RESEARCH ARTICLE

Development of a Colorectal Cancer Screening Intervention for Iranian Adults: Appling Intervention Mapping

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Abstract

　　Background: While the incidence rate of the colorectal cancer (CRC) has been increasing over the last three decades in Iran, very limited interventions to increase CRC screening have been developed for Iranian population. The purpose of this study was to describe the use of Intervention Mapping (IM) for applying theory and evidence and considering local contexts to develop a CRC screening program among adults in Iran. **Materials and Methods:** From April 2014 to July 2016 following the IM process, six steps were formulated and implemented. First a need assessment was conducted involving relevant stakeholders and using focus groups discussions (n=10), individual interviews (n=20), and a household survey (n= 480). Then a matrix of change objectives was developed for each behavioral outcome and theoretical methods and their practical applications were identified to guide intervention development and implementation. A multi-component intervention was developed and piloted. Decision on suitable parts of intervention was made based on feedback of pilot study. Finally, evaluation plan including process and outcome evaluation was generated and conducted to inform future scale up. **Results:** The needs assessment highlighted factors affecting CRC screening including knowledge, self efficacy, social support and perceived benefit and barriers (financial problems, fear of detection of cancer and etc). Results of needs assessment were used to develop next steps IM. The program utilized methods like information delivery, modeling, and persuasion. Practical applications included video presentation, group discussion, role playing and postcards. This program was assessed through a cluster-randomized controlled trial. Results showed that there were significant differences in CRC screening uptake between intervention groups and control (P<0.001). **Conclusions:** IM is a useful process in the design of a theory-based intervention addressing CRC screening among Iranian population.

Keywords: Colorectal neoplasms- intervention mapping- Iran

Introduction

　　Colorectal cancer (CRC) is a major public health problem (Favoriti et al., 2016). It is a significant cause of morbidity and mortality throughout the world (Torre et al., 2015). In the Islamic Republic of Iran, CRC incidence ranks third among all cancers in both genders after stomach and breast cancers (Dolatkhah et al., 2015b). CRC is highly curable in its earlier stage. Therefore, screening strategy including Fecal Occult Blood Test (FOBT), sigmoidoscopy, and colonoscopy and barium enema is recommended to begin at age 50 years for adults at average risk (Levin et al., 2008; Smith et al., 2016). The incidence rate for the CRC has been rising in Iran over the last decades (Dolatkhah et al., 2015b; Abdifard et al., 2016). In addition, the literature search showed that distribution of lower age for CRC is observed in contrast to developed countries data (Dolatkhah et al., 2015a).

Therefore, starting regular screening for the CRC in age less than 50 is a more conservative method in our country.

　　While previous empirical evidence has indicated the effectiveness of CRC screening in reducing the incidence and mortality rates of CRC (Shaukat et al., 2013; Holme et al., 2014), CRC screening rates are significantly lower than for other preventable cancers (such as breast and cervical cancer) (Klabunde et al., 2007). Limited studies addressing CRC screening in Iran pointed out that CRC screening is low among Iranian adults. For example, Salimzadeh et al., (2014) study in Iran showed that overall 11% of the participants reported prior screening using either FOBT (6.5%) or colonoscopy (4.5%) in addition, more than half of participants have never heard regarding CRC screening (Salimzadeh et al., 2011).

　　Although in 2007, a Comprehensive National Cancer Control Program (CNCCP) was developed and was approved by Managers Council in the Ministry of Health

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(MOH) in Iran (Mousavi et al., 2008), by the end of this study processes, there is no national program for screening of CRC.

Very limited interventions to increase CRC screening have been developed for Iranian population (Salimzadeh et al., 2014). In response to this need; we formulated systematically an intervention program on the basis of evidence and theory to increase screening for CRC among adults. Intervention Mapping (IM) (Bartholomew et al., 2011) was chosen for guiding the intervention program development. IM describes a series of steps and processes for planning theory and evidence-based health education and health promotion interventions. The basis for IM is formed using three core processes including searching the literature for empirical findings; evaluating and using theory; collecting and using new data (formative research). The IM comprises of six steps and it has been used mainly as a tool for help health education specialists for the planning and development of health interventions. The six steps of the IM are: (1) conducting needs assessment, (2) creating matrices of change objectives (3) choosing methods and practical applications related change objectives, (4) producing program components and materials, (5) planning program adoption, implementation, and sustainability, finally (6) planning for evaluation. We selected to apply this framework because such a planned and structured process substantially can increase the opportunity of success for intervention development and implementation. Garba and Gadanya (2017) in their systematic review on role of IM in developing, implementation and evaluation of disease prevention interventions worldwide confirmed the successfulness of this approach. The purpose of this study was to demonstrate how IM was utilized to develop a program to increase CRC screening uptake specifically for Iranian adults living in Hamadan city.

Materials and Methods

Methods
Step 1: Needs assessment

Our needs assessment included a literature review, focus groups/ in-depth interviews, and a questionnaire survey.

The starting point for needs assessment was to review the literature to recognize health problem and determinants of CRC screening in asymptomatic individuals. As cited in introduction, evidence justify the importance of focusing on CRC screening. In next step to gain individuals' perspectives on key barriers and facilitators to CRC screening, the ten focus group discussions were conducted separately with men and women between 40 and 70 years who have not undergone screening tests and 20 individual in-depth interviews with people who have been screened. Then, we conducted 12 in-depth interviews with physicians to assess their views about CRC screening. A detailed description of the protocol can be found elsewhere (Unpublished data). These qualitative data and review the literature data were used to design a quantitative study instrument that provided information to appraise factors that affect screening of CRC behavior

and intention among Iranian adults. The instrument was piloted with 30 adult from the people of interest. Then, a questionnaire survey was conducted among 480 adults (40-70 years) living in Hamadan city in 2015. Participants were selected through a two-stage clustered sampling from 20 clusters.

Step 2: Creating matrices of change objectives

The second step of IM involved formulation of change objectives. Performance objectives were specified based on our overall objective (i.e., conducting CRC screening). Next, important and changeable determinants of each performance objectives were identified. By crossing the performance objectives with the determinants, the change objectives (i.e., specific intervention objectives) were identified. Recognition of what program participant needs to learn concerning every determinant was applied to generate change objectives.

Step 3: Selecting methods and practical applications

The third IM step was to choose suitable theoretical methods for influencing changes in the determinants and translate these into practical applications. Theoretical methods are general process to accomplish changes in determinants of behaviors and environmental conditions. Practical applications are defined as the process for applicable utilize of theoretical methods. In IM, it is recommended to involve that perspective of target audience in the development of program ideas. After reviewing the change objectives and their potential appropriate methods and practical applications, the identified list were discussed with a committee of target group. The proposed applications were finalized based on suggestions made by the representative of target group. Our aim was to identify which intervention tools were most suitable to encourage CRC screening from the adults' view.

Step 4: Producing program components and materials

In IM step 4, according to documents obtained from the previous steps and target group characteristics, the program materials were design, produced and piloted.

First, we identified existing intervention materials addressing CRC screening. Second, planning team appraised if the materials covered the intended change objectives. If the materials were culturally appropriate. In case existing materials did not fit with change objectives, new materials were developed to cover all change objectives. We used discussions with target groups and physicians to prepare components of the intervention that fitted the program's change objective and methods. The new materials were evaluated by a group of experts in the field of health education and health promotion and also pilot-tested among 10 adult and the final change were created based on experts' feedback and pilot-tested adults' suggestions. Then the final materials were produced.

Step 5: Planning program adoption and implementation

In order to create a plan for the adoption and implementation of the intervention amongst the target group, we repeated steps 2–3 of the intervention

mapping process. Sufficient time, enough resources and the provision of appropriate materials are needed for prosperous implementation. The participation of adults in choosing the appropriate strategy and materials promoted the opportunity for implementation, and the pretesting of the materials and also piloting of the intervention enabled for additional improvement.

Step 6: Planning for evaluation

The final step in IM was to develop evaluation plan. The content of the questions was built based on the information gathered from the needs assessment and other previous steps of IM. Program's effectiveness on increasing screening and influencing impact variables (intermediate) were measured through a randomized controlled trial study. Also we designed process evaluation questions based on the descriptions of methods, conditions, practical applications, program, and implementation.

Results

Step 1: Needs assessment

Cancer is one of the major causes of death among Iranian population. In Abdifard et al., (2016) study was reported 36,650 cases of CRC during a period of ten years in Iran. In 2009, 6218 people have been affected CRC. This cancer is the third most common cancer with the standardized incidence rate 10.9 per 100,000 persons among women and the fifth most common cancer with the standardized incidence rate 11.3 per 100,000 among men our country.

For this program, the priority population was adults aged 40 -70 years. We focused on this age range because of half of the Iranian CRC patients were less than 50 years of age (Moghimi-Dehkordi et al., 2008). As mentioned in the introduction, reductions in CRC mortality rate in a many number of countries most likely related to CRC screening, or enhanced cancer treatment. However, there no national program for people at average risk in Iran.

Our survey result indicated the screening rates were very low in our target population. Only 7.6% of adults aged 40years and older reported CRC screening within the previous years.

Based on reviewing the literature perceived threat, perceived barriers and benefits from the Health Belief Model (HBM) (Rosenstock, 1974), subjective norms and intention from the Theory of Planned Behavior (TPB) (Ajzen and Fishbein, 1991), and self-efficacy and social support from Social Cognitive Theory (SCT) (Bandura, 1986) were the most important determinants of CRC screening uptake. Accordingly, we selected Preventive Health Model (PHM) (Myers et al., 1997) as an integrated model that allow for the combination of constructs mentioned above. In the PHM, three sets of factors are suggested that predict behavioral intention and health behavior that including background factors, cognitive and psychosocial constructs (e.g., perceived susceptibility to disease , perceived barriers and social support), and program factors (e.g., interventions by health providers) (Figure 1).

Table 1. The Matrix of Change Objectives for Adults

Performance Objectives	Determinants						
	Knowledge	Perceived susceptibility	Perceived benefits	Perceived barriers	Self efficacy	Social support	Intention
PO1. Familiar with CRC and CRC screening	Adults express symptoms and risk factors for CRC						
	Adults express screening methods of CRC						
PO 2. Schedule a FOBT screening	Adults recognize the need for screening	Adults identify themselves at risk of getting CRC	Adults express benefits of having CRC screening	Adults list barriers to undergo screening tests (specially FOBT)	Adults express confidence in scheduling to undergo FOBT	Family members encourage adult to schedule a FOBT screening	Adults state intention to undergo FOBT screening
PO 3. Obtain a FOBT	Adults express one important reason for early detection of cancer	Adults identify themselves at risk of getting CRC	Adults express benefits of having tests screening (specially FOBT)	Adults list barriers to undergo FOBT screening	Adults express confidence about obtaining FOBT	Family members accompany adult to undergo FOBT screening	Adults state intention to undergo FOBT screening
	Adult describes FOBT screening						
PO 4. Follow-up a FOBT result	Adults express where to go if a test result is abnormal		Adults express benefits of following FOBT results	Adults express barriers of following FOBT results	Adults express confidence in being able to receive results	Family members remind adult to get results	
					Adults express confidence in tracking results	Family members help adult to needed follow-up	

Table 2. The Matrix of Change Objectives for Physicians and Providers

Performance Objectives	Determinants			
	Knowledge	Belief	Attitude	Barriers
PO1. Physicians make referrals for FOBT screening	Physicians familiar with CRC screening guidelines	Physicians believe effectiveness of screening (FOBT) in CRC diagnosis	Physicians believe that giving screening commendations are a significant component of the care in health center	Physicians believe that can overcome barriers to give a screening commendation
PO2. Physicians and providers follow-up FOBT results	Physicians and providers Familiar with normal and abnormal tests results		Physicians and providers believe that tracking results are important	Physicians and providers believe that can overcome barriers to track tests results

The findings of the focus groups and interviews with adults 40-70 years old showed that several factors were associated with CRC screening, including awareness and knowledge about CRC and its screening, financial problems, low priority of health concerns, fear of detection of cancer, problems related to nature of CRC screening tests and mistrust in the health care system.

Among the interviewed physicians, the need for educational interventions and structural interventions (insurance coverage, free test) for adults was commonly stressed. All physicians aware of CRC screening methods but only less than half of them recommended CRC screening methods to their patients. Physician had positive attitudes about CRC screening methods. However, more physicians believed that FOBT is not an appropriate screening strategy. Finally, survey findings provided information regarding most important factors related to the CRC screening intention among adults in Hamadan city such as self efficacy, social support, perceived benefit and barriers. Based on information of needs assessment step, the intended program outcomes were developed and both personal and environmental determinants for the health problem were identified also intervention development was guided.

Step 2: Creating matrices of change objectives

Based on the information out of the needs assessment step, two program objectives were created for the CRC

Table 3. Methods and Practical Applications

| Determinants (individual)	Methods	Practical applications
Knowledge	Information delivery	Providing written and verbal Information (lecture , pamphlet), question and answer between the educators and the adults
Susceptibility, benefit, barrier	modeling, persuasion	Video presentation, group discussion
Intention	Modeling, persuasion	video presentation, reminder (postcard-telephone)
Self-efficacy	Modeling, feedback	Video presentation-role playing
Social support	Modeling	Video presentation
Determinants (interpersonal)	Methods	Practical applications
Knowledge	Information delivery	Discussion
Belief, attitude, barriers	Discussion	Discussion
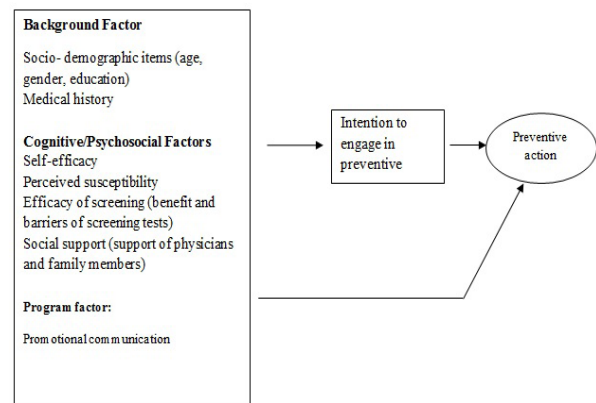
Figure 1. Preventive Health Model

screening intervention. The program objective for the individual level was increase CRC screening (FOBT) among adults. In addition, the program objective for the interpersonal level of the environment was referral for CRC screening. According to the program objectives, the performance objectives were defined for adults at the individual level and at the interpersonal level for providers. After specifying the performance objectives, important and changeable determinants of these objectives were selected, for each level based on the first step results of IM. For the individual level, PHM (Myers et al., 1997) was chosen as a framework to describe factors associated with FOBT screening behavior. Other important determinant is knowledge related to CRC and CRC screening. Finally, for providers (physicians) at the interpersonal level, knowledge related to CRC and CRC screening guidelines, attitude, belief and barriers were selected as determinant. Subsequently, matrixes of change objectives were produced by intersection performance objectives with selected determinants for each level of the intervention separately (Table 1-2). For example, at individual level, the performance objective to obtain a FOBT screening was crossed with the determinant 'self-efficacy' and resulted in the change objective 'adults express confidence about obtaining FOBT'.

Step 3: Selecting methods and practical applications

As mentioned above, step three focused on selecting theoretical methods and practical applications that can be used in the health centers. Some suitable theoretical methods which can influence the identified determinants included information delivery, modeling, persuasion. After selecting the methods, characteristics of the context were examined and the chosen methods were translated

into practical applications in program. Table 3 provides selected methods and practical applications that were identified to change determinants at each level of the intervention.

Step 4: Producing program components and materials

Based on needs assessment data and additional focus group discussion held with target group for collecting information about preferences for intervention tools, the planning team developed a list of intervention materials and activities. For the individual level, a small group intervention was designed in two sessions (during two week period) for the adults in health centers. For the interpersonal level, one-on-one session was held for providers about CRC and screening guidelines in health centers.

Specifically for this intervention program, we developed reminder pack contains postcards and pamphlet. Also an educational video with title "Being a winner in life: how to prevent CRC cancer "was downloaded from the website https://ethnomed.org/patient-education/cancer/CRC-cancer. This video was a Washington university production in 2003 that was dubbed into Persian in Hamadan University. The Washington University permitted to use the video for non- commercial educational goals.

During the first session, the educator talked about CRC, screening recommendations with slide also the questions and answers strategy were used to better understand the issues discussed. During the second session, the educational video was shown for discussing perceived susceptibility, social support, barriers, benefits and intention. Also role playing were used to stimulate discussion in the group about perceived barriers and the ability to overcome these barriers (self efficacy). Finally, the FOBT screening was prescribed by health centers physician for the participants. A month after the last training session, reminder pack contains postcards and pamphlet was mailed for participants. The postcards included key messages to increase FOBT screening behavior, pamphlet included information regarding CRC, screening behavior and strategies to decrease the barriers to screening. Two months after the training session, participants received a reminder phone call to encourage participants to undergo FOBT screening.

The intervention was piloted in two health centers in Jan 2016. The results indicated that more than 90 percent of the participants were satisfied with intervention content, schedule time and number of training sessions. The adults asked to read pamphlet at the end of the pilot program. Most respondents evaluated it understandable, interesting. Also they preferred black text on white background and clearer pictures for better readability.

Step 5: Planning program adoption and implementation

Step 5 of IM guides planners to consider how programs will be initially adopted and implemented. Current program adopters were health centers directors. Program implementers were both one of the researchers of the planning team and health volunteers. Initially we intended to use health center staff in implementing the intervention but due to burden of work and lack of cooperation from staff, team decided to use one of the researchers in program as implementer. In addition, we selected health volunteers due to their capability to access, by personal contact in the community, adults who had not had a FOBT test in the past 1 years and colonoscopy in the past10 years. They helped us to invite priority population for intervention.

Information gathered during stage1 through interviews with program adopters (mainly physician) and review literature helped in development of performance objectives, suitable methods and practical applications to improve adoption and implementation behaviors. Performance objectives for program adoption and implementation included the following (1) Acquaint health centers directors with the program goals. (2) Support health centers directors of program implementation. (3) Educators performed the this program with fidelity, completeness and does.

For health volunteers, training sessions was held in the various health centers that were informed about inclusion criteria people and program flow. Also all health centers directors received detailed information about program.

This program was implemented in 8 health centers. In each health center, 31 adults were included. In total, more than 248 adults were targeted. The target group was divided into 4 groups. The intervention group 1 received education and free FOBT, the intervention group 2 received only education, the intervention group 3 received free FOBT, control group received only the questionnaire.

Step 6: Planning for evaluation

In the last step of the IM, The effectiveness of the program on increasing CRC screening was evaluated in a randomized controlled trial in 4 groups in 8 health centers in Hamadan. Also, questions regarding the determinants of the CRC screening behavior were constructed and target group was asked to fulfill questionnaire during baseline and posttest measurements. Additionally, data were gathered by two researchers via face to face interviews.

To assess the implementation of the intervention, process evaluation questionnaires were developed. The process evaluation plan focused on program reach (participation rate), program fidelity (quality), dose and satisfaction of program (e.g., time the sessions, length of the sessions, and location of the program).

Process measures were based on questionnaires for target group and checklist for educator.

The preliminary evaluation findings revealed that during the 4-month follow up period, CRC screening rates were 87.1%, 61.3%, 54.8 and 1.6% for participants assigned to education with free FOBT, only education, only free FOBT and control group, respectively. Adults in either of the 3 intervention groups were significantly more likely to undergo screening compared to adults in the control group.

The Ethical Committee of the Hamadan University of Medical Sciences whit code p/16/35/9/6385 has approved the study protocol. Trial registration: IRCT2015041821822N1.

More results about the evaluation of the intervention will be described in a separate paper.

Discussion

This paper explains the utilization of IM to develop an intervention to increase CRC screening in adults. IM process guided us through development of theory and evidence based programs for adults.

The needs assessment prepared a significant base for next steps the program by identifying factors affecting CRC screening and environment condition related for the target group. We found that information delivery, modeling, persuasion were appropriate methods for undergo CRC screening, and we chose video presentation, group discussion, role playing and postcard as practical applications in this intervention. Our study was aimed at both the individual and the environmental level. Thereupon, in addition to encouraging adults to undergo CRC screening by designed material and messages also was considered some of the most important environmental barriers especially no physician referral in health centers.

Applying IM process to develop this program leads to significantly increase FOBT screening in intervention groups toward control group that demonstrates the effectiveness of this intervention. Our study consistent with studies of hou et al (2004) and Byrd et al (2012) that used IM process to develop program to increase cervical screening.

In this study, strength in using IM was that specifically collected and combined quantitative and qualitative data from target population, and theorical models to design an intervention tailored to the needs of the adults aged 40 and older. The other strength is the select of the PHM (Myers et al., 1997) as a useful theoretical framework for determinants CRC screening and development of the intervention. This model was greatly utilized in the field of cancer screening especially CRC screening (Watts et al., 2003; Salimzadeh et al., 2014).

Several studies performed in the field CRC screening interventions (Maxwell et al., 2010; Salimzadeh et al., 2014); however we found only one study describing the process of developing a CRC screening interventions (Vernon et al., 2011). On the other hand, based on the best of our knowledge, our study is the first study to develop a program on this issue relevant and appropriate to the socio - cultural context of a developing country.

A limitation of the IM process is the time-consuming that other researchers also mentioned to this issue. Nevertheless, our planning team had believed that applying the IM extremely helped to program prosperity.

In conclusion, interventions to increase CRC screening was formulated based on the IM process that resulted in a comprehensive and structured intervention program in health centers setting. This program was efficient in increasing CRC screening behavior. Results encourage use of IM for planning and developing efficient interventions programs for adults aged 40 and older.

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