID-19 vaccination (62.6%).<sup>27</sup> Another interviewer-administered questionnaire study with 415 participants from Sodo, south-central Ethiopia in April 2021 showed an even lower rate for COVID-19 vaccine acceptance (45.5%).<sup>28</sup> For healthcare workers, a self-administered questionnaire study that involved more than 400 participants in public hospitals in southwestern Ethiopia in March 2021, showed an intention to get COVID-19 vaccination among 48.4% of the participants.<sup>29</sup> Ethiopia was part of a large multinational survey conducted by the Africa Centres for Disease Control and Prevention (Africa CDC), and this survey involved 1001 participants using telephone interviewing during September–October 2020, which reported an acceptance rate for COVID-19 vaccination of 94.0%.<sup>30</sup>

### Kenya

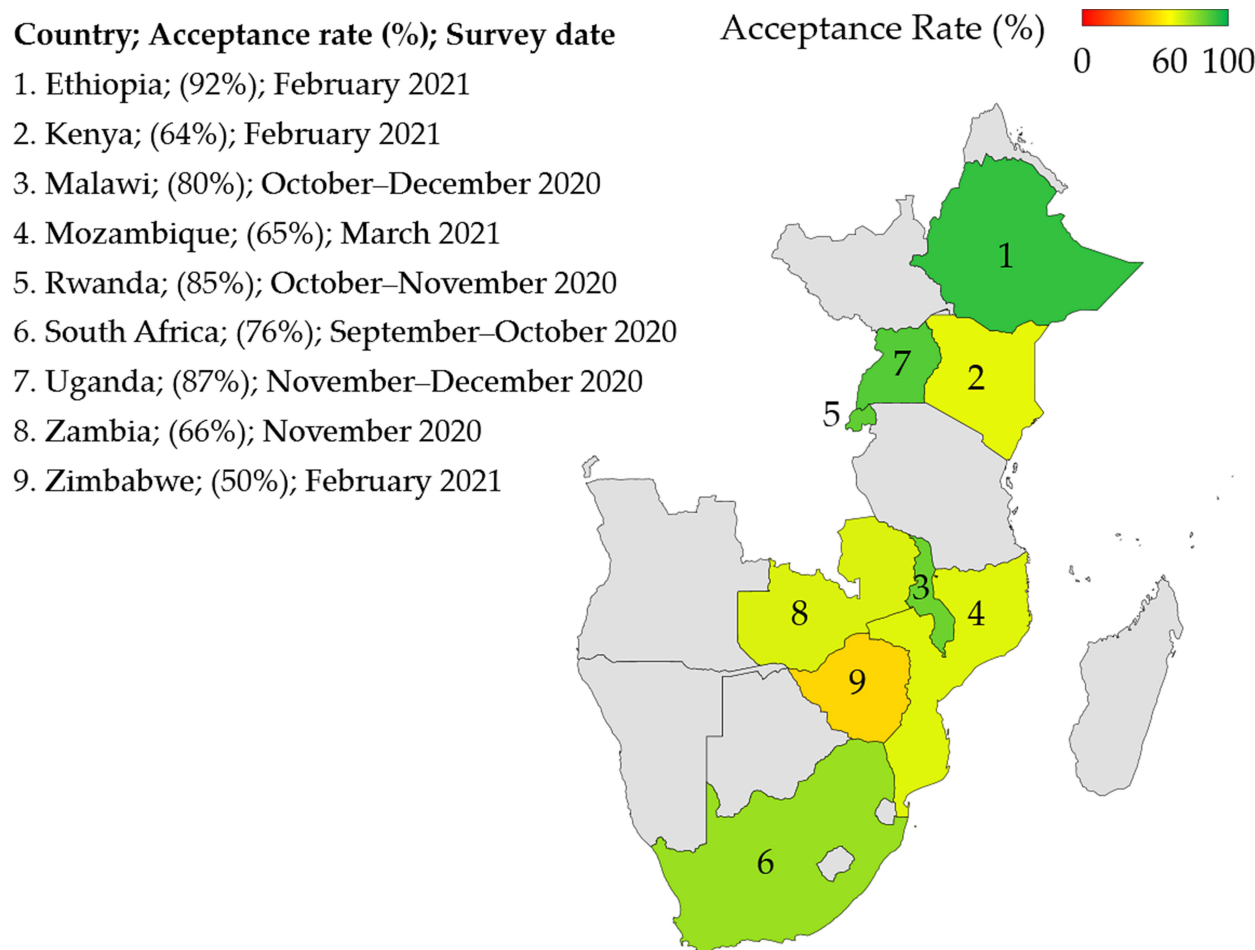
A large phone-based survey that was conducted in February 2021, involving a total of 4136 respondents, reported an overall COVID-19 vaccine acceptance rate of 63.5%.<sup>31</sup> The Africa CDC survey study involved Kenya, and reported an overall COVID-19 vaccine acceptance rate of 85.0%, using telephone interviewing among 1000 participants.<sup>30</sup>

### Malawi

A phone-based survey was conducted during October–November 2020 and showed an overall level of COVID-19 vaccine acceptance of 82.7%, as a part of a multinational study in sub-Saharan Africa, which was reported recently in a preprint.<sup>32</sup> Another survey in the country that was part of a larger study involving 15 African countries reported similar results in Malawi (80.0% among 1009 participants using face-to-face interviews during October–December 2020).<sup>30</sup>

### Mozambique

A self-administered electronic survey was conducted in Mozambique in March 2021 and involved 1878 respondents including healthcare workers.<sup>33</sup> This study reported an overall COVID-19 vaccine acceptance rate of 71.4%, with a higher rate of 86.6% among healthcare workers and 64.8% among other respondents.<sup>33</sup> A large study by Solís



**Figure 2** COVID-19 vaccine acceptance rates in countries from Eastern and Southern Africa. The included countries were numbered, with COVID-19 vaccine acceptance rates shown besides the dates of surveys. The map was generated in Microsoft Excel, powered by Bing, © GeoNames, Microsoft, Navinfo, TomTom, Wikipedia. We are neutral with regard to jurisdictional claims in this map.

Arce et al, in low- and middle-income countries, used a phone-based survey involving 862 participants from Mozambique during October–November 2020 and showed an overall COVID-19 vaccine acceptance rate of 89.1%.<sup>34</sup>

#### Rwanda

The study by Solis Arce et al involved Rwanda using a phone-based survey during October–November 2020 with 1356 participants and reported an acceptance rate for COVID-19 vaccination of 84.9%.<sup>34</sup>

#### South Africa

A large multinational survey that was conducted in June 2020 reported an overall COVID-19 vaccine acceptance rate of 81.6% in South Africa.<sup>35</sup> The Africa CDC survey was also conducted in South Africa during September–October 2020 and involved 1056 participants who were subjected to face-to-face interviews and reported COVID-19 vaccine acceptance rate of 76.0%.<sup>30</sup> In

December 2020, a self-administered questionnaire among 1308 healthcare workers in the Eastern Cape Province of South Africa reported an overall COVID-19 vaccine acceptance rate of 90.1%.<sup>36</sup>

#### Uganda

The survey conducted by Africa CDC involved 1008 participants from Uganda during November–December 2020, who were surveyed through face-to-face interviews, reported an overall COVID-19 vaccine acceptance rate of 87.0%.<sup>30</sup> The study by Solis Arce et al involved Uganda as well, with sub-national phone interviews involving 13 districts during September–December 2020, and showed 85.8% COVID-19 vaccine acceptance rate.<sup>34</sup>

#### Zambia

A survey among parents/guardians who brought their children for childhood vaccination in November 2020 reported an overall COVID-19 vaccine acceptance rate of 66.0%.<sup>37</sup>



A later online survey study among 326 undergraduate pharmacy students in the country in April 2021 showed a much lower rate of COVID-19 vaccine acceptance (24.5%).<sup>38</sup>

### Zimbabwe

The results of an online survey study were reported in a recent preprint, and this survey was conducted in February 2021 among 1168 participants who showed an acceptance rate for COVID-19 vaccination of 49.9%.<sup>39</sup>

## Western and Central Africa

Out of 25 countries in Western and Central Africa region, COVID-19 vaccine acceptance rates were found in 13 countries (Figure 3). Data were found from Benin, Burkina Faso, Cameroon, Côte d'Ivoire, Democratic Republic of the Congo (DRC), Gabon, Ghana, Liberia, Niger, Nigeria, Senegal, Sierra Leone, and Togo, while no data were found from Burundi, Cape Verde, Central African Republic, Chad, Equatorial Guinea, Gambia, Guinea, Guinea-Bissau, Mali, Mauritania, Republic of the Congo and Sao Tome and Principe.

### Benin

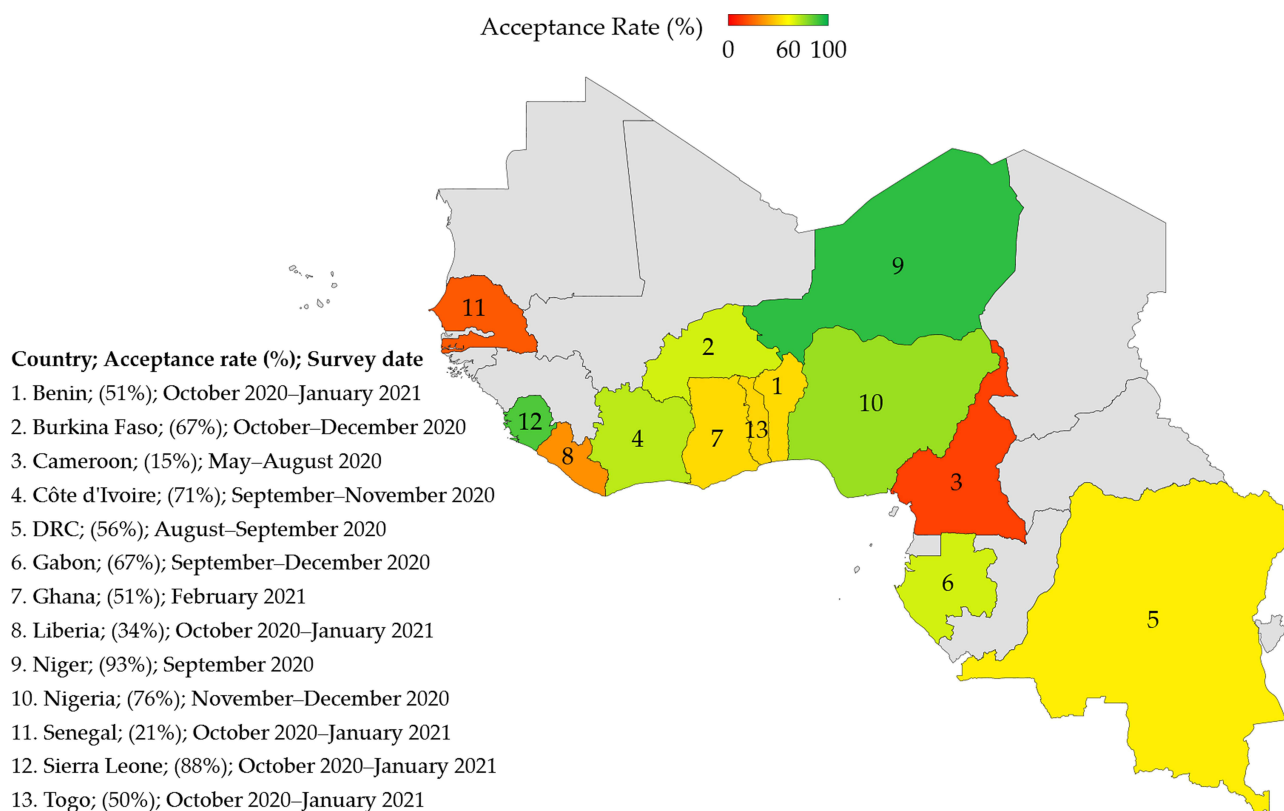
A large survey study in Benin among other western African countries was conducted by Afrobarometer (a non-partisan, pan-African research institution conducting public attitude surveys), using face-to-face interviews in the native languages and a sample of 1200 respondents during October 2020–January 2021.<sup>40</sup> This survey showed that the percentage of COVID-19 vaccine acceptance was 51%.<sup>40</sup>

### Burkina Faso

In a large survey study about COVID-19 vaccine acceptance and hesitancy in low- and middle-income countries, a phone-based survey reported an acceptance rate for COVID-19 vaccination of 66.5% during October–December 2020 with 979 participants.<sup>34</sup> Burkina Faso was also among the countries involved in the earlier Africa CDC survey study, with 1037 participants who had face-to-face interviews, and the overall vaccine acceptance rate was 86.0% during October–November 2020.<sup>30</sup>

### Cameroon

During May–August 2020, a questionnaire was distributed in a hybrid way (in person and online) among Cameroonians



**Figure 3** COVID-19 vaccine acceptance rates in countries from Western and Central Africa. The included countries were numbered, with COVID-19 vaccine acceptance rates shown besides the dates of surveys; DRC: Democratic Republic Of The Congo. The map was generated in Microsoft Excel, powered by Bing, © GeoNames, Microsoft, Navinfo, TomTom, Wikipedia. We are neutral with regard to jurisdictional claims in this map.

inside and outside the country. Among 2512 participants, COVID-19 vaccine acceptance rate was 15.4%.<sup>41</sup>

### Côte d'Ivoire

As a part of a survey conducted by the Africa CDC, face-to-face interviewing among 1039 participants from the country during September–November 2020 revealed an acceptance rate for COVID-19 vaccination of 71.0%.<sup>30</sup>

### Democratic Republic of the Congo

An online survey that was conducted in August–September 2020, and involved 4131 respondents, showed that the overall COVID-19 vaccine acceptance rate was 55.9% in DRC.<sup>42</sup> The acceptance rate was slightly higher in the Africa CDC survey, which involved 1007 participants in DRC using face-to-face interviews during September–October 2020 that reported an acceptance rate of 59.0% for COVID-19 vaccination.<sup>30</sup>

### Gabon

The country was part of the Africa CDC study, which involved 1112 participants who had face-to-face interviews during September–December 2020 and reported COVID-19 vaccine acceptance rate of 67.0%.<sup>30</sup>

### Ghana

A cross-sectional online survey was conducted among 1000 Ghanaian respondents during October–December 2020 and showed an acceptance rate of 54.1% for COVID-19 vaccination.<sup>43</sup> A recent online survey that was conducted in February 2021 and involved 2345 adult Ghanaians showed a slightly lower rate for COVID-19 vaccine acceptance of 51%.<sup>44</sup>

### Liberia

The large survey by Afrobarometer involved Liberia during October 2020–January 2021 and showed an overall COVID-19 vaccine acceptance rate of 34%.<sup>40</sup>

### Niger

As a part of the survey conducted by the Africa CDC, face-to-face interviewing among 1173 participants from the country was conducted in September 2020, which showed an acceptance rate for COVID-19 vaccination of 93%.<sup>30</sup>

### Nigeria

The Africa CDC survey involved Nigeria with face-to-face interviewing of 1172 participants from the country during September–October 2020, which showed an overall

acceptance rate of 73% for COVID-19 vaccination.<sup>30</sup> Another study from Nigeria among healthcare workers using a self-administered questionnaire was conducted in October 2020 and showed an acceptance rate of 55.5% for COVID-19 vaccination.<sup>45</sup> Another study was conducted in December 2020 and involved e-survey with 401 participants in the Delta state, which showed an overall COVID-19 vaccine acceptance rate of 48.6%.<sup>46</sup> Nigeria was also part of the phone survey study conducted during November–December 2020 by Solis Arce et al, which showed an acceptance rate of 76.2% for COVID-19 vaccination among the general public in the country.<sup>34</sup>

### Senegal

The Africa CDC survey study involved Senegal with face-to-face interviewing among 1010 participants from the country during October–November 2020, and this survey showed an overall acceptance rate of 65% for COVID-19 vaccination.<sup>30</sup> The vaccine acceptance rate was much lower in the Afrobarometer survey that involved 1200 respondents during October 2020–January 2021 which reported a COVID-19 vaccine acceptance rate of only 21%.<sup>40</sup>

### Sierra Leone

In the multinational large survey study by Solis Arce et al, a phone-based survey during October 2020–January 2021, reported an acceptance rate for COVID-19 vaccination of 87.9% in the country.<sup>34</sup>

### Togo

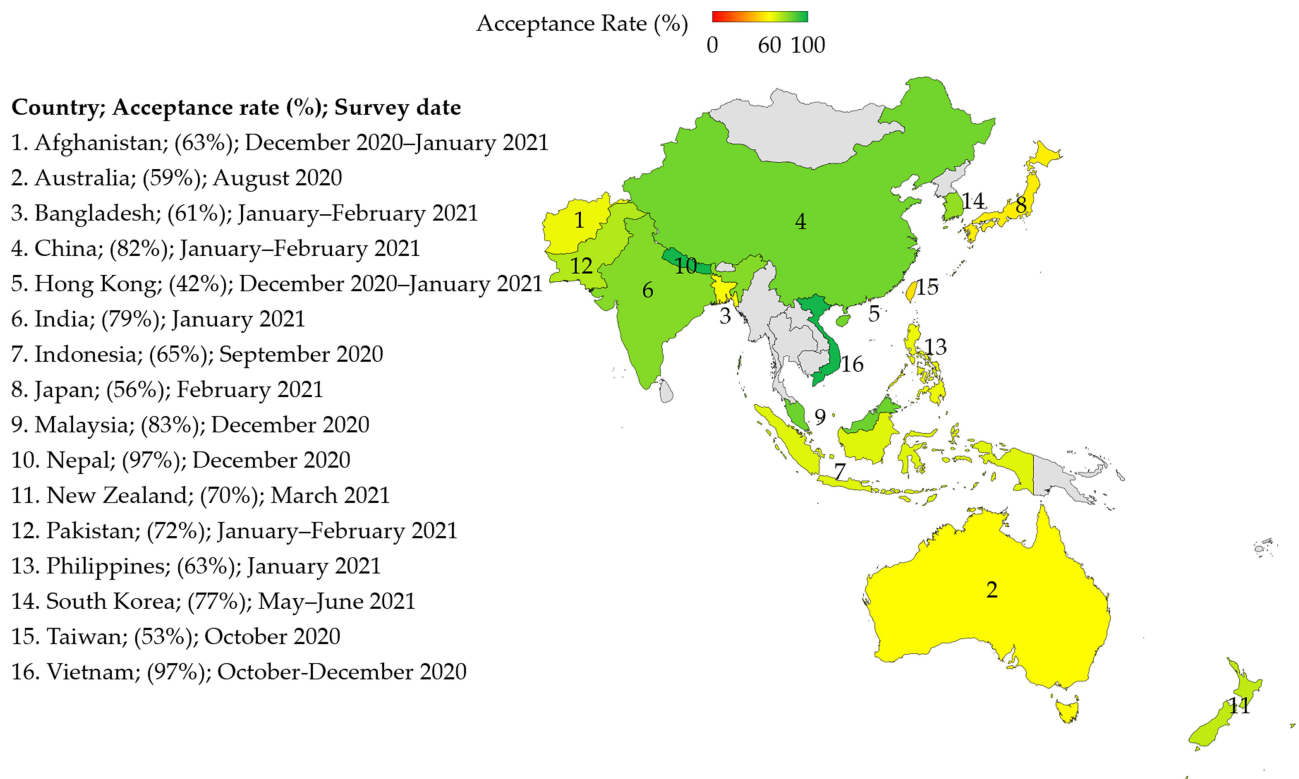
The large study by Afrobarometer involved Togo during October 2020–January 2021 and reported an overall COVID-19 vaccine acceptance rate of 50%.<sup>40</sup>

## Asia and the Pacific

Out of 29 countries/territories in this region, COVID-19 vaccine acceptance rates were found in 16 countries/territories (Figure 4). Data were found from Afghanistan, Australia, Bangladesh, China, Hong Kong, India, Indonesia, Japan, Malaysia, Nepal, New Zealand, Pakistan, Philippines, South Korea, Taiwan, and Vietnam, while no data were found from Bhutan, Brunei, Cambodia, North Korea, Fiji, Laos, Maldives, Mongolia, Myanmar, Papua New Guinea, Singapore, Sri Lanka and Thailand.

### Afghanistan

An online survey during December 2020–January 2021 was conducted among the general public in the country,



**Figure 4** COVID-19 vaccine acceptance rates in countries/territories from Asia and the Pacific. The included countries/territories were numbered, with COVID-19 vaccine acceptance rates shown besides the dates of surveys. The map was generated in Microsoft Excel, powered by Bing, © GeoNames, Microsoft, Navinfo, TomTom, Wikipedia. We are neutral with regard to jurisdictional claims in this map.

with 806 participants.<sup>47</sup> This study showed an overall COVID-19 vaccine acceptance rate of 63.2%.

### Australia

In August 2020, data from 3061 adults in Australia (collected mostly online) showed an acceptance rate for COVID-19 vaccination of 59%.<sup>48</sup> Another online survey study showed that COVID-19 vaccine acceptance rate was 72% in Sydney and 78% in Melbourne during July–September 2020.<sup>49</sup> An earlier study among Australian parents in June 2020 showed that the acceptance rate for COVID-19 vaccination was 75.8% with a 10% declining rate in the same group compared to an earlier study.<sup>50,51</sup>

### Bangladesh

An online-based survey study involving 605 respondents that was conducted during January–February 2021 showed an overall rate for COVID-19 vaccine acceptance of 61.2%.<sup>52</sup> Another study from the country using face-to-face interviews and involved 1134 participants from the general population in January 2021 showed an overall COVID-19 vaccine acceptance rate of 67.5%.<sup>53</sup> In a larger study that used both online and face-to-face

interviews and was conducted during January–February 2021 involving 4175 respondents, the COVID-19 vaccine acceptance rate was 60.5%.<sup>54</sup> A study from Bangladesh among healthcare workers in January 2021 showed that COVID-19 vaccine acceptance rate was only 43.8% among this group.<sup>55</sup>

### China

The recent surveys in the country showed the following: an online survey conducted in January 2021 revealed that COVID-19 vaccine acceptance rate among healthcare workers (n=1329) was 77.0%, while the vaccine acceptance rate among general population (n=1251) was 56.2%.<sup>56</sup> A large study involving both China and the US, with a total of 5375 participants from China during January–February 2021 showed that COVID-19 vaccine acceptance rate was 82.0% in the country.<sup>57</sup> An online survey study conducted in January 2021 with 9508 respondents revealed a lower vaccine acceptance rate of 67.1%.<sup>58</sup>

### Hong Kong

A telephone-based survey conducted during December 2020–January 2021 and involving 1255 adults indicated that

COVID-19 vaccine acceptance rate was 42%.<sup>59</sup> Another study involving two surveys among the same 2047 participants during the first and third waves of the local epidemic showed a declining rate for COVID-19 vaccine acceptance from 44.2% in February 2020 to 34.8% in August/September 2020.<sup>60</sup>

### India

The study by Solís Arce et al involved a sub-national sample from India with data collected using phone interviews during June 2020–January 2021, which revealed an acceptance rate of 84.3% for COVID-19 vaccination.<sup>34</sup> In January 2021, an online survey among 2032 participants showed that 78.6% expressed willingness to receive COVID-19 vaccination.<sup>61</sup> A recent study in March 2021, involving 1294 participants recruited online, showed an acceptance rate of 83.6% for COVID-19 vaccination.<sup>62</sup> Another online survey among 721 healthcare workers in January 2021 showed that 79.3% were willing to get COVID-19 vaccination.<sup>63</sup>

### Indonesia

An early study during March–April 2020 by Harapan et al among 1359 participants showed an acceptance rate of 93.3% for an effective COVID-19 vaccine.<sup>64</sup> However, this rate dropped to only 65% in a tremendous survey conducted by the Ministry of Health, and the Indonesian Technical Advisory Group on Immunization, and was supported by the UNICEF and the World Health Organization (WHO), in September 2020 involving 115,000 people.<sup>65</sup> A study conducted during September–October 2020 with 779 respondents in Bali Province showed an acceptance rate of 60.8% for COVID-19 vaccination.<sup>66</sup>

### Japan

A large web-based survey took place in February 2021, involving 30,053 Japanese adults aged 20 years or older reported an overall COVID-19 vaccine acceptance rate of 56.1%.<sup>67</sup> An earlier study in September 2020 showed an acceptance rate of 65.7% with 1100 participants, while another study in January 2021 with 2956 participants reported an overall acceptance rate of 62.1% for COVID-19 vaccination.<sup>68,69</sup> Another recent study (February 2021) showed that the acceptance rate for COVID-19 vaccination was only 47%.<sup>70</sup>

### Malaysia

A web-based survey conducted in December 2020 with 1406 respondents showed that 64.5% were willing to get

vaccinated against COVID-19.<sup>71</sup> Another study conducted later on in December 2020, using an online survey with 1411 respondents showed a higher COVID-19 vaccine acceptance rate of 83.3%.<sup>72</sup>

### Nepal

The study by Solís Arce et al involved a sub-national sample from the country with data collected using phone interviews during December 2020, which showed an acceptance rate of 96.6% for COVID-19 vaccination.<sup>34</sup>

### New Zealand

An early online survey study from the country in July 2020 involving 1040 participants showed an acceptance rate of 74% for COVID-19 vaccination.<sup>73</sup> A later web-based survey study in March 2021 with 1284 participants showed an overall COVID-19 vaccine acceptance rate of 70%.<sup>74</sup>

### Pakistan

An online survey study conducted during January–February 2021, with 1778 participants showed an overall COVID-19 vaccine acceptance rate of 72%.<sup>75</sup> An earlier online study conducted during September–October 2020 with 883 respondents showed a similar acceptance rate of 70.8% for COVID-19 vaccination.<sup>76</sup> The acceptance rates were also close to those in the study by Solís Arce et al that used phone interviews in a sub-national sample (76.1% during July–September 2020, that declined to 66.5% during September–October 2020).<sup>34</sup> The acceptance rate for COVID-19 vaccination in Pakistan was also similar among healthcare workers in an online survey with 5237 respondents during December 2020–February 2021, which showed an acceptance rate of 70.2%.<sup>77</sup>

### Philippines

A recent preprint by Caple et al reported the initial results of an online survey conducted in January 2021 that involved 7193 respondents, which showed an overall rate for COVID-19 vaccine acceptance of 62.5%.<sup>78</sup>

### South Korea

A recent questionnaire survey conducted during May–June 2021 among parents/guardians in South Korea and involving 226 participants reported an overall COVID-19 vaccine acceptance rate of 76.5%.<sup>79</sup> An earlier global study by de Figueiredo and Larson, that was conducted during October–December 2020 involved 1103 participants from the country has shown an acceptance rate of 86.6% for COVID-19 vaccination.<sup>80</sup>



## Taiwan

A telephone-based survey was conducted in October 2020, which involved 1077 respondents, and showed an overall rate of 52.7% willingness to receive COVID-19 vaccination.<sup>81</sup>

## Vietnam

An email-based online survey study involving 398 students in Ho Chi Minh City showed an acceptance rate of 83.4% for COVID-19 vaccination.<sup>82</sup> The earlier global study by de Figueiredo and Larson during October–December 2020 involved 599 participants from Vietnam and showed an acceptance rate of 96.8% for COVID-19 vaccination.<sup>80</sup>

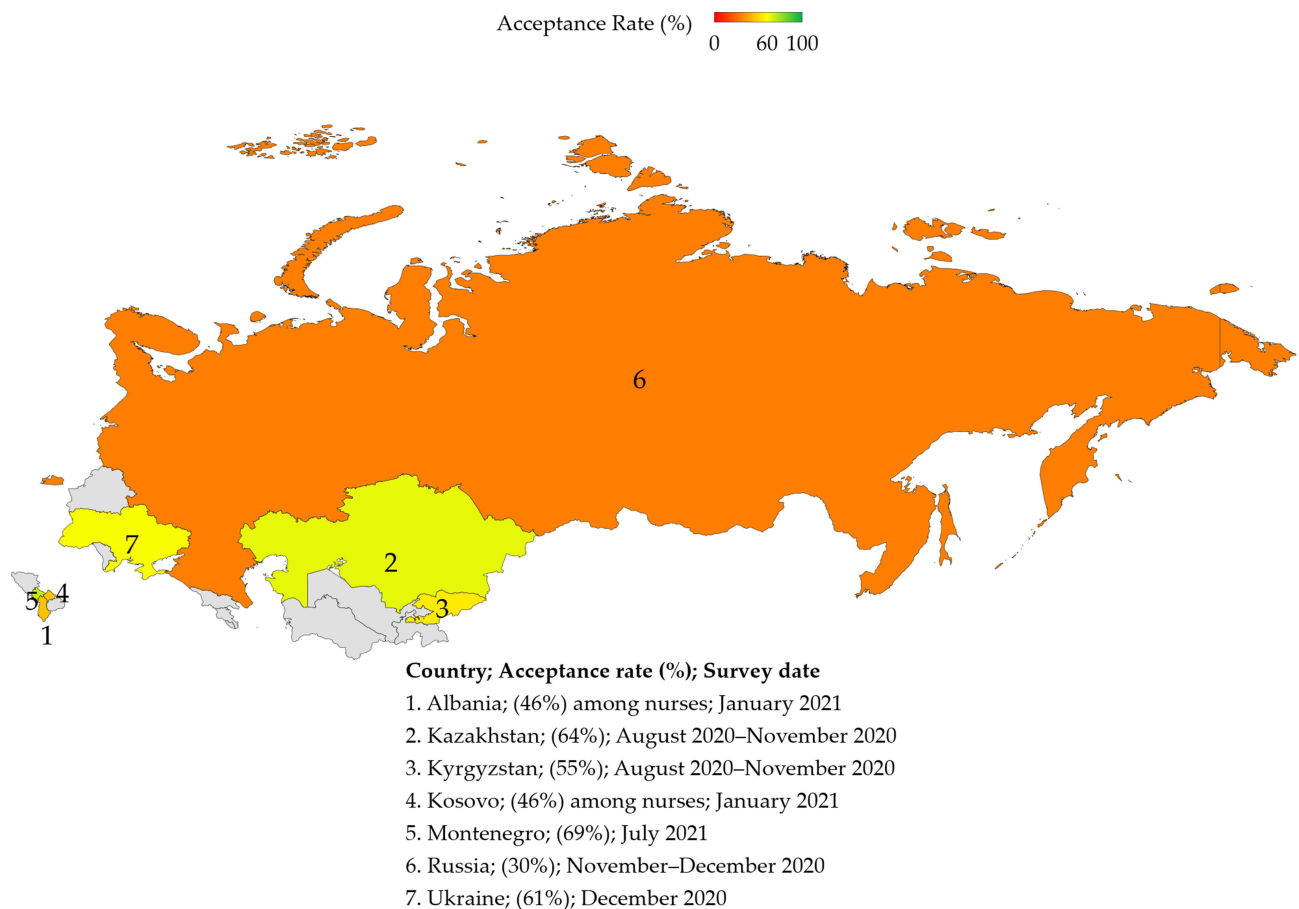
## Eastern Europe and Central Asia

Out of 17 countries in Eastern Europe and Central Asia region, COVID-19 vaccine acceptance rates were found only in 7 countries, 2 of which had survey studies among healthcare workers (nurses) and nursing students, while

the remaining 5 studies involved the general population (Figure 5). Data on COVID-19 vaccine acceptance rates were found from Albania, Kazakhstan, Kosovo, Kyrgyzstan, Montenegro, Russia and Ukraine, while no data were found from Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Georgia, Moldova, Tajikistan, Macedonia, Turkmenistan, and Uzbekistan.

## Albania

A web-based questionnaire involving nurses in five European countries was conducted in January 2021, and this study showed that the intention of Albanian nurses to get COVID-19 vaccination if safe and effective was 46.3%.<sup>83</sup> Another multinational European web survey study involving seven countries (during December 2020–January 2021), investigated COVID-19 vaccine acceptance among nursing students, and the results among Albanian students were lower compared to the first study among nurses (102 of 313 Albanian students, 32.6%) completely or somewhat agreed to accept a safe and effective COVID-19 vaccine.<sup>84</sup>



**Figure 5** COVID-19 vaccine acceptance rates in countries/territories from Eastern Europe and Central Asia. The included countries/territories were numbered, with COVID-19 vaccine acceptance rates shown besides the dates of surveys. The map was generated in Microsoft Excel, powered by Bing, © GeoNames, Microsoft, Navinfo, TomTom, Wikipedia. We are neutral with regard to jurisdictional claims in this map.

## Kazakhstan

A web-based questionnaire was conducted during August 2020–November 2020 through e-mail invitations to students and staff of Nazarbayev University and local hospitals, which showed that 264 out of 417 respondents would get COVID-19 vaccination (63.9%).<sup>85</sup>

## Kyrgyzstan

A joint survey between the Ministry of Health and Social Development of the Kyrgyz Republic with the WHO was conducted through computer-assisted telephone interviewing. This survey involved 1000 individuals in Kyrgyzstan and was conducted in three phases during December 2020–February 2021, showed that about 55% of the participants had a strong or some willingness to accept COVID-19 vaccination.<sup>86</sup>

## Kosovo

A web-based questionnaire involving nurses in five European countries was conducted in January 2021, and this study showed that the intention of nurses from Kosovo to get COVID-19 vaccination if safe and effective was 46.2%.<sup>83</sup> A multinational European study among nursing students showed that 393 of 1020 nursing students from Kosovo (38.5%) completely or somewhat agreed to accept a safe and effective COVID-19 vaccine.<sup>84</sup>

## Montenegro

Using phone interviewing among adults (aged 18 years or older) in Montenegro, an opinion poll was conducted by Ipsos in July 2021 with a total of 830 respondents, and showed that among those who were not vaccinated (57% of the total sample), 45% were planning to get COVID-19 vaccination, 35% were resistant and 19% were hesitant.<sup>87</sup> In the same survey, 43% of the respondents stated that they have been vaccinated, with an overall percentage of 69% of the respondents who either got vaccinated or showed willingness to get vaccinated.<sup>87</sup>

## Russia

In a large survey study regarding COVID-19 vaccine acceptance and hesitancy in low- and middle-income countries, an online-based survey was conducted during November–December 2020, which reported an acceptance rate for COVID-19 vaccination in Russia of 30.4%.<sup>34</sup> This low rate was observed in earlier surveys by Van D. Tran et al (during September–November 2020), and Lazarus et al (in June 2020)

which showed the declining COVID-19 vaccine acceptance rates of 41.7% and 54.9%, respectively.<sup>88,89</sup>

## Ukraine

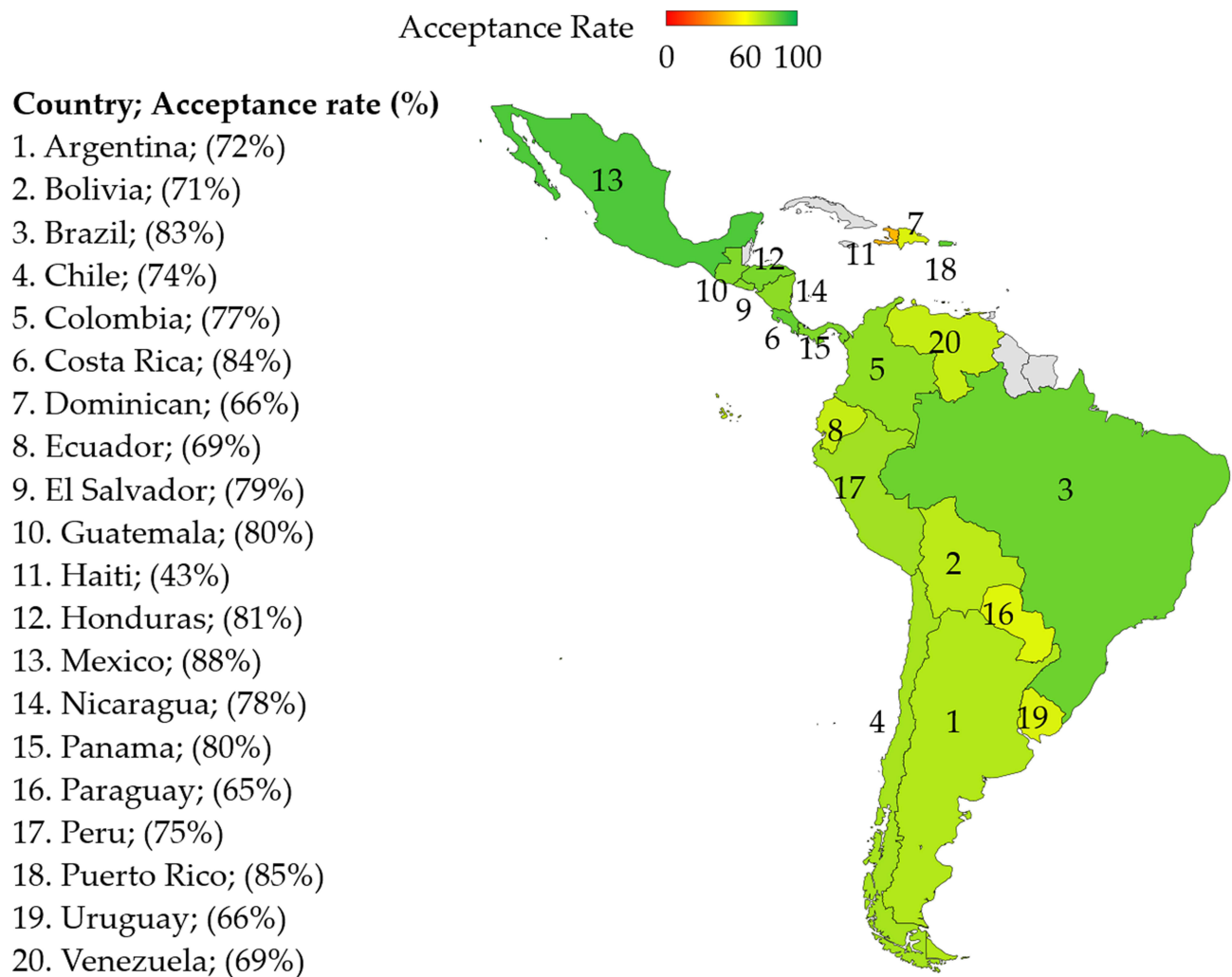
In a letter to the editor by Matiashova et al that cited a survey of the sociological group “Rating”, the COVID-19 vaccine acceptance in Ukraine was 55% if the vaccine is provided for free, and the willingness to pay for the vaccine was 35%.<sup>90</sup> The rate of 55% was slightly lower than the vaccine acceptance rate reported by the RECOVER social science team, which reported an acceptance rate for COVID-19 vaccination in Ukraine of 61% involving 1000 respondents that were surveyed in December 2020.<sup>91</sup>

## Latin America and the Caribbean

Out of 27 countries/territories in Latin America and the Caribbean, COVID-19 vaccine acceptance rates were found in 20 countries/territories (Figure 6). Data were found from Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Puerto Rico, Uruguay, and Venezuela, while no data were found from Barbados, Belize, Cuba, Guyana, Jamaica, Suriname, and Trinidad and Tobago.

A large comprehensive cross-sectional analysis of a database collected by the University of Maryland and Facebook, was conducted by Urrunaga-Pastor et al, which investigated COVID-19 vaccine intentions, perceptions and hesitancy across Latin America and the Caribbean.<sup>92</sup> The study involved participants aged 18 and over during January–February 2021. This study will form the basis for reporting COVID-19 vaccine acceptance in Latin America and the Caribbean in this review as follows:

The study by Urrunaga-Pastor et al involved 33,282 participants from Argentina, with COVID-19 vaccine acceptance rate of 71.7%; 9486 participants from Bolivia with vaccine acceptance rate of 71.0%; 162,763 participants from Brazil, with vaccine acceptance rate of 83.1%; 18,441 participants from Chile, with vaccine acceptance rate of 74.4%; 32,607 participants from Colombia, with vaccine acceptance rate of 77.3%; 5383 participants from Costa Rica, with vaccine acceptance rate of 84.1%; 3712 participants from Dominican Republic, with vaccine acceptance rate of 65.8%; 11,548 participants from Ecuador, with vaccine acceptance rate of 69.3%; 4802 participants from El Salvador, with vaccine acceptance rate of 79.3%; 4746 participants from Guatemala, with vaccine acceptance rate of



**Figure 6** COVID-19 vaccine acceptance rates in countries/territories from Latin America and the Caribbean. All data were collected from the study by Urrunaga-Pastor et al.<sup>92</sup> The included countries/territories were numbered, with COVID-19 vaccine acceptance rates. All surveys were conducted during January–February 2021. The map was generated in Microsoft Excel, powered by Bing, © GeoNames, Microsoft, Navinfo, TomTom, Wikipedia. We are neutral with regard to jurisdictional claims in this map.

79.7%; 272 participants from Haiti, with vaccine acceptance rate of 43.2%; 3842 participants from Honduras, with vaccine acceptance rate of 80.5%; 133,607 participants from Mexico, with vaccine acceptance rate of 88.4%; 2442 participants from Nicaragua, with vaccine acceptance rate of 77.9%; 2712 participants from Panama, with vaccine acceptance rate of 80.2%; 3091 participants from Paraguay, with vaccine acceptance rate of 64.6%; 17,162 participants from Peru, with vaccine acceptance rate of 74.9%; 7148 participants from Puerto Rico with vaccine acceptance rate of 85.0%; 7622 participants from Uruguay, with vaccine acceptance rate of 65.9%; and 7853 participants from Venezuela, with vaccine acceptance rate of 68.8%.<sup>92</sup>

Selected additional studies from the region included a preprint reporting the results of a multinational study

involving Facebook users, which pointed to COVID-19 vaccine acceptance rate of about 75% in Argentina as of March 2021.<sup>93</sup> An earlier study from Brazil (September–October 2020) involving 2771 participants reported a higher vaccine acceptance rate of 74.3%.<sup>94</sup>

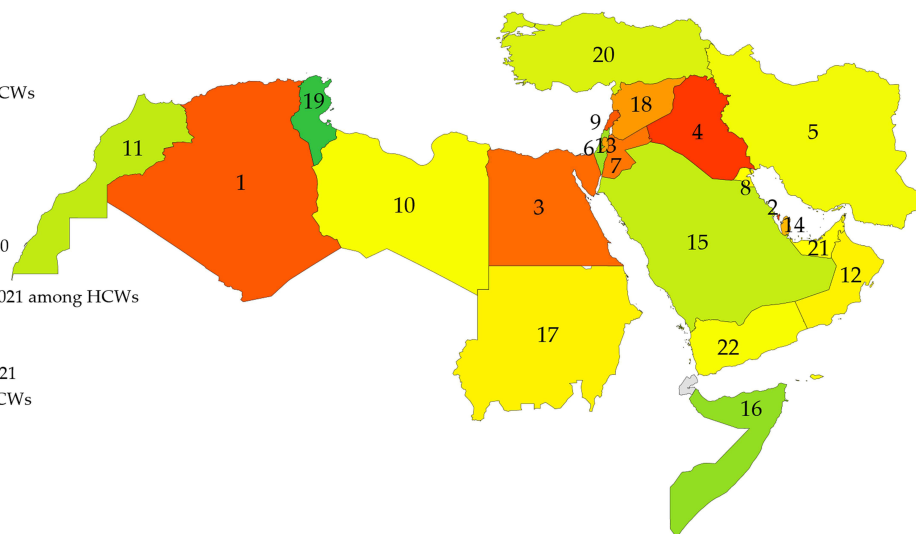
## Middle East and North Africa

Out of 23 countries/territories in the MENA region, COVID-19 vaccine acceptance rates were found in 22 countries/territories (Figure 7). Data were found from Algeria, Bahrain, Egypt, Iraq, Iran, Israel, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Somalia, Sudan, Syria, Tunisia, Turkey, United Arab Emirates (UAE), and Yemen, while no data were found from Djibouti.

**Country; Acceptance rate (%); Survey date**

1. Algeria; (21%); March–April 2021
2. Bahrain; (17%); January 2021
3. Egypt; (25%); January–March 2021
4. Iraq; (13%); January 2021
5. Iran; (62%); February–March 2021 among HCWs
6. Israel; (75%); March 2020
7. Jordan; (28%); December 2020
8. Kuwait; (60%); March–April 2021
9. Lebanon; (21%); November–December 2020
10. Libya; (61%); December 2020
11. Morocco; (70%); September–November 2020
12. Oman; (57%); December 2020
13. Palestine; (38%); December 2020–January 2021 among HCWs
14. Qatar; (43%); December 2020–January 2021
15. Saudi Arabia; (69%); February–April 2021
16. Somalia; (77%); December 2020–January 2021
17. Sudan; (57%); March–April 2021 among HCWs
18. Syria; (36%); December 2020–January 2021
19. Tunisia; (92%); September–November 2020
20. Turkey; (66%); May 2020
21. UAE; (60%); September 2020
22. Yemen; (61%); April 2020

Acceptance Rate  
0 60 100



**Figure 7** COVID-19 vaccine acceptance rates in countries/territories from the Middle East and North Africa. The included countries/territories were numbered, with COVID-19 vaccine acceptance rates shown besides the dates of surveys; HCWs: Healthcare workers; UAE: United Arab Emirates. The map was generated in Microsoft Excel, powered by Bing, © GeoNames, Microsoft, Navinfo, TomTom, Wikipedia. We are neutral with regard to jurisdictional claims in this map.

## Algeria

A recent preprint reported the results of an online survey conducted during March–April 2021 among the general public in the country, with 1019 participants, which showed a willingness to get COVID-19 vaccines at a rate of 21%.<sup>95</sup>

## Bahrain

A large-scale survey study in the Arab countries was conducted in January 2021, which involved Bahrain with 115 participants and the results displayed an acceptance rate for COVID-19 vaccination of 16.5%.<sup>96</sup>

## Egypt

The most recent online survey study from Egypt was conducted during April–May 2021, with 871 participants showed an unusually high acceptance rate for COVID-19 vaccination (88%), compared to previous studies in the country involving healthcare workers (21% acceptance rate during December 2020 to January 2021; 26% acceptance rate in January 2021), and the general public (acceptance rate of only 8% in January 2021).<sup>96–99</sup> A recent nationwide online survey study during January–March 2021 with 1011 participants showed a COVID-19 vaccine acceptance rate of 25%.<sup>100</sup>

## Iraq

The large-scale survey study in January 2021 involved Iraq with 586 participants and reported a COVID-19 vaccine acceptance rate of 13.3%.<sup>96</sup>

## Iran

A recent preprint reported that results of a national survey among healthcare workers (n=3536) during February–March 2021 showed an overall COVID-19 vaccine acceptance of 62.1%.<sup>101</sup>

## Israel

An early study in March 2020, involving 1112 participants from the general population showed an overall COVID-19 vaccine acceptance rate of 75%.<sup>102</sup>

## Jordan

Three online survey studies showed a declining rate of COVID-19 vaccine acceptance from 37.4% in November 2020 (3100 participants), to 28.4% in December 2020 (2173 participants), and reaching 13.2% (7020 participants from the general population), and 34.9% (1106 university students) in January 2021.<sup>96,103–105</sup>

## Kuwait

A recent survey study among the general public was conducted during March–April 2021 with 4147 respondents, which showed an overall COVID-19 vaccine acceptance rate of 59.8%.<sup>106</sup> Another recent survey among healthcare workers in the country showed a higher rate for COVID-19 vaccine acceptance (83.3%) in March 2021 with 1019 participants.<sup>107</sup>



**Lebanon**

A survey study involving 579 respondents from the country was conducted during November–December 2020 showed that COVID-19 vaccine acceptance rate was 21.4%.<sup>108</sup>

**Libya**

A large survey study among the general population and healthcare workers in the country was conducted in December 2020, with 11,120 participants from the general population, 1752 medical students, 1394 medical doctors, and 821 paramedics or nurses.<sup>109</sup> The results showed that COVID-19 vaccine acceptance rate was 60.9% among the general population, 61.1% among medical students, 57.8% among medical doctors and 60.8% among nurses and paramedics.<sup>109</sup>

**Morocco**

The study by Africa CDC involved Morocco, with telephone interviewing of 1000 participants during September–November 2020, and this survey reported an overall COVID-19 vaccine acceptance rate of 70%.<sup>30</sup>

**Oman**

A comprehensive survey involving telephone interviewing with 3000 participants was conducted in the country in December 2020, which showed 56.8% COVID-19 vaccine acceptance rate.<sup>110</sup>

**Palestine**

A study among healthcare workers during December 2020–January 2021, with 1159 respondents showed that the intention to get vaccinated among the study group was 37.8%.<sup>111</sup>

**Qatar**

A phone-based interview study was conducted with a total of 1038 respondents during December 2020–January 2021, showed an acceptance rate of 42.7% for COVID-19 vaccination.<sup>112</sup>

**Saudi Arabia**

In a recent survey study during February–April 2021 that involved 1935 participants, 46.9% reported their intention to receive the COVID-19 vaccine, with 22.4% who received the vaccine, 9.5% who were resistant, and 21.2% who were hesitant resulting in an overall vaccine acceptance rate of 69.3%.<sup>113</sup> Another recent survey (March–April 2021) among healthcare workers in Saudi Arabia, which involved 390 respondents, reported an acceptance rate of 77.8% for COVID-19 vaccination.<sup>114</sup>

**Somalia**

An online survey study involving 4543 respondents was conducted in the country during December 2020–January 2021 and reported an overall COVID-19 vaccine acceptance rate of 76.8%.<sup>115</sup>

**Sudan**

A web-based survey that was conducted during March–April 2021, with 576 healthcare workers in Sudan, reported that 57% were willing to get vaccinated against COVID-19.<sup>116</sup>

**Syria**

An online survey was conducted in the country during December 2020–January 2021, that involved a total of 3402 adults, had reported an acceptance rate of 35.9% for COVID-19 vaccination.<sup>117</sup>

**Tunisia**

The study by Africa CDC involved Tunisia, with telephone interviewing of 1000 participants during September–November 2020, and this study reported an overall COVID-19 vaccine acceptance rate of 92% in the country.<sup>30</sup>

**Turkey**

An early online study in May 2020, that involved 3936 participants in Turkey, showed an overall COVID-19 vaccine acceptance rate of 66%.<sup>118</sup> The rate was higher (84.6%) in a later study (in December 2020) that involved healthcare workers.<sup>119</sup>

**United Arab Emirates (UAE)**

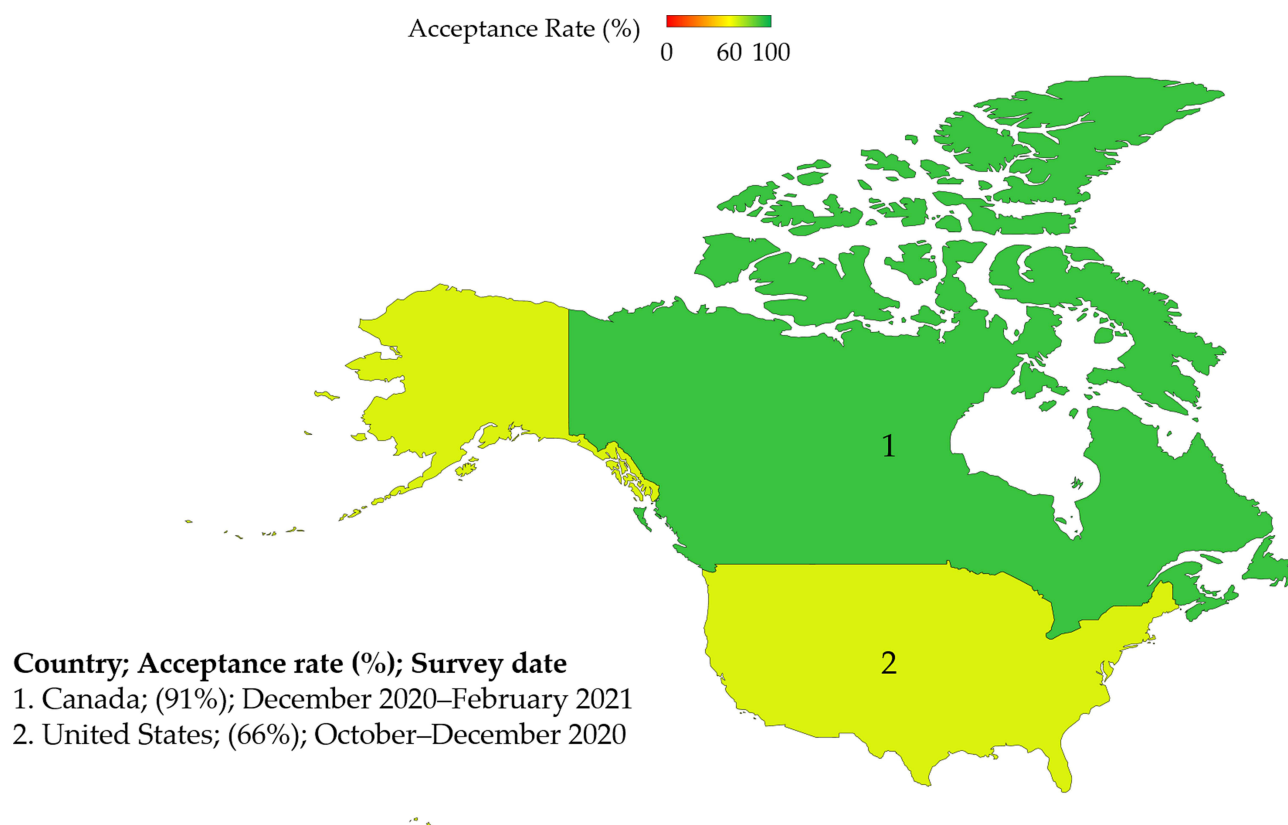
An online survey study was conducted in September 2020 among 2705 participants in the country, with COVID-19 vaccine acceptance rate of 60.1%.<sup>120</sup>

**Yemen**

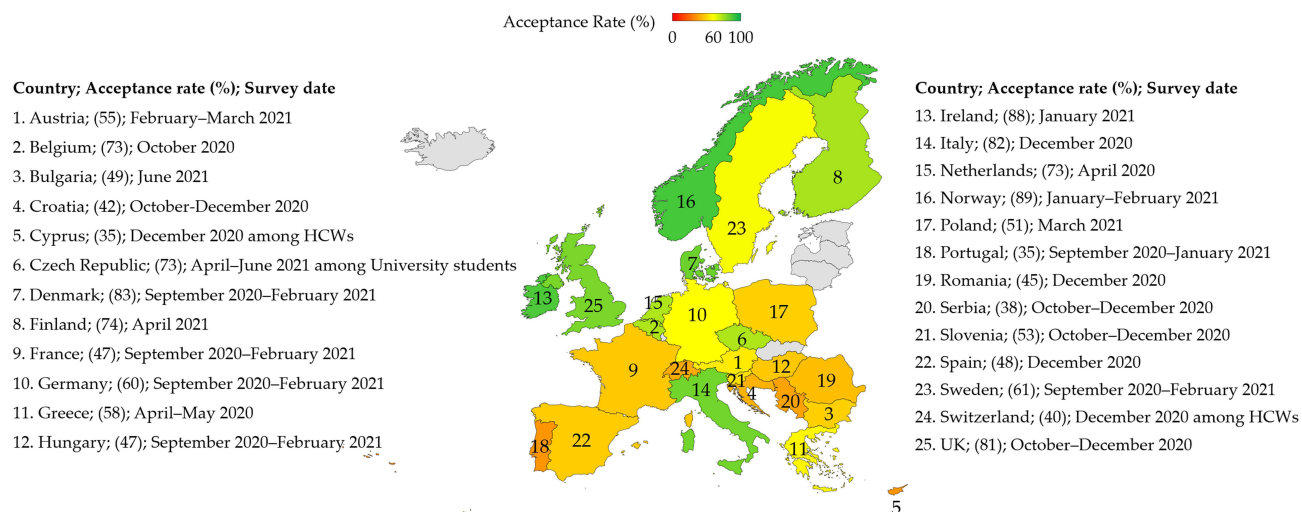
A preprint that reported the results of an online survey conducted in April 2020 among 484 participants showed an acceptance rate of 61.2% for free COVID-19 vaccines.<sup>121</sup>

**Western/Central Europe and North America**

Out of 33 countries in Western/Central Europe and North America region, COVID-19 vaccine acceptance rates were found in 27 countries (Figures 8 and 9). Data were found from Austria, Belgium, Bulgaria, Canada, Croatia, Cyprus, Czech Republic, Denmark,



**Figure 8** COVID-19 vaccine acceptance rates in North America. The map was generated in Microsoft Excel, powered by Bing, © GeoNames, Microsoft, Navinfo, TomTom, Wikipedia. We are neutral with regard to jurisdictional claims in this map.



**Figure 9** COVID-19 vaccine acceptance rates in countries from Central and Western Europe. The included countries were numbered, with COVID-19 vaccine acceptance rates shown besides the dates of surveys; HCWs: Healthcare workers; UK: United Kingdom. The map was generated in Microsoft Excel, powered by Bing, © GeoNames, Microsoft, Navinfo, TomTom, Wikipedia. We are neutral with regard to jurisdictional claims in this map.

Finland, France, Germany, Greece, Hungary, Ireland, Italy, the Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovenia, Spain, Sweden,

Switzerland, the United Kingdom (UK), and the US, while no data were found from Estonia, Iceland, Latvia, Lithuania, Luxembourg, and Slovakia.

**Austria**

An online survey that was conducted during February–March 2021 among the general public in the country, with 1350 respondents, showed an overall rate of 55% participants who were willing to get COVID-19 vaccination.<sup>122</sup>

**Belgium**

An early study conducted in October 2020, with 2060 Belgians showed an acceptance rate of 73% for COVID-19 vaccination.<sup>123</sup>

**Bulgaria**

A preprint reporting the results of an online survey in eight European countries reported a rate of 49.1% for COVID-19 vaccine acceptance in Bulgaria in June 2021.<sup>124</sup>

**Canada**

A nationally representative online survey was conducted during December 2020 through February 2021, with a total of 14,621 respondents, and this survey reported that 91% had intention to get vaccinated against COVID-19.<sup>125</sup>

**Croatia**

A large exploratory study (during October–December 2020) that investigated the global intent to accept COVID-19 vaccination involved Croatia with 519 participants, and this study showed an acceptance rate of 41.5% for COVID-19 vaccination in the country.<sup>80</sup>

**Cyprus**

An online survey study among healthcare workers was conducted in December 2020, with 1220 participants, and it showed an acceptance rate of 34.9% for COVID-19 vaccination.<sup>126</sup>

**Czech Republic**

A recent study involving 1351 university students during April–June 2021 showed an overall acceptance rate for COVID-19 vaccination of 73.3%.<sup>127</sup>

**Denmark**

A study involving eight European countries with participants from Denmark during September 2020–February 2021 with 2765 participants showed an acceptance rate of 83% for COVID-19 vaccination.<sup>128</sup>

**Finland**

A recent study from the country reported a COVID-19 vaccine acceptance rate of 74% in April 2021.<sup>129</sup>

**France**

A study involving eight European countries with participants from France during September 2020–February 2021 with 2090 participants from the country showed an acceptance rate of 47% for COVID-19 vaccination.<sup>128</sup> An early survey conducted during June–July 2020 among 1942 adults in the country showed a higher vaccine acceptance rate of 71.8%.<sup>130</sup> Another earlier survey (in April 2020) in the country involving 5018 participants from the general population reported an overall COVID-19 vaccine acceptance rate of 76%.<sup>131</sup>

**Germany**

A study involving eight European countries with participants from Germany during September 2020–February 2021 with 2380 participants from the country showed that COVID-19 vaccine acceptance rate was 60%.<sup>128</sup> An online survey conducted in February 2021 among 4500 healthcare workers in Germany showed a higher rate for COVID-19 vaccine acceptance (91.7%).<sup>132</sup>

**Greece**

An online survey among the general population in Greece that was conducted during April–May 2020, with 1004 respondents showed an intention for vaccination against COVID-19 at a rate of 57.7%.<sup>133</sup>

**Hungary**

A study involving eight European countries with participants from Hungary during September 2020–February 2021, with 1814 participants from the country showed an acceptance rate of 47% for COVID-19 vaccination.<sup>128</sup>

**Ireland**

In January 2021, a study involving 1600 participants showed an acceptance rate for COVID-19 vaccination of 88.2%.<sup>134</sup>

**Italy**

An online survey study among 7605 respondents from the general adult population in Italy in December 2020 showed that 81.9% were inclined to get vaccinated against COVID-19.<sup>135</sup>

**Netherlands**

An early European survey (in April 2020) involving 1000 participants from the country showed an overall COVID-19 vaccine acceptance rate of 73%.<sup>136</sup>

### Norway

A recent survey study that included 4571 participants and was conducted during January–February 2021 showed an overall rate for COVID-19 vaccine acceptance of 89%.<sup>137</sup>

### Poland

A recent survey study conducted in March 2021 that included 885 respondents showed an overall COVID-19 vaccine acceptance rate of 50.8%.<sup>138</sup>

### Portugal

A study during September 2020–January 2021 with 1943 individuals showed an overall COVID-19 vaccine acceptance rate of 35.3%.<sup>139</sup>

### Romania

An online survey study conducted in October 2020, with 247 adults showed that 21.9% expressed total acceptance for COVID-19 vaccination.<sup>140</sup> Another online survey that was conducted in December 2020, with 432 participants showed 45.4% intention to get vaccinated against COVID-19 among the participants.<sup>141</sup>

### Serbia

The same large exploratory study by de Figueiredo and Larson that was conducted during October–December 2020 and investigated the global intent to accept COVID-19 vaccination involved Serbia with 501 participants and it showed an acceptance rate of 37.8% for COVID-19 vaccination.<sup>80</sup>

### Slovenia

The same study by de Figueiredo and Larson involved Slovenia with 800 participants and it showed an acceptance rate of 53.3% for COVID-19 vaccination.<sup>80</sup>

### Spain

An online survey study that was conducted in December 2020, with 2501 participants, showed an acceptance rate for COVID-19 vaccination of 48.3% in the country.<sup>142</sup>

### Sweden

A study involving eight European countries with participants from Sweden during September 2020–February 2021 with 2149 participants showed an acceptance rate of 61% for COVID-19 vaccination in Sweden.<sup>128</sup>

### Switzerland

A recent preprint reported the results of a web-based survey among 3793 healthcare workers in December 2020 showed

that 39.8% were willingness to accept COVID-19 vaccination.<sup>143</sup>

### The United Kingdom (UK)

The same large exploratory study conducted during October–December 2020 by de Figueiredo and Larson that investigated the global intent to accept COVID-19 vaccination, involved the UK with 1000 participants who showed an acceptance rate of 80.5% for COVID-19 vaccination.<sup>80</sup> An earlier survey among 1500 participants surveyed in July 2020 showed that 64% of the participants reported being very likely to be vaccinated against COVID-19.<sup>144</sup> A recent study reported the results of different surveys in the UK among other countries, conducted between March and August 2020, and the surveys from the UK showed that vaccine acceptance rates ranged between 73.0% and 80.4%.<sup>145</sup> A study from Scotland among 1433 participants in August 2020 showed an acceptance rate of 77.5% for COVID-19 vaccination.<sup>146</sup>

### The United States (US)

In a nationally representative survey, the self-reported likelihood of getting a COVID-19 vaccine declined from 74% in early April 2020 to 56% in early December 2020.<sup>147</sup> The same large exploratory study during October–December 2020 by de Figueiredo and Larson that investigated the global intent to accept COVID-19 vaccination, involved the US with 800 participants and it showed an acceptance rate of 65.7%.<sup>80</sup> Among 2978 respondents, in a nationwide study conducted during May 2020 and January 2021, 81.1% of the participants were likely to receive the vaccine.<sup>148</sup>

## The Potential Gaps in Knowledge Regarding COVID-19 Vaccine Acceptance Worldwide

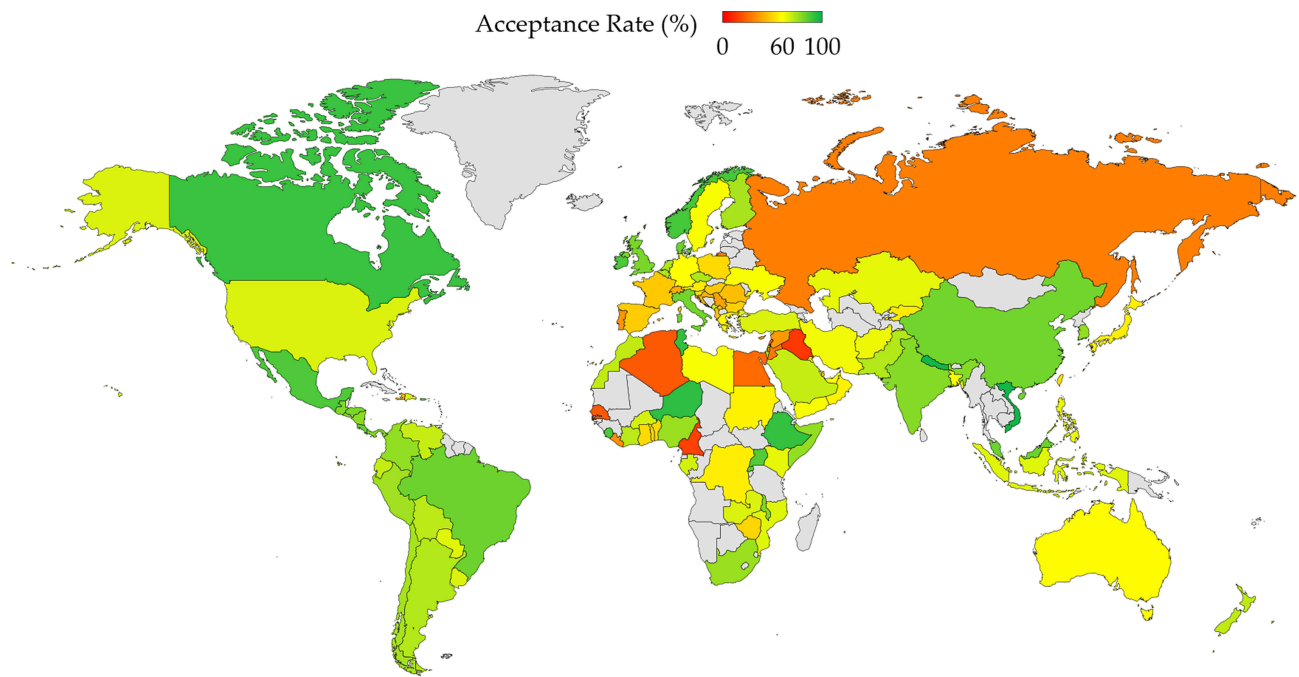
The global rates of COVID-19 vaccine acceptance are shown in [Figure 10](#). The regions where COVID-19 vaccine acceptance levels below 60% predominates over those  $\geq 60\%$  were Eastern Europe and Central Asia, West and Central Africa, the MENA and Western/Central Europe ([Figure 11](#)).

Regions where less than 50% of the countries having estimates on COVID-19 vaccine acceptance using survey studies included Eastern Europe and Central Asia (41.2%) and East and Southern Africa (42.9%).

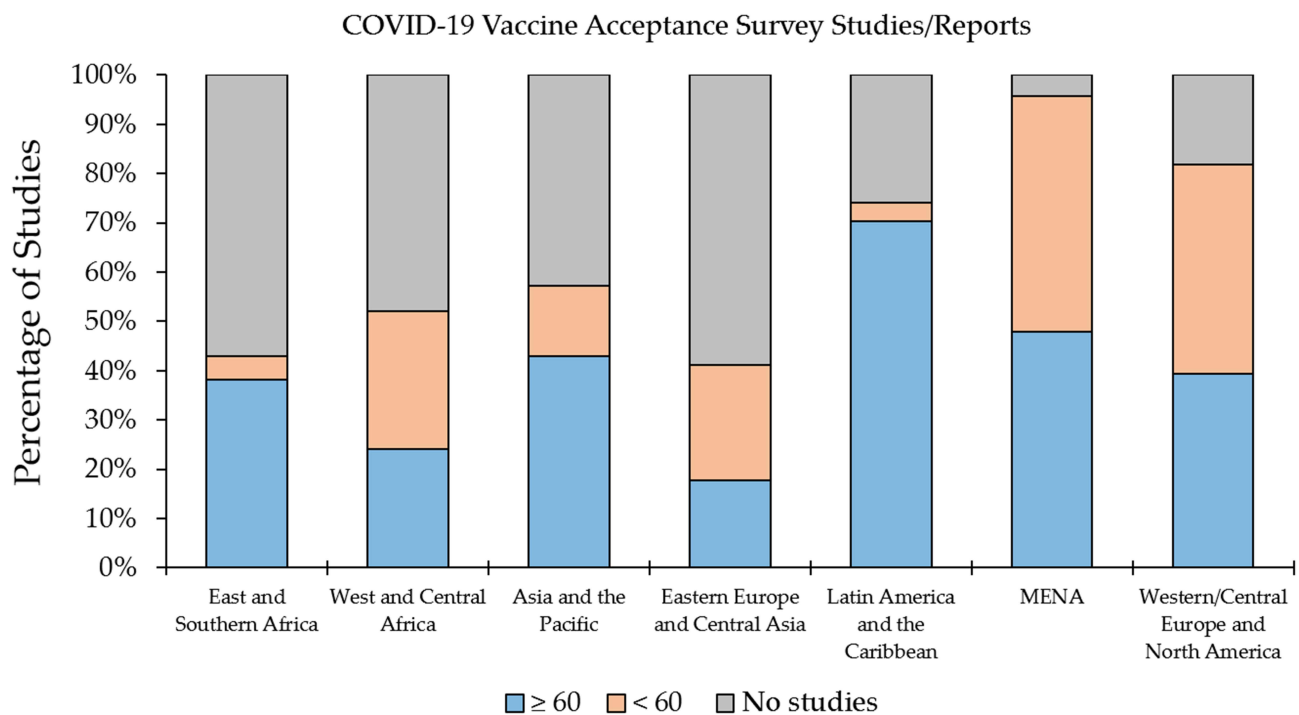
## Discussion

The current narrative review can be viewed as an updated and concise description of COVID-19 vaccine acceptance





**Figure 10** The global rates of COVID-19 vaccine acceptance. The map was generated in Microsoft Excel, powered by Bing, © GeoNames, Microsoft, Navinfo, TomTom, Wikipedia. We are neutral with regard to jurisdictional claims in this map.



**Figure 11** The percentage of studies on COVID-19 vaccine acceptance among different countries in different world region.  
**Abbreviation:** MENA, Middle East and North Africa.

rates among the majority of countries/territories worldwide.

The major issues that necessitate continuous assessment of COVID-19 vaccine acceptance include the increasing

evidence of waning immunity against SARS-CoV-2, accompanied by continuous emergence of viral variants (lineages), some of which may display immune escape from the currently available vaccine formulas.<sup>149–154</sup>

The results of this review indicated a wide variability in willingness to get COVID-19 vaccination in different countries globally. Nevertheless, certain patterns were observed as follows: First, reports on COVID-19 vaccine acceptance/hesitancy in African countries were rarely found by the end of last year.<sup>25</sup> This review showed the growing number of publications and reports from the region with higher rates of COVID-19 vaccine acceptance in East and Southern Africa compared to Western and Central part of the continent. High rates of COVID-19 vaccine hesitancy were found particularly in Cameroon (15%), Senegal (21%), and Liberia (34%). This was mainly attributed to low levels of trust in foreign institutions and pharmaceutical companies.<sup>41</sup> The results also indicated the need for more studies from Africa addressing COVID-19 vaccine hesitancy, as gaps in information still exist in several African countries (eg, Angola, Chad, Republic of Congo, Mali, Mauritania, Namibia, Tanzania).

Second, in Asia and the Pacific region, generally high rates of COVID-19 vaccine acceptance were found in a majority of countries. This was previously linked to relatively high levels of trust in governments, and the generally high level of COVID-19 vaccine acceptance in Asian countries was also found in more recent studies.<sup>89,155,156</sup> However, high rates of COVID-19 vaccine hesitancy were reported in Hong Kong, Taiwan and Japan, and this can be explained by the growing concerns regarding vaccine safety, due to accelerated vaccine development, besides the spread of negative news about COVID-19 vaccines.<sup>60,70</sup> A relatively high level of COVID-19 vaccine hesitancy was also reported in a recent study from India, with only 59% of the respondents inclined to get the vaccination.<sup>157</sup> This emphasizes the continuous need for assessment of COVID-19 vaccine hesitancy mainly in countries with suboptimal coverage of vaccination.

Third, a concerning result was the high rates of COVID-19 vaccine hesitancy and the presence of knowledge gaps in several countries from Eastern Europe and Central Asia. A recent perspective article on vaccine hesitancy in the region suggested the need to address the concerns of caregivers and healthcare professionals, and to reinforce public trust in healthcare providers.<sup>158</sup>

Fourth, in Latin America and the Caribbean, COVID-19 vaccine acceptance rates were generally high (14/20 countries with >70% COVID-19 vaccine acceptance rates). The comprehensive publication by Urrunaga-Pastor et al attributed such a result to the

observation that the region is among the most heavily afflicted regions by the pandemic globally, with high rates of death per capita in the region, which in turn might have led to lower levels of complacency.<sup>92,159</sup> The generally favorable attitude towards COVID-19 vaccine acceptance might have contributed to generally high vaccine coverage observed in the Caribbean.<sup>160</sup>

Fifth, several MENA region countries reported very low levels of COVID-19 vaccine acceptance (with six countries ranked among the top 10 countries with regard to COVID-19 vaccine hesitancy among the countries included in this review). This result was previously reported in an earlier systematic review that reported COVID-19 vaccine acceptance rates by the end of December 2020 and is further supported by the observations made in this review.<sup>25</sup> Such high levels of COVID-19 vaccine hesitancy can be linked to high levels of distrust in healthcare providers and concerns about vaccine safety besides the high embrace of conspiracy beliefs in some countries of the region.<sup>13,96,104,105,161</sup> Despite that, a few countries in the region managed to achieve vaccination coverage rates that were among highest globally (eg, Israel, UAE), which was attributed to the massive efforts to build vaccine confidence.<sup>162,163</sup>

Finally, high rates of COVID-19 vaccine hesitancy were reported in Western and Central Europe. The picture was better in some European countries (Ireland, Italy, Norway and UK) and in Canada and the US. A recent publication regarding COVID-19 vaccine hesitancy in the US, showed that the geospatial disparity of vaccine hesitancy is highly correlated with socio-economics covariates (eg, ethnicity, income, etc), and the authors advocated the role of policymakers, community groups, and faith leaders in increasing public trust to reduce vaccine hesitancy.<sup>164</sup> Vaccine hesitancy in some European countries were linked to concerns about safety and efficacy besides the speed with which these vaccines were developed.<sup>138,139,142</sup>

The conspicuous pattern of declining rates of COVID-19 vaccine acceptance observed in different countries in this review (Australia, Ethiopia, France, Japan and Jordan), can appear antithetical considering the accumulating evidence of safety and efficacy of the currently approved COVID-19 vaccines.<sup>165,166</sup> However, a study involving eight European countries showed increasing levels of vaccine acceptance over time.<sup>128</sup> Thus, the complex nature of COVID-19 vaccine hesitancy must be addressed at a deeper level considering the major factors linked to such phenomenon (demographic, geopolitical, religious and cultural factors).<sup>167</sup>

## Strengths and Limitations

To the best of our knowledge, the current narrative review represents the most detailed update on a majority of publications and relevant preprints and reports that investigated COVID-19 vaccine acceptance rates in different countries, territories and regions worldwide.

Limitations include potential sampling bias in several studies that formed the basis of the current review, besides the different time points during which these surveys were conducted which can complicate the interpretation of their results, particularly in relation to the timing of COVID-19 vaccination rollout in each country. One major limitation is related to the different definitions used to delineate COVID-19 vaccine acceptance, where some studies used yes/no definition, yes/unsure (undecided)/no (undecided), very likely, somewhat likely, etc, besides different survey item phrasing.

An additional limitation is the swift pace of growth in literature addressing COVID-19 vaccine hesitancy, which may have resulted in missing a few recent publications. For example, our analysis missed two recent studies among the general public in Mongolia and Sri Lanka, which was likely the result of timing of these publications.<sup>168,169</sup> These studies reported COVID-19 vaccine acceptance rates of 68.3% in Mongolia, with the survey distributed in February–March 2021, and 86.0% among the general public in Sri Lanka.

The current narrative review focused on reporting the acceptance rates for COVID-19 vaccination per country/territory, and the investigation of the predictors of acceptability was out of scope of this review; however, such factors can be found in other recently published and comprehensive reviews addressing the issue.<sup>170–173</sup>

## Conclusion

In the current narrative review, a concise description of COVID-19 vaccine acceptance rates is presented based on surveys from 114 different countries/territories worldwide. Countries with the highest rates of COVID-19 vaccine acceptance included Nepal and Vietnam (97%), Niger (93%), Ethiopia and Tunisia (92%), and Canada (91), while the lowest rates were reported in Iraq (13%), Cameroon (15%), Bahrain (17%), Algeria, Lebanon and Senegal (21%). The phenomenon of COVID-19 vaccine hesitancy appeared more pronounced in some world regions (the MENA region, Central Europe and Central Asia, and Western and Central Africa). More studies are recommended in Africa, Eastern Europe and Central Asia, considering the presence of large gaps in information

regarding COVID-19 vaccine hesitancy in these regions. Low COVID-19 vaccination rates that might be related to vaccine hesitancy in some regions can cause serious public health threats considering the potential emergence of novel variants with vaccine escape potential.

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## Disclosure

The authors report no conflicts of interest in this work.

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