원 저

코로나 19 동선 관리를 위한 적정 앱 서비스와 도입: 고위험 지역 설문 연구

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〈Abstract〉

Appropriate App Services and Acceptance for Contact Tracing: Survey Focusing on High-Risk Areas of COVID-19 in South Korea

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Purposes: Prompt evaluation of routes and contact tracing are very important for epidemiological investigations of coronavirus disease 2019 (COVID-19). To ensure better adoption of contact tracing apps, it is necessary to understand users' expectations, preferences, and concerns. This study aimed to identify main reasons why people use the apps, appropriate services, and basis for voluntary app services that can improve app participation rates and data sharing.

Methodology/Approach: This study conducted an online survey from November 11 to December 6, 2020, and received a total of 1,048 survey responses. This study analyzed the questionnaire survey findings of 883 respondents in areas with many confirmed cases of COVID-19. This study used a multiple regression analysis.

Findings: Respondents who had experience of using related apps showed a high intention to use contact-tracing apps. Participants wished for the contact tracking apps to be provided by the government or public health centers (74%) and preferred free apps (93.88%). The factors affecting the participants' intention to use these apps were their preventive value, performance expectancy, perceived risk, facilitative ability, and effort expectancy. The results highlighted the need to ensure voluntary participation to address participants' concerns regarding privacy protection and personal information exposure.

Practical Implications: The results can be used to accurately identify user needs and appropriate services and thereby improve the development of contact tracking apps. The findings provide the basis for voluntary app that can enhance app participation rates and data sharing. The results will also serve as the basis for developing trusted apps that can facilitate epidemiological investigations.

Key Words: COVID-19; Contact tracking app; Epidemiological investigation; Infectious diseases, The unified theory of acceptance and use of technology (UTAUT)

Ⅰ. Introduction

To overcome the coronavirus disease 2019 (COVID-19) pandemic, the world is gradually learning to live with the virus. However, preventive and public health efforts to manage in-

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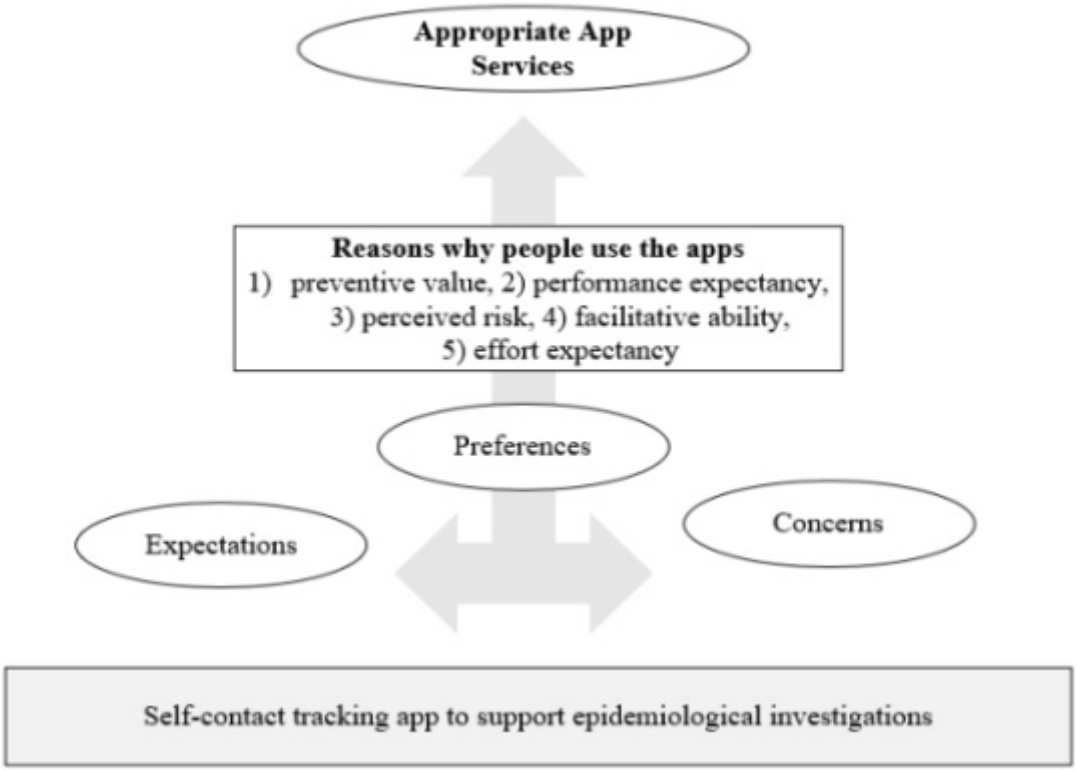


<Figure 1> Research Concepts and Objectives

fections are still essential. Various applications have been developed and used worldwide for managing cases of COVID-19, including contact tracing apps and apps for self-isolation[1]. However, the usage of these apps remains low because of privacy concerns or lack of user motivation[2-4]. Thus, many issues remain to be solved to ensure optimal usage of COVID-19-related apps in overcoming the pandemic.

Despite their low usage rates, contact-tracing apps play an important supportive role in epidemiological investigations[5, 6]. A thorough understanding of patient routes and prompt contact tracing are essential in these investigations, and these tasks are extremely time- and effort-intensive. Thus, there is a continuous need for tools to support these tasks, and properly used contact tracking apps can be reliably utilized for epidemiological investigations[7].

Since thorough epidemiological investigations require patients to provide reliable records of their own routes and not many people can remember their routes in detail, contact-tracing apps should help users remember their route in detail. However, to develop apps for this purpose, the services that people wish to receive through these apps should be identified and the factors that influence Korean people's adoption of apps should be determined, as in previous studies [8, 9].

The purpose of this study was to conduct a preliminary study to develop a self-contact tracking app to support epidemiological investigations. This study aims to identify the services that people would like to receive through magnetic contact tracking apps. We attempted to determine the important factors influencing the usage of contact tracing apps. We attempted to find a voluntary app service that can enhance the app participation rate and data sharing.

Ⅱ. Methods

1. Objectives

We conducted an online survey from November 11 to December 6, 2020 on people living in South Korea, and collected data from 1,148 people. The survey began after the respondent provided consent for participation by using the survey consent form. Coffee vouchers were provided to respondents in all surveys.

We subsequently decided to consider only the respondents from the following four regions with the highest number of confirmed cases in the country: Seoul, Gyeonggi-do, Incheon Metropolitan City, and Daegu Metropolitan City. As of December 6, 2020, the number of confirmed cases of COVID-19 in Korea reached 79% in Seoul, Gyeonggi-do, Incheon Metropolitan City, and Daegu Metropolitan City[10]. Therefore, we decided to use respondents' data from four regions for the study. Thus, data from 883 people living in areas classified as total risk areas were used for the analysis.

2. Definitions of the constructs

We conducted a literature search to extract six constructs—effort expectancy, performance expectancy, facilitating conditions, perceived risk, preventive value, and behavioral intention—that were to be used as dependent variables. Based on the unified theory of acceptance and use of technology (UTAUT)[10], each construct was defined according to the research purpose[12, 13] as follows: Effort expectancy refers to the degree to which contact tracing apps can be used. Performance expectancy refers to the degree to which the use of the apps is perceived to be useful in managing the user's route. Facilitating conditions are the degree to which the infrastructure to support the use of the apps is perceived to be in place. Behavioral intention refers to the degree of willingness to use the apps. We focused on perceived risk on the basis of previous studies that pointed out risks such as personal information protection of COVID-19-related apps[7, 14]. Perceived risk referred to concerns about personal information exposure and misuse associated with the use of the apps.

Finally, we added preventive value to the research model on the basis of previous studies[15]. When consuming a product or service, users measure its utility by comparing the benefits and sacrifices of using it[16]. Utility refers to the perceived value. Perceived value can be divided into several categories over diverse contexts, such as price, quality, and emotional value[17]. In the study by Sheth et al., consumption was defined in terms of functional value, social value, emotional value, cognitive value, and conditional value[18]. In consideration of the COVID-19 situation, we decided that the preventive value of the COVID-19-related app against infectious diseases is the value users perceive for these apps. In this context, preventive value refers to the degree to which the use of the apps is considered valuable in preventing and overcoming infectious diseases.

3. Statistical analysis

A multiple regression analysis was performed with behavioral intention to use the app as the dependent variable and preventive value, performance expectancy, perceived risk, facilitating conditions, and effort expectancy as independent variables.

In addition, we examined the differences in the intention to use apps between demographic groups. Parametric and non-parametric analyses, including the two-independent-samples t-test, one-way ANOVA, Mann-Whitney, and Kruskal-Wallis tests,

were used according to the characteristics of the variables. Kruskal-Wallis tests were performed to examine the differences in the intention to use the apps in relation to age, marital status, and education. The Mann-Whitney U test was performed to examine the differences in the intention to use the apps in relation to sex. One-way ANOVA was performed to examine the differences in the intention to use the apps in relation to occupation, monthly income, and location. Two-independent-samples t-tests were performed to examine the differences in the intention to use the apps in relation to variables other than those mentioned above. SPSS version 26.0 software (SPSS Inc.) was used to perform the statistical analyses.

4. Ethics

The study procedures were carried out in accordance with the Declaration of Helsinki and were approved by the Institutional Review Board (MC20QISI0125).

Ⅳ. Results

1. Respondent characteristics

Among the 883 respondents, 515 were male (58.3%); 356 were in their 30s (40.3%); 455 were married (51.5%); 652 had a university degree or higher (73.8%); 447 were professional, administrative, and office workers (50.6%); 795 were medical workers (90%); and 304 had salaries ranging from $1,796.95 to $3,593.89 (34.4%)(Table 1). A total of 420 respondents lived in Seoul, representing the largest percentage (47.6%); 807 had no underlying diseases (91.4%); 857 had no contact with a confirmed case of COVID-19 (97.1%); 76 (8.6%) had undergone self-quarantine; 752 had never been tested for COVID-19 (85.2%); and only three had ever tested COVID-19-positive (0.4%). While 265 people responded that their occupations involved high exposure to COVID-19 patients (30%), 162 stated that they had used a COVID-19-related app (18.3%).

The intention to use the app differed significantly in relation to the experience of using COVID-19-related apps ($t = -2.831$, $p < 0.01$) and between medical workers and those in other occupations ($t = 2.227$, $p < 0.05$). People who had previously used COVID-19-related apps expressed a high intention to use the app (mean = 15.562 vs. 14.863). On the other hand, the intention to use the app was higher in non-medical workers than in the medical workers (mean = 15.067 vs. 14.307).

2. Appropriate app services and providers of self-contact tracing apps

<Table 1> Respondent characteristics

Variables		N	%	P-value
Sex	Male	368	41.7	0.247
	Female	515	58.3	
Age	18-19 years	13	1.5	0.115
	20-29 years	250	28.3	
	30-39 years	356	40.3	
	40-49 years	199	22.5	
	Over 50 years	65	7.4	

Variables		N	%	P-value
Marital status	Single	415	47.0	0.943
	Married	455	51.5	
	Other(divorced, separated, or widowed)	13	1.5	
Education	High school graduation or lower	73	8.3	0.071
	College student	158	17.9	
	University graduation or higher	652	73.8	
Job	Professional, administrative job, office worker	447	50.6	0.476
	Service/sales/production	72	8.2	
	Self-employed/freelancer	75	8.5	
	Housewife	109	12.3	
	Student	136	15.4	
	Other or unemployed	44	5.0	
Medical workers	No	795	90.0	0.026*
	Yes	88	10.0	
Monthly income[a]	Under $1,796.95	52	5.9	0.078
	$1,796.95-$3,593.89	304	34.4	
	$3,593.89-$5,390.84	256	29.0	
	Over $5,390.84	271	30.7	
Location	Gyeonggi-do	299	33.9	0.286
	Daegu Metropolitan City	103	11.7	
	Seoul	420	47.6	
	Incheon Metropolitan City	61	6.9	
Presence of underlying disease	No	807	91.4	0.486
	Yes	76	8.6	
Contact with an infected person	No	857	97.1	0.368
	Yes	26	2.9	
Self-isolation experience	No	807	91.4	0.762
	Yes	76	8.6	
COVID-19 testing experience	No	752	85.2	0.580
	Yes	131	14.8	
COVID-19 confirmed experience	No	880	99.7	0.257
	Yes	3	0.3	
Jobs with high exposure to COVID-19	No	618	70.0	0.471
	Yes	265	30.0	
Experience using apps related to COVID-19	No	721	81.7	0.005**
	Yes	162	18.3	
Total		883	100	

[a]The exchange rate for Korean won to the U.S. dollar is 1,113 won (buy and sell base rate on November 11, 2020). *t(0.05) = 1.960, **t(0.01) = 2.576

While 653 (73.9%) respondents said that the app should be provided by government agencies, such as local governments or public health centers, 829 people (93.9%) wanted it to be provided free of charge (Table 2). When asked to select their preferred way to record routes in contact tracing apps, 427 participants preferred the check-in method with registration by QR codes or a mobile phone (48.4%), 346 preferred to enter additional information after searching for a location on the map (39.2%), and only 10 preferred GPS-based automatic recording (1.1%).

We also surveyed the preferences regarding app services (Table 3). These preferences were de-

<Table 2> Service types and providers of self-contact-tracing apps

Questions	Response	N	%
Appropriate app providers	Government agencies such as local governments	438	49.6
	Public Health	215	24.3
	Hospital	106	12.0
	Any provider	67	7.6
	Health care company	57	6.5
Service cost	Free	829	93.9
	Paid	54	6.12
What is the most appropriate method to record the route?	Recording after check-in(QR code, phone call)	427	48.4
	Enter additional input after searching for a map location	346	39.2
	Manual input	78	8.8
	Record as a drawing or photograph	22	2.5
	Automatic recording of GPS-based movement	10	1.1
Total		883	100

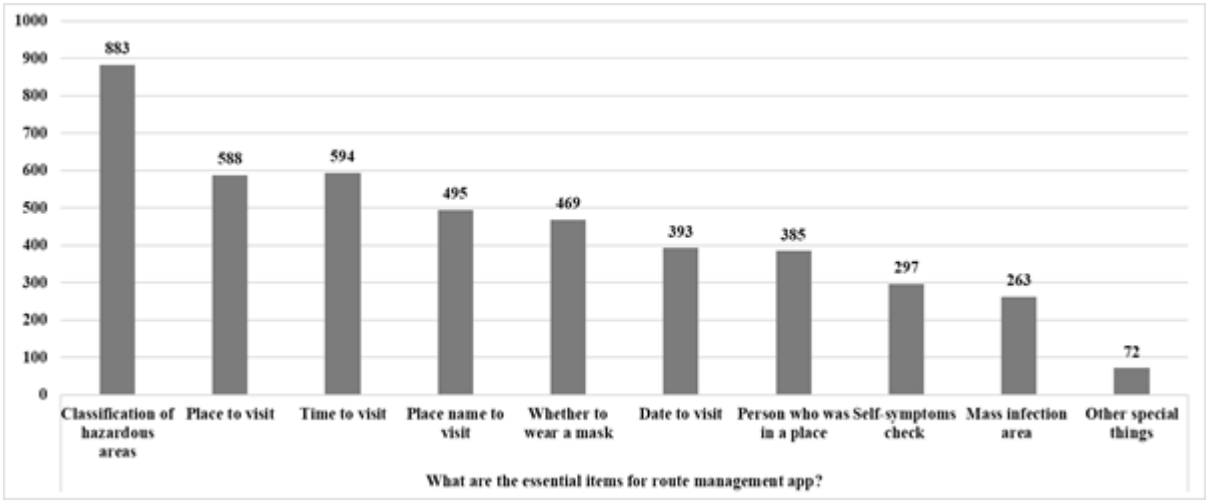
termined using multiple response questionnaires, so respondents were able to select duplicate items. First, we asked the participants to select the services they would like the app to provide. The participants selected route-recording (22.6%), self-symptom management (21%), provision of information on infectious diseases (14.8%), hospital search (13.6%), information on disposal of route records (10.3%), personal information management and utilization (9.5%), and psychologist link services (8.2%).

Second, we asked respondents to select the service items the app needed (Figure 1). They selected classification of hazardous areas (19.9%),

<Table 3> Service preferences for self-contact-tracing apps

Questions	Response	N	%	Case %
What service would you like to receive from the route management app?	Route-recording service	606	22.60%	68.60%
	Self-symptom management	563	21.00%	63.80%
	Providing information on infectious diseases	398	14.80%	45.10%
	Hospital search service	364	13.60%	41.20%
	Information on disposal of route records	276	10.30%	31.30%
	Personal information management and utilization	256	9.50%	29%
	Psychologist link service	220	8.20%	24.90%
	Total	2683	100%	303.90%
What essential information should be provided by the route-management app?	Classification of hazardous areas	883	19.90%	100%
	Place type to visit	588	13.20%	66.60%
	Time to visit	594	13.40%	67.30%
	Place name tovisit	495	11.20%	56.10%
	Necessity of wearing a mask	469	10.60%	53.10%
	Date to visit	393	8.90%	44.50%
	Persons who were in an area	385	8.70%	43.60%
	Self-symptom check	297	6.70%	33.60%
	Mass infection area	263	5.90%	29.80%
	Other special items	72	1.60%	8.20%
	Total	4439	100%	502.70%

Questions	Response	N	%	Case %
What information would you like to receive from the app?	Risk of surrounding facilities	506	24.10%	57.30%
	Disclosure of the route of COVID-19-confirmed patients	496	23.60%	56.20%
	Statistical information of COVID-19-confirmed patients	466	22.20%	52.80%
	Information on nearby screening clinics	400	19%	45.30%
	Related product store information	234	11.10%	26.50%
	Total	2102	100%	238.10%



<Figure 2> The service items the app needed

place type to visit (13.2%), time to visit (13.4%), place name to visit (11.2%), need to wear a mask (10.6%), date to visit (8.9%), persons who were in an area (8.7%), self-symptom check (6.7%), mass infection area (5.9%), and other special items (1.6%). Finally, we asked respondents to select the information they would like the app to provide. They selected risk of surrounding facilities (24.1%), disclosure of route of COVID-19 confirmed patients (23.6%), statistical information of COVID-19 confirmed patients (22.2%), information on nearby screening clinics (19%), and related product store information (11.1%).

3. Factors affecting intention to use self-contact-tracing apps

There are the results of the principal component analysis using varimax rotation for the construct (Appendix Table 1). The results demonstrated that all factors had construct validity, with factor loadings exceeding 0.60 for each construct. This result confirms the presence of all factors with eigenvalues greater than 1.0, which accounted for 15.774% of the total variance. Community values ranged from 0.593 to 0.816. We examined Cronbach's alpha to check the reliability of internal consistency. Cronbach's alpha values for all factors ranged from 0.706 to 0.886. The results demonstrated that all factors had reliable internal consistency with Cronbach's alpha values exceeding 0.70 [19]. Accordingly, all the factors were distinct unidimensional scales.

All factors contributed significantly to the behavioral intention to use the app ($F = 227.209$, $p = 0.000$). The coefficient of determination (R^2) for this model was 0.562, indicating that 56% of the variation in behavioral intention to use could be

<Table 4> Factors affecting the intention to use contact tracing apps

Factors	Unstandardized coefficients		Standardized coefficients	T-value	Significance level	Collinearity statistics	
	B	Standard Error	Beta			Tolerance	VIF
(Constant)	2.100	0.602	–	3.491	0.001	–	–
Preventive value	0.462	0.037	0.397	12.465	0.000***	0.488	2.047
Performance expectancy	0.549	0.047	0.375	11.715	0.000***	0.485	2.061
Perceived risk	−0.086	0.018	−0.112	−4.881	0.000***	0.947	1.056
Facilitating conditions	0.186	0.040	0.125	4.607	0.000***	0.675	1.481
Effort expectancy	−0.112	0.043	−0.071	−2.576	0.010**	0.650	1.538

explained by five independent variables. Table 4 shows that preventive value (t = 12.465, p = 0.001), performance expectancy (t = 11.715, p = 0.001), perceived risk (t = −4.881, p = 0.001), facilitating conditions (t = 4.607, p = 0.001), and effort expectancy (t = −2.576, p = 0.01) were significantly associated with the behavioral intention to use the apps.

4. Reasons hindering users from recording and sharing routes in the apps

We asked respondents to list the reasons that would hinder them from logging routes into the apps (Table 5). While 560 respondents cited invasion of privacy and disclosure of personal information as the reason (63.2%), 249 people identified the inconvenience of recording as the reason (28.1%).

We asked users to list the reasons preventing them from sharing the recorded routes to epidemiological investigation agencies. While 674 respondents cited invasion of privacy and disclosure of personal information as the reason (76%), 186 respondents cited unwanted attention and criticism from others as the reason for not sharing route information (21%).

Ⅴ. Discussion and conclusion

We attempted to find the basis for voluntary app services that would promote high participation rates and greater data sharing. The findings suggested that people preferred contact tracing apps

<Table 5> Reasons hindering users from recording and sharing routes in app

Questions	Items	N	%
Hindrances to log your route traces into the contact tracing app	Disclosure of personal information	265	29.9
	Invasion of privacy	295	33.3
	Inconvenience of recording	249	28.1
	No reason	74	8.4
	No burden	3	0.3
Hindrances to providing recorded route information to epidemiological investigation agencies	Disclosure of personal information	363	41
	Invasion of privacy	311	35
	Unwanted attention and criticism from others	186	21
	No burden	23	3
	Total	883	100

that were provided free of charge by governments and public institutions. People also wanted their check-in records to be used to automatically record routes in the app. In South Korea, when entering a multi-use facility such as a restaurant, customers must either scan a QR code or call the COVID-19 safety number. The respondents wanted the recording to occur automatically when they scanned a QR code or called the COVID-19 safety number. In addition, the most preferred method of inputting the route was to save the route after searching for a location on the map and to input additional information. People want an easy way to save their routes as a public service. The findings indicate the necessity of developing government-led apps that can support people in safely protecting themselves from COVID-19.

Next, the services that people wanted to receive from the app were self-route management, COVID-19-related symptom management, COVID-19-related information, and a function to find related hospitals. Despite the importance of psychological counseling and treatment related to COVID-19[20-22], the need for self-contact-tracing apps is relatively low. It seems desirable to classify this service rather than service it within the contact tracing app.

The following results indicate which items are desirable in the design of the apps. The apps should collect information classifying hazardous areas, including the visited place, time, name of place, whether a mask is worn, date of visit, person in attendance, etc. It is desirable to plan based on the epidemiological investigation report so that such information can be utilized as much as possible during the epidemiological investigation.

The participants were concerned about hazardous areas and recognized that classification and recognition of these areas was extremely necessary. They wanted to receive information such as the risk level of nearby facilities and patient movement information. Self-management of one's COVID-19 risk levels is a critical aspect of controlling the spread of the pandemic. Accordingly, it seems necessary to continuously collect and process data related to the risk rate of hazardous facilities and information on COVID-19 confirmed patients. However, too much information can increase fatigue; therefore, it is important to provide accurate and necessary information in a refined manner. In addition, the intention to use the apps was higher in non-medical workers than in the medical workers. Therefore, our results can be viewed as more suitable for non-medical users.

Next, we determined the factors that influence people's adoption of contact tracing apps. The most important factor influencing the acceptance of the apps was whether they had preventive value. Thus, the content or service provided by the app should support users in avoiding or overcoming COVID-19 as a preventive measure. In addition, people expected the the apps to be useful in overcoming and preventing epidemiological investigations and infectious diseases through self-route management. Thus, the app should be designed so that it can be used to self-manage the user's own route from COVID-19 and report the route during epidemiological investigations.

In addition, the lower the risks of threats such as privacy exposure, the higher the willingness to use the self-contact tracing app, as in previous research[23]. Therefore, it seems desirable to develop the app such that the data collected by it is stored on the user's device. Another option would be to apply the relevant app security techniques. This is a very important point in increasing the use of the apps.

The ease of using the apps and factors promoting the use of the apps were also important factors influencing the intention to use the apps. However,

this causal relationship is negative in case of effort expectancy. This result differed from the traditional technology acceptance model[11, 24-27]. However, effort expectancy is still an important factor in ntention to use the apps. As mentioned earlier, when entering a multi-use facility, Koreans had to either scan a QR code or call the COVID-19 safety number as of December 2020. Since COVID-19 prevention protocols already force people to follow various rules and steps such as wearing masks and scanning QR codes, the app should avoid increasing this burden and, if possible, reduce the inconvenience caused by this situation.

Although the respondents' intention to use the apps was affected by these five factors, they still showed reluctance to track and manage their movement in the apps because of concerns related to personal information exposure and invasion of privacy. Despite advancements in contact tracing apps, people remain concerned about exposure of their information. One previous study proposed using reliable security measures that can prevent problems such as exposure of personal information[3]. However, these concerns from users and privacy issues cannot be not addressed solely by technology[28]. To avoid exposure of personal information and invasion of privacy, the route records should be stored only on the users' mobile phones. Moreover, users should be allowed to control whether their data can be shared with third parties or organizations. Thus, the apps should be improved to encourage voluntary participation and address the concerns regarding privacy protection and personal information exposure. In addition, for some of the respondents, a major reason for their reluctance to use the app was inconvenience and the bother of recording. Thus, it is necessary to develop a service that can minimize the inconvenience of moving line records.

The biggest reason for reluctance to provide contact-tracing records to epidemiological investigation agencies was the potential exposure of personal information and invasion of privacy. In addition, the respondents also wished to avoid unwanted attention and criticism from others. These factors are extremely important when conducting epidemiological investigations and understanding people's movements and contact. Therefore, approaches that encourage people to voluntarily share their contact records for epidemiological investigations are important. In addition, while transferring these data to epidemiological investigation agencies, security measures to prevent exposure of the provider's personal information and avoid invasion of their privacy should be implemented.

Active usage of reliable contact-tracing apps will be essential during the pandemic. To this end, we hope to design an app based on the results of this study. In addition, it will be necessary to design and develop contact tracing apps that people can use easily, conveniently, comfortably, and voluntarily. Contact tracing apps have been reported to be meaningful if they are used by 90% of the population[29]. Thus, to increase the usage rate of these apps, they should be developed from the user's perspective instead of being built from the perspective of data collection and utilization. In addition, data collection and utilization through these apps should be planned such that the user has ownership of the data. Even in situations involving a third party or an app service provider, a system based on user donation should be implemented.

There are several limitations. First, we could not use many relevant references to interpret the app service-related results. Although various COVID-19-related studies are being conducted around the world, the literature on the app service was limited

at the time of the survey. However, our results and opinions will be helpful to researchers planning similar app services. Second, the respondents included very few individuals who had experience of a COVID-19 test, contact with a confirmed patient, experience of self-isolation, and experience of COVID-19 diagnostic tests. The low rate may be attributed to the fact that survey response period was in December 2020. As of June 2022, if the same questionnaire is conducted, it will be possible to secure more people who have been confirmed or tested for COVID-19. Thus, these results may show limited generalizability depending on the COVID-19 situation in each country. Third, we conducted with people living in regions which had more COVID-19 confirmed cases than other regions in South Korea. The findings could not reflect the opinions of individuals in low-risk areas. It would be meaningful to conduct additional research on respondents from other regions. Fourth, although the UTAUT model includes social influence, we did not use it in the study because the reliability and validity of the social influence items were not secured. This may be the result of not reflecting the intention of the survey properly in the process of modifying social influence to fit the current research purpose. Thus, it may be desirable to include social influence through the development of a clear questionnaire in the future. Fifth, we used the UTAUT model to derive the main variables. This model can provide a comprehensive understanding of users' acceptance in healthcare, And future studies may be conducted using diverse technology acceptance models such as UTAUT2 and TAM2. Finally, our results showed that non-medical users were more willing to use the apps and demand for psychiatric services was relatively low. However, according to previous study[30], medical staff have stress and depress from COVID-19. App services for medical users seems to need access new approaches and study.

At the time of this study, there is a limit to the interpretation of the results due to the difference in the COVID-19 situation in 2020 and June 2022. Although there are these limitations, these results can provide useful information to developers creating similar worldwide apps. This is because each country has a different situation and level of response to COVID-19. Our results can facilitate apps planning by accurately identifying user needs and allowing the development of appropriate apps. The results also provide the basis for developing voluntary apps with high rates of participation and data sharing.

Disclosure Statement

There is no conflict of interest occurred in this paper.

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<Appendix Table 1> Loadings, cross-loadings, and reliability

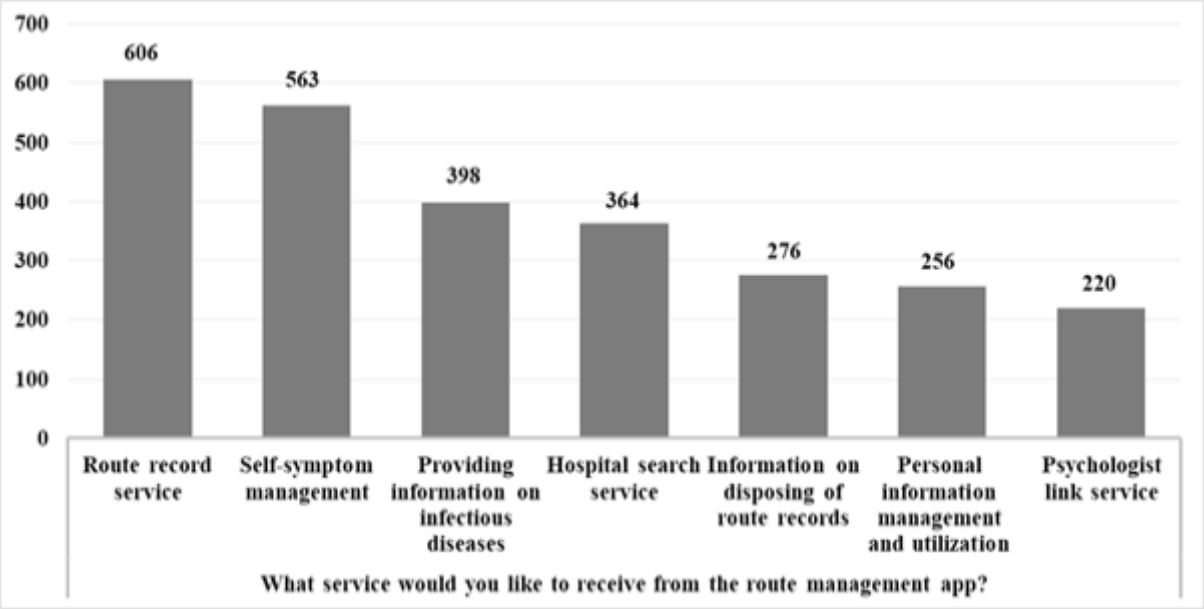
Variables		1	2	3	4	5	6	Communality	Cronbach's α
Perceived risk	PR2	**.873**	−.083	−.013	.022	−.002	.053	.772	0.884
	PR1	**.827**	−.039	−.006	.115	.002	.106	.710	
	PR3	**.822**	−.048	−.026	−.015	.036	.003	.680	
	PR6	**.807**	−.052	.058	.141	.016	−.078	.684	
	PR5	**.786**	.014	.025	.041	−.081	.027	.628	
Behavioral intention to use	BIU1	−.030	**.826**	.271	.117	.138	.142	.810	0.886
	BIU3	−.045	**.802**	.285	.150	.187	.067	.789	
	BIU2	−.090	**.771**	.228	.052	.242	.168	.744	
	BIU4	−.111	**.694**	.226	.107	.274	.139	.651	
Preventive value	PV2	−.014	.301	**.740**	.078	.262	.156	.737	0.855
	PV3	.000	.314	**.717**	.127	.241	.162	.713	
	PV1	.074	.240	**.711**	.351	.039	.096	.703	
	PV4	.000	.342	**.661**	.162	.262	.219	.698	
Effort expectancy	EE1	.115	.053	.206	**.836**	.199	.075	.803	0.807
	EE2	.085	.063	.230	**.811**	.273	.090	.804	
	EE4	.102	.211	.053	**.711**	.072	.159	.593	
Performance expectancy	PE2	−.032	.339	.222	.260	**.754**	.121	.816	0.850
	PE3	−.027	.311	.221	.266	**.749**	.128	.795	
	PE5	.026	.306	.313	.184	**.651**	.145	.671	
Facilitating conditions	FC1	.124	.088	.073	.235	−.028	**.824**	.763	0.706
	FC2	.001	.136	.363	.028	.215	**.700**	.686	
	FC4	−.026	.377	.147	.085	.272	**.612**	.621	
Eigenvalue		3.470	3.305	2.719	2.355	2.187	1.836	3.470	
% of Variance		15.774	15.022	12.357	10.703	9.939	8.344	15.774	
Cumulative %		15.774	30.796	43.153	53.857	63.796	72.140	15.774	

<Appendix Table 2> Factors definition and questionnaire(5-point scale)

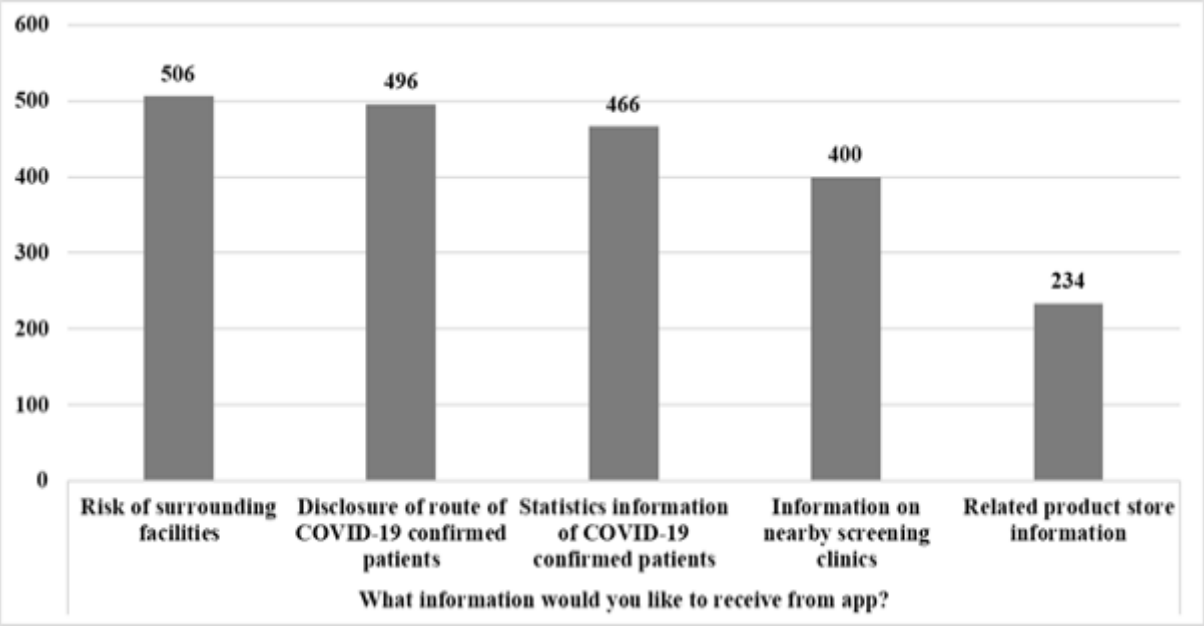
Construct	Items	References
Effort expectancy	**The degree to which contact tracing apps can be used.** 1. It should be easy to record my movement with the app. 2. It should be easy to check my movement. 3. It should be easy to provide my route to related organizations, etc. 4. It should be easy to store and delete information.	11, 25
Performance expectancy	**The degree to which the use of the apps is perceived to be useful in managing the user's route.** 1. The information provided through the app will be useful. 2. The app will be useful for recording my movement. 3. The app will be useful for checking my movement. 4. The app will be useful for future epidemiological investigations. 5. The app will be useful in preventing and overcoming infectious diseases.	11, 25
Facilitating conditions	**The degree to which the infrastructure to support the use of the apps is perceived to be in place.** 1. I have the necessary knowledge to use the app. 2. The app will be compatible with infection–prevention methods that have been used before. 3. The app is compatible with my infectious disease management style. 4. Help is easily available when I encounter difficulties while using the app.	24, 25
Perceived risk	**Concerns about personal information exposure and misuse associated with the use of the apps.** 1. I am concerned that the app will expose my privacy. 2. When using the app, sensitive information is likely to be exposed without my consent. 3. When using the app, data will be collected and utilized excessively. 4. I wish anonymity was guaranteed. 5. There is a risk that the information in the app may be used inappropriately by related organizations. 6. I am reluctant to expose personal information through apps.	7, 14
Preventive value	**The degree to which the use of the apps is considered valuable in preventing and overcoming infectious diseases.** 1. The app should have value in protecting me from infectious diseases. 2. The app should be useful in preventing infectious diseases. 3. The app is valuable as a precautionary measure. 4. Route recording through the infectious disease management app can contribute to overcoming infectious diseases.	17, 18
Behavioral intention	**The degree of willingness to use the apps** 1. If there is a chance in the future, I would like to use this app. 2. I will recommend it to my acquaintances. 3. I am willing to manage my own movement through the app as a preventative measure. 4. I am willing to record my movement through the app and provide it to related organizations.	11, 25

<Appendix Table 3> Questionnaire

Questions	Response
Appropriate app providers	Government agencies such as local governments
	Public Health
	Hospital
	Any provider
	Health care company
Service cost	Free
	Paid
What is the most appropriate method to record the route?	Recording after check-in(QR code, phone call)
	Enter additional input after searching for a map location
	Manual input
	Record as a drawing or photograph
	Automatic recording of GPS-based movement
What service would you like to receive from the route management app?	Route-recording service
	Self-symptom management
	Providing information on infectious diseases
	Hospital search service
	Information on disposal of route records
	Personal information management and utilization
	Psychologist link service
What essential information should be provided by the route-management app?	Classification of hazardous areas
	Place type to visit
	Time to visit
	Place name to visit
	Necessity of wearing a mask
	Date to visit
	Persons who were in an area
	Self-symptom check
	Mass infection area
	Other special items
What information would you like to receive from the app?	Risk of surrounding facilities
	Disclosure of the route of COVID-19-confirmed patients
	Statistical information of COVID-19-confirmed patients
	Information on nearby screening clinics
	Related product store information
Hindrances to log your route traces into the self-contact-tracing app	Disclosure of personal information
	Invasion of privacy
	Inconvenience of recording
	No reason
	No burden
Hindrances to providing recorded route information to epidemiological investigation agencies	Disclosure of personal information
	Invasion of privacy
	Unwanted attention and criticism from others
	No burden



<Appendix Figure 1> The services they would like the app to provide



<Appendix Figure 2> The information they would like the app to provide

〈한글 초록〉

연구목적: 적절한 동선 파악과 동선 추적은 코로나19 역학조사를 위해서 매우 중요하다. 동선 추적 앱 도입을 활발히 하기 위해서는 사용자들의 앱에 대한 기대, 선호 그리고 우려하는 부분에 대한 이해가 필요하다. 본 연구는 동선 추적 앱의 사용률을 높이고, 데이터 공유를 원활히 할 수 있게 해주는 자발적 앱 서비스에 대한 기본적 특징과 적절한 서비스를 찾고자 하였다. 또한 사람들이 왜 동선 추적 앱을 사용하려고 하는지에 대한 주요요인을 확인하였다.

연구방법: 이 연구는 2020년 11월 11일부터 12월 6일까지 온라인 서베이를 실시하였고, 통 1,048명의 응답 데이터를 수집하였다. 응답 데이터 중 2020년 가장 많은 코로나19 확진자가 나온 지역의 883명의 응답자 데이터를 분석에 사용하였다.

결과: 코로나 19 관련 앱을 사용해본 경험자들은 동선 추적 앱에 대한 높은 사용의도를 가지고 있는 것으로 나타났다. 응답자들은 보건소와 같은 공공기관에서(74%), 무료(93.88%)로 앱을 제공해주기를 원했다. 동선 추적 앱 사용의도에 영향을 미치는 요인으로는 예방적 가치, 기대성과, 인지된 위험, 촉진기능, 노력기대 등으로 나타났다. 또한 개인정보 보호 및 개인정보 노출에 대한 사용자들의 우려를 해결하고 자발적 앱 사용이 필요한 것으로 분석되었다.

함의: 본 연구 결과는 동선 추적 개발에 있어, 적절한 서비스와 사용자들의 니즈를 파악하는데 유용할 것이다. 사람들의 앱 참여율과 데이터 공유를 높일 수 있는 자발적 앱 개발을 위한 기반을 제공해준다. 또한 본 연구는 역학조사에 협조가 가능한 신뢰 가능한 동선 추적 앱 개발의 근간을 마련할 수 있다.

중심단어: 코로나19, 동선 추적 앱, 역학조사, 감염병, 확장된 통합기술수용모형