



## The Attitude of Mobile Apps and It Impact in Health and Life Services Through Pandemic (Covid-19) In Iraq National Survey

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### ABSTRACT

Through and after the quarantine period of the COVID-19 epidemic, Mobile Applications developed for different purposes and goals, such as contacts and patient tracing, digital services, monitoring and testing, epidemiological research, and quarantine compliance. The main aim of this study is to highlight the effect of mobile pandemic applications in Iraqi society and the trustworthiness of developers and distributors of apps. To this end, we explored differences in the attitudes of smartphone users toward pandemic apps and shared the data to conduct research. The method adopted to achieve the Survey in this study is an Email and telephone-based Survey of (318) participants adults over 18 years old in Iraq. We used a total of (315) for Statistical Analysis. This 9-item Survey examined the current use of epidemic applications, motivations for using them, trust in app distributors, data handling, willingness to share coded data with researchers using a pandemic app, attitudes toward app use among people, demographics, and personal characteristics. The results of this study showed that most participants stated they were using smartphones (307/315, 97.5), but only (77/307, 24.4) were using pandemic apps on their smartphones. Intriguingly, in this Survey, when participants asked for the preferable organizations for storing data and application division, trust in federal or state government, regional health office, public-appointed such as statutory health insurance, or government-funded organizations (research institutes) was much higher than in private organizations (private research institutions, clinics, health insurances, information technology companies).

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Keywords: Mobile Apps, Covid-19 Pandemic, Smartphone, Iraq, Health Insurances.

### 1. Introduction

#### Background

Through and after the period of quarantine of the COVID-19 epidemic, different governments and the European Union agree on the need for digital solutions and, significantly, smartphone applications should contribute to both the management and research of the pandemic<sup>[1,2]</sup>.

They used four different digital technologies.

Applications for contact tracing and determining their location on mobile devices.

They utilize Mobile and web applications for Monitoring Symptoms.

Quarantine compliance with digital tools

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Flow modeling using data analytic tools<sup>[3]</sup>.

In many cases, governments have taken preventative measures, such as isolation of cases, social segregation, restricting travel, and partial or complete lockdowns, to contain the pandemic because no effective pharmaceutical treatments are available<sup>[4,5]</sup>. The World Health Organization (WHO) has published a recommendation list for enhancing population health through the adoption of health information technologies, which is a good development considering that the battle against this disease is being waged in the era of digital technologies<sup>[6]</sup>.

Applications designed for mobile devices are one example of a digital revolution tool that facilitates long-distance communication and has already demonstrated its efficiency and efficacy in terms of adaptability, functionality, and accessibility<sup>[7]</sup>. The global rate of smartphone usage is currently around 48%; therefore, this enormous subscriber base indicates an increasing opportunity for the efficient use of mobile applications for prohibiting, medicating, and managing the epidemic<sup>[8,9]</sup>. In Iraq, it was anticipated that there would be more

than 36.95 million cellphone users in 2019<sup>[10]</sup>, with 95% of them can access to the internet. In other words, 95% of mobile cellular customers had internet access<sup>[8]</sup>. Because the Iraqi populace as a whole has adopted cell phones<sup>[11]</sup>, the Iraqi Ministry of Health (MOH) did not launch any health applications for public health aims<sup>[5]</sup>.

Even though the COVID-19 epidemic is a relatively recent occurrence, previous research has been conducted to determine and characterize several aspects of more than sixty mobile health software connected to the virus developed in various countries. According to the research, various mobile apps for monitoring and managing the epidemic have entered the market. Additionally, the app market still needs to be more organized and regulated in several countries<sup>[12]</sup>. Nevertheless, none of these researches addressed the impact of applications in Iraq, nor did they include an analysis of the matter from the point of view of the national system. Our research concentrates on Iraq, one of the countries looking forward to digital transformation, to highlight the impact of mobile apps on the health sector in Iraq and society.

### Objectives

This research aims to shed light on attitudes about mobile applications and their impacts during the COVID-19 period in Iraq, as well as highlight particular challenges associated with app utilization. It is the first nationwide telephone and email survey in Iraq following the development of pandemic applications. It is also the first study focusing solely on individual data sharing via innovative cell phone applications for the epidemic study. The survey questions were (1) "Which sociodemographic and personal factors influence the use of an epidemic application amongst mobile phone subscribers in the Iraqi society?" and (2) "How do users and nonusers of epidemic programs vary in their motives, attitudes toward epidemic applications, and their willingness of sharing data with researchers?"

As a result, the study aimed to investigate distinct attitudes concerning epidemic applications and to share data for research amongst subscribers of smartphones in general, with a particular emphasis on differences in attitudes between application users and nonusers. The outcomes may be utilized to provide empirically supported ethical recommendations for future application development, design, and deployment. In addition, this research aims to highlight the importance of privacy and integrity in sharing users' application data in Iraqi society and (3) "whether the government benefits from the data shared with apps?"

### 2. Literature Survey

Smartphones and other mobile technologies, known as "mobile health" or "m-Health," help to speed up the process and minimize the costs and complexities of delivering direct health care<sup>[9, 12]</sup>. Mobile health, often known as "m-Health," is a sort of health information technology that functions primarily as a supportive tool in delivering medical treatment. Various healthcare-related applications and software have been created on mobile platforms<sup>[13]</sup>. Because of its accessibility, its simplicity of use, and the fact that it attracts a large number of users, mobile health, also known as m-Health, has the potential to be used in epidemic

and pandemic outbreaks<sup>[14]</sup>. Because of this, m-Health has seen an uptick in recent years as a tool for dealing with epidemics. Utilizing information technology, especially mobile health applications, is one of the essential strategies for reducing COVID-19. In the past few years, many countries have used m-Health as a new way to control pandemics, with decent results.

According to Navin et al.<sup>[15]</sup>, in 2017, a mobile health solution was developed for public health epidemic monitoring and showed a high capacity to identify disease outbreaks.

Lwin et al.<sup>[16]</sup> utilized a mobile health app called FluMob to collect real-time epidemiology and tracking data from doctors and other healthcare practitioners. These experts could then use their mobile devices to report any cases of influenza. It allowed the researchers to compile real-time epidemiology and tracking data.

During the COVID-19 pervasive, several nations have collaborated to create mobile health apps to enhance the delivery of medical services to patients and slow the dissemination of the new Coronavirus<sup>[17,18]</sup>. Most of these studies, remarkably a few of them, are connected to the inquiry that is now being conducted. For instance, one study found that more than 2 million subscribers in the United Kingdom and the United States utilized a mobile application available for free on smartphones to report suspected COVID-19 symptoms<sup>[19]</sup>.

Similarly, in<sup>[20]</sup>, they reveal that the applications for COVID-19 in Canadian app stores were available from the beginning of the pandemic.

Additionally<sup>[21]</sup>, in 2020, it was approved that using mobile apps in gastroenterology diseases is very useful for patients, especially with chronic diseases. At the same time, they concluded that there are no standard or uniform criteria for digital apps that have been set up to help users figure out how good the quality of a medical app is. It can lead to a patient using an app that is not good enough or, in the worst case, one that could hurt the patient or even cause death.

The authors of<sup>[22]</sup> ask, "Are smartphone app customers aware of what collected data about them, by whom, and how this data is used?" The researchers have used many methods to determine whether or not people might benefit from understanding how smartphone apps gather data. Furthermore, they concluded that users made decisions that were distinct from and more confident than those made using a conventional permissions interface. Keeping channels open and transparent and holding information-gathering activities accountable will lead to more application confidence.

According to<sup>[23]</sup>, by using Contact Tracing Mobile Apps for COVID-19, Israel's government could follow anyone with a suspected infection using mobile phone data. The COVID-19 software created in the United Kingdom, Europe countries, India, Brazil, Canada, Bangladesh, Australia, and Vietnam were discovered in separate research<sup>[20]</sup>.

In<sup>[24]</sup>, Singh et al. detected other mobile apps for COVID-19 in China, Europe, the United Kingdom, Iran, Russia, the United

States, and Turkey. According to previous studies, many countries employed and benefited from mobile health apps for tracking and following up on diseases during the Covid-19 pandemic. For instance, in<sup>[23]</sup>, Israel's government used Contact Tracing Mobile Apps to track suspected COVID-19 infections using mobile phone data. Also, in<sup>[19]</sup>, Mobile applications are free to report suspected COVID-19 symptoms. In<sup>[20]</sup>, Applications for COVID-19 were available in Canadian app stores before the pandemic. We revealed that many countries depended on mobile apps during Covid-19. This Survey provides a throughout Analysis of the impact of mobile apps in health and life services through the COVID-19 pandemic in Iraq, people's treatment according to Age, Gender, and region with health apps services. Additionally, the present study explores differences in smartphone users' attitudes toward pandemic apps and sharing the data to conduct research.

### 3. Methodology

#### 3.1 Study design

We have designed a survey including nine questions (see Appendix 1) to investigate the impact and attitudes of mobile apps during a pandemic and attitudes towards data sharing and privacy for research. The research for the study has been accepted by the scientific and research committee of the National Institute of Technology (NIT)<sup>[25]</sup>.

A representative telephone survey is preferable to online panels to reach individuals who are not internet-savvy or shun online surveys. Specifically, when it comes to concerns about the public's acceptance of today's technology, such as smartphone applications, there needs to be more consensus. The samples were collected from all regions of Iraq (the Middle, North, and South regions). Furthermore, the criteria were: people who were 1) older > than 18 years, 2) staying in Iraq, and 3) literate in Iraq.

The Survey was conducted by researchers using a Google Form and shared with different groups from various areas in Iraq. It took approximately 10-15 minutes to fill out the questionnaires. Two method sampling approaches were used. The first was via Email, and the second was through sharing within groups of people using mobile apps. The Email was (n = 103), and the mobile app group was (n = 211). They were then combined by statistical weighting.

#### 3.2 Sample

Between December, May 2021, and July 5, 2021, a representative telephone-based population survey was carried out in Iraq with 314 adults aged 18 or older. The Iraqi population over 18 currently stands at 23,241,285;<sup>[26]</sup> A sample size of 314 respondents has been collected from different regions in Iraq (South, Middle, and North (Kurdistan Region), and the Survey has been translated into three languages (English, Arabic, and Kurdish). See appendix1. A Google Form was used to share the Survey and collect the respondents.

#### 3.3 Survey Items

The telephone questionnaire survey instrument consists of closed-ended questions sorts. The questionnaire consisted of 9

questions in English, Arabic, and Kurdish. It covered the following areas: (1) Smartphone and pandemic app use; (2) reasons people use or do not use epidemic applications; (3) people's confidence in application distributors and storage of the data; (4) willingness to share coded data with research organizations through the use of a pandemic application and opinions regarding the handling of data; (5) social attitudes toward application usage; and (6) demographic characteristics as well as personal characteristics (Appendix 1). According to the findings of this Survey, "pandemic apps" are defined as native mobile applications for smartphones developed solely for the prevention, management, and research of pandemic and epidemic infectious illnesses. Three-question units permitted multiple responses, and six questions were designed as yes/no questions ("yes," "no," "I don't know," and "other reason"). Each person was asked the same questions in the same order, but the order of answers within each question was chosen randomly to eliminate response-set bias.

#### 3.4 Statistical Analysis

Since we were concerned about the epidemic of smartphone applications and perspectives towards data sharing with research institutes, we concentrated our statistical Analysis (n = 314) on mobile users. It was done so that we could get the most relevant results. Crosstab analysis was utilized to discover differences between app users and nonusers regarding readiness to share data, social attitudes toward app usage, views of the app provider's trustworthiness, and preferred location for storing data. Logistic regression analysis was performed to assess the factors impacting app usage. The model incorporated sociodemographic factors such as Age, Gender, education, and location of residence for this purpose. Additionally, respondents were asked about their experiences with being directly affected by the Corina-virus or knowing someone affected by the virus (personal affection). P values of 0.05 were utilized to evaluate statistical significance. Likert-scale responses were categorized (for example, "completely agree" and "rather agree" were combined into "fully/rather agree" and "totally disagree" and "rather disagree").

### 4. Results and Discussions

#### 4.1 The Demographics of Smartphone Users:

There were 315 participants included in the statistical Analysis, and 97.5% (307/315) showed that they utilized a smartphone. In this Analysis, we focus on this subset of smartphone subscribers since we consider cellphone usage a critical situation of technology-specific considerations. Including non-smartphone users would have resulted in a mix of distinct versus hypothetical usage attitudes.

In Table 1, It is shown here the demographic and personal characteristics of the sample of survey participants as well as the subsample of smartphone subscribers. Smartphone subscribers varied slightly in three ways from the overall sample, whose demographic characteristics are representative of the population of Iraq: (1) they were younger, (2) they had a higher degree of education, and (3) they were personally infected by the COVID-19 epidemic slightly more than the overall sample. The Age of the participants ranged from 20 to 51. The smartphone users were

167(53%) males and 148(47%) females (see Table 1, Table 2, Figure 1 & Figure 2). Moreover, Table 3 shows that the sample of participants was collected from different parts of Iraq at the

rate of 124 (39.4%) from the central region, 107(34%) from the North region, and 84 (26.7%) from the south region.

**Table 1:** Usage of Smartphones by Age.

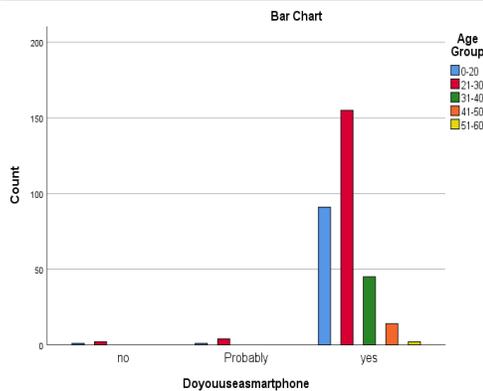
		Age Group					Total	
		0-20	21-30	31-40	41-50	51-60		
Do you use a smartphone?	no	Count	1	2	0	0	0	3
		% Of Total	0.3%	0.6%	0.0%	0.0%	0.0%	1.0%
	Probably	Count	1	4	0	0	0	5
		% Of Total	0.3%	1.3%	0.0%	0.0%	0.0%	1.6%
	yes	Count	91	155	45	14	2	307
		% Of Total	28.9%	49.2%	14.3%	4.4%	0.6%	97.5%
<b>Total</b>		Count	93	161	45	14	2	315
		% Of Total	29.5%	51.1%	14.3%	4.4%	0.6%	100.0%

**Table 2:** Usage of Smartphones by Gender.

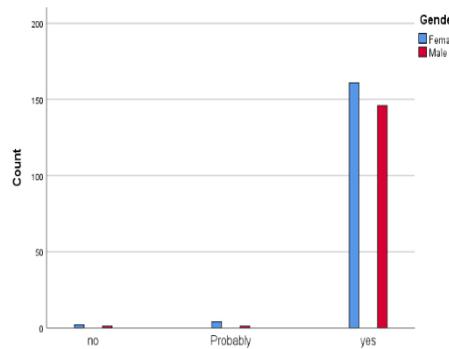
		Gender		Total	
		Female	Male		
Do you use a smartphone?	no	Count	2	1	3
		% Of Total	0.6%	0.3%	1.0%
	Probably	Count	4	1	5
		% Of Total	1.3%	0.3%	1.6%
	yes	Count	161	146	307
		% Of Total	51.1%	46.3%	97.5%
<b>Total</b>		Count	167	148	315
		% Of Total	53.0%	47.0%	100.0%

**Table 3:** Usage of Smartphones by Region.

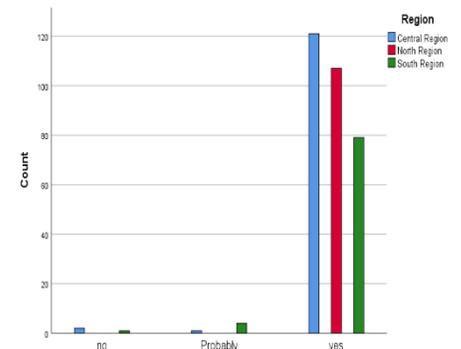
		Region			Total	
		Central Region	North Region	South Region		
Do you use a smartphone?	no	Count	2	0	1	3
		% Of Total	0.6%	0.0%	0.3%	1.0%
	Probably	Count	1	0	4	5
		% Of Total	0.3%	0.0%	1.3%	1.6%
	yes	Count	121	107	79	307
		% Of Total	38.4%	34.0%	25.1%	97.5%
<b>Total</b>		Count	124	107	84	315
		% Of Total	39.4%	34.0%	26.7%	100.0%



**Figure 1:** Smartphone Usage based on Age.



**Figure 2:** Smartphone Usage based on Gender. **Figure 3:** Smartphone Usage based on region.3



### 4.2 Factors Influencing the Usage of an Epidemic Application (Q2)

In our Survey, less than a quarter of the people who answered said they had used a pandemic app.(77/315, 24.4%), 205 (65.1%) were not using the mobile pandemic app, and 33 (10.5%) had probably responded to our survey question related to the usage of the pandemic apps (Table 4, Figure 4). Furthermore, we notice that the older the participants get, the less they use mobile applications during the pandemic of COVID-19. Of 77 participants, 14(4.4%) the age 20, 44(14%) of participants were aged 21 to 30, 12(3.8%) the age 31 to 40, and lastly 7(2.2%) were aged 41 to 60. In Table 5, of 77 (24.4%) participants using pandemic apps, 42 (13.3%) were male, and 35 (11.1%) were female. While Table 6 shows that 32 (10.2%) are from the southern region of Iraq, 23 (7.3%) are from the northern region of Iraq, and 22 (7%) are from the central region of Iraq. According to the Analysis of the study results, we conclude that Age is the main factor affecting the use of mobile pandemic apps.

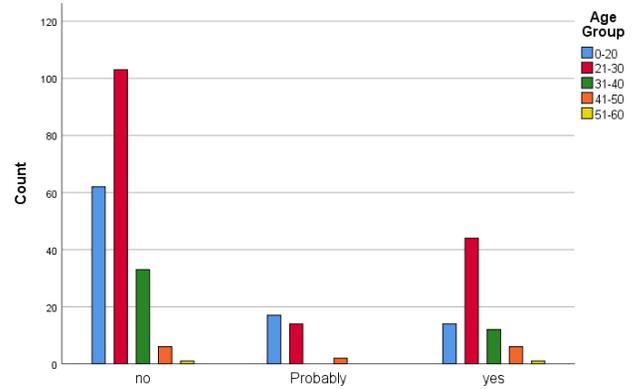


Figure 4: Pandemic app Usage by Age.

Table 4: Usage of Pandemic app based on Age.

			Age Group					Total
			0-20	21-30	31-40	41-50	51-60	
Do you currently use a pandemic app on your smartphone?	no	Count	62	103	33	6	1	205
		% of Total	19.7%	32.7%	10.5%	1.9%	0.3%	65.1%
	Probably	Count	17	14	0	2	0	33
		% of Total	5.4%	4.4%	0.0%	0.6%	0.0%	10.5%
	yes	Count	14	44	12	6	1	77
		% of Total	4.4%	14.0%	3.8%	1.9%	0.3%	24.4%
Total		Count	93	161	45	14	2	315
		% of Total	29.5%	51.1%	14.3%	4.4%	0.6%	100.0%

Table 5: Usage of Pandemic app based on Gender.

				Gender		Total
				Female	Male	
Do you currently use a pandemic app on your smartphone?	no	Count		110	95	205
		% of Total		34.9%	30.2%	65.1%
	Probably	Count		22	11	33
		% of Total		7.0%	3.5%	10.5%
	yes	Count		35	42	77
		% of Total		11.1%	13.3%	24.4%
Total		Count		167	148	315
		% of Total		53.0%	47.0%	100.0%

Table 6: Usage of Pandemic app based on region.

		Central Region		North Region	South Region	Total
Do you currently use a pandemic app on your smartphone?	no	Count	81	83	41	205
		% of Total	25.7%	26.3%	13.0%	65.1%
	Probably	Count	21	1	11	33
		% of Total	6.7%	0.3%	3.5%	10.5%
	yes	Count	22	23	32	77
		% of Total	7.0%	7.3%	10.2%	24.4%
Total		Count	124	107	84	315
		% of Total	39.4%	34.0%	26.7%	100.0%

### 4.3 Smartphone users' perspectives on pandemic app providers and the sharing of data with research institutes(Q6)

There were two major topics we focused on when analyzing mobile app attitudes. First, we provide a report on perceptions toward application providers that we take to include organizations and institutions that are engaged in the development, production, and operation of epidemic applications (see Table 7, Figure 5 ). In the second part of the study, we discuss what we learned about how people feel about sharing data from an app about a pandemic for research.

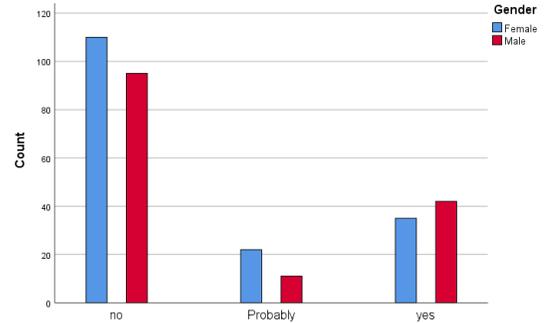


Figure 5: Pandemic app Usage by Age.

Table 7: Smartphone users' perspective on the pandemic app and sharing data.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	At a non-profit organization that manages app data as a trustee	6	1.9%	1.9%	1.9%
	In a government research institution.	202	64.1%	64.1%	66.0%
	In federal agencies.	3	1.0%	1.0%	67.0%
	In the software company that produces the application.	30	9.5%	9.5%	76.5%
	on the smartphone itself	74	23.5%	23.5%	100.0%
	Total	315	100.0%	100.0%	

### 4.4 Trust in State (-Funded) Organizations: Apps Providers' Attitudes

According to our Survey, Iraqi smart cellphone owners strongly preferred governmental organizations or their phones when asked which provider they trusted most when storing application data and application providers. The preference for a particular application actor for data storage is a signal of confidence in the application actor (or the smartphone) for data storage and management. Figure (6) indicates that significant smartphone users preferred to store the data for the epidemic application in a government research institute (111, 35.2%) or a research institute funded by the government (79, 25.1%). Smartphone owners ranked the Iraqi software company responsible for the epidemic

apps as the least desirable place to keep their data (3, 1.0%). There has been a consistent pattern of trusting attitudes toward pandemic app distributors. We noticed that in this section, there was much more trust in governmental (federal or state government, regional health office), public-appointed (statutory health insurance), or government-funded research institutes or organizations as application dispensers than confidence in private organizations (research institutions, clinics, health insurance).

### 4.5 Attitudes to Data Sharing with Research Institute

In line with the high level of trust in government-funded application suppliers, 202 (64.1%) smartphone owners agreed to have their application data shared with government-funded research institutions (see table) (8). We referred to the subsample of individuals prepared to share data with research institutes as the "data sharers." When individuals were asked what sort of data they would be willing to give for research, Figure 7 (7, Q7) found that 126 (40%) intended to provide their data to the research institute. Meanwhile, figure (6) shows that over 64% of participants trust the government institute's research for three reasons: (1) they were concerned about the lack of concerns about app data. (2) the concerns that the third party could use their data without permission. (3), and the third is the doubts that app data could be used to research forward.

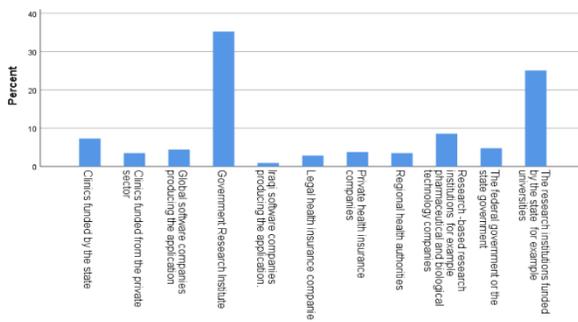
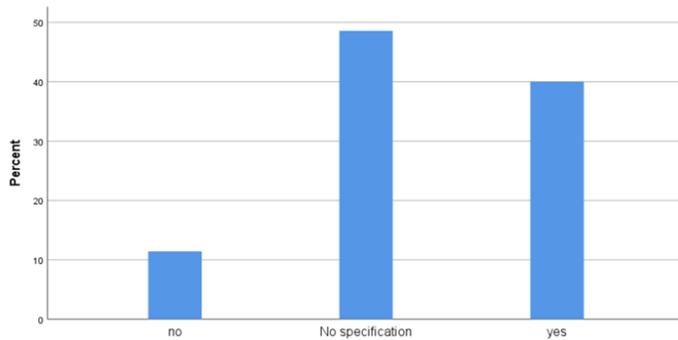


Figure 6: Trustworthiness of a distributor for a pandemic app.

Table 8: Storage places of pandemic apps data.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	At the software company that produces the app.	6	1.9%	1.9%	1.9%
	In a government research institution.	202	64.1%	64.1%	66.0%
	In federal agencies.	3	1.0%	1.0%	67.0%
	In the software company that produces the application.	30	9.5%	9.5%	76.5%

	on the smartphone itself	74	23.5%	23.5%	100.0%
	<b>Total</b>	315	100.0%	100.0%	



**Figure 7:** Data collection of the pandemic app in code form.

#### 4.6 Discussion

A study examined the use of pandemic apps and attitudes toward data sharing with research centers and institutes amongst smartphone users, a sample of a representative population survey in Iraq. Several significant findings are presented in our study. In the following sections of this study, we concentrate on four of them. First, the results showed a favorable attitude toward sharing data with government-funded research institutes for epidemic study. However, a significant need for autonomous data handling and transparency regarding the engaged research organizations accompanied this attitude. Second, comparing privately funded organizations to state-funded ones, there was a striking decline in trust toward those involved in data storage and distribution of epidemic applications. Third, regression analysis revealed a positive correlation between app usage and a higher level of education and younger Age. Fourth, we found significant differences between app users in their trust attitudes.

#### 4.7 Positive willingness to share data with the governmental research organization

Findings concerning cellphone subscribers' desire to share data with research institutions need to be placed in the context of their stated preferences for data processing and sharing criteria. Different criteria were explored in our study to provide a more nuanced picture: (1) The kind of data that will be shared (such as location or health data); (2) Transparency regarding research institutions that will receive the data; (3) The technique of collecting data; and (4) Transmitting data. Our research showed the following features are necessary for pandemic apps to have sufficient rates of users application sharing data for research aims: (1) data storing to comprise experiment outcomes, communication with individuals, location, and movement data (less supporting for data from a fitness watch); (2) extensive clarity regarding receiving data with research institutes (as opposed to having no openness about the data receiver); (3) manual data entering (as opposed to automatic data collection); (4) enabled data transmission, either manual or automatic sending; and (5) storage of collected or disclosed data via a global epidemic application on servers of the respective state-funded organizations (most minor support for application storage by private organizations, such as technology companies). In

conclusion, those ready for data sharing for research desire a self-determined approach to sharing data. Processes for manual handling, after turning on data transferring with a set of selected types of data, then providing clear and explained information on how data is processed, would probably make people more desire to share data with research centers.

#### 4.8 Characteristics of Users and Attitudes Toward Mobile App Usage

Our Survey examined how Age, Gender, and region affect smartphone users. The results showed that Age significantly affects how people use mobile apps, as most pandemic app users are between the ages of 20 and 40, and more men than women use pandemic apps. Another study discovered that both were no or only weak predictors of epidemic application usage<sup>[27,28,29,30]</sup>. However, research shows that people of different ages have different attitudes toward using apps<sup>[31,32,33]</sup>. The outcomes revealed no statistical connection between the personal effect of COVID-19 and epidemic application usage. It is an inversion to former research that has proposed at least a weakly considerable effect of personal affection in direct infection with COVID-19 on app adoption<sup>[28,30]</sup>.

#### 4.9 Trusting issue Between State-Funded and Private Organizations

One of the most significant findings in our study is that there is a significant difference between the attitudes of smartphone users toward state-funded and private app providers: Private app providers are considered less trustworthy when it comes to storing data and providing apps. This particular organization interpreted a storage location preference as a trust expression. For app data storage, citizens place a great deal of confidence in agencies of government and research institutes funded by the state (almost two-thirds of smartphone subscribers). Even while recent public arguments regarding privacy, data security, governmental surveillance techniques, and centralized vs. decentralized storage solutions for epidemic applications would provide the opposite impression, this is a promising signal for state-funded research intuitions<sup>[34,35]</sup>. However, media reports and increased awareness about how information technology companies utilize cloud backups and data streaming, such as Google Cloud or Apple Cloud, have raised concerns among providers, particularly regarding health issues.

#### 4.10 Limitations

The results presented in this study are subject to at least two limitations. First, to meet the inclusion criteria of the Survey, all participants were Iraqis over 18 (it is also considered an ethical and legal requirement for such a survey) and attainable via cellphone. Thus, statements could only be made by those older than 18 or with a cellphone connection. Second, we decided to concentrate on our statistical Analysis of the users of smartphones (n = 307) based on the suspicion that non-smartphone users would not have accurate conceptions of specific applications or

app data and would not have definite opinions regarding them, so their responses to app details could have been somewhat speculative.

## Conclusion

As mHealth applications extend rapidly, their purposes, features, and architecture are diverse. Many types of pandemic apps are available for smartphones, which might confuse users. Our research aimed to examine a field of mHealth with potential relevance for public health research and policy-making. A governance policy and research on ESIL (Ethical, Social, and Legal) are part of the current app development process. Privacy and data security are already considered critical issues in these frameworks.

## Apps Data Governance and Social Implications

According to our findings, trust in and trustworthiness of various application providers for storing data and application distribution, self-determination of storing data and transmission, and social attitudes regarding epidemic control are critical for such governance. Moreover, a future framework should also incorporate easily accessible information that considers social and cultural factors and different levels of eHealth literacy. The research in the future (for example, on how to get people to use apps and share data or "donate data" [36,37]) might also look at how trust and trust ability can be used as indirect motivation to encourage people to use mHealth apps and share data.

## Recommendation for pandemic Apps Development

Based on our study results on smartphone users, we found a trust gap between the government research institute and private organizational providers. Furthermore, to maintain the desire for data sharing with the research institute, all the government and private organizations that provide these apps must be transparent. Furthermore, the government health organization should have a more prominent role in adopting digital solutions in the field of health and benefiting from the data obtained through pandemic applications in this field, employing it in the areas of research and development and dealing with such epidemics in the future through the available data and experiments.

## Conflict of interests

No

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