Effectiveness of the Health Belief Model on Medication Adherence, Dietary Behavior, and Exercise for Patients with Myocardial Infarction

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Abstract

Background: Myocardial infarction (MI) continues to be a major global health concern, placing a heavy burden on patients, families, healthcare systems, and economies. Therefore, MI management are necessary to enhance the patient outcomes and their quality of life. **Aim:** This study aimed to assess the effectiveness of applying the Health Belief Model (HBM) on medication adherence, dietary behavior, and exercise for patients with myocardial infarction. **Research Design:** A quasi-experimental comparative study (repeated-measures design) was used to conduct this study. **Setting:** The study was conducted at Cardiac Outpatient Clinics affiliated to Beni- Suef University's Hospital, Egypt. **Subjects:** A purposive sample of 80 MI patients who agreed to participate in the study was recruited for this study. **Data collection tools:** Three tools were used, tool l: self-administered questionnaires including part 1: socio-demographic data, part 2: health history, & part 3: knowledge, tool II: self-care practices, and tool III: The Health Belief Model Questionnaire. **Results:** The significance test demonstrated highly significant improvements in the mean scores of the total intervention group's knowledge and practice from baseline assessment to post-tests (P<0.001) with a very large effect size of the educational intervention. In comparison, the control group results showed insignificant differences in mean scores of knowledge and practice at the three study stages. Additionally, post-intervention, the mean scores of all HBM constructs were significantly improved in the intervention group compared to the control groups throughout the three study phases (P<0.001).**Conclusion:** The use of the HBM has been shown to effectively enhance knowledge, self-care practices, and improve health beliefs among patients with myocardial infarction. **Recommendations:** Emphasizing the importance of patients understanding their diagnosis, adhering to the medication regimen, and embracing a healthy lifestyle through educational and training programs is essential. Thus, supportive, ongoing, and well- structured training programs for healthcare professionals must be implemented to utilize the HBM in the prevention and management of chronic diseases.

Keywords: Health Belief Model (HBM), Myocardial Infraction, Medication Adherence, Dietary Behavior, and Exercise practices.

Introduction:

Myocardial infarction (MI) remains a top cause of death globally, presenting substantial difficulties for long-term patient management. Efficient secondary prevention methods, including medication adherence, dietary changes, and engaging in regular physical activity, are crucial for reducing subsequent cardiac complications and enhancing overall outcomes ***(Salari et al., 2023).*** Although the advantages of these interventions are well-established, compliance with suggested regimens is frequently inadequate. Behavioral frameworks, especially the Health Belief Model (HBM), are increasingly being used for tackling these challenges, providing a structured approach for understanding and influencing patient behavior (***Alyafei &Easton-Carr, 2024).***

As stated by ***Alamer (2024),*** the Health Belief Model (HBM) is a psychological framework that explores how beliefs influence health behaviors through constructs such as perceived susceptibility, severity, benefits, barriers, and self-efficacy. This model aids in determining the elements that encourage patients to participate in health promotion activities.

Similarly, ***Parwat et al., (2021)*** cited that that interventions based on the HBM improve medication adherence in post-MI care by targeting patients' perceptions on the severity of their condition and the benefits of treatment, resulting in better compliance and clinical outcomes.

Dietary habits play a vital role in cardiovascular health, yet adhering to heart-healthy dietary regimens post-MI remains a major challenge. Many patients encounter cultural, economic, and psychological obstacles to implementing long-term dietary changes. Interventions based on HBM have successfully addressed these obstacles, equipping patients with the resources and motivation to adopt healthier eating habits. By highlighting perceived benefits and self-efficacy, such approaches enable patients to make informed decisions that align with their long-term health goals ***(Diab et al., 2023).***

Exercise serves as a vital element of secondary prevention following a myocardial infarction, offering advantages such as enhanced cardiovascular fitness, improved stress management, and a better quality of life. Nonetheless, concerns about overexertion or insufficient knowledge regarding safe exercise regimens frequently prevent patients from participating in regular physical activity. Programs based on the Health Belief Model (HBM) address these concerns by increasing patient confidence through education and goal setting. These interventions often include cues to action, such as regular follow-ups and support groups, to help patients maintain their exercise routines over time ***(Racodon et al., 2019).***

A nurse plays a vital role in health promotion through disease management and prevention by providing patients with myocardial infarction with the necessary support and information. Nurses can effectively guide and inform patients about self-care, motivate them to adopt healthy habits, prevent disease progression, and provide social and emotional support. Furthermore, the nurse should give patients time to express their concerns about complaints and treatment options ***(Zakeri et al., 2022).***

While the HBM has shown promise in improving medication compliance, dietary habits, and physical exercise in MI patients, its complete effectiveness has not yet been achieved **(Kam & Lee, 2024).** The model's capability to methodically address patients' psychological and behavioral obstacles opens the door for creating more efficient, tailored interventions ***(Green et al., 2020).*** Thus, this study aims to assess the effectiveness of the health belief model on medication adherence, dietary behavior, and exercise for patients with myocardial infarction.

Significance of the study:

The prevalence of noncommunicable diseases, including coronary artery diseases, has increased owing to changes in human lifestyles **(Mohammadi et al., 2018).** Coronary artery diseases are classified into the category of atherosclerotic diseases and have an inflammatory nature and emerge with angina, myocardial infarction, and sudden cardiac death **(Malakar et al.,2019.)** **C**oronary artery diseases have become a global health concern and a major cause of death in developed and developing countries. In addition to high mortality, they have social, psychological, and physical consequences**(Huang et al., 2023).**

According to the latest reports of the World Health Organization published in 2018, CAD deaths in Egypt reached to 163,171, or 29.38% of the total deaths **(Reda et al., 2019).** Unfortunately, a quarter of people with acute MI die, and most survivors complain of angina pain and deterioration in quality of life. The incidence of MI increases due to the presence of cardiac risk factors such as hypertension, diabetes, obesity, uncontrolled cholesterol levels, stress, smoking, and aging is another risk factor **(Kaibab et al., 2017).**

Despite the availability of advanced diagnostic and treatment methods, one third of myocardial infarction patients still die, and two thirds of survivors have not fully recovered and need rehabilitation as well as other treatment modalities. Therefore, myocardial infarction imposes economic burdens on hospitals to treat the disease and its complications **(Vahedian-azimi et al., 2015).** Accordingly, it is imperative to develop an effective nursing intervention that supports myocardial infarction patients to properly manage their disease.

Aim of the study:

To assess the effectiveness of the Health Belief Model on medication adherence, dietary behavior, and exercise for patients with myocardial infarction through the following objectives:

1. Assessing the patients' knowledge related to myocardial infraction management.
2. Designing and implement health belief model based on preliminary collected knowledge, self-reported practice (activity of daily living and exercise) and health

beliefs of myocardial infraction management.

3. Evaluating the effectiveness of health belief model on improvement of knowledge, self-reported practice and health beliefs of myocardial infraction management.

Research Hypotheses:

To achieve the study's aim, the following research hypotheses were developed:

H_1: The post-mean patients' knowledge regarding myocardial infraction management in the intervention group would be better than that in the control group.

H_2: The post-mean patients' reported practice regarding myocardial infraction management in the intervention group would be better than that in the control group.

H_3: The post-mean patients' health beliefs regarding medication adherence, dietary behavior, and exercise in the intervention group would be better than that in the control group.

Subjects and Methods:

Research design:

A comparative quasi-experimental study with a repeated measures design was employed to conduct this study. It is the optimal design for determining the cause-and-effect relationship between the dependent and independent variables.

Research Setting:

The study was conducted at Cardiac Outpatient Clinics affiliated to Beni- Suef University's Hospital, Egypt. The clinics are responsible for providing follow-up care of MI patients.

Subjects:

A purposive sample of 80 adult MI patients who agreed to participate in the study was recruited for this study.

The inclusion criteria of the study was:

- ✓ Literate.
- ✓ Ability to communicate.
- ✓ Normal visual and hearing health.
- ✓ No specific dietary restrictions.
- ✓ Regular attendance at the selected setting for planned follow-up for at least three visits.

Exclusion criteria of the study was:

- ✓ Several chronic diseases.

Sampling technique and size calculation:

A purposive sampling technique was employed to recruit participants for this study. The sample size was determined using the G*Power formula for two independent matched samples with a continuous outcome, based on the study parameters from the previous research by ***Fatahian et al., (2024).***

$$n = \left(\frac{Z_{1-\alpha/2} + Z_{1-\beta}}{ES} \right)^2$$

In this formula, n denotes the sample size, the significance level is set at 5%, Z1-α/2 equals 1.96, 1-β indicates the chosen power (P) of 80%, Z1-β is 0.84, and the expected effect size (ES) is medium at 0.50. Consequently, a sample size of 33 patients is expected. Considering a dropout rate of 20%, a total sample size of 40 is needed for each group. Therefore, the overall necessary sample size is 80.

Outcome measures:

Primary outcome measures:

Improved of myocardial fraction patients' related knowledge, self-care practices, and health beliefs.

Secondary outcome measures:

Controlling risky behaviors and adopting a healthy lifestyle.

Data collection methods:

The data collection tools were designed by the researchers after reviewing the preceding relevant studies ***(Fatahian et al., 2024; Mostafa et al., 2023; and Kourbelis et al., 2020).*** Four structured self-administrated sheets were utilized in this study before and after the implementation of HBM.

Tool I: A Self-administered Questionnaire:

This tool will be designed based on the related literature **(Fatahian et al., 2024; Metwaly, & Zatton, 2020; and Kourbelis et al., 2020). It** was comprised three parts.

Part (1) included the patients' socio-demographic characteristics such as age, gender, marital status, residence, educational level, occupation, monthly income and the living condition.

Part (2) was related to health history, including previous heart surgery, type of operation, number of hospital admissions, onset of myocardial infarction, other chronic diseases, family history of MI and risky health

Part (3): Patients' knowledge concerning myocardial infraction:

The sheet included knowledge questions about the following: **A:** MI disease and its management (medication and periodic follow-up. **B:** knowledge questions about a healthy diet for MI.**C:** knowledge questions about a suitable exercise regimen for MI patients.

Knowledge scoring system: the researchers assigned a (1) point for a correct answer and (0) points for wrong or missed response or don't know. The total score was categorized based on the study of Mostafa et al. (2023) as follows:

Scoring interpretation:

Score	Percentage	Inference
<25	<50%	Poor knowledge
25-<37.5	50%-75%	Fair knowledge
>37.5	>75%	Good knowledge

Tool II: Patients self-care reported practices scale.

The tool involved eight domains as follow: movement and daily living activities, nutritional practices, medication compliance, exercise practices, rest and sleep practices, healthy habits to prevent infection, psycho-social care, and management of pain and difficulty breathing.

Practice scoring was calculated as follows: (2) scores for always done, (1) score for some times done, and (0) for never done. The patient's total reported practice score was classified based on ***Mostafa et al. (2023)*** as follows:

Scoring interpretation:

Score	Percentage	Inference
<32	<80%	Unsatisfactory practice
≥32	≥80%	Satisfactory practice

Tool III: The Health Belief Model Questionnaire.

The HBM is adapted from ***(Fatahian et al., 2024; & Mohamed et al., 2021).*** It had five domains arranged in 40 statements. It include the following: perceived susceptibility (six questions; e.g., I might have another Myocardial Infarction), perceived severity (seven questions; e.g., Myocardial Infarction attack is very dangerous and may cause disability and shorten my life), perceived benefits (nine questions; e.g., by controlling my disease through diet, I will prevent another Myocardial Infarction), perceived barriers (nine questions; e.g., I don't follow the diet because it costs a lot for the me/family), and perceived self-efficacy (nine questions; e.g., I can implement my diet plan).

The scoring system of HBM: Responses were classified into five categories: strongly agree (5), agree (4), neutral (3), disagree (2), and strongly disagree (1). If the statement was phrased negatively, the scoring method in SPSS was inverted. Every construct was computed separately, resulting in six unique scores for each patient. The mean scores of the model was obtained by summing. The possible total score range was (40- 200 marks), and a higher score indicated a more positive health belief toward myocardial infraction.

Tools validity and reliability:

Academic experts assessed the myocardial infraction program that based on HBM and the study tools regarding their content, design, language, and structure to compute the **content validity index (0.90)** of the first draft of the program and the study tools.

A **pilot study** was conducted on 10% of the overall patient sample size (8) who were not part of the main sample to assess the feasibility, practicality, necessary resources, and time needed before launching the educational program for the entire sample.

The reliability of the Patients' self-care reported practices scale and the Health Belief Model Questionnaire were tested by Cronbach's α and all emerged as acceptable (α=0.80, and α=0.71 respectively). As well as the domains of the HBM was tests separately to be emerged as 0.70 for perceived susceptibility, 0.69 for perceived severity, 0.73 for perceived benefits, 0.79 for perceived barriers, 0.75 for self-efficacy, and 0.73 for cues to action).

Ethical considerations:

The research ethics committee of the Faculty of Nursing at Beni-Suef University approved the study protocol (no: …). The researchers received formal approval to conduct the study through a letter from the Beni-Suef Faculty of Nursing to the directors of Beni-Suef university hospitals. Written consent was also secured from patients participating in the study by answering questions after guarantee their right to withdraw at any time.

Field work:

The study was implemented throughout the period from beginning of January to end of April 2025 according to the following phases:

Preliminary assessment:

The researchers informed the head of the cardiology outpatient clinics and the patients about the aim of the study at the selected clinics to gain their cooperation. The preliminary data were collected through administering questionnaires to assess the baseline knowledge, self-care practices, and health beliefs concerning myocardial infarction from the patients in both groups using Tools I, II, and III. The researchers collected data from nearly 10 patients per visit. The researchers spent approximately 20-25 minutes collecting tools for each patient in the waiting area at the previously selected setting.

The researchers divided the patients into two groups: subjects who attended the clinic on Saturday and accepted to participate in the study were recruited to the intervention group, and the subjects who attended the clinics on Monday were recruited to the control group. Additionally, the researchers tried to build trusting relationships with the patients and to understand the various issues facing them at home by providing their private number for answering any questions and for easy contact at any time.

Development of HBM educational intervention:

Based on preliminary data obtained from a pre-test assessment of the patients and after reviewing recent references, the researchers designed the educational intervention contents based on the Health Belief Model and following the principles of health education, using plain Arabic language. The main goal was raising awareness among MI patients about their susceptibility to myocardial infarction complications, disease severity, and how to mitigate the risks. This involved enhancing their self-confidence in managing the disease and promoting positive health beliefs regarding the benefits of adopting healthy behaviors. Health education information was sourced from the European Society of Cardiology (ESC). The constructs of the HBM guided each educational session provided to the patients. The initial version of the educational intervention was reviewed by a group of cardiac professionals and academic experts to determine its effectiveness regarding content, language, and teaching approaches, and to compute the content validity index (0.91).

Application of the HBM educational intervention:

The intervention group:

The researchers applied the structured HBM educational intervention to the patients through four face-to-face group sessions (on average 60 minutes) two days per week for one month in the health education room at the outpatient clinic and at a suitable time for the patient's schedule. Each session included an average of ten patients. The first session concentrated on enhancing understanding of myocardial infarction (MI), various food categories, and the significance of nutrition through the use of educational videos and lectures. The second session of the educational program focused on elevating awareness of perceived severity and susceptibility. This session covered the risks associated with the recurrence of MI, the implications of an unhealthy diet, and the potential consequences and complications of the condition, including its effects on professional, social, and family dynamics. The third session explored the advantages of a healthy diet, the obstacles to achieving it, and strategies for overcoming these challenges. Patients encouraged to document the benefits and barriers related to a proper diet and to share their effective dietary strategies. To enhance self-efficacy in the fourth session, patients invited to share their successful dietary experiences with their peers. Additionally, those who had adhered to dietary recommendations received encouragement. The researcher followed up the patients in intervention group through phone calls to ensure that the educational program was being implemented by patients at home.

The control group

The patients didn't receive any education during the intervention; however, the educational content was delivered to them in a booklet after collecting two posttests data. control group receive routine nursing care including (measuring vital signs, medication administration, physical examination etc.,)

Evaluation of the HBM educational intervention:

The researchers collected the knowledge questionnaire immediately after and three-month post-application the intervention from the patients in both study groups using. In addition, the researchers filled the self-care practice scale and HBM checklist for the studied patients in both study groups after one month and three months post-tests following the implementation of the educational intervention based on HBM.

Statistical analysis:

Data were analyzed using IBM SPSS version 20.0 (IBM Corp., Armonk, NY, USA). In the descriptive statistics, the mean (standard deviation) was used for quantitative variables. For between-groups comparisons, the independent t-test was used for variables that fit a normal distribution, and Cohen's d was computed as the effect size of the t-test between the study groups. Additionally, repeated measures ANOVA (RE- ANOVA) was used to test differences between three related groups, with partial eta squared calculated as the effect size for the ANOVA. The Pearson chi-square and exact tests were used to test the similarity of baseline qualitative characteristics. Fisher's exact test was used for two-by-two structures. The significance level was set at 5%.

Results:

Socio-demographic characteristics and health history of the studied patients with myocardial infraction:

Table (1) reveals the socio-demographic characteristics of the studied patients with myocardial infarction. This table shows homogeneity between the two study groups, as Chi -square and independent t -tests indicate non- significant differences in terms of age (P=0.729), gender (P=0.260), education level (P=0.668), occupation (P=0.605), marital status (P=0.258), residence (P=0.469), monthly income (P=0.369), living condition (P=0.814) between the intervention and the control group. The mean age of the intervention group was 48.72 ± 8.38, and 49.40 ± 8.89 among the control group. 50% of intervention and 62.5% of control patients were male. Regarding marital status, 90% of intervention and 77.5% of control patients were married. Concerning education, 60% of the intervention group and 50% of the control group had a diploma. Additionally, a large percentage of the intervention group and the control group resided in urban areas with their families and had free work which sufficient work to meet life requirements.

Table (2) illustrates the health history of the studied patients with myocardial infarction. This table indicates similarity between the two study groups, as Chi -square and Fisher Exact tests show insignificant differences in terms of previous heart surgery (p=0.496), type of operation (p=0.751), number of hospital admissions (p=0.876), onset of disease (p=0.483), type of chronic diseases (p=0.841), family history of myocardial infarction (p=0.348), smoking (p=0.366) and an eating unhealthy diet (p=0.366), between the two study groups. 62.5% of the intervention group and 55% of the control group had previous heart surgery, and a large percentage of them had cardiac catheterization. Regarding the number of hospital admissions, 62.5 % of the intervention group and 57.5 % of the control group were admitted once to the hospital with myocardial infarction. Concerning the type of chronic diseases, 35% of the intervention group and 27.5% of the control group were suffering from hypertension. Furthermore, 60% of the intervention group and 70 % of the control group had a family history of myocardial infarction. Regarding risky habits, 37.5 % of the intervention group and 52.5 % of the control group were smokers.

Patients' knowledge about myocardial infraction:

Table (3) demonstrate the distribution of patients' knowledge in both groups regarding general information about the disease, the diet regimen, and suitable exercise regimen for myocardial infarction at the three study phases. At the pre-test assessment, both study groups reported poor knowledge levels in all the above-mentioned categories. Compared to the post-tests, these poor mean scores improved in the interventional group but remained low in the control group as follows: general information about the disease (interventional group: 17.30±1.81, and control group: 8.17±2.69); diet regimen (interventional group: 10.40±1.51, and control group: 6.20±1.65); and suitable exercise regimen (interventional group: 13.10±2.41, and control group: 5.77±2.58). Similarly, the three-month follow-up results showed continued improvements in the interventional group's mean scores for all mentioned knowledge categories, while the control group's scores remained lower. Furthermore, RM-ANOVA results for the interventional group indicated highly significant differences with a large effect size for all the above-mentioned categories ($P \leq 0.001$), compared to insignificant differences in the control group at the three study stages (P= 0.203, P= 0.071, and P=

0.125, respectively).

Totally, the RM-ANOVA test revealed highly significant differences in the total interventional group knowledge mean score from baseline (18.12±4.64) to post-test (40.80±4.25) and three months post-test (36.05±2.62) at (F=976.27, P≤0.001, η^2=0.962). In contrast, the control group showed insignificant differences at (F=3.77, P=0.059, η^2=0.088), with a lower change in mean score from baseline (18.27±4.46) to post-test (20.15±4.35) and three-months post-test (19.47±4.66) as shown in **Table (3) and Figure** (1) **.**

Patients' self-care practice regarding myocardial infraction:

Table (4) reveals the distribution of the studied patients' practice in both groups regarding movement and daily living activities, nutritional practices, medication compliance, and exercise practices at the three study phases. At the baseline assessment, an unsatisfactory practice mean score was reported by both study groups regarding all the mentioned categories. Compared to post-test results, this unsatisfactory mean score improved in the interventional group but remained unsatisfactory in the control group as follows: movement and daily living activities (interventional group: 4.40±0.81, and control group: 2.47±0.84); nutritional practices (interventional group: 6.00±0.45, and control group: 4.30±1.09);except for medication compliance (interventional group: 1.62±0.49, and control group: 1.75±0.43); and exercise practices (interventional group: 4.45±1.19, and control group: 2.70±0.99). As regards three months-follow-up results, a satisfactory level was reported in the interventional group toward all mentioned practice categories, compared to an unsatisfactory level in the control group. Additionally, the RM-ANOVA results of the interventional group showed highly significant differences with a high effect size regarding all previous practice categories (p ≤0.001), compared with insignificant differences detected in the control group at the three study stages (P=0.382, P=0.135, P=0.166 and P=0.205 respectively).

Table (5) demonstrates the distribution of the studied patients' practices in both groups toward rest and sleep practices, healthy habits for preventing infection, psycho-social care, and management of pain and difficulty breathing. At the baseline survey, an unsatisfactory level of practice was indicated by both study groups regarding all mentioned practices categories. Compared to the three month follow-up results, this unsatisfactory mean score improved in the interventional group but remained unsatisfactory in the control group as follows: rest and sleep practices (interventional group: 3.82±0.38, and control group: 3.20±0.40); healthy habits for preventing infection (interventional group: 2.75±0.43, and control group: 1.65±0.48); psycho-social care (interventional group: 2.77±0.42, and control group: 1.72±0.45); and management of pain and difficulty breathing (interventional group: 4.67±0.57, and control group: 3.52±0.93). The significance test also demonstrated very high significant differences with an elevated effect size in the intervention group regarding all mentioned practice categories (p ≤0.001), In the control group results, insignificant differences were indicated at the three study stages (P=0.071, P=0.135, P=0.083 and P=0.503, respectively).

Figure (1) and Table (5) show that the RM-ANOVA test demonstrated highly statistically significant differences in the total interventional group practice mean score from baseline (19.52±2.83) to post-test (26.37±2.91) and three months post-test (33.22±2.52) at (F= 8.33, P=0.001, η^2=0.94). In contrast, the control group results showed insignificant differences at (F=2.82, P=0.065, η^2=0.068), with a lower change in mean score from baseline (20.82±3.86) to post-test (21.17±3.97) and three-months post-test (21.20±3.85) at the three study stages.

Patients' health belief between the intervention and control groups:

Table (6) presents the mean scores of health beliefs before, one month, and three months after the educational intervention for the study and control groups. An independent t-test showed similarity in the pre-test scores of perceived susceptibility, severity, and benefits domains before the intervention (P=0.941, P=0.573, and P=0.371). Compared to the one-month post-test, there were significant differences between the intervention and control groups in all the HBM domains (P ≤0.001). Similarly, the three-month post-test results showed highly significant differences between the intervention and control groups in all the HBM domains, with substantial effect sizes of the educational intervention on perceived susceptibility, severity, and benefits domains (d=1.20, d=0.677, and d=0.691, respectively). Additionally, there were improvements in the perceived susceptibility, severity, and benefits mean scores in the intervention group, which were significantly higher than the changes in the control group throughout the three study phases.

Table (7) illustrates the mean scores of health beliefs before, one month, and three months after the educational intervention for the study and control groups. The baseline assessment of perceived barriers and efficacy domains showed homogeneity in mean scores before the intervention (P=0.241 and P=0.250). Compared to the one-month post-test, there were significant differences between the intervention and control groups in the efficacy domain (P≤ 0.001), while insignificant differences were demonstrated in the barrier domain (P=0.06). Similarly, the three-month post-test results indicated highly significant differences between the intervention and control groups in the perceived barriers and efficacy domains, with moderate to high effect sizes of the educational intervention on perceived barriers and efficacy domains (d=0.42 and d=1.23, respectively). Additionally, there were significant improvements in the perceived barriers and efficacy mean scores in the intervention group, which were higher than the changes in the control group throughout the three study phases.

There were significant improvements in the total interventional group HBM mean score from baseline (156.72±5.47) to one-month post-test (181.57±5.34) and three months post-test (172.65±5.96). In contrast, the control group showed minimal significant differences with only a three-point change in mean score from baseline (159.37±7.02) to one-month post-test (156.65±8.43) and three-month post-test (153.52±8.98) at the three study stages.

Table (1): Patients' socio-demographic characteristics, (n=80)

Socio-demographic characteristics	Interventional N=(40)		Control N= (40)		P- value Significance test
	No.	%	No.	%	
Age in years					
18-<30	00	00	00	00	0.729
30-<40	8	20	7	17.5	
40 -<50	9	22.5	8	20	
50-<65	23	57.5	25	62.5	
Mean(SD)	48.72(8.38)		49.40(8.98)		
Gender					
Male	20	50	25	62.5	0.260
Female	20	50	15	37.5	
Educational level					
Preparatory	8	20	10	25	0.668
Secondary/Diploma	24	60	20	50	
University	8	20	10	25	
Occupation					
Employee	12	30	12	30	0.605
Free work	12	30	13	32.5	
Not working/housewife	8	20	4	10	
Retiree	8	20	11	27.5	
Marital status					
Married	36	90	31	77.5	0.258
Divorce	4	10	8	20	
Widow	0	0	1	2.5	
Residence					
Urban	29	72.5	26	65	0.469
Rural	11	27.5	14	35	
Monthly income					
Sufficient for life requirement	24	60	20	50	0.369
Not sufficient for life requirement	16	40	20	50	
Living condition					
Live with family	24	60	21	52.5	0.814
Live alone	4	10	5	12.5	
Live with others	12	30	14	35	

P-value for Chi-square test or Fisher Exact tests, Independent t test, **P** Significance * Significant ($p \leq 0.05$).

Table (2): Patients' health history, (n=80)

Health history	Interventional N=(40)		Control N= (40)		P- value Significance test
	No.	%	No.	%	
Previous heart surgery					
No	25	62.5	22	55	0.496
Yes	15	37.5	18	45	
Type of operation					
None	25	62.5	22	55	0.751
Open heart	5	12.5	7	17.5	
Cardiac catheterization	10	25	11	27.5	
Number of hospital admissions with myocardial infarction					
No previous admission	5	12.5	5	12.5	0.876
Once	25	62.5	23	57.5	
Twice	10	25	12	30	
Onset of myocardial infarction (In months)					
>3	8	20	5	12.5	0.483
3> 6	14	35	12	30	
6 -12	18	45	23	57.5	
Presence of other chronic diseases					
Yes	40	100	40	100	NA
Type of the chronic diseases					
Hypertension	14	35	11	27.5	0.841
Diabetes	10	25	10	25	
Obesity	8	20	8	20	
Chest diseases	8	20	11	27.5	
Family history of myocardial infarction					
No	24	60	28	70	0.348
Yes	16	40	12	30	
Risky habits					
Eating unhealthy diet	25	62.5	19	47.5	0.366
Smoking	15	37.5	21	52.5	0.366

P-value for Chi-square test or Fisher Exact tests, Independent t test, NA: Not Applicable,
P Significance * Significant ($p \leq 0.05$)

Table (3): Patients' knowledge categories scores toward myocardial infraction throughout the three study phases, (n=80).

Items	Interventional N=(40)						Control N= (40)						Significance test between pre-tests of the both study groups
	Pre-test		Post-test		Follow up-test		Pre-test		Post-test		Follow up-test		
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
General information about Myocardial infraction disease score=(20)													
Poor	21	52.5	00	00	00	00	29	72.5	26	65	28	70	
Average	19	47.5	4	10	16	40	11	27.5	14	35	12	30	
Good	00	00	36	90	24	60	00	00	00	00	00	00	t=1.66 P =0.101
Mean(SD)	8.47(2.96)		17.30(1.81)		14.90(1.31)		7.42(2.68)		8.17(2.69)		7.40(2.89)		
Significance test	F=249.47 P-value≤0.001			η²=0.865			F= 1.628 P-value = 0.203			η²=0.04			
Diet regimen for Myocardial infraction score=(12)													
Poor	28	70	00	00	00	00	20	50	17	42.5	14	35	
Average	8	20	4	10	11	27.5	15	37.5	18	45	21	52.5	t=1.266
Good	4	10	36	90	29	72.5	5	12.5	5	12.5	5	12.5	P=0.209
Mean(SD)	5.0(2.07)		10.40(1.51)		9.35(1.49)		5.57(1.98)		6.20(1.65)		6.10(2.21)		
Significance test	F=147.95 P-value≤0.001			η²=0.791			F= 3.11 P-value =0.071			η²=0.074			
Suitable exercise regimen for Myocardial infraction score=(18)													
Poor	36	90	00	00	00	00	33	82.5	28	70	29	72.5	
Average	4	10	24	60	28	70	7	17.5	12	30	11	27.5	
Good	00	00	16	40	12	30	00	00	00	00	00	00	t=1.197
Mean(SD)	4.65(2.29)		13.10(2.41)		11.80(1.91)		5.27(2.37)		5.77(2.58)		5.97(2.45)		P=0.235
Significance test	F= 1157.55 P-value≤0.001			η²=0.967			F= 2.13 P-value= 0.125			η²=0.052			
Total knowledge score=(50)													
Poor	38	95	00	00	00	00	36	90	35	87.5	33	82.5	t=0.147
Average	2	5	8	20	29	72.5	4	10	5	12.5	7	17.5	P=0.883
Good	00	00	32	80	11	27.5	00	00	00	00	00	00	
Mean(SD)	18.12(4.64)		40.80(4.25)		36.05(2.62)		18.27(4.46)		20.15(4.35)		19.47(4.66)		
Significance test	F=976.27 P-value≤0.001			η²=0.962			F=3.77 P-value = 0.059			η²=0.088			

F for repeated measure ANOVA, η^2 = partial eta squared, **P** Significance t: Independent t test, * Significant (p≤ 0.05).

Figure 1: Comparisons of the total patients' knowledge and practice about myocardial infraction throughout the three study phases

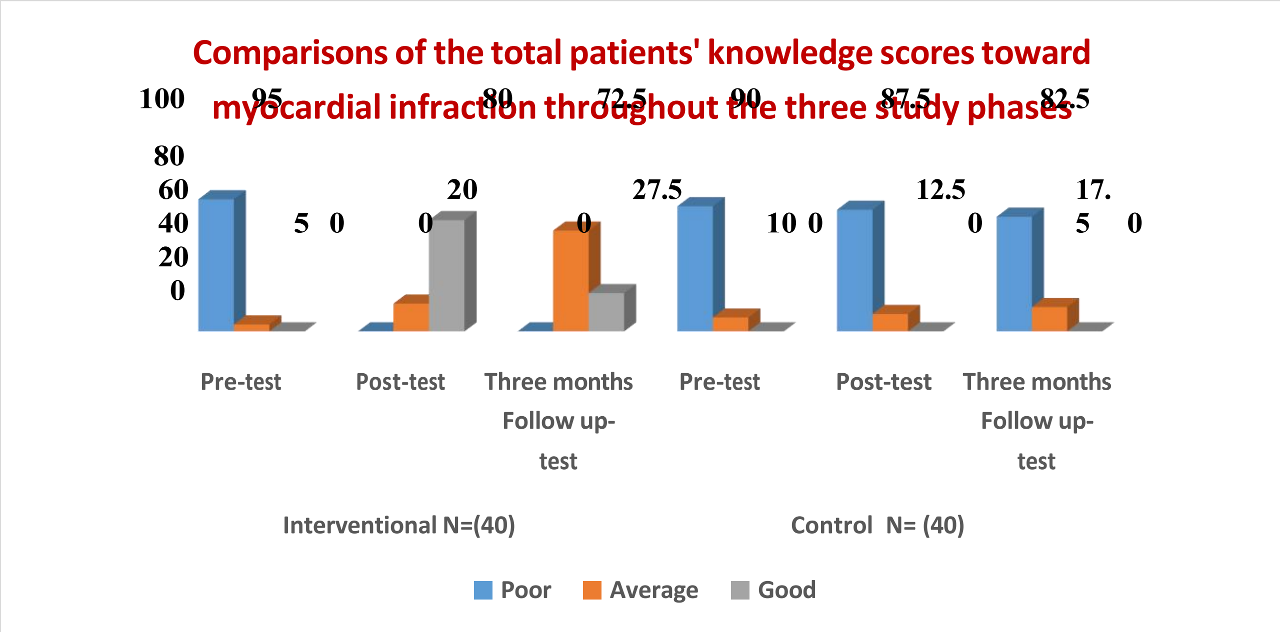

Table (4): Patients'self-care reported practice categories scores toward myocardial infraction throughout the three study phases, (n=80).

Items	Interventional N=(40)						Control N= (40)						Significance test between pre-test of the both study groups
	Pre-test		Post-test		Three months Follow up-test		Pre-test		Post-test		Three months Follow up-test		
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
Movement and daily living activities score=(4)													
Unsatisfactory	37	92.5	8	20	13	32.5	35	87.5	35	87.5	35	87.5	t=1.231
Satisfactory	3	7.5	32	80	27	67.5	5	12.5	5	12.5	5	12.5	P=0.222
Mean(SD)	2.05(0.90)		3.95(0.81)		3.85(0.69)		2.30(0.91)		2.47(0.84)		2.37(0.95)		
Significance test	F= 325.83		P-value≤0.001		η²=0.89		F=0.973		P-value = 0.382				
Nutritional practices score=(6)													
Unsatisfactory	36	90	4	10	9	22.5	34	85	34	85	33	82.5	t=1.021
Satisfactory	4	10	36	90	31	77.5	6	15	6	15	7	17.5	P=0.310
Mean(SD)	4.00(1.09)		5.90(0.45)		5.77(0.42)		4.25(1.08)		4.30(1.09)		4.35(1.22)		
Significance test	F= 130.70		P-value≤0.001		η²=0.77		F=2.053		P-value = 0.135		η²=0.05		
Medication compliance score=(2)													
Unsatisfactory	15	37.5	15	37.5	6	15	10	25	10	25	13	32.5	t=1.202
Satisfactory	25	62.5	25	62.5	34	85	30	75	30	75	27	67.5	P=0.233
Mean(SD)	1.62(0.49)		1.62(0.49)		1.85(0.36)		1.75(0.43)		1.75(0.43)		1.67(0.47)		
Significance test	F= 11.32		P-value≤0.001		η²=0.225		F= 1.83		P-value=0.166		η²=0.045		
Exercise practices score=(10)													
Unsatisfactory	40	100	38	95	12	30	40	100	40	100	40	100	t=1.272
Satisfactory	00	00	2	5	28	70	00	00	00	00	00	00	P=0.207
Mean(SD)	2.30(0.91)		4.45(1.19)		7.72(0.75)		2.55(0.84)		2.70(0.99)		2.72(0.81)		
Significance test	F=404.13		P-value≤0.001		η²=0.912		F= 1.617 η²=0.04		P-value=0.205				

F for repeated measure ANOVA, η^2 = partial eta squared, **P** Significance * Significant (p≤ 0.05).

Table (5): Patients'self- reported practice categories scores toward myocardial infraction throughout the three study phases, Cont (n=80).

Items	Interventional N=(40)						Control N= (40)						Significance test between pre- tests of both study groups
	Pre-test		Post-test		Three months Follow up-test		Pre-test		Post-test		Three months Follow up-test		
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
Rest and sleep practices score=(4)													
Unsatisfactory	36	90	36	90	7	17.5	32	80	32	80	32	80	t=1.535
Satisfactory	4	10	4	10	33	82.5	8	20	8	20	8	20	P=0.129
Mean(SD)	2.95(0.50)		3.00(0.45)		3.82(0.38)		3.12(0.51)		3.10(0.54)		3.20(0.40)		
Significance test	F=70.51		P-value≤0.001		η^2=0.644		F=3.449		P-value=0.071		η^2=0.081		
Healthy habits for preventing infection score=(4)													
Unsatisfactory	40	100	38	95	10	25	40	100	40	100	40	100	t=0.888
Satisfactory	00	00	2	5	30	75	00	00	00	00	00	00	P=0.377
Mean(SD)	1.45(0.50)		1.65(0.57)		2.75(0.43)		1.55(0.50)		1.60(0.49)		1.65(0.48)		
Significance test	F=87.52		P-value≤0.001		η^2=0.692		F=2.053		P-value=0.135		η^2=0.05		
Psycho-social care score=(4)													
Unsatisfactory	40	100	40	100	9	22.5	40	100	40	100	40	100	t=0.447
Satisfactory	00	00	00	00	31	77.5	00	00	00	00	00	00	P=0.656
Mean(SD)	1.55(0.50)		1.65(0.48)		2.77(0.42)		1.60(0.50)		1.62(0.49)		1.72(0.45)		
Significance test	F=173.58		P-value≤0.001		η^2=0.817		F=3.16		P-value=0.083		η^2=0.075		
Management of pain and difficulty breathing score=(6)													
Unsatisfactory	16	40	16	40	2	5	15	37.5	15	37.5	13	32.5	t=0.352
Satisfactory	24	60	24	60	38	95	25	62.5	25	62.5	27	67.5	P=0.726
Mean(SD)	3.60(0.49)		3.60(0.49)		4.67(0.57)		3.55(0.74)		3.62(0.49)		3.52(0.93)		
Significance test	F=266.09		P-value≤0.001		η^2=0.872		F= 0.458		P-value = 0.503		η^2=0.012		
Total practice score=(40)													
Unsatisfactory	40	100	32	80	2	5	38	95	38	95	38	95	t=0.3.13
Satisfactory	00	00	8	20	38	95	2	5	2	5	2	5	P=0.08
Mean(SD)	19.52(2.83)		26.37(2.91)		33.22(2.52)		20.82(3.86)		21.17(3.97)		21.20(3.85)		
Significance test	F= 8.33		P-value≤0.001		η^2=0.94		F=2.82		P-value=0.065		η^2=0.068		

Table (6): Comparison of the mean scores of Health Belief Model categories between the intervention and control groups throughout the three study phases, (n=80).

HBM categories	Interventional N=(40)		Control N=(40)		Significance test between mean scores	Effect size (Cohen's d)
	Mean	SD	Mean	SD		
Perceived susceptibility score=(*30*)						
Pre-test	23.02	3.28	23.07	2.73	t=0.074 P=0.941	-----
Post-test	27.10	3.24	23.27	2.56	t=5.847 P≤0.001	1.31
Three months Follow up-test	26.77	3.25	23.20	2.67	t=5.37 P≤0.001	1.20
Significance test between three study phases	F=52.23 P≤0.001 η^2=0.573		F= 2.84 P=0.064 η^2=0.068			
Perceived severity score=(*35*)						
Pre-test	30.80	3.25	31.25	3.57	t=0.565 P=0.573	-----
Post-test	32.72	2.02	31.35	3.46	t=2.165 P≤0.001	0.483
Three months Follow up-test	33.40	1.51	31.35	3.46	t=3.426 P=0.001	0.677
Significance test between three study phases	F= 15.90 P≤0.001 η^2=0.290		F=2.78 P=0.068 η^2=0.067			
Perceived benefits score=(*45*)						
Pre-test	39.50	2.68	40.02	2.52	t=0.900 P=0.371	-----
Post-test	42.80	1.80	40.02	2.92	t=5.114	1.146
					P≤0.001	
Three months Follow up-test	40.80	2.01	39.27	2.40	t=3.072 P=0.003	0.691
Significance test between three study phases	F=146.29 P≤0.001 η^2=0.790		F=2.05 P =0.135 η^2=0.05			

t*: Independent t-test, **F** for repeated measure ANOVA, $\boldsymbol{\eta^2}$ = partial eta squared (Effect size of ANOVA), d: Effect size of t tests (Cohen's d) d<0.2 small, d=0.5 medium, d>0.8 large, Significant (p≤ 0.05)

Table (7): Comparison of the mean scores of Health Belief Model categories between the intervention and control groups throughout the three study phases, Cont (n=80).

HBM categories	Interventional N=(40)		Control N= (40)		Significance test between mean scores	Effect size (Cohen's d)
	Mean	SD	Mean	SD		
Perceived barriers score=(*45*)						
Pre-test	32.15	3.66	31.17	3.73	t=1.181 P=0.241	-----
Post-test	30.80	3.19	32.15	3.21	t=1.88 P=0.06	0.42
Three months Follow up- test	27.10	4.41	31.72	3.31	t=5.30 P≤0.001	1.23
Significance test between three study phases	F=29.25 P≤0.001 η^2=0.43		F=3.41 P=0.001 η^2=0.08			
Perceived efficacy score=(*45*)						
Pre-test	32.00	3.38	32.87	3.36	t=1.158 P=0.250	------
Post-test	40.10	1.72	31.20	2.89	t=16.72 P≤0.001	3.74
Three months Follow up- test	36.50	1.88	30.20	2.90	t=11.52 P≤0.001	2.57
Significance test between three study phases	F=257.27 P≤0.001 η^2=0.0868		F=21.9 P=0.000 η^2=0.361			
Total HBM score=(200)						
Pre-test	156.72	5.47	159.37	7.02	t=1.88 P=0.064	-----
Post-test	181.57	5.34	156.65	8.43	t=15.78 P≤0.001	3.53
Three months Follow up- test	172.65	5.96	153.52	8.98	t=11.212 P≤0.001	2.51
Significance test between three study phases	F= 372.04 P≤0.001 η^2=0.90		F= 19.80 P=0.00 η^2=0.337			

t*: Independent t-test, **F** for repeated measure ANOVA, $\boldsymbol{\eta^2}$ = partial eta squared (Effect size of ANOVA), d: Effect size of t tests (Cohen's d) d<0.2 small, d=0.5 medium, d>0.8 large, Significant (p≤ 0.05)

Discussion:

The results of this research highlight the substantial effect of the Health Belief Model (HBM) on enhancing medication adherence, dietary habits, and physical exercise among patients with myocardial infarction (MI). The data indicated that patient education led to improvements across all aspects of the HBM, as well as in medication adherence, healthy diet, and exercise behaviors, demonstrating the beneficial outcomes of the educational intervention.

Regarding socio-demographic and clinical characteristics, similarity-determining tests showed non-significant differences in all tested variables between the intervention and control groups, indicating homogeneity between the two groups. This homogeneity is a basic requirement for any comparative experimental study to ensure that observed changes in outcomes are due to the educational intervention rather than confounding factors. This finding is consistent with several experimental studies by ***Habibzadeh et al. (2021) and Nouri et al., (2024).*** who reported that "there were non-significant differences in descriptive characteristics between the study and control groups."

Prior to the intervention, both groups exhibited a low level of knowledge and practice toward myocardial infarction management strategies. This observation aligns with the findings of **Erfan, etal., (2022).** Notably, following the educational intervention, the control group's scores remained unchanged, while the intervention group experienced a significant increase, ultimately exceeding the control group's scores. This emphasizes the efficacy of educational initiatives in enhancing patients' knowledge and practices.

The results of the study on patients' knowledge about myocardial infarction management strategies showed that both study groups reported a poor level. Compared to the post-tests, this poor level increased in the intervention group compared to the control group. From researchers' views, this is related to a number of the model's elements being responsible for the improvement. In particular, increasing participants' perceptions of severity and susceptibility probably encouraged them to prioritize drug adherence.

This outcome is consistent with ***Metwaly and Zatton (2020),*** who reported a significant improvement in patients' compliance with dietary regimens, treatment regimens, and lifestyle modifications post-program compared to before. Additionally, a systematic review by ***Huriani et al., (2022***) highlighted the importance of providing education on management strategies for myocardial infarction patients after discharge from the hospital. It would be even more effective and efficient to incorporate follow-up education sessions during regular clinic visits or established services.

Furthermore, this is supported by a randomized controlled trial conducted by ***Turan Kavradim and Canli Özer (2020),*** who concluded that “education and follow-up intervention had positive and significant results in the intervention group after 12 weeks compared to the usual care group”. Similarly, a randomized clinical study by ***Doležel and Jarošová (2019)*** found that post-myocardial infarction participants educated by a nurse had a significantly higher level of knowledge about their disease management than controls who did not receive education.

The results of the patients' practice regarding myocardial infarction management strategies revealed that both study groups exhibited an unsatisfactory level of daily activities, nutritional habits, medication adherence, and exercise practices. While, the intervention group showed significant improvements compared to the control group during follow-up. Researchers attribute this progress to enhanced health literacy among the intervention group, which enabled informed decision-making, consistent follow-up that encouraged positive behavior changes, and a supportive environment that fostered the prioritization of health improvements. The lack of these supportive measures in the control group likely accounts for their continued unsatisfactory practice.

This finding is compatible with a multi-site study by ***Ghisi et al. (2020)*** that focused on patient education for cardiac rehabilitation patients in Canada, which showed significant improvements in scores for patients' nutritional habits and exercise practices after an educational intervention. This is further supported by ***Fatahian et al. (2024),*** who stated that the educational intervention based on the HBM had a positive effect on the nutritional behavior and indices of patients with MI, providing a necessary basis for preventing the recurrence of MI and its associated complications.

The three-month follow-up clearly demonstrated an improvement in the mean scores of perceived susceptibilities, perceived severity, perceived benefits, cues to action, and self-efficacy, and a decrease in the mean score of perceived barriers post-application of the HBM educational intervention compared to the pre-test assessment. This could be interpreted as the involvement in this HBM educational intervention expanding the patients' knowledge which changes their health beliefs regarding myocardial infarction. Accordingly, the study hypothesis was accepted.

This finding is consistent with different HBM studies such as **Zhang** ***et al., (2024)*** and ***Mohamed et al., (2021).*** Furthermore, a prospective research carried out by ***Mosleh et al., (2024)*** shows that a significant increase occurred in all model constructs, and the perceived barriers construct decreased significantly after the educational intervention.

Also, this finding is compatible with ***Fatahian et al. (2024)*** who investigated "The effect of a health belief model-based education on nutritional behavior and biochemical factors of patients with myocardial infarction" and cited similar findings. According to the results of the present study, patients' participation in the HBM educational intervention increased their mean scores of perceived susceptibility and perceived severity after the application of the HBM educational intervention (P< 0.001). These findings are in line with ***Abd El Rhman et al., (2020).***

Similar to our findings, a study by ***Khah et al., (2025)*** revealed that the mean scores of perceived benefits increased following the intervention. This increase may enhance patients' motivation, willingness, and adherence to self-care practices. As education should lay the groundwork for patients to understand fewer obstacles on the path to educational goals, the mean score for perceived barriers decreased significantly after the HBM educational intervention.

Furthermore, ***Pezeshki et al. (2022)*** reported in their study that perceived barriers significantly diminished following education. ***Afshari et al. (2022)*** confirmed that individuals will be more likely to adhere to recommended health behaviors if they develop self-regulation abilities to modify their health behaviors. A significant increase in self-efficacy mean score was observed post-HBM intervention compared to baseline assessment, which is compatible with ***Kıssal and Kartal (2019).***

Finally, by addressing factors such as perceived susceptibility, severity, benefits of action, and barriers to change, these interventions can motivate individuals to adopt healthier behaviors, leading to improvements in patients' knowledge of myocardial infarction, self-care practices, and reduction of further complications, thereby improving the patients' quality of life.

Conclusion:

Utilizing the Health Belief Model shows significant promise in enhancing medication compliance, dietary habits, and physical activity in patients with myocardial infarction. By considering cognitive and emotional factors and providing practical tools for behavior modification, the HBM presents a strong framework for creating effective interventions.

Recommendation:

Future research should focus on refining these approaches, such as the Health Belief Model (HBM), to maximize their impact and ensure their applicability across diverse patient populations.

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