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Effects of Gain- and Loss-Framed Messages on Preventive Nutrition Behaviors of Osteoporosis in Iranian Female Students: A Text Messaging Intervention

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Abstract

Background: Adopting a healthy life style in children may protect them against osteoporosis in later life. This study was done to determine the effectiveness of gain-framed versus loss-framed using mobile phones short-messages service (SMS) intervention in promoting knowledge, attitude and preventive nutrition behaviors of osteoporosis among a sample of Iranian female students.

Materials and Methods: In this quasi-experimental study, 345 female students in Semnan, Iran were randomly selected and assigned to either intervention group 1 (receiving gain-framed text messages, n=115), intervention group 2 (receiving loss-framed text messages, n=115), and control group (no receiving text messages, n=115). Knowledge, attitude and dietary behaviors related to osteoporosis prevention were collected by a researcher-made questionnaire before and one month after the delivery of the framed information via SMS. Seventy two short messages that emphasized the benefits of adopting the behavior (n=35), and the costs of non adopting it (n=35) have been sent to the participants' phones in intervention group 1 and 2, respectively during the 35-day intervention period.

Results: The age of participants in the three groups was 12 years. They were studying in the seventh grade. After the intervention, the mean scores of knowledge (2.32±0.60, $p<0.001$), attitude (1.52±0.60, $p=0.03$), and adopting the preventive nutrition behaviors of osteoporosis (1.30±0.58, $p=0.05$) variables in the intervention group 1 had a significant increase compared to the intervention group 2.

Conclusion: The results of the study showed that gain-framed text messages significantly improved adopting osteoporosis preventive nutrition behaviors than loss framed text messages.

Key Words: Gain- and loss-framed messages, Nutrition, Preventive, Osteoporosis, Students.

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1- INTRODUCTION

Osteoporosis, as a metabolic bone disease, is a serious health problem among Iranian population older than 30 years, especially in women (1, 2). The prevalence of osteoporosis in Iranian population aged 50 years and older was reported 36.1% in women, and 24.5% in men (3). Bone mass depends on the peak bone mass achieved during growth and the rate of subsequent age-related bone loss (4). About 90% of total adult bone mass is accrued by age 20, and a significant proportion of this is achieved during puberty alone (5). Literature has shown that a wide variety of nutrients and diet components influence bone health (6, 7). To maximize the accretion of bone during growth, adopting a healthy diet at earlier ages is recommended (6). Unfortunately, many children and teenagers do not have enough knowledge regarding the prevention of osteoporosis (8). Design of further nutrition education efforts through various channels and media can increase individuals' behaviors in terms of osteoporosis. Mobile Short-Message Service (SMS) -based interventions have been acknowledged as an effective method in the field of behavior change (10, 11).

This interesting and modern technology can create appropriate opportunities to health providers for developing efforts in health behavior change, disease management, disease prevention, surveillance, self-management and adherence (12-14). Subsequently, messages can either stress the benefits of taking a healthy behavior (gain-frame) or the costs of failing to take a healthy behavior (loss-frame). These two frames have different persuasive effects (15). Literature showed that gain-framed appeals were more persuasive than loss-framed appeals in the field of disease preventive behaviors; whereas loss-framed appeals were more effective once behaviors that sight the presence of a disease are targeted (16). In order to gain a full understanding of the influence of gain-framed appeals, researchers and practitioners must aim to deliver and evaluate individually appropriate framed messages (17). Although osteoporosis is a worldwide health concern (18), and developing education efforts for prevention of osteoporosis at earlier ages (6,19) through interesting and favored communication technologies of children and adolescents (such as mobile phone), (20) is essential, it seems that few attempts have been made to investigate the effects of various educational strategies in terms of prevention of osteoporosis. Therefore, the study examined the effects of message framing in the context of a SMS-based intervention on knowledge, attitude and preventive nutrition behaviors of osteoporosis among a sample of Iranian female students.

2- MATERIALS AND METHODS

2-1. Study participants and setting

The presented study was conducted in Semnan, Iran during the period October 2017 to May 2018. In order to increase the intervention fidelity and reduce the contamination between intervention and control groups, two female middle schools were selected randomly. Students in 7th grade of one of the schools were considered the control group and students of the other school were considered the intervention group. Then, according to the estimated sample size, 115 students of the first school were randomly selected as control group (n=115). Two hundred thirty students of the second school were randomly selected as intervention group and assigned to either the intervention group 1 (receiving gain-framed text messages, n=115), or intervention group 2 (receiving loss-framed text messages, n=115). Inclusion criteria in this study were satisfaction to participate in the study, having a personal mobile phone for

receiving SMSs and no history of illnesses (e.g. Cushing's syndrome) or consumption (e.g. Thyroxin) of medications which limit calcium absorbtion. The study protocol was approved by the Ethics Committee of the Iran University of Medical Sciences (ID-code: 1396.9511107006). The necessary explanations were presented to the students in terms of the objectives, methodology, the consent process, and the maintenance of confidentiality at all steps of the present study.

2-2. Study instruments and measures

An instrument was designed and validated to assess the knowledge, attitudes and nutritional behaviors in terms of prevention of osteoporosis. The initial items of the instrument were designed according to the literature review and interviews with 20 female students and 5 experts in health education and nutrition. At this stage, a 76-item instrument with 3 sub-scales including knowledge (42 items), attitude (16 items), and behavior (18 items) was developed. Then, a panel of 12 health education and nutrition experts assessed the relevance or representativeness of the scale items. According to their suggestions, the Content Validity Index (CVI), and Content Validity Ratio (CVR) of the items were measured. Items having CVR< 0.56 and CVI < 0.79 (21, 22) were deleted. At this stage, two items were deleted. According to twenty-five female students' opinions about the clarity, simplicity, and readability of the items, qualitative face validity of the developed instrument items was assessed. In this stage, two items were edited and four items were deleted. In the next stage, to determine the stability of the instrument items, the thirty students measured the test-retest correlation coefficients (with a 2-week interval between the tests). The estimate of test–retest correlation coefficient ≥0.61 was considered satisfactory (23). Internal consistency of attitude and behavior subscales was measured by Cronbach's Alpha. In the present study, Cronbach's Alpha of ≥ 0.70 was considered satisfactory (24). No items were deleted at this stage. The final instrument had 63 items to measure the participants' knowledge (35 items), attitude (15 items), and nutritional behaviors in terms of prevention of osteoporosis (13 items).

2-2-1. Knowledge about osteoporosis and preventive nutritional behaviors

This 35-item scale has 3 parts. In part one, knowledge of the participants regarding the definition of osteoprosis, it complications and age at which bone density reaches the maximum was measured by 7 items. Part 2 contained 15 items about influencing vitamins and minerals in developing osteoprosis and Part 3 contained 13 items about nutritional behaviors which can prevent the development of osteoporosis. The items of these parts were measured on Yes/No/I don't know. The test–retest correlation coefficient for this subscale was 0.91 (p = 0.002).

2-2-2. Attitude towards adopting nutritional behaviors for prevention of osteoporosis

Fifteen items were used to measure this subscale. The items were measured on a Likert scale ranging from one= "completely agree" to five = "completely disagree". The test–retest correlation coefficient and Cronbach's alpha for this sub-scale were 0.72 (p = 0.001), and 0.91, respectively.

2-2-3. Adopting nutritional behaviors in terms of prevention of osteoporosis

Thirteen items were used to measure this subscale. The items were measured on a Likert scale ranging from one= "I do not eat at all" to six = "I'm eating every day". The test–retest correlation coefficient and Cronbach's alpha for this sub-scale were 0.77 (p = 0.001), and 0.91, respectively.

2-3. Developing the SMS-intervention program according to gain- and loss-framed messages

According to the pretest results, 76 initial short messages, 38 of which emphasized on the benefits of adopting the recommended behavior (gains), and 38 emphasized on the costs of not adopting the recommended behavior (losses) were developed. Valid scientific references in the field of nutrition and osteoporosis and message design (25, 26) were used for developing initial messages. In addition, a nutrition expert employed in the research team confirmed the scientific content of developed initial messages. Then, the initial messages were pre-tested by 5 experts in health education and nutrition and 12 female students through face-to-face interviews.

To guide the interviews for testing messages in the various materials that were introduced by the AIDSCAP Behavior Change Communication Unit- some semi-structured questions (e.g. "Are there any words that you do not understand? What are they?") were used for pre-test messages (27). Based on their comments, 6 messages were deleted and 6 were edited. Finally, 35 messages were confirmed in the gain frame (for example, "A person who has no osteoporosis has a good bone density. As a result, with a simple blow, his bones do not easily break"), and 35 messages in the loss frame (for example, "A person with osteoporosis will reduce his bone density. As a result, with a simple blow, his bones may break").

Before the intervention, the phone numbers of the participants in the intervention groups were taken by one of the researchers. The time of sending messages was mutually agreed on by the researcher and the participants (8 PM). After developing gain- and loss-framed messages, one member of the research team respectively sent gain- and loss-framed messages daily to the students' mobile phone in the intervention group 1 and intervention group 2 during the 35-day intervention period. In order to rectify the possible failure of system, delivery reports of the mobile phones were checked by one of the researchers of the study. Students in the control group did not receive any messages. Three groups were followed up one month after the delivery of the framed information via SMS, and they completed the instrument again.

2-4. Statistical analysis

The data were analyzed using SPSS software package (version 21.0, SPSS, Inc., Chicago, IL, USA). Kolmogorov–Smirnov test was used to measure the normality of data. The results showed that knowledge score did not have a normal distribution among the three groups. To analyze the homogeneity of variables of three groups, Kruskal Wallis H and One-Way ANOVA were used. Differences in the total mean scores of knowledge and attitude or behavior among the three groups before and after the intervention were also tested using Kruskal Wallis H and One-Way ANOVA, respectively. Wilcoxon and Paired-samples t-tests respectively were used to assess the differences in the total mean scores of the participants' knowledge and attitude or behavior in each group before and after the intervention. Differences in the total mean scores of knowledge, attitude and behavior between the intervention groups (1 and 2) after the intervention were also tested using Post Hoc. The data were reported as frequency and Mean ± standard deviation (SD). $P<0.05$ was considered as significant in the study.

3- RESULTS

The age of participants in the three groups was 12 years. All of the participants were studying in the seventh grade. Other demographic characteristics of study participants in the three groups were shown in **Table.1**. The results of

Kruskal Wallis H exam showed that there were no significant differences among three groups for father's education level (p=0.32), mother's education level (p=0.25), occupation of mother (p=0.30) and occupation of father (p=0.30) variables before the intervention. As presented in **Table.2**, there were significant differences in the mean scores of knowledge, attitude and adopting the preventive nutrition behaviors of osteoporosis variables in each group after the intervention than before the intervention. In addition, the results showed that after the intervention, the mean scores of knowledge, attitude and adopting the preventive nutrition behaviors of osteoporosis variables in students in the intervention group 1 had a significant increase compared to the intervention group 2 or the control group (**Table.2**).

Table-1: Baseline characteristics of participants in the two intervention groups and the one control group (n=110 in each groups).

Variables	Intervention group 1 Number (%)	Intervention group 2 Number (%)	Control group Number (%)
Father's education level			
≤12th grade	74 (64.3)	83 (72.2)	70 (65.2)
>12th grade	41 (35.7)	32 (27.8)	40 (34.8)
Mother's education level			
≤12th grade	83 (72.2)	78 (67.8)	77 (71.3)
>12th grade	32 (27.8)	37 (32.2)	33 (28.7)
Occupation of mother			
Self-employed	25 (21.8)	33 (28.7)	24 (24.3)
Employed	29 (25.2)	21 (18.3)	23 (20.9)
Household duties	61 (53.0)	61 (53.0)	63 (54.8)
Occupation of father			
Self-employed	29 (25.2)	33 (28.7)	27 (23.5)
Employed	22 (19.1)	21 (18.3)	22 (19.1)
Casual laborer	59 (51.4)	53 (46.0)	46 (44.4)
Retired	5 (4.3)	8 (7.0)	15 (13.0)

Table 2- Comparison of knowledge, attitude and nutrition behaviors in terms of prevention of osteoporosis before and after two interventions delivered via gain- and loss-framed short messages according to study intervention groups and control group.

Variables	Intervention group 2 (receiving gain-framed messages)				P-value (1)	Intervention group 2 (receiving loss-framed messages)				P-value (2)	Control group				P-value (3)	P-value (4)	P-value (5)
	Pre-intervention		One-month after intervention			Pre-intervention		One-month after intervention			Pre-intervention		One-month after intervention				
	Mean	SD	Mean	SD		Mean	SD	Mean	SD		Mean	SD	Mean	SD			
Knowledge	10.67	5.64	25.47	2.98	<0.0001*	11.22	5.23	23.69	3.17	<0.0001*	11.69	5.33	14.67	6.10	<0.0001*	<0.0001$^{\beta}$	<0.001 $^{\varphi}$
Attitude	38.53	6.82	48.86	4.45	<0.0001 $^{\alpha}$	38.81	7.61	47.62	4.34	<0.0001 $^{\alpha}$	38.31	7.37	40.05	7.41	<0.0001 $^{\alpha}$	0.01^{T}	0.03 $^{\varphi}$
Adopting nutrition behaviors	38.39	6.58	47.05	4.74	<0.0001 $^{\alpha}$	38.05	7.90	45.40	5.11	<0.0001 $^{\alpha}$	36.61	7.54	38.47	7.63	<0.0001 $^{\alpha}$	0.02 ^{T}	0.05 $^{\varphi}$

P-value (1) = Significant differences between the mean score of variables in the intervention group 1 before and after the intervention.
P-value (2) =Significant differences between the mean score of variables in the intervention group 2 before and after the intervention.
P-value (3) =Significant differences between the mean score of variables in the control group before and after the intervention.
P-value (4) =Significant differences between the mean score of variables in the three groups after the intervention.
P-value (5) =Significant differences between the mean score of variables in the two intervention groups after the intervention.
Mean values were significantly different from those before the intervention (Wilcoxon): *P<0.05.
Mean values were significantly different from those before the intervention (Paired-samples t-tests): $^{\alpha}$ P<0.05.
Mean values were significantly different from those of the intervention groups and the control group (Kruskal Wallis H): $^{\beta}$ P<0.05.
Mean values were significantly different from those of the intervention groups and the control group (One-Way ANOVA): ^{T}P<0.05.
Mean values of the intervention group 1 were significantly different from those of the intervention group 2 (Post Hoc): $^{\varphi}$ P<0.05.

4- DISCUSSION

This study aimed to determine the effectiveness of gain- framed versus loss-framed using mobile phones short-messages service intervention in promoting knowledge, attitude and preventive nutrition behaviors of osteoporosis among a sample of Iranian female students. The results of the presented study revealed that gain-framed messages (which emphasize the benefits of performing a behavior) resulted in more knowledge in terms of osteoporosis and also a more positive attitude about the role of nutrition behaviors in prevention of it than loss-framed messages (which emphasize the costs of failing a behavior). To the best our knowledge, this is the first study to examine the effects of framed messages in the context of a SMS tailored intervention to promote nutrition behaviors regarding prevention of osteoporosis. However, our findings are consistent with those of Detweiler et al.; they showed that participants who read gain-framed brochures, compared with those who read loss-framed brochures, had more attitude and intention to use sunscreen (28).

In a study, Warner et al. found that gain-framed message significantly increased Florida residents' attitude to conserving water (29). Given these findings, it was concluded to increase female students' knowledge and improve their positive attitudes toward prevention of osteoporosis; gain-framed text messages would be significantly more persuasive than loss-framed messages. Given the importance of the theories in developing theory-based efforts in the field of behavior change (30), to develop effective SMS-based education interventions in terms of prevention of osteoporosis using theoretical frameworks (such as health belief model) could be suggested. In addition, adding osteoporosis education through teens' favored media and communication channels in school curriculums is suggested. In the current study, gain-framed messages were more persuasive in adopting nutrition behaviors for prevention of osteoporosis than loss-framed messages. On the one hand, this finding is consistent with published research on message framing that suggests the use of gain-framed messages when targeting behaviors that prevent the onset of disease (28, 16). On the other hand, it is different from studies such as Van't Riet et al. They reported that there were no significant differences between the effects of gain- and loss-framed messages in promoting physical activity behavior (31). Rafieyan-Kopaei et al. also showed that there was no significant difference in behavior of mothers concerning the appropriate onset of complementary feeding between two groups receiving gain-and loss-framed education intervention (32). The reason of the contradiction in the results of framing studies may be explained due to the role of delivery of the text messages in increasing knowledge and recognition of the participants. Individuals with higher levels of knowledge were less susceptible to the framing effect (33).

Such studies demonstrated that the effectiveness of framed messages was moderated by several factors such as characteristics of the recipient's characteristics and the features of the recommended behavior (16, 34). For example, Godinho et al. also suggested that the success of framed messages for fruit and vegetable consumption depends upon the characteristics of participants such as their motivational orientation, baseline intentions, and cultural background. They claimed that loss-frame messages could promote fruit and vegetable intake among college students who were prevention-oriented and had higher baseline intentions to perform behavior (34). In a study, De Graaf et al. showed that a gain frame message led to

more positive attitude and intention toward responsible alcohol use among participants having low issue-involvement, whereas a loss frame message did not have any effects on them (35). Stewart et al. showed that smokers having high need for cognition had more intention of smoking cessation after reading a gain-framed message than after reading a loss-framed message (36). Hwang et al. reported that perceived susceptibility to skin cancer moderated framing effects on the intention of sunscreen use in high school students (37). Given that the choice of a suitable frame in developing interventions, rather than aspects of the health behavior, is under the influence of multiple personal characteristics, we suggest that messages can be framed to match with recipients' characteristics.

In conclusion, in accordance with the suggestion provided by Van't Riet et al. (31), the present study suggests that health care providers who aim to promote nutrition behaviors in terms of osteoporosis prevention may emphasize on gain-framed messages, instead of loss-framed. Although the present study is the first study regarding the effectiveness of gain-versus loss-framed short messages in promoting preventive nutrition behaviors of osteoporosis among a sample of Iranian female students, it had some limitations. The limitations were small sample size; use of a sample of female students in 7th grade in Semnan, Iran; use of self-report forms for measuring the frequency of nutrition behavior; and short duration of follow- up.

5- CONCLUSION

Based on the results, gain-framed text messages were significantly more effective than loss-framed text massages to promote participants' knowledge, attitude and adopt preventive nutrition behaviors of osteoporosis among Iranian female students. Further research studies are needed to define the role of message framing to improve preventive nutrition behaviors of osteoporosis among specific subgroups of students such as students having high issue-involvement, need for cognition and risk perception in this issue.

6- CONFLICT OF INTEREST: None.

7- ACKNOWLEDGMENTS

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