Research Square

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Application of the Intervention Mapping Approach to prevention of infectious respiratory diseases among Iranian Students

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Abstract

Introduction

the infectious respiratory diseases highly contagious and transmissible, leading to a high incidence rate within populations and their epidemics often turn into a major global public health concern. For example widespread school closures during the COVID-19 or influenza pandemic reflect the prominent role of such educational settings in controlling the spread of the virus. Considering the multitude and multidimensional nature of the factors that influence the adoption of infectious respiratory diseases prevention behaviors, educational planning frameworks can be utilized to develop more effective programs for the promotion of these behaviors. This study aimed to develop, implement and evaluate an educational intervention program based on the intervention mapping approach for the Improving preventive behaviors of infectious respiratory diseases among students.

Method

A controlled pretest-posttest parallel study was conducted with the participation of 241 male seventh to ninth grade students. The educational intervention implemented for the intervention group consisted of six 45–60 minute sessions of education held over a period of one month, which involved lecture, interactive education methods like Q&A and group discussion, and the use of posters, pamphlets, videos, and PowerPoint presentations. The data collection tool was a researcher-made self-report questionnaire.

Results

The mean and standard deviation of the scores of the constructs for all students were as follows: Knowledge (4.07 ± 1.34), Perceived Susceptibility (18.87 ± 3.12), Perceived Severity (22.79 ± 3.58), Attitude (19.95 ± 2.81), Subjective Norms (33.29 ± 4.18), Perceived Behavioral Control (21.66 ± 4.11), and Practice (21.57 ± 3.33). While there was no statistically significant difference between the control and intervention groups before the intervention, a statistically significant difference was observed between them in terms of all determinants two and four months after the intervention ($P < 0.05$).

Conclusion

The educational intervention programs that are designed based on the identification of determinants of behavioral change appear to be more effective in achieving their goals. The findings of this study support the existing evidence of the effectiveness of school-based interventions designed and implemented based on intervention mapping in the Improving preventive behaviors of infectious respiratory diseases among students. The findings also suggest the theoretical framework used in this study can be used for the development of similar programs in the future.

Introduction

Common infectious respiratory diseases include influenza, tuberculosis, mycoplasma pneumonia, and the novel coronavirus pneumonia, among others. they are highly contagious and transmissible, leading to a high incidence rate within populations and their epidemics often turn into a major global public health concern (1). For example COVID-19 is an infectious acute respiratory disease caused by a coronavirus called SARS-CoV-2, which the World Health Organization (WHO) declared a public health emergency of international concern on January 30, 2020 (2). The COVID-19 pandemic has had major social, economic, political, and educational consequences across the world, forcing many governments to adopt strict disease control policies and strategies including school closures (3). This is while schools are among the most fundamental and effective educational settings for health promotion (4). According to the American Centers for Disease Control and Prevention (CDC), investing in the health of adolescents and young adults in educational settings is one of the most important interventional strategies of health systems (5, 6). Indeed, encouraging young people to adopt preventive behaviors could be highly effective in preventing the spread of communicable diseases (7). Also, it is believed people's health is a consequence of their everyday life environment, where they learn, work, and play (8).

In Iran, there are more than 12 million students, which constitute a significant part of the country's 85 million population (9). On the one hand, many risk factors in schools threaten the health of students (10), but on the other hand, schools offer a good opportunity for encouraging students to participate in health promotion interventions. However, adolescents tend to have limited participation in health promotion programs because of their age (11). Identifying barriers to participation and adopting measures to facilitate participation in health promotion programs could be effective in attracting the participation of target groups and ensuring the success of intervention programs (12). Thus, to ensure good participation in a health promotion program, it is crucial to identify the audience of the program, whether they are individuals, groups, or organizations, and determine the factors that shape their health behaviors (13, 14).

Educational planning frameworks can provide guidance for multiple stages of intervention development and implementation, including needs assessment, design, execution, and evaluation, enabling the interventions to achieve their intended results (15, 16). Thus, such frameworks are somewhat essential for the development, execution, and evaluation of health education and promotion programs and for predicting their success in engaging the audience. One of these frameworks is Intervention Mapping (IM), which can be described as a systematic process for designing, implementing, and evaluating health promotion programs by the combined use of the existing scientific literature, relevant theories, and population data. IM is a multi-stage process that starts with an assessment of the target population and progresses by factoring in the inputs of community stakeholders in the development, planning, execution, and evaluation of the intervention (17, 18). In the IM approach, the goal is to promote public health and social participation and change the behavior of high-risk individuals by trying to approach the problem and plan the intervention with due consideration of stakeholders at different ecological levels (individual, interpersonal, organizational, community, and society) (17, 19, 20).

The IM approach has been used in the development of a large number of health promotion programs and guidelines around the world, including for example a school-based HIV prevention program (21), an AIDS risk reduction program for drug users (22), guidelines for diabetes intervention based on peer support (17), a community-based intervention for the prevention of childhood obesity (19), a worksite physical activity intervention (23), a school-based nutrition education program (24), a cancer prevention program (25), and a program for improving diet and physical activity behaviors (18).

In this study, the IM approach was used to develop a protocol for promoting infectious respiratory diseases transmission prevention behaviors among students, and then the efficacy of the protocol was evaluated in four schools in the city of Yasuj (Kohgiluyeh and Boyer-Ahmad Province, Iran).

Materials and methods

A controlled pretest-posttest parallel study was conducted to evaluate the effect of an intervention for the promotion of infectious respiratory diseases transmission prevention behaviors among students, between late September 2020 and March 2021, which was designed and implemented by the use of intervention mapping (IM) as the guiding theoretical framework. The IM approach consists of six steps, each comprised of various activities, whose results determine how the process progresses in subsequent steps (26). The procedures followed in each step of IM are described below.

Step 1: needs assessment with the PRECEDE model

The first step of IM was to form the planning group. This planning group consisted of the head of the health office of the education department of Kohgiluyeh and Boyer-Ahmad Province, the head of the health office of the education department of the city of Yasuj, principals and health educators of the four selected schools, and four teachers working in these schools plus the research team. This step involved identifying and better understanding the target community, which was done by reviewing the literature and interviewing individuals who were knowledgeable in this regard, reaching a description and analysis of the problem, and identifying its environmental and behavioral determinants. In this step, the infectious respiratory diseases prevention behaviors were determined to be mask-wearing, physical distancing, observation of hand hygiene, observation of respiratory hygiene, and vaccination, and the determinants of these disease prevention behaviors were identified to be knowledge, perceived susceptibility, perceived severity, attitude, subjective norms, perceived behavioral control, and practice. The methodology and findings of this step, which was carried out in the form of a qualitative study, have been described in another article (27).

Step 2: Creating matrices of change objectives

As the main tool of IM, the matrix of change objectives determines what or whom the intervention tries to change. To create this matrix, we combined the performance objectives with the identified

determinants and determined the most urgent change (intervention) objectives. The output of this step was a list of the expected outcomes of the intervention and the things it is supposed to change.

Step 3: Choosing theoretical methods and producing practical applications

The third step involved choosing the theoretical methods by which the identified behavioral determinants would be changed and transforming them into practical solutions based on the personal experiences of the research team and the experiences reported in the literature. The ideas that were initially put forward for the intervention were revised into more practical ideas with the help of the planning group. At the end of this step, we identified the theoretical methods that would suit each determinant and also the practical strategies that would be suitable for changing that determinant.

Step 4: Producing the program's components and materials

The program's components and materials were produced by a workgroup consisting of a graphic artist and four health education specialists. In this step, the program's materials, delivery channels, and communication tools were chosen according to the determinants identified and the theoretical methods chosen in the previous steps. We also chose a title (infectious respiratory diseases prevention by attentive and responsible students) and designed a logo for the program. The program's educational materials were produced after a pilot test.

Step 5: Planning for the program's adoption, execution, and sustainability

In this step, we selected people who would implement the program, determined the roles to be assigned to each person, and set the schedule of each activity and the person responsible for each activity. We also listed the required and available resources and capacities and coordinated and specified the conditions for the use of resources according to the needs in order to improve the program's sustainability.

Step 6: Planning for the program evaluation

In this step, we prepared a checklist for evaluating the processes included in the program and their impacts and revise the program's model if needed. The purpose of this evaluation was to ensure that the program is executed as intended, determine its strengths and weaknesses, and identify the obstacles that may prevent it from achieving its goals. The findings of this evaluation are reported in the conclusion section of the paper.

Participants and sampling

The program was executed with the participation of 241 male seventh to ninth grade students in four schools in the city of Yasuj. The participants were chosen by randomized multi-stage cluster sampling. The sampling process involved listing all all-boys[1] middle schools in Yasuj and choosing four schools at random using a table of random numbers, and then listing all classrooms in each selected school and selecting two classrooms from each school at random again using a table of random numbers. All students in the selected classrooms were included in the study. After the pre-test, two schools were randomly assigned to the intervention group and the other two were used as the control group.

The minimum sample size required for the study was determined to be 160 (2), but because of the method of sampling and the inclusion of all students in the selected classrooms, the sample size increased to 241. All of the selected students (100%) filled out the researcher-made self-administered questionnaire at both pre-test and post-test stages without the intervention of the researchers. Informed consent was obtained from all participants.

Data collection tool

The data collection tool was a questionnaire developed by the research team according to the factors and behaviors identified in Step 1 for assessing the determinants of infectious respiratory diseases prevention behaviors among students.

Validity assessment was performed by checking face validity and content validity. Face validity was established by taking both qualitative and quantitative inputs from the target group. Content validity was established qualitatively by modifying the questionnaire's items according to the feedback received from experts and also quantitatively by computing the Content Validity Ratio (CVR) and Content Validity Index (CVI) (28). Reliability of the questionnaire was established by checking its internal consistency and stability using Cronbach's alpha and the test-retest method, respectively (29).

The questionnaire was comprised of two sections. The first section was devoted to demographic information and consisted of 5 questions concerning student's grade, his father's education and occupation and his mother's education and occupation. The second section of the questionnaire consisted of 44 items concerning the determinants of infectious respiratory diseases prevention behaviors in 6 dimensions:

1. Knowledge: 7 items with three responses (True, False, I don't know); each correct response was awarded a score of 1 and incorrect and "I don't know" responses were not awarded any score; the score of this dimension ranged from a minimum of 0 to a maximum of 7;
2. Perceived Susceptibility: 5 items on a five-point Likert scale (Completely Agree to Completely Disagree) with a minimum score of 5 and a maximum score of 25;

3. Perceived Severity: 6 items on a five-point Likert scale (Completely Agree to Completely Disagree) with a minimum score of 6 and a maximum score of 30;
4. Attitude (towards behavior): 5 items on a five-point Likert scale (Completely Agree to Completely Disagree) with a minimum score of 5 and a maximum score of 25;
5. Subjective Norms: 8 items with a minimum score of 8 and a maximum score of 40;
6. Perceived Behavioral Control: 6 items on a five-point Likert scale (Completely Agree to Completely Disagree) with a minimum score of 6 and a maximum score of 30;
7. Practice: 7 items on a four-point Likert scale (Always to Never) with a minimum score of 7 and a maximum score of 28.

Educational intervention

The educational intervention implemented for the intervention group consisted of six 45–60 minute sessions of education held over a period of one month, which involved lecture, interactive education (e.g. Q&A and group discussion), and the use of posters, pamphlets, videos, and PowerPoint presentations. The details of the intervention developed using the IM approach are provided in Table 1. The control group received the conventional education provided in schools.

Table 1

Details of the intervention program designed and implemented using the intervention mapping approach

Media	Channel	Practical application	Theoretical method	Determinant	Schedule
Instructor and pamphlet	Interpersonal	Lecture and group discussion	Group discussion, lecture, education and information transfer	Knowledge	Week 1 / 45 minutes Session 1 in Week 1
Activities carried out until the next session: The reference teacher installed a poster containing educational information in the classroom with the participation of students. The posters were created in bulk in advance and were given to the teachers of the schools assigned to the intervention group.					
Expected outcomes in relation to Knowledge: Students were expected to be able to describe the types of infectious respiratory diseases, its symptoms, transmission methods, and transmission prevention methods, the effect of mask wearing, physical distancing, respiratory hygiene and hand hygiene on disease prevention, the stages of vaccination, and the role of vaccines in disease prevention.					
Instructor, video, and pamphlet	Interpersonal	Discussion and group learning	Group discussion, persuasive communication and presenting comparative information, modeling, explaining the magnitude of the problem, explaining the positive impact of compliance and the negative impact of non-compliance, decisional balance	Attitude	Week 1 / 60 minutes Session 2 in Week 1
Activities carried out until the next session: The reference teacher installed a poster focused on changing the attitude of the students towards adopting preventive behaviors in the classroom with the participation of students.					
Expected outcomes in relation to Attitude: Students were expected to acquire a positive and agreeable attitude towards mask wearing, physical distancing, observing hand hygiene, observing respiratory hygiene, and vaccination.					
Activities carried out in the final session: In this session, the health promotion instructor and a psychology expert repeated and summarized the materials covered in previous sessions and answered the students' questions. They also held a number of group competitions about the topics covered in previous sessions and also presented an entertainment program with prizes to motivate the students.					

Media	Channel	Practical application	Theoretical method	Determinant	Schedule
Instructor, video, and pamphlet	Interpersonal	Discussion and group learning	Providing information about perceived risk, group discussion, drawing a picture, explaining the magnitude of the problem, explaining the positive impact of compliance and the negative impact of non-compliance, decisional balance	Perceived Threat (perceived Susceptibility and Perceived Severity)	Week 2 / 45 minutes Session 3 in Week 2
Activities carried out until the next session: The reference teacher installed a poster focused on increasing students' understanding of the threat in the classroom with the participation of students.					
Expected outcomes in relation to Perceived Threat: Students were expected to understand the consequences of not wearing mask, not observing physical distance, not observing hand hygiene, not observing respiratory hygiene, and avoiding vaccination in terms of the risk of contracting the disease for themselves and others.					
Instructor and reference teacher	Interpersonal	Discussion, group learning, and contact with parents and teachers	Persuasive communication and modeling	Subjective Norms	Week 2 / 60 minutes Session 4 in Week 2
Activities carried out until the next session: The reference teacher installed a poster about the opinion of physicians on the importance of adopting preventive behaviors in the classroom with the participation of students.					
Expected outcomes in relation to Subjective Norms: Students were expected to use masks, observe physical distancing, respiratory hygiene and hand hygiene, and take the vaccine to gain the approval of reference individuals whom they consider to be important.					
Instructor, video, and pamphlet	Interpersonal	Discussion, group learning, and contact with parents and teachers	Group discussion, modeling, self-monitoring of behaviors, vicarious experiences (positive and negative)	Perceived Behavioral Control	Week 3 / 60 minutes Session 5 in Week 3
Activities carried out in the final session: In this session, the health promotion instructor and a psychology expert repeated and summarized the materials covered in previous sessions and answered the students' questions. They also held a number of group competitions about the topics covered in previous sessions and also presented an entertainment program with prizes to motivate the students.					

Media	Channel	Practical application	Theoretical method	Determinant	Schedule
Activities carried out until the next session: The reference teacher installed a poster focused on improving the students' understanding of and ability to manage the situation and overcome the barriers to preventive behavior in the classroom with the participation of students.					
Expected outcomes in relation to Perceived Behavioral Control: Students were expected to be able to control and manage the adverse conditions and obstacles of using masks, observing physical distance, observing hand hygiene, observing respiratory hygiene, and undergoing vaccination.					
Instructor	Interpersonal	Discussion and group learning	Explaining the magnitude of the problem, explaining the positive impact of compliance and the negative impact of non-compliance, decisional balance, presenting entertainment programs and offering prizes	Knowledge, Attitude, Perceived Threat, Subjective Norms, and Perceived Behavioral Control	Week 4 / 60 minutes Session 6 in Week (Conclusion)
Activities carried out in the final session: In this session, the health promotion instructor and a psychology expert repeated and summarized the materials covered in previous sessions and answered the students' questions. They also held a number of group competitions about the topics covered in previous sessions and also presented an entertainment program with prizes to motivate the students.					

Data analysis

All data were analyzed in SPSS version 25. In the descriptive analysis, quantitative results were reported as mean ± standard deviation (SD) or frequency (percentage). Intergroup comparisons were performed by the use of an independent t-test for the pretest stage and repeated-measures ANOVA for the posttest stage. The significance level was considered to be $p < 0.05$.

Findings

Pretest results

The independent t-test showed no statistically significant difference between the control and intervention groups in terms of any of the determinants before the intervention (Table 2).

Table 2
Pretest results and Posttest results

		Intervention Group	Control Group	Independent t test	repeated measures ANOVA	
		Mean ± SD	Mean ± SD	P Value	P Value	effect size
Knowledge	Before Intervention	4.7 ± 1.28	4.4 ± 1.26	0.085	< 0.001	0.7
	two Months After Intervention	6.5 ± 0.75	4.72 ± 1.14			
	four Months After Intervention	6.58 ± 0.65	4.74 ± 1.16			
Perceived susceptibility	Before Intervention	18.78 ± 3.00	18.96 ± 3.24	0.664	< 0.001	0.8
	two Months After Intervention	21.33 ± 2.89	18.96 ± 3.14			
	four Months After Intervention	21.46 ± 2.72	18.82 ± 3.32			
Perceived severity	Before Intervention	22.81 ± 3.76	22.78 ± 3.42	0.946	< 0.001	0.9
	two Months After Intervention	26.17 ± 3.25	22.77 ± 3.22			
	four Months After Intervention	26.18 ± 3.25	22.65 ± 3.28			
Attitude	Before Intervention	19.97 ± 2.89	19.93 ± 2.75	0.928	< 0.001	0.8
	two Months After Intervention	22.73 ± 2.40	20.05 ± 2.61			
	four Months After Intervention	22.61 ± 2.35	20.07 ± 2.54			
Subjective norms	Before Intervention	33.12 ± 4.36	33.46 ± 4.00	0.522	< 0.001	1
	two Months After	36.28 ± 3.96	33.51 ± 4.05			

	Intervention					
	four Months After Intervention	35.66 ± 4.30	33.24 ± 4.15			
Perceived behavioral control	Before Intervention	21.21 ± 4.09	22.01 ± 4.09	0.093	< 0.001	0.97
	two Months After Intervention	25.00 ± 3.74	22.17 ± 3.79			
	four Months After Intervention	24.94 ± 3.82	22.07 ± 3.89			
practice	Before Intervention	21.58 ± 3.38	21.57 ± 3.30	0.991	< 0.001	1
	two Months After Intervention	25.24 ± 2.84	21.69 ± 3.14			
	four Months After Intervention	25.01 ± 3.13	21.51 ± 3.16			

Posttest results

The mean scores of Knowledge, Perceived Susceptibility, Perceived Severity, Attitude, Subjective Norms, Perceived Behavioral Control, and Practice constructs in the intervention and control groups are compared in Table 2. The repeated-measures ANOVA, according to time/group, showed statistically significant between intervention and control group differences in the mean scores of all constructs two months and four months after the intervention ($p < 0.001$).

For example, The mean score of the knowledge construct increased from 4.7 to 6.50 in the intervention group two months after the intervention, and four months after the intervention, it was associated with a slight change (6.58). Also, the effect size equal to 0.7 shows the effectiveness of the intervention. The mean score of perceived sensitivity structure in two months after the intervention in the intervention group increased from 18.78 to 21.33 and four months after the intervention it was associated with a slight change (21.46). Also, the effect size equal to 0.9 shows the effectiveness of the intervention. In the same way, the amount of changes and the effectiveness of the intervention in the rest of the structure can be seen in Table 2.

Discussion

Research has shown the positive effect of the IM approach on the success of health promotion programs specifically those developed for schools (21, 30). Like other studies in the field, the present

study also found that given the ability of the IM approach to provide a comprehensive understanding of health problems and the factors that influence them while taking into account the views and opinions of target groups, it can serve as an excellent framework for the development and implementation of targeted health promotion programs in different settings (22, 30).

Several studies have used the IM approach to identify the determinants of students' health (30, 31). Using this approach, the intervention developed in this study managed to achieve high efficacy by targeting multiple constructs including knowledge, perceived susceptibility, perceived intensity, attitude (towards behavior), subjective norms, perceived behavioral control, and practice.

In a study by Wiysonge et al., they stated that knowledge as a contextual variable can play a key role in the adoption of COVID-19 prevention behaviors (32). In the present study, the mean knowledge score increased significantly after the intervention. Other studies have also shown that improving people's knowledge and awareness can greatly affect their COVID-19 prevention behaviors (33, 34).

In the present study, there was a statistically significant change in the mean score of Perceived Susceptibility in the intervention groups two months and four months after the intervention. Other studies have also shown that higher perceived risk is associated with increased adherence to preventive behaviors (35, 36). Contrary to our findings, Mahindarathne et al. reported that perceived susceptibility has an insignificant effect on COVID-19 prevention behaviors (33). This discrepancy can perhaps be related to the manner of administration of questionnaires, as Mahindarathne et al. emailed their questionnaires to potential respondents and almost half of the recipients did not respond to the email.

The mean score of Perceived Severity in the intervention group also significantly changed from before the intervention to two months and four months after the intervention. Several other studies have identified perceived severity as a determinant of preventive behaviors (37, 38). This is likely because the perception of risk can affect how much people accept and adopt behaviors (39). Thus, improving students' understanding of risk in schools and at home can be expected to result in better adoption of disease transmission control and prevention behaviors. Indeed, many studies have shown a significant relationship between perceived severity and preventive behaviors (40–42).

According to some studies, a positive attitude towards behavior can be a determinant of the person's adherence to the behavior (43, 44). In the present study, attitude towards the behavior was also identified as a determinant of the adoption of infectious respiratory diseases prevention behaviors. On the contrary, a study by Park et al. reported that students' attitude toward preventive behaviors does not have a significant impact on their intent to perform these behaviors (45). This discrepancy could be due to the difference in the methods of the two studies.

In this study, subjective norms were also found to be affecting the promotion of COVID-19 prevention behaviors among students. According to Yang et al., social atmosphere is a major predictor of mask-wearing (46). Other studies have also explored the influence of peers and social networks on the

Improving preventive behaviors of COVID-19 disease (37, 38). Park et al. also stated that students tend to imitate the behavior of people they consider important in life (45).

According to the self-report findings of this study, giving students protective equipment can facilitate their adoption of infectious respiratory diseases prevention behaviors. Other studies have also reported that the availability of facilities and equipment is a determinant of the adoption of preventive behaviors (47). However, it has been shown that in people with a high perceived behavioral control, the obstacles and inconveniences of using a mask cannot prevent the adoption of COVID-19 prevention behaviors (48, 49).

Conclusion

The results of this study indicate that a multitude of factors can influence the Improving preventive behaviors of infectious respiratory diseases among students. The educational intervention programs that are designed based on the identification of determinants of behavioral change appear to be more effective in achieving their goals. The findings of this study support the existing evidence of the effectiveness of the theoretical framework and the school-based intervention designed and implemented based on the IM approach in the Improving preventive behaviors of infectious respiratory diseases among students. The findings of the study can pave the way for researchers, educational institutions, schools, and healthcare professionals who are interested in implementing such behavior change strategies.

Research limitations

- The short duration of the school year
- The inability to plan the intervention for all pertinent levels, despite the identification of environmental factors as behavioral determinants, because of time constraints.
- The lack of a dedicated educational program for parents and teachers
- Not having female students in the sample

Declarations

Ethical Considerations

The research project was approved by the ethics committee of Shiraz University of Medical Sciences with the code of ethics of IR.SUMS.REC.1400.135. Participation in the study was voluntary and the subjects were entered into the study following receiving informed consent from them. In addition, they were ensured of the confidentiality terms regarding their personal information, meaning that the collected data was presented anonymously.

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Competing interests

The authors declare that they have no competing interests

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author upon reasonable request.

Authors' contributions

M I: Research methodology, Collecting data, Statistical analysis, Interpretation of results, References. M H K: Research concept, Research methodology, Collecting material, Statistical analysis, Interpretation of results, References. M K: Research methodology, Interpretation of results. All authors read and approved the final manuscript.

Ethical approval and consent to participate

All the participants received verbal explanation about the study objectives and procedures and then signed written informed consents for taking part in the study. The participants were also reassured about the anonymity and confidentiality of their information. Also, ethics committee of Shiraz University of Medical Sciences has approved the research with ethical N0: IR.SUMS.REC.1400.135. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments including informed consent and confidentiality of all personal information.

Consent for publication

Applicable.

Clinical trial number

Not applicable

References

1. Hui DS, Zumla A. Severe Acute Respiratory Syndrome: Historical, Epidemiologic, and Clinical Features. Infectious Disease Clinics. 2019;33(4):869-89.
2. Zhong B-L, Luo W, Li H-M, Zhang Q-Q, Liu X-G, Li W-T, et al. Knowledge, attitudes, and practices towards COVID-19 among Chinese residents during the rapid rise period of the COVID-19 outbreak: a quick online cross-sectional survey. International journal of biological sciences. 2020;16(10):1745.

3. Sobkow A, Zaleskiewicz T, Petrova D, Garcia-Retamero R, Traczyk J. Worry, risk perception, and controllability predict intentions toward COVID-19 preventive behaviors. Frontiers in psychology. 2020;11.
4. Green LW, Poland BD, Rootman I. The settings approach to health promotion. Settings for health promotion: Linking theory and practice. 2000:1-43.
5. Deschesnes M, Martin C, Hill AJ. Comprehensive approaches to school health promotion: how to achieve broader implementation? Health promotion international. 2003;18(4):387-96.
6. McIsaac J-LD, Read K, Veugelers PJ, Kirk SF. Culture matters: a case of school health promotion in Canada. Health promotion international. 2017;32(2):207-17.
7. Barari S, Caria S, Davola A, Falco P, Fetzer T, Fiorin S, et al. Evaluating COVID-19 public health messaging in Italy: Self-reported compliance and growing mental health concerns. MedRxiv. 2020.
8. Grossmann R, Scala K. Health promotion and organizational development: developing settings for health: IFF Health and Organizational Development; 1993.
9. Charoghchian Khorasani E, Peyman N, Yaghobi F. Health promoting schools in Iran: Features and challenges. J Educ Community Health. 2019;6(3):127-9.
10. Eaton DK, Kann L, Kinchen S, Ross J, Hawkins J, Harris WA, et al. Youth risk behavior surveillance—United States, 2005. Journal of school health. 2006;76(7):353-72.
11. Simovska V. The changing meanings of participation in school-based health education and health promotion: the participants' voices. Health Education Research. 2007;22(6):864-78.
12. Khani Jeihooni A, Layeghiasl M, Yari A, Rakhshani T. The effect of educational intervention based on the theory of planned behavior on improving physical and nutrition status of obese and overweight women. BMC Women's Health. 2022;22(1):1-9.
13. Kokko S. Health promoting sports club: youth sports clubs' health promotion profiles, guidance, and associated coaching practice, in Finland: Jyväskylän yliopisto; 2010.
14. Karimi M, Kaveh MH, Morowatisharifabad MA. The Viewpoints of Urban High School Male Students, Parents and Teachers About Cigarette Smoking by Adolescents: A Social Marketing-Based Qualitative Study, Shiraz, Iran. Shiraz E-Medical Journal. 2020;21(10).
15. Rastgarimehr B, Afkari ME, Solhi M, Taghdisi MH, Mansourian M, Shafieyan Z, et al. Relationship Between the educational stage of PRECEDE MODEL and quality of life improvement in the elderly affiliated with Tehran Culture House for the aged. Iranian Journal of Diabetes and Metabolism. 2014;13(6):469-78.
16. Mohammadi F, Hossei M. The effect of educational inter components of PRECEDE mod patients. 2018.
17. Cherrington A, Martin MY, Hayes M, Halanych JH, Andreae SJ, Safford M, et al. Intervention mapping as a guide for the development of a diabetes peer support intervention in rural Alabama. Preventing chronic disease. 2012;9.

18. Brug J, Oenema A, Ferreira I. Theory, evidence and Intervention Mapping to improve behavior nutrition and physical activity interventions. International Journal of Behavioral Nutrition and Physical Activity. 2005;2(1):2.
19. Verbestel V, De Henauw S, Maes L, Haerens L, Mårild S, Eiben G, et al. Using the intervention mapping protocol to develop a community-based intervention for the prevention of childhood obesity in a multi-centre European project: the IDEFICS intervention. International Journal of Behavioral Nutrition and Physical Activity. 2011;8(1):82.
20. Kok G, Schaalma H, Ruiter RA, Van Empelen P, Brug J. Intervention mapping: protocol for applying health psychology theory to prevention programmes. Journal of health psychology. 2004;9(1):85-98.
21. Mkumbo K, Schaalma H, Kaaya S, Leerlooijer J, Mbwambo J, Kilonzo G. The application of Intervention Mapping in developing and implementing school-based sexuality and HIV/AIDS education in a developing country context: The case of Tanzania. Scandinavian journal of public health. 2009;37(2_suppl):28-36.
22. van Empelen P, Kok G, Schaalma HP, Bartholomew LK. An AIDS risk reduction program for Dutch drug users: an intervention mapping approach to planning. Health promotion practice. 2003;4(4):402-12.
23. McEachan RR, Lawton RJ, Jackson C, Conner M, Lunt J. Evidence, theory and context: using intervention mapping to develop a worksite physical activity intervention. BMC public health. 2008;8(1):326.
24. Lytle LA, Perry CL. Applying research and theory in program planning: An example from a nutrition education intervention. Health Promotion Practice. 2001;2(1):68-80.
25. Scarinci IC, Bandura L, Hidalgo B, Cherrington A. Development of a theory-based (PEN-3 and health belief model), culturally relevant intervention on cervical cancer prevention among Latina immigrants using intervention mapping. Health promotion practice. 2012;13(1):29-40.
26. Eldredge LKB, Markham CM, Kok G, Ruiter RA, Parcel GS. Planning health promotion programs: an intervention mapping approach: John Wiley & Sons; 2016.
27. Layeghiasl M, Kaveh MH, Karimi M, Mirahmadizadeh A. Components Affecting the Promotion of COVID-19 Disease Prevention Behaviors among Iranian Students: A Qualitative Study by Using the PRECEDE Model. BioMed Research International. 2022;2022.
28. Hajizadeh E. Statistical analysis with regard to research in life sciences and health. Jahad daneshgahi Publication. 2012.
29. Waltz CF, Strickland OL, Lenz ER. Measurement in nursing and health research: Springer publishing company; 2010.
30. Verbestel V, Henauw SD, Maes L, Haerens L, Mårild S, Eiben G, et al. Using the intervention mapping protocol to develop a community-based intervention for the prevention of childhood obesity in a multi-centre European project: the IDEFICS intervention. International Journal of Behavioral Nutrition and Physical Activity. 2011;8(1):1-15.

31. Peskin MF, Markham CM, Gabay EK, Shegog R, Cuccaro PM, Temple JR, et al. Using Intervention Mapping to Develop “Me & You: Building Healthy Relationships,” A Healthy Relationship Intervention for Early Middle School Students. Adolescent Dating Violence: Elsevier; 2019. p. 467-501.
32. Wiysonge CS, Ndwandwe D, Ryan J, Jaca A, Batouré O, Anya B-PM, et al. Vaccine hesitancy in the era of COVID-19: could lessons from the past help in divining the future? Human vaccines & immunotherapeutics. 2022;18(1):1-3.
33. Mahindarathne PP. Assessing COVID-19 preventive behaviours using the health belief model: A Sri Lankan study. Journal of Taibah University Medical Sciences. 2021;16(6):914-9.
34. Du M, Tao L, Liu J. The association between risk perception and COVID-19 vaccine hesitancy for children among reproductive women in China: an online survey. Frontiers in medicine. 2021:1494.
35. Shabu S, Amen KM, Mahmood KI, Shabila NP. Risk perception and behavioral response to COVID-19 in Iraqi Kurdistan Region. 2020.
36. Bish A, Michie S. Demographic and attitudinal determinants of protective behaviours during a pandemic: A review. British journal of health psychology. 2010;15(4):797-824.
37. Wang C, Horby PW, Hayden FG, Gao GF. A novel coronavirus outbreak of global health concern. The lancet. 2020;395(10223):470-3.
38. Shahnazi H, Ahmadi-Livani M, Pahlavanzadeh B, Rajabi A, Hamrah MS, Charkazi A. Assessing preventive health behaviors from COVID-19: a cross sectional study with health belief model in Golestan Province, Northern of Iran. Infectious diseases of poverty. 2020;9(1):1-9.
39. Dryhurst S, Schneider CR, Kerr J, Freeman AL, Recchia G, Van Der Bles AM, et al. Risk perceptions of COVID-19 around the world. Journal of Risk Research. 2020;23(7-8):994-1006.
40. Badr H, Zhang X, Oluyomi A, Woodard LD, Adepoju OE, Raza SA, et al. Overcoming COVID-19 vaccine hesitancy: insights from an online population-based survey in the United States. Vaccines. 2021;9(10):1100.
41. Hossain MB, Alam M, Islam M, Sultan S, Faysal M, Rima S, et al. Health belief model, theory of planned behavior, or psychological antecedents: What predicts COVID-19 vaccine hesitancy better among the Bangladeshi adults? Frontiers in Public Health. 2021:1172.
42. Lee M, You M. Direct and Indirect Associations of Media Use With COVID-19 Vaccine Hesitancy in South Korea: Cross-sectional Web-Based Survey. Journal of Medical Internet Research. 2022;24(1):e32329.
43. Webster RK, Brooks SK, Smith LE, Woodland L, Wessely S, Rubin GJ. How to improve adherence with quarantine: rapid review of the evidence. Public Health. 2020;182:163-9.
44. Khani Jeihooni A, Rakhshani T, Harsini PA, Layeghiasl M. Effect of educational program based on theory of planned behavior on promoting nutritional behaviors preventing Anemia in a sample of Iranian pregnant women. BMC public health. 2021;21(1):1-9.
45. Park S, Oh S. Factors associated with preventive behaviors for COVID-19 among adolescents in South Korea. Journal of pediatric nursing. 2021.

46. Yang Z, Li X, Garg H, Qi M. Decision support algorithm for selecting an antivirus mask over COVID-19 pandemic under spherical normal fuzzy environment. International Journal of Environmental Research and Public Health. 2020;17(10):3407.
47. Hirai M, Graham JP, Mattson KD, Kelsey A, Mukherji S, Cronin AA. Exploring determinants of handwashing with soap in Indonesia: a quantitative analysis. International journal of environmental research and public health. 2016;13(9):868.
48. Jenner EA, Watson P, Miller L, Jones F, Scott G. Explaining hand hygiene practice: an extended application of the Theory of Planned Behaviour. Psychology, Health & Medicine. 2002;7(3):311-26.
49. Jeong SY, Kim KM. Influencing factors on hand hygiene behavior of nursing students based on theory of planned behavior: A descriptive survey study. Nurse education today. 2016;36:159-64.

Footnotes

1. In Iran, schools are segregated by gender.