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COVID-19 Vaccination Promotion Program Based on COM-B Model: an App-Based Educational Program in Northern Iraq

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Abstract

Vaccines have effectively reduced the spread of the COVID-19 pandemic. This study aimed to evaluate a program promoting COVID-19 vaccination for Kurdish individuals in Said Sadiq, northern Iraq, using the COM-B model. A total of 150 adults over 18 years old in the city of Said Sadiq participated as the intervention and control group. This was a quasi-experimental study to implement a behavior modification-based intervention to promote of COVID-19 vaccine uptake. The authors developed an organized and innovative educational application program to improve determinants related to COVID-19 vaccine uptake among adults over 18 years old in Said Sadiq. The mobile application consisted of eight educational lessons. Independent t-tests and paired sample t-tests were employed to determine the comparability of the intervention compared to the control group. The effect size was estimated as "small" for social opportunity, “medium" for physical capability, psychological capability, physical opportunity, and reflective motivation, and “large" for automatic motivation. Our findings showed a significant increase in the rate of COVID-19 vaccine uptake among participants in the intervention group compared to the control group (P= 0.033) after the program implementation. This study utilized the COM-B model to provide useful guidance for understanding the adult population in Iraqi Kurdistan to increase COVID-19 vaccine uptake. The study demonstrates the ability to use the COM-B model in the development of an m-health intervention to promote COVID-19 vaccine uptake in northern Iraq. Although our intervention was brief, it showed promising findings. Our findings have valuable implications as they demonstrate that a short, inexpensive, and convenient intervention can effectively educate and empower people during the COVID-19 pandemic.

Keywords: COVID-19, Vaccine; Behavior Change, COM-B model, Education, m-health

Introduction

The coronavirus known as SARS-CoV-2 or COVID-19, has caused numerous economic, social, and health problems worldwide (1-3). Throughout the COVID-19 pandemic, medical institutions globally have been developing vaccines to help control and prevent the spread of the disease (4-6). Several studies have identified various factors that influence the acceptance of a new vaccine within a community. These factors include the safety and effectiveness of the vaccine, the frequency of negative health effects, misunderstandings about the importance of vaccination, and a lack of trust in the healthcare system (7-15). It is crucial to note that spreading false information can create doubt in society about the safety of vaccines, putting people's health at risk during an epidemic (10). Even vaccinated individuals may still have doubts and concerns about receiving follow-up doses of the vaccine (11, 12). Those who lack trust in the government may also question vaccines created by pharmaceutical companies, leading to public worry about vaccine acceptance (16). Therefore, despite the availability of a safe and effective COVID-19 vaccine, it remains uncertain whether people will be willing to accept it (17). COVID-19 vaccine uptake is essential to halt the spread of the virus, as many individuals have refused vaccination despite its significant benefits and minimal risks (18). Behavioral theories play a crucial role in public health interventions, with evidence suggesting that interventions based on theory are more successful in changing health behaviors than those lacking a theoretical foundation (19). Behavior change theories and models help us understand why people choose to engage or not engage in health-promoting behaviors, identify necessary information for successful intervention strategies, and determine priorities for educational and health-promoting interventions (20). The COM-B model is commonly used to determine necessary changes for a behavior change intervention to succeed (21, 22). This model proposes that public health intervention use key elements of behavior change to increase vaccine acceptance. Messages should be created as multi-component strategies to support people's abilities, opportunities, and motivation for behavior change. This theory is currently being implemented to understand factors related to COVID-19 vaccine uptake, emphasizing key considerations for reducing transmission of the virus, increasing knowledge of personal protective behaviors, providing resource signposting, and explaining the need for behavior modification to lower emotional responses (23). Educational planners face challenges in selecting health education methods, with various tools available for health promotion, including e-health and m-Health methods. Educational mobile apps have been developed to address health issues and enhance well-being, utilizing smartphones and personal computers for sharing and tracking health information and education (24). This study aimed to evaluate a COVID-19 vaccination promotion program for Kurdish individuals in Said Sadiq, northern Iraq using the COM-B model.

Materials and Methods

Participants

This research study involved 144 participants over the age of 18 in Said Sadiq, Sulaymaniyah Governorate, Kurdistan Region, Iraq. The participants had not yet received their complete COVID-19 vaccination. The study utilized a smartphone application to deliver a two-month educational program specifically designed for this research. The educational program was developed based on the findings of a previous study (25) and focused on key elements of the COM-B model. One group received the educational program while the other group did

not receive any intervention. The questionnaire used in the study had two parts: one assessing background information and the other evaluating components of the COM-B model (25). The survey was conducted in the Kurdish language.

The educational application program contents

An organized and modern educational application program named “Take the COVID-19 Vaccine” was designed by the authors to address factors associated with vaccine hesitancy among Kurdish people, specifically the population of the Said Sadiq district. The contents of the educational application intervention were designed based on the analysis of results from a cross-sectional study (25). This analysis determined educational priorities for each variable, aligning the program’s contents with these priorities and expert opinions. The number of intervention lessons was determined based on the authors’ experiences. In this study, the COM-B model was used as a theoretical framework to explain behavior change. Figure 1 shows an image of the mobile phone application used in the study.

The objectives for each training session were established after conducting a needs assessment in the formative evaluation study and considering the determinants of the COM-B model. The training sessions were tailored to the participants' ability to use smartphones and the advantages of using this method of delivery. The sessions were based on the m-Health strategy and utilized a mobile application called "Take the COVID-19 Vaccine."

The application consisted of eight educational lessons. Each lesson's content was developed and edited by the authors. The first lesson focused on enhancing participants' knowledge about the benefits of taking the COVID-19 vaccine. The second, third, and eighth lessons aimed to motivate people by providing accessible, evidence-based information about the vaccine's safety, effectiveness, and benefits. The fifth lesson aimed to enhance the self-efficacy of the population by providing information about how the vaccines work, their safety record, and the approval process they have undergone. The sixth and seventh lessons focused on the risks associated with not being vaccinated, including severe illness, hospitalization, and long-term complications. The fourth lesson provided information about social norms, such as sharing vaccination experiences and endorsing the importance of getting vaccinated by popular government figures. To make the educational lessons engaging, the application included interactive methods such as short videos, written material, and images. A set of theoretical behavior change methods based on the Kok et al (26, 27) classification was used for each determinant. More detail is shown in Table 1.

Data analysis

Analyses were conducted using SPSS-16 to compare two groups before implementing a program. The groups were matched on socio-demographic variables. Cross-tabulation and independent t-tests were used to assess the status of these variables. Independent t-tests and paired sample t-tests were used to determine how the intervention group compared to the control group. The effect size (Cohen's d) for the COM-B components was calculated by subtracting the mean score of the intervention group from the mean score of the control group and dividing by the standard deviation. Cohen's guidelines were used to interpret the effect size: less than 0.2 is small, 0.2 to 0.499 is medium, 0.5 to 0.8 is large, and more than 0.8 is very large (28). Cronbach's Coefficient Alpha was used to measure the internal consistency of the different measures.

Ethical considerations

The study was approved by Kermanshah University of Medical Sciences IR.KUMS.REC.1401.391. Fundamental of informed consent and confidentiality were observed during the data collection process.

Results

Table 2 shows that prior to implementing the intervention program, there was no statistically significant difference between the intervention

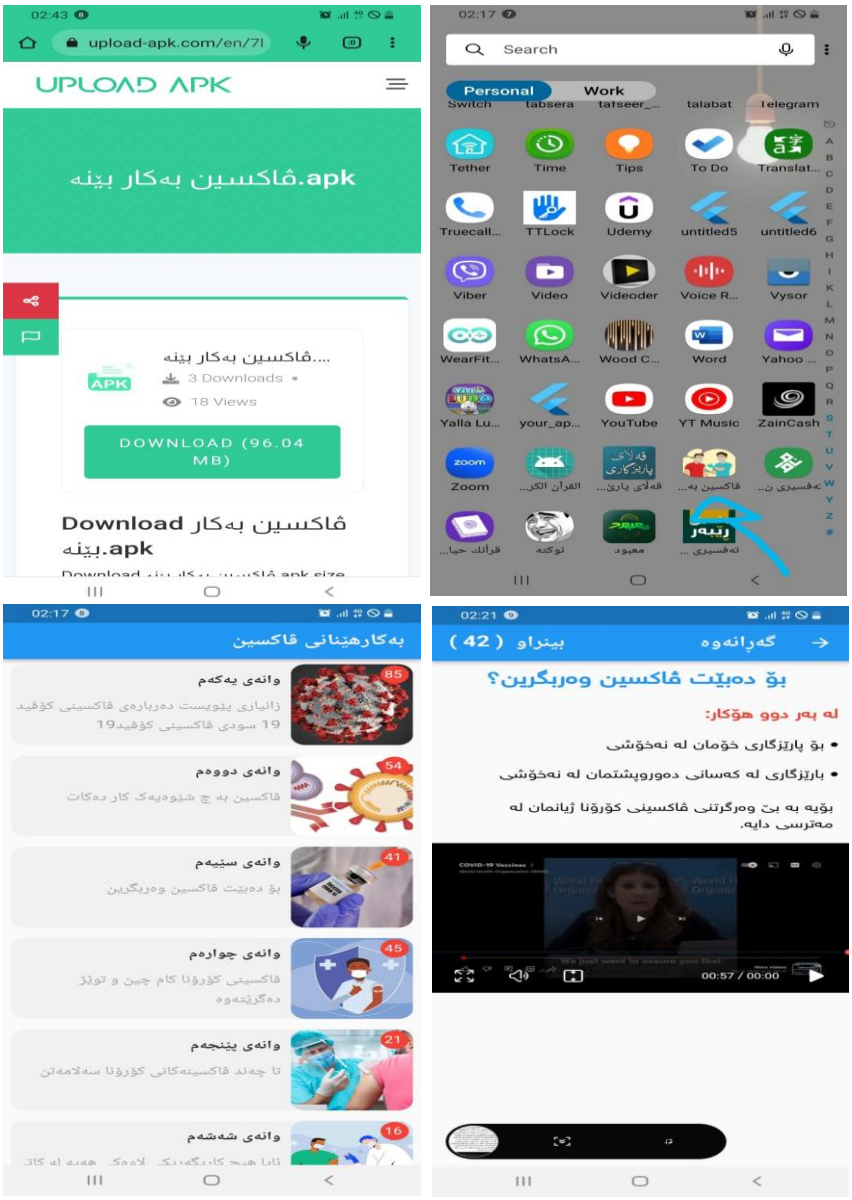

Figure 1. An image of the mobile phone application used in the present study

and control groups in demographic and background variables.

A comparison of COM-B construct scores among the intervention and control groups before and after program implementation was shown in Table 3. Our results indicated the effect size was estimated as "small" for social opportunity, “medium" for physical capability, psychological capability, physical opportunity, and reflective motivation. Additionally, the

Table 1. Determinants, practical application, parameter use, and change objectives of the educational program in the present study

Determinants	**Lessons**	**Practical application, strategy**	**Parameter use**	**Change objectives**
Knowledge (Psychological Capability)	Lesson one	Providing written material, images	Should be relevant, plain, and vary in format and media, Learning moments should be short, adding helpful information	Enhance the knowledge of participants toward the benefits of taking COVID-19 vaccine Increase the knowledge of participants via images about the necessity of taking COVID-19 vaccine
Motivation	Lessons two, three, and eight	Providing written material, images	Should be relevant, comprehensible, and interesting to follow Reinforcement of the model	To enhance and motivate people we Offered accessible, evidence-based information about the COVID-19 vaccines, including their safety, effectiveness, and benefits of vaccination. We provided vaccination centers in accessible locations, including mobile vaccination units or pop-up clinics in our community settings.
Social norms (Social Opportunity)	Lesson four	Providing written material, images, and short videos	Emphasized the role of vaccination in protecting individuals, their loved ones, and the wider community	Affecting social norms by publicly sharing some vaccination experiences and endorsing the importance of getting vaccinated by popular people of the government. Increasing social norms via individuals who have received the vaccine, and share their experiences with their friends, family, and social networks.
Self-efficacy (Psychological Capability)	Lesson five	Providing written material, images, short videos	Should be relevant, comprehensible, and interesting to follow Reinforcement of the model	Enhancing the self-efficacy of the population towards the vaccination process via lessons about how the vaccines work, their safety record, and the approval processes they have undergone.
Perceived risk (Psychological Capability)	Lessons six and seven	Providing written material, images, and short videos	Should be relevant, comprehensible	providing the risks associated with not being vaccinated, including severe illness, hospitalization, long-term complications, and death Providing new variants of the virus can emerge when it continues to spread, and they may be more transmissible or resistant to current treatments. Effectiveness of vaccines in reducing the likelihood of infection, severe illness

Table 2. Comparison of demographic and background variables between intervention and control groups

Variables		**Intervention n (%) Mean (SD)**	**Control n (%) Mean (SD)**	**P**
Age		32.07 (8.57)	30.39 (9.60)	0.260
Gender	Female	41 (51.9 %)	38 (48.1 %)	0.744*
	Male	34 (47.9 %)	37 (52.1 %)	
Marital status	Married	35 (53.8 %)	30 (46.2 %)	0.510*
	Single	40 (47.1 %)	45 (52.9 %)	
Educational level	Under Diploma	11 (36.7 %)	19 (63.3 %)	0.241
	Diploma	25 (51 %)	24 (49 %)	
	Academic	39 (54.9 %)	32 (45.1 %)	
Job	Employed	30 (52.6 %)	27 (47.4 %)	0.690
	Self-job	23 (45.1 %)	28 (54.9 %)	
	Housewife	22 (52.4 %)	20 (47.6 %)	

Family Size	1-2 number	9 (39.1 %)	14 (60.9 %)	0.568
	3-4 number	26 (48.1 %)	28 (51.9 %)	
	5-6 number	32 (56.1 %)	25 (43.9 %)	
	More than 6	8 (50 %)	8 (50 %)	
Economic Status	Very bad	16 (57.1 %)	12 (42.9 %)	0.215
	Bad	20 (40 %)	30 (60 %)	
	Good	39 (54.2 %)	33 (54.8 %)	
Positive family history of COVID-19	No	22 (44.9 %)	27 (55.1 %)	0.486*
	Yes	53 (52.5 %)	48 (47.5 %)	
Positive friends history of COVID-19	No	20 (41.7 %)	28 (58.3 %)	0.220*
	Yes	55 (53.9 %)	47 (46.1 %)	
History of death due to corona in relatives and acquaintances	No	39 (46.4 %)	45 (53.6 %)	0.411*
	Yes	36 (54.5 %)	30 (45.5 %)	

***Fisher's exact test**

Table 3. Average responses for COM-B constructs before and after the implementation of the education program

Constructs		Before Intervention Mean (±SD)	After Intervention Mean (±SD)	Paired sample t-test	Effect size
Physical Capability	Intervention Group	2.96 (1.22)	3.05 (1.06)	0.550	0.23
	Control Group	2.73 (1.34)	2.80 (1.11)	0.402	Medium
	Independent t-test	0.283	0.157		
Psychological Capability	Intervention Group	25.65 (5.10)	28.46 (4.82)	< 0.001	0.36
	Control Group	26.20 (5.38)	26.68 (4.81)	0.141	Medium
	Independent t-test	0.524	0.025		
Physical Opportunity	Intervention Group	8.30 (2.25)	9.10 (2.30)	0.004	0.42
	Control Group	7.97 (2.54)	8.17 (2.06)	0.075	Medium
	Independent t-test	0.389	0.010		
Social Opportunity	Intervention Group	22.02 (5.73)	23.49 (5.64)	< 0.001	0.06
	Control Group	22.93 (7.63)	23.10 (7.56)	0.124	Small
	Independent t-test	0.412	0.723		
Reflective Motivation	Intervention Group	20.62 (5.30)	23.44 (5.56)	< 0.001	0.36
	Control Group	21.04 (5.99)	21.38 (5.70)	0.091	Medium
	Independent t-test	0.655	0.027		
Automatic Motivation	Intervention Group	7.94 (3.01)	9.21 (3.08)	< 0.001	0.53
	Control Group	7.40 (3.20)	7.61 (2.93)	0.106	Large
	Independent t-test	0.284	0.001		

Table 4. COVID-19 vaccine uptake before and after implementation of program among intervention and control groups

Group	Before Intervention		After Intervention	
	Yes n (%)	No n (%)	Yes n (%)	No n (%)
Intervention Group	37 (49.3 %)	38 (50.7 %)	48 (64 %)	27 (36 %)
Control Group	31 (41.3 %)	44 (58.7 %)	34 (45.3 %)	41 (54.7 %)
P	0.412		0.033	

effect size for automatic motivation was estimated as “large". Furthermore, as seen in Table 3, the implementation of the program had a significant effect on increasing the score of

psychological capability, physical opportunity, social opportunity, reflective motivation, and automatic motivation. However, it did not have a significant effect on increasing the physical capability scores.

Our findings showed a significant increase in the rate of COVID-19 vaccine uptake among participants in the intervention group compared to the control group (P= 0.033), after the implementation of the program, as shown in Table 4.

Discussion

To our knowledge, the present study is the first of its kind in northern Iraq to adopt an interventional approach to determine the efficacy of an app-based educational program in promoting COVID-19 vaccine uptake based on COM-B. The findings of the present study indicated a significant increase in the score of the psychological capability component among the participants of the intervention group.

In this study, knowledge, self-efficacy and perceived risk were evaluated as determinants of the psychological capability component. Our findings are consistent with other studies. For example, Barnawi et al (2023) conducted a study among 508 people in Saudi Arabia and indicated the significant effect of a video-based educational intervention on improving knowledge about the COVID-19 vaccine among the intervention group (29). Our findings are also in line with Elgzar et al. (2020) study, which showed a positive effect of education program on promoting knowledge of the COVID-19 vaccine among students in Saudi Arabia (30). Cultural, societal, and religious misconceptions and rumors about COVID-19, mainly in informal social networks, negatively affect knowledge and increase public concerns about receiving COVID-19 vaccines (31-33). Accessible information about the safety of COVID-19 vaccines will expedite the vaccination process and minimize uncertainty and anxiety about vaccination (34). These studies highlight the importance of interventions to promote accurate knowledge about COVID-19 vaccines. Elgzar et al. (2020) conducted research among nursing college students in Najran University in Saudi Arabia and indicated the positive effect of an educational intervention on improving the determinants of self-efficacy, severity and perceived susceptibility to COVID-19 (30). Risk perception has been identified as an important mediating factor between government intervention and public acceptance of protective action recommendations (PARs), and increasing public risk perception is an effective strategy for governments seeking to encourage public adoption of PARs during the COVID-19 pandemic (35). Considering the efficacy of the present study in increasing the psychological capability component (of which risk perception was a part of), it seems that the use of application-based educational interventions may be useful in promoting risk perception.

The present study found that the implemented intervention did not significantly improve the score of the physical capability component. The ability to walk, drive or use other means of transportation to reach the vaccination center was examined as a component of physical capability. Strategies such as vaccine availability and proximity of injection sites to people's residences could be beneficial, and should be considered by health policy makers in northern Iraq.

The allocation of time for vaccine recipients and easy access to vaccination sites were investigated in the physical opportunity component. The study revealed a significant increase in the average score of the physical opportunity component among intervention group participants. These findings are promising and demonstrate the effectiveness of health education interventions in promoting healthy behaviors in society.

Another significant finding of the study was an increase in the average score of the social opportunity component among intervention group participants post-program implementation. However, this increase was not

significant when comparing intervention and control groups. This component assesses social pressures and norms. Our short intervention program was effective in this regard. Previous studies have shown the effectiveness of interventions in improving subjective norms to increase vaccine uptake. For example, Zomordi et al (2022) demonstrated the impact of an educational intervention on improving subjective norms encouraging HPV vaccination in female students (36). People's health behaviors and attitudes are influenced by their peers' behaviors and attitudes (social norms) (37). This also applies to COVID vaccination, with studies a positive relationship between social norms and intention to receive the COVID vaccine (38, 39). Behavioral scientists are exploring strategies to boost community COVID vaccine uptake (38), with correcting normative misperceptions being a promising approach (39). Given the promising results of the study in increasing the social opportunity component among intervention group participants, implementing educational programs in this area could yield beneficial outcomes.

A significant increase in the average score of reflective and automatic motivation components among the participants of the intervention group was another finding of the present study. This increase was also significant compared to the control group. In this study, optimism and beliefs about the COVID-19 vaccine were measured as determinants of reflective motivation, while emotions and concerns were measured as determinants of automatic motivation. Understanding the factors related to the public's active involvement in protective behaviors to mitigate the destructive consequences of emergencies is a critical component of an effective response to adversity, especially against pandemics like COVID-19 (40). Therefore, it is of crucial importance to identify educational mechanisms that are effective in fostering such collaborative actions (41). The findings of our cross-sectional study showed that automatic motivation was a strong predictor of receiving the COVID-19 vaccine in adults in northern Iraq. Our findings regarding the promotion of motivation components were promising and indicate the usefulness of implementing educational intervention programs to increase the acceptance rate of the COVID-19 vaccine. In line with our study, Barnawi et al (2023) demonstrated the effectiveness of an educational intervention program in reducing concerns about receiving the COVID-19 vaccine in Saudi Arabia (29). Li et al (2022) also showed the impact of educational interventions in reducing COVID-19 vaccine hesitancy (42). Additionally, Kaim et al (2020, 2021) illustrated the effectiveness of educational programs in improving attitudes towards receiving the COVID-19 vaccine (41, 43). Zolotarova et al (2023) showed a significant improvement in attitude determinant scores towards the COVID-19 vaccine after implementing an educational intervention in Canada (44). The findings of our study suggest the benefits of educational programs in enhancing reflective and automatic motivation structures towards vaccine acceptability. Incorporating these educational programs by authorities may improve COVID-19 vaccination uptake and help address public vaccine hesitancy.

Finally, our findings showed a significant increase in the rate of receiving the COVID-19 vaccine among the participants of the intervention group compared to the control group. Consistent with the findings of the present study, Zolotarova et al (2023) also demonstrated a similar increase in COVID-19 vaccine acceptance after implementing a training program in Canadian federal prisons (44). However, Sun et al. (2022) emphasized the need for ongoing, intermittent education to maintain motivation and encourage vaccination behavior (45). In essence, additional educational sessions or interventions may be necessary to address persistent hesitancy over time. Given the effectiveness of the implemented intervention in improving COVID-19 vaccine acceptance, our study recommends that public health officials in northern Iraq develop and implement educational intervention programs like the one

used in this study to empower the population and drive behavioral changes. The results of this study highlight a cost-effective and feasible intervention design that can facilitate rapid dissemination of targeted, relevant information to achieve specific goals during emergencies and crises.

Our study does have limitations. The small sample size of the intervention group is a notable limitation. Despite this, the study yielded valuable results, suggesting that similar interventions should be conducted on larger populations. Participants provided data through self-reporting, which may not have been entirely accurate due to social desirability bias or recall bias, potentially introducing some error into the results.

Conclusions

This study demonstrates the effectiveness of using the COM-B model to develop an m-health intervention program aimed at increasing COVID-19 vaccine uptake in northern Iraq. Despite the brevity of our intervention, it yielded promising results. Our findings highlight the positive impact of the intervention program on enhancing COVID-19 vaccination rates among participants in the intervention group. The study underscores the ease of implementing m-health educational interventions and their efficacy in educating and empowering individuals, making them a valuable tool for future outbreak responses. Our results suggest that short, cost-effective, and convenient interventions can effectively educate and empower in individuals during the COVID-19 pandemic. Additionally, we recommend conducting comprehensive research on health behaviors grounded in behavior change theories specific to Iraqi Kurdistan to develop successful health promotion initiatives. By considering the unique cultural and social dynamics of the Kurdish population in northern Iraq, a deeper understanding of the outcomes and implications can be achieved.

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Contributorship Statement

M.M.A and F.J designed the research and wrote the manuscript. I.A.F collected data and wrote the manuscript. M.M.A. and F.J described and analyzed the data and edited the manuscript. All authors read and approved the edited manuscript.

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Declaration of Conflicting Interests

The authors declare that they have no conflict of interest.

Data Availability Statements

The data can be obtained from the corresponding author upon request.

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