The willingness to adopt m-Health among Chinese parents during the COVID-19 outbreak：Cross-Sectional Questionnaire Study

Siyu Yang, Yijing Chen, Leshan Zhou, Yuting Huang, Jiahui Dai

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Abstract

Background: Under COVID-19 outbreak, m-Health can assist with health promotion, medicine instruction, disease diagnosis via online chat, video consultation without visiting hospitals.

Objective: This study aimed at identifying associated factors of willingness to adopt m-Health among Chinese parents under COVID-19 outbreak, investigated the correlation between the frequency of adopting m-Health and parent's behaviour towards child-health at home.

Methods: An online-based survey was performed among Chinese parents from 25th January to 15th February, 2020. Two questionnaires including demographic variables and parent's behavior towards child-health at home were used to measure the procedure.

Results: Out of 254 parents, 202 (79.53%) were willing to adopt m-Health under COVID-19 outbreak. Multivariable logistics regression model demonstrated that parent's age, parent's attention to the pandemic of COVID-19, the source to recommend m-Health, the child with chronic disease, parent's duration of daily internet use, adopt mobile health service before COVID-19 outbreak were significantly correlated with parent's willingness to adopt m-Health under COVID-19 outbreak. Pearson chi-square test revealed a strong indication of dependency between the frequency of using m-Health in one month and parent's behavior towards child-health at home ($P < 0.05$).

Conclusions: Willingness to adopt m-Health was high. parent's age, parent's attention to the pandemic of COVID-19, the source to recommend m-Health, the child with chronic disease, parent's duration of daily internet use, adopt mobile health service before COVID-19 outbreak were significantly associated factors. Providing the option of m-Health to patients under COVID-19 outbreak would be a better way to educate and instruct them to improve self-management in child-health at home.

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The willingness to adopt m-Health among Chinese parents during the COVID-19 outbreak：Cross-Sectional Questionnaire Study

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Abstract

Background: Parental involvement in m-health to consult with medical professionals appears to be prevalent in China with rapid development in Internet. More parents with busy jobs choose m-health without time limitation. During the ongoing COVID-19 outbreak, m-Health can assist with health promotion, directions for medication usage and disease diagnosis via online chat and video consultation without contacting others. To our knowledge, no studies have been performed to explore the role of m-health in parents' attitudes towards child health at home during COVID-19 outbreak.

Objectives: Our study aimed to identify the associated factors of willingness to adopt m-Health among Chinese parents during the COVID-19 outbreak, and to explore the correlation between the frequency of adopting m-Health and parents' attitudes towards child health at home.

Method: Chinese parents were asked to complete an online survey from 25th January to 15th February, 2020. The questionnaire comprised of two parts with a total of sixteen items, including parents' demographic variables and attitudes towards child health at home. By multivariate logistic regression we explored factors associated with parents' willingness to adopt m-Health during the COVID-19 outbreak. Pearson chi-square test was used to reveal the correlation between the frequency of adopting m-Health and parents' attitudes towards child health at home.

Results: A total of 254 parents enrolled, from which 202 out 254 (79.5%) were willing to adopt m-Health during the COVID-19 outbreak. Parents' age ((adjusted OR

(AOR): 8.114(95% CI: 1.471 to 44.764)), parents' interest in the COVID-19 pandemic (AOR: 8.753(95% CI: 2.009 to 38.127); AOR: 22.194(95% CI: 5.509 to 89.411)), the source to recommend m-Health (AOR: 4.257(95% CI: 1.439 to 12.596)), presence of chronic disease in children (AOR: 20.844(95% CI: 4.600 to 94.443)), parents' duration of daily internet use (AOR: 6.487(95% CI: 1.870 to 22.495); AOR: 8.766(95% CI: 1.883 to 40.804)), and adoption of m-Health before the COVID-19 outbreak (AOR: 3.413(95% CI: 1.234 to 9.444)) were significantly correlated with parents' willingness to adopt m-Health during the COVID-19 outbreak. The frequency of m-health usage among parents was correlated with their behaviors in regards to hand-washing (χ^2=18.967, *P*=.004), mask-wearing (χ^2=45.364, *P*< .001), frequency of leaving the home (χ^2=16.767, *P*=.01*)*, room disinfection and ventilation (χ^2=19.515, *P*=.003), temperature checking (χ^2=17.47, *P*=.007), and mental health-care of children (χ^2=63.810, *P*< .001) during the COVID-19 pandemic.

Conclusion: We found various objective factors to be associated with parents' willingness to adopt m-Health during the COVID-19 outbreak. Overall, parents' willingness to adopt m-Health was high. The frequency of m-health usage among parents was correlated with their attitudes towards child

health at home. The option of m-Health to patients at home during the COVID-19 outbreak would be beneficial for education and improvement in self-management of child health at home.

Key Words m-Health, parents, child-health at home; COVID-19

Introduction

Background

Coronavirus disease 2019 (COVID-19), which causes severe acute respiratory syndrome, is an ongoing pandemic and an important public health concern. The major transmission modes of COVID-19 are airborne droplets from coughing or sneezing and direct contact with contaminated surfaces such as doorknobs, dishes and handrails [1]. Particular circumstances, including tracheal incubation or opening suction in hospital, stays in confined spaces with infected people, and fomites attached to ventilation system can result in mass infection [1].

Infants and children are a typically vulnerable population due to immaturity of the respiratory tract and hypoimmunity [2]. According to an analysis of 2143 pediatric cases in China, the median age of the infected child is seven years old [3]. The majority of severe pediatric cases arose from exposure to infected family members and few were infected in hospital or as a result of travel [4]. To effectively prevent and control the COVID-19 outbreak among Chinese children, the National Health Commission issued guidelines termed "Epidemiological characteristics and prevention and control measures of Corona Virus Disease 2019 in children", which clearly state that children are required to be isolated at home under parents' supervision [5]. In addition, experts also suggest that parents do not take children to hospital to avoid cross infection [6]. To prevent large scale gatherings, all regional governments of China shut down schools and colleges and decreased the run time of public transportation. Residents dwelling in high-risk areas are forbidden to go out except to acquire daily necessities and to visit the hospital [6].

In China, more than 1.3 billion people access the internet via their mobile phones, which has which become an indispensable part of daily life [7]. The application of m-Health is widely recommended for Chinese parents to replace visiting hospital during the COVID-19 outbreak. m-Health is defined as the use of wireless electronic devices to transmit various contents and medical services among patients and caregivers. Besides routine use, Chinese people could use m-Health during COVID-19 pandemic through phone applications [8, 9], the hospital website, and doctors' official social accounts on Wechat or Alipay to get primary diagnoses between common clod or flu and pneumonia, achieve self-monitor, access to online lecture about COVID-19 prevention, purchase essential medicine from online diagnosis. Specific Individuals could also acquire urgent care in emergency situations by m-Health to contact specialists or hospitals designed to delivery, chronic disease patient, terminal cancer. m-Health is viewed as an easily accessible, cost-efficient approach to

enhancing adherence to medication, expanding access to medical care, and increasing the number of medical consultations [10]. Overall, m-Health has proven to be a great success for the management of chronic disease management [11], remote monitoring of weight control [12], improvement of child vaccine coverage and neonatal care among young mothers [13].

Objectives

Though robust evidence highlights the potential benefits of m-Health, individual willingness to adopt m-Health is a decisive factor. Therefore, the purpose of article was to (1) explore factors associated with willingness to adopt m-Health among Chinese parents during the COVID-19 outbreak for better promotion of m-Health in China; (2) to investigate the correlation between frequency of adopting m-Health during the COVID-19 outbreak in one month and parents' attitudes towards child health at home.

Methods

Definition of variables

The willingness to adopt m-Health among Chinese parents was measured as "yes or no".

m-Health in China is defined as the dissemination of medical information, consultation about disease diagnosis and treatment, postoperative care management , mental health care, and making medical appointments via phone applications or social media [14].

Participant Recruitment

This cross-sectional study was conducted between 25th January 2020 and 15th February, 2020. Data were collected using structured questionnaires based on literature review. 12 participants were recruited to test the original questionnaire for feedback, ensuring this questionnaire was understandable. Regarding the pandemic of COVID-19, only an online version of this questionnaire was used for distributing the survey. The online questionnaire link was forwarded to social media groups such as breastfeeding groups, parental involvement in kindergarten or primary school online groups and posted on pediatric researchers' social account home pages where health education about children was performed to maximize recruitment of respondents. If parents were interested in our study, they could enter into our questionnaire by link and a description of this study were on the first page of the online questionnaire. Parents could only answer the rest of questionnaire provided they clicked "agree" after reading the consent information on the first page and submission was admitted after all items completed.

Parents who met any of the following criteria were excluded: (1) completed the questionnaire in under 120 seconds; (2) the age of child □14 years old; (3) the parent does not live with his/her child during the COVID-19 pandemic; (4) one parent or both have confirmed COVID-19; (5) no internet access; (6) more than one questionnaire from the same IP address; (7) any missing items from the.

Two researchers, who were master's degree students, selected valid questionnaires in accordance with exclusion criteria. This study was approved by the Ethics Committees of Xiangya Nursing School, Central South University. In total, 18 questionnaires were considered substandard and excluded, and 254 Chinese parents participated in the online survey with an effective rate of 93.38%.

Measurement of variables

Following a literature review by our research team, consisting of one professor and five graduate students, a structured questionnaire was designed for this study. The 23-item questionnaire was comprised of two parts: (1) parents' demographic variables including gender, age, education level, family annual income, occupation, age of the child, residence, attention to the pandemic of COVID-19, how they heard about m-Health, presence of chronic disease in their child, their use of m-Health before the COVID-19 outbreak, confirmed case/suspected case of COVID-19 in their community, and duration of daily internet use. (2) parents attitudes towards child health at home were with regards to diet, exercise, personal hygiene, sleep quality, and mental care (all items are shown in table 3). In total, 30 parents were involved in the pilot study to modify the statements in the questionnaire. Subsequently, "worries about privacy disclosure" and "the frequency of nutrition supplement intake among children" were deleted. (Most parents reported that their name or phone number would be hidden when using m-Health, and other confounding factors such as residence, family income, and education level were related to the intake of nutritional supplements.

Statistical analysis

Each questionnaire was screened by two separate researchers and input into SPSS.V.22 for analysis. Mean +/- standard deviation was used to describe the continuous variables with normal distribution. Number and percentage were used to represent categorical variables. The associated factors of willingness to adopt m-Health among Chinese parents during the COVID-19 outbreak were analyzed by binary and multivariate logistic regression. To eliminate the effects of confounding variables on the results, variables with a p value < 0.2 following bivariate logistic regression analyses entered into logistic regression. Correlation Chi-square test was used to determine the correlation between the frequency of adopting m-Health during the COVID-19 outbreak in one month and parents' attitudes towards child health at home. Corrected p values <.05 was considered statistically significant.

Results

Socio-demographic characteristics

In total, 254 parents were recruited, 172 out of 254 (67.7%) were female. The age ranged from 26–35. Overall, 175 out of 254 (68.9%) parents had bachelor degree or above. Almost half of parents' family annual income reached more than 50,000 yuan. 179 out of 254 (70.5%) had jobs working in IT, medicine, service or other industry, and others were self-employed or jobless. In total, 165 out of

254 (64.9%) parents were living in urban areas during the COVID-19 outbreak. All details about parents' socio-demographic characteristics are presented in table 1.

Table 1. Demographics of parents (N=254)

		Willingness to adopt m-Health	
Variables		No	Yes
Gender, n (%)			
	Male	20 (24.4)	62 (75.6)
	female	32 (18.6)	140 (81.4)
Age, n(%)			
	18~25	6 (37.5)	10 (62.5)
	26~35	37 (18.7)	161 (81.3)
	≥ 36	9 (22.5)	31 (77.5)
Education level, n(%)			
	Middle school or below	12 (20)	48 (80)
	High school	6 (31.6)	13 (68.4)
	University or college	29 (20.1)	115 (79.9)
	Master's degree or above	5 (16.1)	26 (83.9)
Family annual income, n(%)			
	<10,000	10 (18.5)	44 (81.5)
	10,000~50,000	15 (20.3)	59 (79.7)
	50,000~100,000	14 (29.2)	34 (70.8)
	> 100,000	13 (16.7)	65 (83.3)
Occupation, n (%)			
	Medical care	4 (14.3)	24 (85.7)
	IT	2 (14.3)	12(85.7)
	service	14 (18.2)	63 (81.8)
	other	19 (31.7)	41 (68.3)
	Self-employed	6 (12.5)	42 (87.5)
	Jobless	7 (5.5)	20 (74.1)
Age of the child, n(%) (if more than one child, please refer to the youngest one)			
	<3	33 (18.8)	143 (81.3)
	3~6	16 (23.9)	51 (76.1)
	7~14	3 (27.3)	8 (72.7)
Residence, n(%)			
	Urban	21 (23.6)	68 (76.4)
	Rural	31 (18.8)	134 (81.2)
Attention to the COVID-19 pandemic, n(%)			
	Low	13 (59.1)	9 (40.9)
	Moderate	14 (26.4)	39 (73.6)
	High	25 (14)	154 (86)
The recommendation about m-Health received from, n(%)			
	Media (phone message, internet, TV program)	19 (32.3)	40 (67.8)
	Community or people you are familiar with	19 (25.7)	55 (74.3)
	Medical health providers	14 (11.6)	107 (88.4)

Presence of chronic disease in children, n(%)		
Yes	3 (3.8)	75 (96.2)
No	49 (27.8)	127 (72.2)
Adoption of m-Health before the COVID-19 outbreak, n(%)		
Yes	7 (9.9)	64 (90.1)
No	45 (24.6)	138 (75.4)
Confirmed case or suspected case was found in your community, n(%)		
Yes	9 (16.4)	46 (83.6)
No	43 (21.6)	156 (78.4)
Duration of daily Internet use, n(%)		
<2 hours	12 (54.5)	10 (45.5)
2~4 hours	19 (32.8)	39 (67.2)
4~6 hours	16 (12.9)	108 (87.1)
>6 hours	5 (10)	45 (90)

Willingness to adopt m-Health

The majority of parents (202 out of 254, 79.5%) reported that they were willing to adopt m-Health during the COVID-19 outbreak (Table 1). The proportion of parents with a high or moderate interest in in the COVID-19 pandemic who were willing to adopt m-Health was higher than those with low interest (73.6% or 86% vs 40.9%, respectively). Willingness to adopt m-Health was highest among parents of children with chronic diseases (75 out of 78 , 96.2%). Willingness to adopt m-Health increased with parents' duration of daily internet use.

Factors associated with willingness to adopt m-Health

Results from the bivariate analyses demonstrated that age, interest in the pandemic, the source to recommend m-Health, presence of chronic disease in children, parents' duration of daily internet use, and use of m-Health before the COVID-19 outbreak were associated with willingness to adopt m-Health during the pandemic. The multivariate logistics regression model indicated that parents' age (26–35; 8.114, 95% confidence interval [CI]: 1.471 to 44.764), parents' interest in the COVID-19 pandemic (moderate; 8.753, 95% CI: 2.009 to 38.127; high; 22.194, 95% CI: 5.509 to 89.411), the source to recommend m-Health (medical health providers; 4.257, 95% CI: 1.439 to 12.596), presence of chronic disease in children (yes; 20.844, 95% CI: 4.600 to 94.443), parents' duration of daily internet use (4–6 hrs; 6.487, 95% CI: 1.870 to 22.495), > 6 hrs; 8.766, 95% CI: 1.883 to 40.804), and adoption of m-Health before the COVID-19 outbreak (yes; 3.413, 95% CI: 1.234 to 9.444), were significantly correlated with parents' willingness to adopt m-Health during the COVID-19 outbreak (table 2).

Table. 2 Multivariate analyses of factors associated with willingness to adopt m-Health among Chinese parents (N=254)

able	Willingness to adopt m-Health		Crude OR (95% CI)	Adjusted OR (95% CI)			P value
	No	Yes					
, n(%)							
18~25	6 (37.5)	10 (62.5)	1	1			
26~35	37 (18.7)	161 (81.3)	11.591 (1.805 to 74.448)	8.114 (1.471 to 44.764)*			.016
≥ 36	9 (22.5)	31 (77.5)	12.513 (1.362 to 114.971)	5.794 (0.841 to 39.913)			.074
ntion to the VID-19 pandemic,)							
Low	13 (59.1)	9 (40.9)	1	1			
Moderate	14 (26.4)	39 (73.6)	13.113 (2.119 to 84.124)	8.753 (2.009 to 38.127)*			.004
High	25 (14)	154 (86)	31.889 (6.395 to 159.020)	22.194 (5.509 to 89.411)*			<.001
recommendation t m-Health ived from, n(%)							
media (phone message, internet, TV program)	19 (24.4)	59 (75.6)	1	1			
Medical health providers	14 (14.3)	84 (85.7)	4.710 (1.382 to 16.049)	4.257 (1.439 to 12.596)*			.009
ence of chronic ase in children,)							
No	3 (3.8)	75 (96.2)	1	1			
Yes	49 (27.8)	127 (72.2)	30.571 (5.552 to 168.331)	20.844 (4.600 to 94.443)*			<.001
ation of daily rnet use, n(%)							
< 2 hours	12 (54.5)	10 (45.5)	1	1			
4~6 hours	16 (12.9)	108 (87.1)	6.860 (1.591 to 29.575)	6.487 (1.870 to 22.495)*			.003
> 6 hours	5 (10)	45 (90)	6.794 (1.141 to 40.455)	8.766 (1.883 to 40.804)*			.006

of m-Health
re the COVID-19
reak, n(%)

No	45 (24.6)	138 (75.4)	1		1			
Yes	7 (9.9)	64 (90.1)	3.759 (1.185 to 11.928)		3.413	(1.234 to 9.444)*		.018

*Statistically significant *(P* <.05).

The odds of willing to adopt m-Health were 8.1 times greater in parents aged from 26–35 than 18–25-year-old parents *(P*=.016). The odds of willing to adopt m-Health were 8.6 times greater in respondents with moderate interest in the pandemic than respondents with low interest *(P*=.004). Meanwhile, the odds of willing to adopt m-Health were 22.2 times greater in participants with high interest in the pandemic than respondents with low interest in the pandemic *(P*<.001). Odds of willing to adopt m-Health were 4.3 times greater in parents who were recommended m-health from medical health providers than parents who received the recommendation from the media *(P*=.009). The odds of willing to adopt m-Health were 21 times greater in parents of children with chronic diseases than parents of children without chronic diseases *(P*=<.001). The odds of willing to adopt m-Health were 6.5 times greater in respondents with 4–6 hours of daily internet use than respondents with 2 hours of daily internet use *(P*=.003). Moreover, the odds of willing to adopt m-Health were 8.8 times greater in participants with > 6 hours of daily internet use than respondents with 2 hours of daily internet use *(P*=.006). Furthermore, odds of willing to adopt m-Health were 3.4 times greater in parents who had ever adopted m-Health than those who did not *(P*=.018).

Correlation between frequency of using m-Health during the COVID-19 outbreak in one month and parents' attitudes towards child health at home

Table. 3 Correlation between parents' attitudes towards child health at home and the frequency of adopting m-Health in one month (N=254)

	The frequency of mobile health service use				x^2	*P* value
m	0	1–2	3–4	>4		
duce the frequency of children ving the home, n (%)					16.767	.01
Never/seldom	10 (26.6)	7 (23.5)	8 (16.7)	9 (19)		
Sometimes	31 (21.5)	4 (21.6)	17(33.3)	17 (22.4)		
Often/always	38 (51.9)	40 (54.9)	41(50)	32 (58.6)		
ntilation and daily disinfection child's room, n (%)					19.515	.003
Never/seldom	13(16.5)	4 (7.8)	2 (3)	10 (17.2)		
Sometimes	3 (3.8)	9 (17.6)	6 (9.1)	11 (19)		
Often/always	63 (79.7)	38 (74.5)	58 (87.9)	37 (63.8)		
idance for the child on washing nds properly every time, n(%)					18.967	.004
Never/seldom	22 (27.8)	9 (17.6)	11 (16.7)	6 (10.3)		
Sometimes	24 (30.4)	14 (27.5)	25 (37.9)	9 (15.5)		
Often/always	33 (41.8)	28 (54.9)	30 (45.5)	43 (74.1)		
structing children to wear edical masks appropriately, n(%)					45.364	<.001

					χ²	P
Never/seldom	11 (13.9)	13 (25.5)	13 (19.7)	3 (5.2)		
Sometimes	45 (57)	27 (52.9)	28 (42.4)	11 (19)		
Often/always	23(29.1)	11 (21.6)	25 (25.2)	44 (75.9)		
...oking nutritional meals, n(%)					4.174	.65
Never/seldom	20 (25.3)	16 (31.4)	16 (24.2)	15 (25.9)		
Sometimes	28 (31.1)	18 (35.3)	32 (48.5)	22 (37.9)		
Often/always	31 (27.1)	17 (33.3)	18 (27.3)	21 (36.2)		
...proving child's sleep quality, ...%)					6.996	.32
Never/seldom	19 (24.1)	13 (25.5)	17 (25.8)	20 (34.5)		
Sometimes	27 (34.2)	21 (43.1)	23 (34.8)	25 (43.1)		
Often/always	33 (27.4)	16 (31.4)	26 (39.4)	13 (22.4)		
...couraging child to exercise at ...me, n(%)					6.188	.40
Never/seldom	11 (13.9)	10 (19.6)	10 (15.2)	6 (10.3)		
Sometimes	17 (21.5)	12 (23.5)	23 (34.8)	14 (24.1)		
Often/always	51 (64.6)	29 (56.9)	33 (50)	38 (65.5)		
...lieving child's negative ...otions at home, n(%)					63.810	<.001
Never/seldom	41 (51.9)	20 (39.2)	8 (12.1)	6 (10.3)		
Sometimes	33 (41.8)	30 (58.8)	32 (48.5)	34 (58.6)		
Often/always	5 (6.3)	1 (2)	26 (39.4)	18 (31)		
...ecking child's temperature ...gularly, n(%)					17.847	.007
Never/seldom	32 (40.5)	10 (19.6)	15 (22.7)	8 (13.8)		
Sometimes	20 (25.3)	10 (19.6)	16 (24.2)	17 (29.3)		
Often/always	27 (34.2)	31 (60.8)	35 (53)	33 (56.9)		
...pdate knowledge about COVID-... prevention, n(%)					5.041	.53
Never/seldom	21 (26.6)	12 (23.5)	11 (16.7)	11 (19)		
Sometimes	17 (21.5)	11 (21.6)	22 (33.3)	13(22.4)		
Often/always	41 (51.9)	28 (54.9)	33 (50)	34 (58.6)		

Table 3 presents the results of the correlation between frequency of using m-Health during the COVID-19 outbreak in one month and parents' attitudes towards child health at home. Frequency of using m-Health during the COVID-19 outbreak in one month was associated with parents' attitudes towards ventilation and daily disinfection of child's room (*P*=.003) and guidance for the child on washing hands properly every time (*P*=.004). Specific actions to prevent children from contracting COVID-19 such as instructing them to wear medical masks appropriately (*P*<.001) and reducing the frequency of children leaving the home (*P*=.01) were correlated with the frequency of using m-Health during the COVID-19 outbreak in one month. In addition, the frequency of using m-Health during the COVID-19 outbreak in one month was significantly correlated with parents' attitudes towards checking children's' temperature regularly (*P*=.007) and ensuring mental care at home as well (*P*<.001).

Discussion

Principle findings

Our primary finding was that parents' age and interest in the COVID-19 pandemic, the source to recommend m-Health, presence of chronic disease in children, duration of daily internet use among parents, and adoption of mobile health service before the COVID-19 outbreak were significantly correlated with parents' willingness to adopt m-Health during the COVID-19 outbreak. In addition, the frequency of m-health usage for parents was correlated with their attitudes towards hand-washing, mask-wearing, frequency of going out, room disinfection and ventilation, temperature checking, and care of children's mental health during the COVID-19 pandemic.

The findings show that overall, parents' willingness to adopt m-Health during the COVID-19 pandemic was high (79.5%), which is supported by another study that willingness to adopt m-health at 80% [15]. However, another study conducted in China reported that just 66.1% of participants were willing to participate in mobile health programs for patients with chronic diseases [7]. James and Cedric showed an almost identical result (67%, n=881) [16]. One possible explanation is that the proportion of participants who were willing to engage with various components of mobile health technology varied from 59–81% [17].

Our study revealed several factors influencing parents' willingness to adopt m-health, including age, interest in the COVID-19 pandemic, the source to recommend m-Health, presence of chronic disease in children, duration of daily internet use and adoption of m-Health before the COVID-19 outbreak. Age was shown to be significantly related to parents' willingness to adopt m-Health in our study, which is in line with previous published studies on m-Health acceptance factors, where age is an important factor among both patients and medical professionals [18-20]. Importantly, age has specific moderating effects on the adoption of m-Health [18]. However, age in our study did not play as significant a role as in other studies [20], and one possible explanation for this may be the the varied age group included [21].

We found that the odds of willing to adopt m-Health was greater in parents with higher levels of attention to the COVID-19 pandemic than those with lower attention, which is consistent with previous studies on the adoption of e-health service during the COVID-19 pandemic [22,23]. Previous studies confirmed a direct relationship between perception risk and technology adoption [24,25]. The outbreak of COVID-19 is regarded as a facilitating factor for the adoption and acceptance of technology [26]. Many measures were taken to accelerate the adoption of m-Health including practical guidance for individual practices to quickly adopt m-Health in response to

COVID-19 [22,27]. Moreover, the range of providers who could deliver care through m-Health was broadened and rules around patient eligibility and audiovisual equipment requirements were relaxed specifically to address COVID-19 [22,28].

This study demonstrated that the source of referral was associated with parents' willingness to participate in m-health programs, specifically the odds was greater in patients who were recommended by medical professionals (n=98, 85.7%), which is consistent with previous findings which said that about one third of patients would like to be able to contact their doctors using an electronic device [20]. On the contrary, another study found that the source of referral for m-Health was various media sources (eg e-mail). One possible reason is that all the users included were children with a median age of six [29].

The current study indicated that duration of daily internet use was associated with a willingness to adopt m-Health among parents, which is in line with a previous study, which reported that time spent on the internet is greatly associated with the level of e-health literacy [30,31]. However, time spent on the internet was reported to be a non-significant factor in other studies; therefore, the small sample size and methodological differences may have played an important role in it [32,33].

Overall, our study found that the odds of willing to adopt m-Health was greater in parents of children with chronic diseases (> 90%). This finding is consistent with a previous study that found the most chronically-ill patients (> 80%) would be willing to participate in m-Health programs in developing countries [15]. Prior findings indicate that sharing personal health information and receiving support through social networking can benefit adolescents with chronic illness [34-36]. The positive association is likely due to the patient's improved awareness of the importance of mobile phones for care of chronic health conditions [37-40].

Previous usage of m-health was found to be greatly associated with participants' willingness to adopt m-Health in this trial. This finding is consistent with a previous study in which respondents who had used we-chat before were more willing to adopt m-health as a result of their greater familiarity and confidence in new technology [7]. One potential reason is that prior usage experiences influence various beliefs and, consequently, willingness to use technology in a consumer context [41].

The frequency of m-health usage for parents was associated with their attitudes towards hand washing, mask wearing, frequency of going-out, room disinfection and ventilation, temperature checking, and care of children's mental health during the COVID-19 pandemic. A previous published study demonstrated the effectiveness of hand hygiene, mask wearing and social distancing for the prevention of COVID-19 as well as other respiratory infectious diseases [42]. Interestingly, mask

wearing and hand washing among children were found to be influenced by frequency of leaving the house, mothers' educational background and fathers' occupation [43]. Furthermore, mental health status was found to be a big issue during the crisis for children who were isolated and quarantined [44]. A large increase in sedentary behavior was observed due to the pandemic, and students were found to be more depressed and anxious during this time [45]. Thus, psychological crisis interventions targeted to different pediatric age groups could be conducted to minimize the psychological trauma and subsequent psycho-social problems caused by the COVID-19 pandemic [46]. m-health is ideal tool for the control of communicable diseases. Social distance is a significant role in cutting the transmission of the virus and decreasing the chance of face to face. Especially during COVID-19 outbreak, m-health could provide some recommendations about health management for people quarantined at home.

Limitations

Firstly, the sample size was insufficient. A study with a larger sample is recommended to further improve the representative of the study results. In addition, social desirability bias and recall bias may arise from self-reporting. Confounding and/or unknown factors omitted from the survey may also cause residual confounding, and instrumental variable analysis should be utilized to control these confounding factors. Finally, a cause-effect relationship may not be established due to the inherent nature of the cross-sectional study design.

Conclusion

The COVID-19 pandemic has enormously changed health-care systems worldwide, and internet-based medical care is likely to play a major role during the COVID-19 pandemic to increase widespread access to effective care and overcome the challenges and restrictions imposed by the outbreak[47]. We found various objective factors to be associated with parents' willingness to adopt m-Health during the COVID-19 outbreak, and the frequency of m-health usage among parents was correlated with their attitudes towards child health at home. Furthermore, our study provides new insight into how parents cope with pandemic-related mental health problems in children. These findings provide valuable information for m-Health service providers and policy makers to develop policy and strategies for the successful implementation and acceleration of the adoption of this technology.

Funding

Conflicts of Interest

There are no conflicts of interest related to this study.

Authors Contribution

Each author made a significant contribution to this study. Siyu Yang, Yuting Huang, Leshan Zhou and Jiahui Dai conceived and designed the study and collected the data. Siyu Yang and Yijing Chen performed the data analysis and drafted the manuscript. Leshan Zhou instructed the process of study, reviewed the study design and interpreted study findings. All authors approved the final version of the manuscript. Each author certified that he or she had participated sufficiently in the work to believe in its overall validity and to take public responsibility for appropriate portions of its content.

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