



Effect of Mobile Health Intervention on Health-related Quality of life among Cardiac Syndrome X Patients

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Abstract

Background: Cardiac syndrome X (CSX) is a heart condition associated with Microvessel dysfunction, causing angina with severe chest pain. The CSX often severely impairs the quality of life and imposes a considerable additional cost burden on the health care system.

Objectives: The present study aimed to assess the effectiveness of mobile health (mHealth) intervention on health-related quality of life (HRQoL) among CSX patients.

Methods: This randomized control trial (RCT) study was conducted at the Clinic of Tehran Heart Centre from March to August 2019. A total of 100 CSX outpatients were selected by randomized sampling and assigned to the intervention (n=50) and control groups (n=50). This study was focused on the effectiveness of the mHealth intervention in HRQoL. The pre-test and post-test were conducted via questionnaires.

Results: Repeated measure MANOVA test for both groups across time pointed to a significant difference between the two groups in HRLQoL subscales at a 0.05 level of significance ($F(3,95) = 7.358; P < 0.001$; Wilk's $\Lambda = 0.811, \eta^2 = 0.189$). The result indicated the positive effect of the intervention on HRQoL for CSX patients. Bonferroni test also revealed that the experimental and control groups did not differ significantly in three subscales of the questionnaire in the pre-test ($P > 0.05$); nonetheless, they were significantly different in the post-test ($P < 0.05$).

Conclusion: The HRQoL is considered an essential outcome measure in cardiac diseases, especially CSX, which is associated with impaired HRQoL. As evidenced by the results of the current study, the mHealth program, as a low-cost intervention, can promote the HRQoL among these patients.

Keywords: Cardiac syndrome x, Educational intervention, Health-related quality of life, mHealth

1. Background

Cardiovascular diseases (CVDs) are the leading cause of morbidity and mortality across the globe. According to the World Health Organization, 17.9 million (31%) of the world's total annual deaths are due to CVDs (1), which are currently one of the three leading causes of death and disability in the world (1, 2). In addition, Cardiac syndrome X (CSX) is considered a form of cardiac heart disease with functional coronary microvascular abnormalities (2). This irregularity function, often associated with endothelial dysfunction, reduces coronary blood flow reserve (3, 4). The CSX symptoms are often debilitating, severely impair the quality of life, and impose a considerable additional cost burden on the health care system incurred by repeated hospitalization (4, 5).

According to the result of a study in the USA, 2 and 1.7 million patients undergo coronary angiographic procedures in Europe and the USA, respectively. Out of this population, 20%-30% of cases have CSX (2, 4). There is no clear evidence of CSX prevalence in Iran; nonetheless, Saadat conducted a study in the heart center hospital and demonstrated that from 559 females with typical

angina and a positive exercise tolerance test (ETT) who underwent coronary angiography in this center, 288 (51.5%) patients were found to have obstructive CAD, and 271 (48.5%) cases had CSX (5).

Meanwhile, Masoudkabar performed a study in the heart center hospital and demonstrated that out of 809 women with typical angina and a positive ETT who underwent coronary angiography in this center, more than 40% of cases had CSX (2, 3, 5). In the same vein, some researchers reported that approximately 60%-70% of CSX patients were women aged 45-55 years, particularly pre- and postmenopausal, due to estrogen deficiency (3, 5, 6). Moreover, Najafipour indicated that most combined risk factors of CAD in Iran were dyslipidemia plus low physical activity (37.9%), as well as metabolic syndrome (27.7%) (6). In addition, CSX patients have high morbidity and re-hospitalization rate, as well as health care expenditure comparable to patients with obstructive coronary artery disease (CAD) (7, 8).

Some researchers are of the belief that CSX is a major diagnostic and therapeutic challenge presented to patients' quality of life (QoL) and functioning (8, 9). In addition, the previous studies revealed that the same risk factors (including high cholesterol levels, high blood pressure, women during or after

menopause, and having mild arthritis) which cause atherosclerosis could lead to CSX disease (9-13). Therefore, health promotion could improve microcirculation and the quality of life by modifying behavioral approaches and educational intervention (11, 13). Furthermore, many researchers revealed that following recommendations about lifestyle and some unhealthy habits could help in alleviating the symptoms of cardiac diseases and, consequently, promote their health-related quality of life (14, 15).

In addition, some studies have demonstrated that educational programs and lifestyle modifications represent a highly effective and low-cost intervention that could reduce the incidence, progression, and morbidity associated with CSX (16, 17). Furthermore, the pursuit of lifestyle changes using health education strategies is a necessary step in the reduction of cardiac events. One of the most effective strategies is to emphasize the improvement of knowledge and attitude towards CSX risk factors (17-19). Moreover, there is developing evidence that mobile health (mHealth) interventions can effectively enhance health-related quality of life (HRQoL) (20-23). Meanwhile, mobile phones can deliver health interventions via short messaging service (SMS), smartphone applications, or video messaging (24, 25).

The previous studies pointed out that mHealth interventions and health information are considered suitable for the study setting. They have suggested that mHealth can be a good tool for health educational interventions (25, 26). In this regard, Bandura noted that "knowledge of health risks and benefits creates the precondition for change" (p.144). He has demonstrated that educational interventions are a pivotal construct and directly affect behavior change (26, 27). Due to its low cost and broad approach, mobile health is one of the alternative approaches that could promote health care for patients, health providers, and policymakers (28, 29). Likewise, mobility, instantaneous access, and direct communication of mobile technology allow for faster transfer of health information, which in turn supports medical and public health practices. It is commonly stated that mHealth effectively improves the HRQoL via the enhancement of knowledge; moreover, it can be quickly adapted on a large scale at a low cost (30, 31).

Among the mobile technologies available, mobile messaging apps are of great help in distributing medical information in the future. Mobile Health intervention can interact with people and efficiently provide information due to its compact size.

2. Objectives

This experimental study aimed to evaluate the effectiveness of using WhatsApp as a health intervention method in a healthy lifestyle program in order to promote health-related quality of Life in CSX patients.

3. Methods

3.1. Study Design

This experimental research was focused on the effectiveness of mHealth-delivered education interventions on knowledge, Adherence to a healthy lifestyle, and HRQoL among patients with Cardiac Syndrome X. In the previous article, we reported the effectiveness of educational interventions on knowledge and Adherence to a healthy lifestyle among CSX Patients (32). In this study, we evaluated the effect of an educational program via mobile health app on HRQoL among CSX Patients. The referred two-arm parallel randomized controlled trial was conducted in the Clinic of Heart Centre, University of Tehran, 222 from March to Aug 2019. In this study, 100 CSX outpatients were selected by randomized sampling and assigned to the intervention (n=50) and control groups (n=50). We assessed the effectiveness of an educational program via mobile health app on HRQoL with a pre-test at the beginning of the study and a post-test after the educational intervention among CSX patients.

3.2. Research Instruments

The MacNew Heart Disease HRQL questionnaire: This 27-item scale consists of three domains (physical, emotional, and social). The Persian version of this questionnaire was validated and used by Abasi et al. It is a self-report instrument that assesses the HRQoL (33). The questionnaire is proven reliable with the alpha coefficient. The Cronbach alpha coefficient in their study was 0.73. The discriminant validity of HRQoL was assessed by the known-groups approach. All analyses were performed in SPSS software (version 23) and the level of significance was set at $P < 0.05$. According to the results, the mean HRQoL Global score was 3.6 ± 0.82 . Our results demonstrated that internal consistency ($\alpha=0.94$) and reproducibility ($ICC=0.84$) of the Persian version of the HRQoL were confirmed and all items in the questionnaire were reliable. The research instruments for this study were validated based on experts' evaluation and a statistical method. Therefore, after the permission from the original writers and Dr. Abasi, we used it in this study.

3.3. Participants and Recruitment

As mentioned in the previous article (32), the target population of the study were 100 CSX outpatients referring to the Clinic of Tehran Heart Centre Hospital (IRAN) for visit and treatment. They were selected by randomized sampling according to the inclusion criteria of this study. Simple random sampling was used based on the computer-generated list and blinded. The sampling size determinant was based on the level of significance ($\alpha=0.05$) with a two-sided type of test and the power of 80% set in this study. Moreover, an additional 10% of the

sample was added, considering the possibility of attrition. A total of 100 participants were recruited and randomly assigned to experimental (n=50) and control groups (n=50). The data collection process of this study was conducted for the pre-and post-test among the intervention and control groups.

3.4. Study Intervention

The intervention group received the educational program according to the earlier article. At the baseline, the educational material was designed in order to attain the goals of this study for increasing CSX patients' knowledge of cardiac risk factors and a healthy lifestyle. The educational program was produced based on the American College of Cardiology/ American Heart Association (1, 34) guidelines and European guidelines. The educational contents were developed through the literature review panel, and its content validity was confirmed by experts as a guideline. The educational program consisted of information about the anatomy and physiology of the heart, CSX risk factors, symptoms and diagnosis of CSX disease, a healthy diet (fruit, vegetables, oils, foods) and regular exercise, the advantages of self-care through the management of a healthy lifestyle, blood pressure, blood sugar, and cholesterol monitoring, as well as control of weight (BMI) and stress.

At the baseline, mobile health intervention was introduced to the intervention group. The function of WhatsApp as an information-sharing tool was explained. They were informed not to share personal information with the group to avoid privacy issues. The educational program was provided to the experimental group. The duration of follow-up was 14 weeks. Technology was used to facilitate learning and reinforce the teaching administered during the face-to-face workshop conducted by the researcher. Throughout the study, the information was shared with the group on a daily basis. The participants were encouraged to actively engage in the discussion. For the whole duration, the researcher uploaded the information prepared for an educational program, while the control group only received the standard of care delivered by the clinical nurses and health providers. The outcome was evaluated after the education programs for post-test. Blinding was performed to limit the contamination. After the post-test of data collection, the educational program also was provided to the control group via a day workshop and booklet.

3.5. Statistical Analysis

In this study, the collected data were analyzed in SPSS software (version). All demographic variables were studied using descriptive statistics separately in each group (control and intervention) and compared between control and intervention groups using an independent t-test for continuous variables and a chi-square test for categorical variables. To assess the

homogeneity of the research variables for both intervention and control groups, an independent sample t-test was used separately for awareness of CSX risk factors and HRQoL. Testing the normality of the research data is a prerequisite for parametric inferential statistics. Therefore, a normality test was conducted to establish the normality of the data. Two-way repeated-measures (RM)-MANCOVA and RM-ANCOVA, followed by the Bonferroni post hoc test, were used in order to test research hypotheses between the two groups pre- and post-intervention. Meanwhile, in order to determine the association between patients' demographic characteristics and HRQoL, the independent t-test was applied. Descriptive statistics (mean and standard deviation), two-way RM-MANCOVA, and Bonferroni Post Hoc test were utilized to assess the difference in the quality of life between intervention and control groups pre and post-intervention.

4. Results

4.1. Sample Characteristics

The participants' demographic data, as reported by Malekzadeh et al. (2022), including age, gender, educational level, marital status, and employment status, were collected and grouped. The majority of participants (58%) were female and widow (86%), and their mean age was 55.79 ± 12.54 years. In terms of education level, most participants (43%) hold a diploma, 34% had an academic education, and 22 had primary education. The majority of participants (49%) had low incomes. The demographic distribution of the participants is demonstrated and no significant differences were found between the experimental and control groups in different categories of demographic variables ($P > 0.05$). The current study revealed that participants were homogenous in their demographic data, and no significant difference was identified in their demographic characteristics.

4.2. Effectiveness of mHealth Intervention in health-related quality of life among CSX Patients

Repeated measure MANOVA test for both groups across the time illustrated that there were significant differences between the two groups (control and intervention) in HRQoL subscales at a 0.05 level of significance ($F(3,95) = 7.358$; $P < 0.001$; Wilk's $\Lambda = 0.811$, $\eta^2 = 0.189$). According to these results, the overall effect of time was also significant on all dependent variables ($F(3,95) = 27.487$; $P < 0.001$; Wilk's $\Lambda = 0.535$, $\eta^2 = 0.465$). This result also revealed that the interaction between group and time was statistically significant ($F(3,95) = 16.817$, $P < 0.001$, Wilk's $\Lambda = 0.653$, $\eta^2 = 0.347$), suggesting that the groups had significantly different patterns overtime for all dependent variables (Table 1).

Moreover, based on the results, it was found that

Table 1. Descriptive statistics of quality of life in both groups

Variable	Group	Pre-test		Post-test	
		Mean	SD	Mean	SD
EMO	Control	5.15	1.15	5.4	0.64
	Intervention	4.98	1.03	6.09	0.63
PHYS	Control	5.35	1	5.59	0.59
	Intervention	5.41	0.92	6.26	0.51
SOC	Control	5.4	0.75	5.59	0.6
	Intervention	5.21	0.82	6.63	0.35

EMO: Emotional, PHYS: Physical, SOC: Social

none of the background variables was significantly correlated with dependent variables. The results also showed that three subscales of HRQoL, including emotional, physical, and social, were correlated; therefore, a two-way repeated measure MANOVA was followed by a two-way repeated measure ANOVA. Bonferroni post hoc test was also applied for pairwise comparisons among tests and groups for the three

subscales of HRQoL, including emotional, physical, and social, across time (Table 2). According to the result of the Bonferroni test, the difference in three subscales between the pre-test and post-test in intervention groups were statistically different ($P < 0.01$), while in the control group, the changes in score of HRQoL subscales were not statistically significant between the pre-test and post-test (Table 3).

Table 2. Summary of RM-MANOVA results for comparing the groups across the time

Effect	Wilks' Lambda	F	Hypothesis df	Error df	P-value	η^2p
Group	0.811	7.358	3	95	<0.001	0.189
Time	0.535	27.487	3	95	<0.001	0.465
Time* group	0.653	16.817	3	95	<0.001	0.347

Since multivariate significance was observed, we could look through the univariate results

Table 3. Pairwise comparison between pre and post-test for both control and intervention

Variable	Group	(I) group	(J) group	Mean Difference (I-J)	SE	P-value	95% CI for Difference	
							LB	UB
EMO	Control	Pre-test	Post-test	-0.248	0.18	0.17	-0.605	0.108
	Intervention	Pre-test	Post-test	-1.113*	0.178	<0.001	-1.466	-0.76
PSY	Control	Pre-test	Post-test	-0.236	0.16	0.144	-0.554	0.082
	Intervention	Pre-test	Post-test	-0.851*	0.159	<0.001	-1.166	-0.537
SOC	Control	Pre-test	Post-test	-0.191	0.126	0.134	-0.442	0.06
	Intervention	Pre-test	Post-test	-1.420*	0.125	<0.001	-1.669	-1.171

The mean difference is significant at the 0.05 level. b Adjustment for multiple comparisons: Bonferroni. EMO: Emotional, PHYS: Physical, SOC: Social

5. Discussion

The current study was conducted to assess the effect of mHealth intervention on HRQoL among CSX Patients. The results demonstrated that three subscales of the HRQoL questionnaire, including emotional, physical, and social, were correlated. In this regard, the results revealed that educational intervention could improve HRQoL in the experimental group compared to the control group. In addition, the score of the total HRQoL and its subscales improved in the experimental group after the intervention as compared to the baseline score.

There are a few studies in Iran related to CSX; however, there are differences in their intervention and the studied populations. Mohsenipouya et al. (35) reported that there was a significant relationship between QoL and awareness of a healthy lifestyle among CVD patients. Moreover, evidence from epidemiological and experimental studies has pointed to the beneficial impact of healthy lifestyle behaviors on cardiovascular risk.

Consistent with a study conducted in Malaysia (9), the results of the current research demonstrated that the mHealth-delivered education interventions can develop people's abilities and encourage them to follow a healthy lifestyle program. In comparison with the present research, a study by Abbasi et al. evaluated the effect of a walking program at home on the quality of life and functional ability in patients with heart failure using a Minnesota questionnaire.

Moreover, Anchah in Malaysia used the Short Form 36 Health Survey Questionnaire (SF-36) to evaluate the HRQoL in acute coronary syndrome patients via Cardiac Rehabilitation Programme. The results showed that pharmaceutical care intervention significantly improved HRQoL (9). Both studies analogized QoL between case and control groups; nonetheless, the present study compared the HRQoL among CSX patients in the pre and post-test by the MacNew questionnaire (9,36). The rate obtained in the present study was in accordance with the finding of different studies, as reported in the literature.

According to previous research, heart diseases, especially CSX, are known to be associated with impaired HRQoL (14,20,37).

In line with the current study, Thompson (31) found that educational intervention developed heart symptoms management, self-care, psychological condition, and QOL in the intervention group as compared to the control group. In contrast to the current study, Petek et al. revealed a significant association between knowledge and practice, independent of socio-demographic and personal disease characteristics (12). However, the result of a study by Chaaya in Lebanon indicated that the demographic and socio-economic characteristics of older adults with insufficient income (68% of cases) were associated with CVD risk factors (38). In a similar study, Ammouri et al. in Oman assessed patients' awareness of coronary heart disease risk factors and HRQoL among Omanis adults. The results of the stated study denoted that the health care intervention significantly improved HRQoL (22).

Nowadays, health literacy is an essential issue in health care. According to previously conducted studies, the findings indicated that educational interventions via mHealth could improve patients' awareness and attitude toward acute cardiovascular events (30,35,36). It is similar to the result of the current study regarding the enhancement of quality of life in CSX patients as the result of educational intervention. In addition, in this regard, some studies have pointed to the vital role of mobile technology in the health system. They also reported that mobile health messaging apps (as a mandatory healthcare intervention) are an excellent tool to assist the knowledge transfer between healthcare providers and patients, promoting HRQoL (23,25,26,28). In sum, it can be stated that the foundation for the effects of education enhances the patients' knowledge of CSX risk factors and promotes their HRQoL. Therefore, educational intervention via mHealth messaging is a key element for health awareness to attain an appropriate lifestyle and better QOL.

6. Conclusion

As evidenced by the result of this study, mHealth intervention could bring about a change in patients' behavior and promote their HRQoL. It was also reported that the mHealth application has significant effects on HRQoL and the economy of the health system. Although the treatment of CSX is still a big challenge, the result of this study displays that educational programs via Mobile Health app and lifestyle modification represent a highly effective and low-cost intervention. All things considered, the present study has attained the objectives and expected outcomes. However, despite some

limitations, this study could contribute greatly to the current health education sector and the obtained finding can be useful to nurses and health providers. Among the mobile technologies available, mobile messaging apps have great potential and are of great help in distributing medical information in the future.

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Footnotes

Conflicts of Interest: The authors of this article declare that they have no conflicts of interest.

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Ethical Considerations: The present study is a part of outstanding experimental research which was focused on the effectiveness of the educational intervention via the mHealth program in knowledge, adherence to a healthy lifestyle, and HRQoL among patients with Cardiac Syndrome X. It was approved by: The University of Malaya and Tehran Heart Centre Hospital

The approval numbers were 201839-6110 & MEDICINE.REC.1398.901.

Moreover, informed written consent was received from the participants.

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