

The effectiveness of mobile health intervention in colorectal cancer screening in Iran

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Background: This study aimed to evaluate the impact of mobile health (mHealth) intervention on colorectal cancer (CRC) screening. **Materials and Methods:** This semiexperimental study collected data from individuals aged 50–70 years who had no history of CRC screening. Participants ($n = 350$) were randomly assigned to one control and five intervention groups. The data were collected by theory-based CRC screening questionnaire before and after the mHealth intervention. **Results:** The results indicated a significant improvement in screening rates when utilizing mHealth interventions, which included text messages, videos, and telephone calls from health workers, showing a rate of 68.6% ($P < 0.001$) compared to 5.7% of individuals in the routine care group. Logistic regression analysis revealed that “perceived severity” and “perceived benefits” were significantly associated with increased screening uptake, compared to the routine care group. **Conclusion:** The current study indicates that mobile phone technology significantly impacts the outreach efforts for encouraging the covered population to participate in screening.

Key words: Colorectal cancer, effectiveness, mobile phone technology, screening

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INTRODUCTION

Colorectal cancer (CRC) accounts for approximately 10% of cancer-related deaths globally.^[1] It is projected that by 2040, the burden of CRC will increase to 3.2 million new cases (a 63% increase) and 1.6 million annual deaths (a 73% increase).^[2]

Dehghani *et al.* showed an increasing trend of cancer in both men and women in Iran.^[3] A meta-analysis in Iran estimated that the cumulative incidence rate in the latest national data was nearly 15/100,000 population.^[4]

Ongoing research highlights the effectiveness of various CRC screening methods. Survival rates of cancer patients were improved by early diagnosis through effective cancer screening programs.^[5] Fecal occult blood

tests (FOBTs) are one of the first noninvasive tests used for CRC screening. Annual FOBT screening has been shown to reduce CRC mortality by 33% over the past 30 years.^[5]

Many factors influenced people’s willingness to participate in CRC screening. A study highlighted the increase of certain factors, such as knowledge, perceived benefits, and perceived severity, in community participation and the performance of CRC screening.^[6]

Mobile health (mHealth) refers to the application of mobile phones or other portable electronic devices in healthcare services to improve individual health levels. The term “mHealth” was introduced into the field of health in the early 21st century and is a subfield of electronic health.^[7] The development of mHealth applications for cancer screening represents a cost-effective and user-friendly strategy that has

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been well received by patients and caregivers, potentially improving the quality of health care.^[8]

Many studies have found that cancer screening rates are low in Iran. It is necessary to identify the barriers and work to remove them in order to improve community health.^[9,10] Therefore, the present study aimed to investigate the effect of mHealth on CRC screening. The main practical objective of the study is to encourage individuals to undergo screening.

MATERIALS AND METHODS

Study setting and participants

The present study was conducted using a semiexperimental method with the control group and before-and-after measurements, in compliance with ethical principles. According to the national CRC screening protocol, the target population of the study was 350 individuals aged 50–70 years from urban and rural areas of Fereyduhshahr County in 2024.

To identify the research population, in the first stage, samples were selected from each center using convenience sampling. Then, the intervention (as relevant protocol) was randomly assigned to groups.

There were four intervention groups. In Group 1, a short message service (SMS) was sent to each individual every 7 days to encourage screening. In Group 2, an application (or video guide and five short educational videos in accordance with the screening protocols announced by the Ministry of Health were sent to this group every 15 days) was installed on the individual's mobile phone or those of close family members. In Group 3, a phone call (from the researcher) was made to each individual every 7 days to encourage screening. Finally, Group 4 received a combination of the above three educational interventions (in addition to the video guide, a phone call and an SMS were sent to the individual every 7 days to encourage screening). Seventy individuals in the control group received only the current health system training.

Data collection

To collect data for the study, we utilized a theory-based CRC screening questionnaire, the validity and reliability of which were confirmed. The first part of the questionnaire contained participants' demographic information and the second part contained seven questions regarding CRC, whereas the third part included items related to the Health Belief Model constructs in five sections: perceived susceptibility (5 items), perceived severity (5 items), perceived benefits (5 items), perceived barriers (4 items), and perceived self-efficacy (2 items). These items were designed in a Likert-type format

with a 5-point response scale (very low, low, somewhat, high, and very high). The content validity index was 0.79. The reliability estimated by Cronbach's alpha was 0.70.^[11]

Once the research participants were identified, the questionnaires were completed by the samples at the health centers through interviews. Baseline scores were then determined. The intervention was carried out weekly over 3 months. After the mHealth intervention ended, the groups were reevaluated using the corresponding questionnaire.

Data analysis

Descriptive statistics and analytical test were performed by SPSS Version 25, IBM Corporation, Armonk, New York, United States at a significance level of 0.05. Paired *t*-tests, Pearson's Chi-square test, and logistic regression analysis were used to estimate the effect of each structure on screening behavior (doing/not doing screening; FOBTs).

RESULTS

Of the 350 participants in the study, 47.4% were male ($n = 166$) and 52.6% were female ($n = 184$). The mean age (\pm standard deviation) of the participants was 59.58 (± 6.26) years.

According to the results of paired *t*-tests, there was a significant difference among the scores of all five constructs before and 3 months after the intervention.

Table 1 presents the proportion of individuals who underwent (or did not undergo) CRC screening, categorized by the control group and four intervention groups.

The results of the logistic regression analysis showed that the perception "colon cancer could be fatal for me" increased screening behavior by 29% compared to the routine care group. Moreover, the perceived benefits associated with "a FOBT can help reduce the potential complications associated with colon cancer" resulted in a substantial 76% increase in screening behavior [Table 2].

DISCUSSION

The results of the present study revealed that the effectiveness levels of educational interventions through SMS, video, and phone calls from healthcare workers were 14.3%, 35.7%, and 51.4%, respectively. Furthermore, the combination of all three interventions was 68.6% effective in encouraging the target group to undergo CRC screening ($P < 0.001$). These results indicate that phone calls from healthcare workers and phone call training have a significant impact on calling for the target population to undergo screening (effectiveness of 51.4%). The effect of sending SMS was less than other

Table 1: Frequency distribution and percentage of colorectal cancer screening referrals by the type of intervention

Groups	Performing cancer screening, frequency (%)	Not perform, frequency (%)	Sample (n)	Pearson Chi-square test	P
Control (routine care)	4 (5.7)	66 (94.3)	70	82.43	0.001
SMS	10 (14.3)	60 (85.7)	70		
Video	25 (35.7)	45 (64.3)	70		
Phone call	36 (51.4)	34 (48.6)	70		
SMS + video + phone call	48 (68.7)	22 (31.4)	70		
Total	123 (35.1)	227 (64.9)	350		

SMS=Short message service, Significance level: $p < 0.05$ **Table 2: Results from logistic regression modeling to evaluate colon cancer screening behaviors (doing/not fecal occult blood tests) among research participants**

Components	Meaning questions	SE	B	OR	CI	P
Perceived susceptibility	-	-	-	-	-	-
Perceived severity	Colon cancer could be fatal for me	0.12	0.25	1.26	1.10–1.64	0.042
Perceived benefits	A fecal occult blood test can help reduce the potential complications associated with colon cancer	0.21	0.56	1.76	1.17–2.64	0.007
	A fecal occult blood test is beneficial for my health	0.18	0.33	0.71	90.49–0.99	0.050
Perceived barriers	-	-	-	-	-	-
Self-efficacy	-	-	-	-	-	-

SE=Standard error; OR=Odds ratio; CI=Confidence interval, B=Regression coefficient, Significance level: $P < 0.05$

educational interventions (14.3%), which may be due to the fact that individuals are not reading or not paying attention to promotional SMSs.

Elepaño *et al.* conducted a review study that showed the use of various types of mHealth and text messaging increased CRC screening rates by an adjusted odds ratio (OR) of 1.33 (95% confidence interval: 1.20–1.46). compared to usual care.^[12] Sadeghi *et al.* indicated a positive effect in using the colon cancer app on self-assessment and participation to undertake screening.^[13]

The logistic regression of the present study found that improvement in the constructs of perceived benefits (OR = 1.76, $P = 0.007$) and perceived severity (OR = 1.26, $P = 0.042$) was effective for doing FOBT.

Chen *et al.* showed that the factors affecting nondoin FOBT in individuals aged over 65 years included lower perceived benefits, lower sensitivity, self-efficacy, more perceived barriers, and lower motivation. In younger people, all factors except perceived severity and perceived benefits were effective.^[14]

A population-based study on 7200 individuals showed that the effects of higher knowledge, perceived severity, and perceived benefits of taking and participating in screening programs were more effective in older people.^[15] Denizard-Thompson *et al.* showed the effect of using mHealth at the individual and system levels. Perceived benefits, self-efficacy, and discourse between the

patient and provider were more than 76.3% of the factors influencing screening behavior. They also showed that mHealth technology effectively plays a complementary role between the provider and the recipient.^[16] Furthermore, some studies in the country showed that despite free screening programs for various types of cancer at the first level of the health system, the screening index is low.^[6,9,10] By implementing these innovative systems, we can significantly reduce costs and eliminate workflow inefficiencies, ultimately enhancing the healthcare value.^[17]

CONCLUSION

The results of our study demonstrate that the utilization of mHealth technology has a significant effect on calling for the target population to undergo screening.

The incorporation of health technologies by telephone and Internet, through phone calls and mobile applications, into clinical practice is revolutionizing care across the entire continuum, from cancer screening and treatment management to posttreatment follow-up and survivorship. This translates to better patient outcomes and an improved quality of life for those we serve. Embracing this change is not only beneficial but also essential for advancing healthcare.

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Conflicts of interest

There are no conflicts of interest.

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