Journal of Pioneering Medical Sciences
Received: August 11, 2025 | Accepted: September 10, 2025 | Published: February 05, 2026
Volume 15, Issue 01, Pages 30-35

DOI https://doi.org/10.47310/jpms2026150104

Effectiveness of an Educational Program on Metabolic Parameters among CHD Patients in Iraq

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Abstract **Background:** Coronary heart disease (CHD) leads to the reduction of blood flow to the cardiac muscle due to a build-up of atherosclerotic plaque in the arteries of the heart. Applying an educational program aimed at improving these patients 'physical activity and quality of life and lessening their risk factors. **Objectives:** To compare metabolic parameters before and after applying an educational program in patients with CHD who underwent percutaneous coronary intervention and had metabolic syndrome. **Methods:** A comparative interventional study using a convenience sample technique was conducted to collect data from 350 patients diagnosed with CHD who were admitted to the Catheterization Unit at Sulaimani Cardiac Hospital, Iraq, from January 2023 to January 2024. Data were collected using a validated questionnaire through direct interviews. Then patients with metabolic syndrome (n = 196) were equally divided into a control group (n = 98) and an intervention group (n = 98). An educational program consisting of 6 scales was applied to the study group for up to 6 months, after which data were collected from patients, analysed, compared and interpreted. **Results:** Most patients had hypertension (54.9%), while 42.8% had diabetes and 26.6% had dyslipidaemia during the last 3 years. Most patients had high waist circumference (WC), triglyceride (TG) and blood pressure (BP), which led to abnormal MetS components among 53.7% patients. Applying an education program in the study group results in a highly significant decrease ($p < 0.001$) in the mean BMI, WC, fasting blood glucose, HbA1c, total cholesterol, TG, LDL, with systolic and diastolic BP, while a highly significant increase in the mean heart rate. HDL was observed ($p < 0.001$). **Conclusions:** Educational programs that focus on lifestyle changes and risk factor management can significantly improve metabolic parameters in patients with CHD. These programs, often incorporating cardiac rehabilitation, have been shown to positively impact weight, lipid profile, blood pressure and glucose tolerance.

Key Words Educational Program, Metabolic Syndrome, Coronary Heart Disease, Risk Factors, Positive Correlation

INTRODUCTION

Heart diseases are the common cause of death worldwide, with coronary heart disease (CHD) being the most prevalent [1]. CHD includes the diagnoses of angina pectoris, myocardial infarction (MI) and silent myocardial ischemia. In turn, CHD mortality results from coronary artery disease (CAD) [2]. CHD is a major cause of death and disability worldwide, in which the affected patients usually present with angina or a heart attack, heart failure and arrhythmias [3]. Although the mortality of CHD cases has gradually declined over the last decades in many high-income countries, it still causes about 1/3 of all deaths in people aged >35 years. The prognosis for CHD varies, with advancements in medical and surgical treatments significantly improving survival rates, but disparities exist across different populations. The pathophysiological concept of CHD implies that the particular coronary artery stenosis that is likely to give rise to a MI can be treated successfully with percutaneous coronary intervention (PCI) [4], which is a minimally invasive procedure used to open blocked or narrowed coronary arteries, thereby improving blood flow to the heart [5].

International Diabetes Federation (IDF) and American Heart Association/National Heart, Lung and Blood Institute (AHA/NHLBI) confirmed metabolic syndrome (MetS) when any 3 or more than 5 risk factors are present, including

abdominal obesity (waist circumference of ≥94 cm in men and ≥80 cm in women), elevated triglycerides (≥150 mg/d), low HDL (<40 mg/dL in men and <50 mg/dL in women), elevated blood pressure (SBP ≥130 mmHg and/or DBP ≥85 mmHg) and elevated fasting blood glucose (FBG) of ≥100 mg/dL [6]. About 80% of heart diseases are claimed to be preventable via lowering these risk factors and CHD is among them. Established modifiable biological and behavioural risk factors included in clinical guidelines are dyslipidaemia, smoking, hypertension, diabetes mellitus, overweight, depression, stress, poor sleep, insufficient physical activity and unhealthy diet [7]. Modification of these risk factors can prevent the occurrence of CHD by minimizing the clinical events and premature death, as well as decreasing the possibility of cardiovascular disease due to one or more risk factors [8]. If these risk factors are not prevented, the CHD may require PCI and the patient might develop MetS [9], which is a clustering of interrelated and co-incident risk factors, including abdominal obesity, impaired glucose tolerance, hypertriglyceridemia, diminished high-density lipoprotein (HDL), and/or hypertension [10]. Numerous studies showed that patients with CHD have diverse and significant educational needs, including psychosocial education, information about the disease and the associated risk factors, medications, cardiac anatomy and physical activity requirements [11,12]. Currently, in Iraq, there is a lack of enough patient education for this condition that negatively affects their outcomes and prognosis. Consequently, patient education is a crucial factor in enhancing patient outcomes and is a recommended element of comprehensive, multidisciplinary cardiac rehabilitation and prevention programs [13,14].

Objective

This study aimed to compare metabolic parameters among patients with CHD who underwent percutaneous coronary intervention and had metabolic syndrome before and after applying an educational program. Also, to know the effect of applying an educational program on patient outcomes in this population.

METHODS

Study Design and Setting

A comparative, cross-sectional, randomized study was conducted to collect data from 350 patients diagnosed with CHD who underwent PCI were admitted to the Catheterization Unit at Sulaimani Cardiac Hospital, Iraq, from January 2023 to January 2024.

Inclusion Criteria

Adult patients aged ≥40 years old with CHD confirmed by PCI.

Exclusion Criteria

Patients under 18 years old or those with other diseases, such as chronic obstructive pulmonary disease, renal and hepatic failure or cancer and those with severe mental issues.

Study Protocol

The study employed a convenience sample technique and utilized a validated questionnaire through direct interviews. Then, among tested patients, only those were selected that had MetS (n = 196) and they were randomly assigned to two groups as an intervention group (n = 98) that received an educational program for up to 6 months and a control group (n = 98) that did not practice the program. The validated self-administered questionnaire was used to collect patients' data, which consists of 6 main parts. The 1st part covered participants' sociodemographic characteristics, such as age, gender, marital status, education level, occupation and economic status, as well as clinical features, such as family history of heart disease, chronic illness, medications and body mass index (BMI), together with laboratory findings, including blood pressure (BP), fasting blood glucose (FBG), glycated hemoglobin (HbA1C), heart rate (HR) and lipid profile. The second part included the Starting the Conversation Diet Scale (STCDS) and the Mediterranean Diet Adherence Screener (MEDAS). In contrast, the 3rd part collected data regarding physical activity using the International Physical Activity Questionnaire (IPAQ-short form). The 4th part involved questions about perceived stress using the Perceived Stress Scale (PSS-10). In contrast, the 5th part assessed Medication Adherence Screener (MMAS-8) and the final part estimated Sleep Quality (SQ) using the Pittsburgh Sleep Quality Questionnaire (PSQI). Scoring and interpretation of these scales are presented in Supplementary data 1. Before primary data collection, a pilot study was conducted with 30 participants to determine the adequacy and clarity of the questionnaire, as well as respondents' perceptions of the questionnaire's content and the sequence of topics. Then, the reliability of the three tools was assessed using Cronbach's alpha and acceptable values were obtained with a coefficient greater than 0.80.

Statistical Analysis

The Statistical Package for the Social Sciences (SPSS, IBM, Armonk, NY, USA, version 26) was used to analyse the data. The numerical variables were presented as means ± standard deviations (SD) and medians, whereas categorical variables were presented as frequencies and percentages. The Chi-square test was used to evaluate differences in proportions across groups. The McNemar-Bowker test was used to compare proportions of the same sample but at two different times. Paired t-test was used to compare means of continuous variables, before and after the educational program, while the Unpaired t-test was used to compare the means of two groups. The Mann-Whitney test was used to compare the mean ranks of the scores between the two study groups, while the Wilcoxon signed-rank test was used to compare the medians of scores within the same sample at two different periods. A $p \leq 0.05$ was considered statistically significant, while $p \leq 0.001$ was set as highly significant. Tests of normality were not done because t test was used for continuous numerical variables and the sample size (n = 350) was considered high. Thus, the data were considered as normally distributed before conducting the t test.

RESULTS

The mean age of the patients was 57.5 years, with a median of 57 years and an age range of 40-88 years. Most patients were aged 50-59 (46.9%), males (58%), married (95.7%), graduated from primary school (45.7%), had a free work (42.9%), living in urban areas (93.4%) and their income was not sufficient (61%) (Table 1).

The majority of the patients had ST elevation myocardial infarction (STEMI) (71.7%), with one vessel involved (64.6%), especially the right coronary artery (56.6%). Data revealed that 27.4% had no history of hypertension, 54.9% had it during the previous three years and the duration was greater than three years in 17.7%. Around half (48.9%) of the patients had no diabetes and 42.8% had it for three years, while 26.6% had dyslipidaemia during the last 3 years and 1.1% had it for >3 years (Table 2).

The mean BMI was 30.1 kg/m2, waist circumference (WC) was 92.6 cm, systolic BP was 131.7 mmHg, diastolic BP was 85.6 mmHg, HR was 79.9 beats/minute (bpm), FBG was 141.8 mg/dl, HbA1c was 6.7%, total cholesterol (TC) was 202 mg/dl, LDL was 150 mg/dl, HDL was 42.6 mg/dl and TG was190.1 mg/dl) (Table 3).

Most patients had high WC (66%), high TG (60.6%), low HDL (54%), high BP (65.1%) and high FBG (67.1%). Consequently, the five components of MetS were abnormal among 53.7% of the patients (Table 4).

Table 1: Basic characteristics of the participants

Variable	Number	Percentage
Age (Years)		
40-49	58	16.6
50-59	164	46.9
60-69	96	27.4
≥ 70	32	9.1
Gender		
Male	203	58.0
Female	147	42.0
Marital status		
Single	3	0.9
Married	335	95.7
Divorced	3	0.9
Separated	1	0.3
Widowed	8	2.3
Educational level		
No formal education	97	27.7
Primary	160	45.7
Intermediate	40	11.4
Preparatory	23	6.6
Institute	16	4.6
College	9	2.6
Post-graduate	5	1.4
Occupation		
Public sector	29	8.3
Private sector	15	4.3
Retired	31	8.9
Housewife	125	35.7
Free work	150	42.9
Residency		
Urban	327	93.4
Rural	23	6.6
Income		
Sufficient	37	10.6
Barely sufficient	99	28.3
Not sufficient	214	61.1
Total	350	100.0

After applying an education program with six scales in the intervention group, there was a highly significant decrease ($p < 0.001$) in the mean of BMI (31.8 to 29.88), WC (97.02 to 93.15), systolic BP (141.42 to 119.76) and diastolic BP (90.15 to 79.59). At the same time, there was an increase in the mean HR (77.98 to 78.14). Regarding the laboratory tests, there was a highly significant ($p<0.001$)

Table 2: Medical history of the studied participants

Variable	Number	Percentage
ST elevation myocardial infarction (STEMI)		
Yes	251	71.7
No	99	28.3
Number of vessels involved		
One	226	64.6
Two	80	22.9
Three	33	9.4
Four	11	3.1
Vessel involved		
Left Anterior Descending artery (LAD)	188	53.7
Left Circumflex artery (LCX)	125	35.7
Right Coronary Artery (RCA)	198	56.6
Left Main Stem (LMS)	13	3.7
Diseases and their duration		
Hypertension		
None	96	27.4
1-3 Years	192	54.9
>3 Years	62	17.7
Diabetes		
None	171	48.9
1-3 Years	150	42.8
>3 Years	29	8.3
Dyslipidaemia		
None	253	72.3
1-3 Years	93	26.6
>3 Years	4	1.1
History of stroke		
None	347	99.1
1-3 Years	3	0.9
Peripheral artery disease		
None	343	98.0
1-3 Years	7	2.0
Kidney disease		
None	344	98.3
1-3 Years	6	1.7
Thyroid disease		
None	347	99.1
1-3 Years	3	0.9
Coronary artery bypass graft		
None	345	98.6
1-3 Years	3	0.9
>3 Years	2	0.6
Heart failure		
None	340	97.1
1-3 Years	6	1.7
>3 Years	4	1.1
Family history of heart disease		
Yes	122	34.9
No	126	36.0
Unknown	102	29.1
Medications		
Antihypertensive	255	72.9
Cholesterol-lowering agents	69	19.7
Oral antidiabetic agents	84	24.0
Insulin	19	5.4
Antiplatelet agents	350	100.0
Antihyperlipidemic Agent	22	6.3

Table 3: Descriptive statistics of the studied laboratory and clinical parameters at baseline

Parameter	Mean	Median	SD	Min.	Max.
Body mass index (kg/m2)	30.1	30.1	4.0	19.6	50.0
Waist circumference (cm)	92.6	92.0	10.2	72.0	135.0
Systolic BP (mmHg)	131.7	134.5	11.6	96.0	170.0
Diastolic BP (mmHg)	85.6	86.0	6.5	69.0	101.0
Heart rate (beats/minute)	79.9	79.0	5.4	63.0	90.0
Fasting blood glucose (mg/dl)	141.8	118.0	56.7	78.0	377.0
HbA1c%	6.7	5.9	1.8	4.6	12.6
Total cholesterol (mg/dl)	202.0	186.5	54.9	100.0	355.0
LDL cholesterol (mg/dl)	150.0	148.0	32.5	63.0	291.0
HDL cholesterol (mg/dl)	42.6	40.0	8.3	30.0	85.0
Triglycerides (mg/dl)	190.1	181.5	78.7	55.0	615.0

BP: Blood pressure, HbA1C: Glycated haemoglobin, LDL: Low-density lipoprotein, HDL: High- density lipoprotein

Table 4: Indicators of metabolic syndrome parameters among patients as assessed at baseline

Variable	Number	Percentage
Waist circumference		
Normal	119	34.0
High	231	66.0
Triglycerides		
Normal	138	39.4
High	212	60.6
HDL		
Normal (High)	161	46.0
Abnormal (Low)	189	54.0
BP control		
Normal	122	34.9
High	228	65.1
Fasting blood glucose		
Normal	115	32.9
High	235	67.1
Number of abnormal metabolic syndrome components		
0.00	83	23.7
1.00	50	14.3
2.00	5	1.4
3.00	1	0.3
4.00	23	6.6
5.00	188	53.7
Total	350	100.0

decrease in the mean of FBG (176.49 to 115.12), HbA1c (7.77 to 5.78), TC (231.99 to 152.13), LDL (150.28 to 112.47) and TG (245.81 to 148.80). At the same time, there was a significant increase in the mean of HDL from 36.77 to 42.88 (p <0.001) (Table 5).

The degree of improvement indicated that the mean BMI after the program was 1.3 kg/m² in the intervention group, compared with 0.11 kg/m² in the control group (p <0.001). Other improvements include WC (3.87 vs 0.37 cm), systolic BP (61.83 vs 49.43 mmHg), diastolic BP (10.56 vs 0.24 mmHg), FBG (61.37 vs 6.92 mg/dl), HbA1c (1.99 vs 0.14%), TC (79.86 vs 28.13 mg/dl), LDL (37.81 vs 12.62 mg/dl), HDL (6.11 vs 0.91 mg/dl) and TG (97.01 vs 13.74 mg/dl). Regarding the HR, there was a significant increase of 0.16 bpm in the intervention group compared to a 2.71 bpm decrease in the control group (p = 0.009) (Table 6).

In the intervention group, significant alterations were observed in the mean scores of each scale following the program. The median score of the STCDS was significantly decreased from 10 to 4, MEDAS was increased from 5 to 11,

Table 5: Comparing the laboratory and clinical parameters before and after applying the educational program in the intervention group

Variable	Before program		After program		p-value
	Mean	SD	Mean	SD	
Body mass index (kg/m2)	31.18	3.45	29.88	3.13	<0.001**
Waist circumference (cm)	97.02	10.73	93.15	10.03	<0.001**
Systolic BP (mmHg)	141.42	6.72	119.76	7.09	<0.001**
Diastolic BP (mmHg)	90.15	3.90	79.59	4.28	<0.001**
Heart rate (beats/minute)	77.98	4.98	78.14	4.81	<0.001**
Fasting blood glucose (mg/dl)	176.49	59.01	115.12	19.00	<0.001**
HbA1c%	7.77	1.65	5.78	0.68	<0.001**
Total cholesterol (mg/dl)	231.99	47.27	152.13	34.64	<0.001**
LDL cholesterol (mg/dl)	150.28	30.64	112.47	16.87	<0.001**
HDL cholesterol (mg/dl)	36.77	3.48	42.88	3.32	<0.001**
Triglycerides (mg/dl)	245.81	71.63	148.80	29.48	<0.001**

BP: Blood pressure, HbA1C: Glycated haemoglobin, LDL: Low-density lipoprotein, HDL: High-density lipoprotein, **Highly significant difference using Paired t-test

Table 6: Comparing the laboratory and clinical parameters among groups after applying the educational program

Variable	Intervention		Control		p-value
	Mean	SD	Mean	SD	
Body mass index (kg/m2)	1.30	0.91	0.11	0.36	<0.001**
Waist circumference (cm)	3.87	3.25	0.37	1.20	<0.001**
Systolic BP (mmHg)	61.83	8.63	49.43	5.31	<0.001**
Diastolic BP (mmHg)	10.56	5.49	0.24	3.94	<0.001**
Heart rate (beats/minute)	-0.16	3.80	2.71	10.07	0.009*
Fasting blood glucose (mg/dl)	61.37	57.08	6.92	23.75	<0.001**
HbA1c %	1.99	1.65	0.14	0.60	<0.001**
Total cholesterol (mg/dl)	79.86	37.69	28.13	47.46	<0.001**
LDL cholesterol (mg/dl)	37.81	23.72	12.62	24.46	<0.001**
HDL cholesterol (mg/dl)	6.11	5.11	0.91	3.11	<0.001**
Triglycerides (mg/dl)	97.01	66.18	13.74	41.38	<0.001**

BP: Blood pressure, HbA1C: Glycated haemoglobin, LDL: Low-density lipoprotein, HDL: High-density lipoprotein, *Significant difference and **Highly significant difference using Unpaired t-test

IPAQ rose from 241.5 to 1971, PSS-10 decreased from 22 to 12, MMAS-8 increased from 6 to 8 and PSQI decreased from 7 to 4 (p <0.001) (Table 7).

DISCUSSION

In 2024, CHD remained a leading cause of death and disability globally, with significant variations in incidence across different regions and populations. At the same time, some developed nations have seen a decline in CHD incidence due to improved treatments and prevention. However, the overall incidence of this disease may not

Table 7: Scores before and after the educational program in each of the study groups

Variable	Before the program			After the program			p-value
	Mean	SD	Median	Mean	SD	Median	
STCDS	10.07	3.16	10.00	4.96	2.99	4.00	<0.001**
MEDAS	5.18	2.91	5.00	10.62	2.22	11.00	<0.001**
IPAQ short form	358.59	422.86	241.50	1869.0	182.28	1971.0	<0.001**
PSS-10	22.35	8.76	22.00	15.50	7.15	12.00	<0.001**
MMAS-8	5.81	1.74	6.00	7.22	1.27	8.00	<0.001**
PSQI	6.95	1.84	7.00	4.45	1.91	4.00	<0.001**

MEDAS: Mediterranean Diet Adherence Screener, MMAS-8: Medication Adherence, IPAQ: International Physical Activity Questionnaire, PPS-10: Perceived Stress Scale, STCDS: The Starting Test Conversation Diet Scale. **Highly significant difference using the Wilcoxon signed-rank test

decrease with age. Developing countries, on the other hand, are experiencing a rise in CHD cases due to the adoption of Western lifestyles [15]. Generally, applying a well-known, trustworthy and scientifically validated educational program for CHD patients might ensure the long-term success of cardiac rehabilitation, promote participation in an outpatient heart group, strengthen patients' competence in medical emergencies and improve adherence to both medication and non-medication treatments. However, to date, there is no detailed study on this concept in our locality. Thus, we aimed to conduct such a study to educate our patients on how to improve their condition while living with CHD in combination with MetS.

In this study, most patients were aged 50-59, males, married, had basic education level, had a free work, from urban areas and had insufficient income. These outcomes are consistent with the international studies that mentioned CHD incidence generally increases with age and has a higher incidence among men at an earlier age. However, after menopause, the rate of CHD in women increases and can eventually exceed that of men in older age groups. Additionally, other studies have indicated that the incidence of CHD is related to health literacy and self-care, findings similar to those of this study [1,16]. Also, in this study, most patients had STEMI (71.7%), with one vessel involved (64.6%), especially the right coronary artery (56.6%). These outcomes are aligned with other studies, which stated that vessels and coronary arteries are damaged during CHD [17-19]. Most of the patients in this study were obese (66%), had hypertension (54.9%), while 42.8% had diabetes and 26.6% had dyslipidaemia during the last 3 years. These are among the common CHD-related risk factors that have been globally confirmed [18]. Additionally, a large proportion of our patients had high levels of TG (60.6%), BP (65.1%) and FBG (67.1%), which are considered leading causes of abnormal MetS components among the majority of patients (53.7%). These findings are consistent with those of Chen *et al.*, who reported that MetS components are prevalent among patients with CHD [20]. Thus, it is essential to control metabolic components in a reasonable control range to lower the risk factors and cardiovascular mortality among CHD patients.

Educational interventions for secondary prevention, in various modes and intensities, are effective in improving disease knowledge and healthy behaviours at both short-term (≥3 months) and long-term (≥6 months) follow-up. The most striking results were observed in the short-term improvement of healthy dietary habits [14]. In the current study, after applying an education program with six scales to the intervention group for 6 months, each of BMI, WC and systolic/diastolic BP decreased significantly ($p < 0.001$). However, some studies mentioned that no associations of BMI and BP with the risks of all-cause and cardiovascular mortality among CHD patients [21,22]. These disparities among studies might be related to sample size, patient age, family history of CHD, patient dishonesty in applying the education program and other risk factors.

Similarly, each of FBG, HbA1c and lipid profile (TC, LDL and TG) decreased significantly, accompanied by a significant increase in HDL ($p < 0.001$). These potential alterations indicate a promising improvement of health behaviour among the patients through the reduction of CHD-related risk factors (unhealthy diet, poor sleep, physical inactivity, stress and not using the prescribed medications by the specialist). These outcomes are in agreement with those of other studies conducted in different countries and nations [16,23,24].

In the intervention group, significant alterations were observed in the mean scores of each scale after the program was applied (STCDS and PSS-10 decreased, while MEDAS, IPAQ and MMAS-8 increased). These findings are impressive evidence of improvements in MetS components among CHD patients and are consistent with the outcomes of other studies, which have shown that increasing numbers of MetS components are associated with a gradually increased risk for all-cause and cardiovascular mortality [20]. Generally, insufficient disease- related knowledge among patients with CHD results in underestimated educational needs and somewhat unmet [11].

To the best of our knowledge, this is the first study to investigate educational interventions for the secondary prevention of CHD and their impact on health behaviour outcomes among patients in our locality. However, this study has some limitations, including single-centre research, a short follow-up period and findings of physical activity based on subjective reports, which entail a risk of misjudgement due to social desirability bias. Additionally, we were unable to examine the influence of other facets of patient education, such as intensity and delivery mode, due to the complexity of these factors and the lack of complete information.

CONCLUSIONS

Implement an educational program to change lifestyle, such as adopting a healthy diet, regular physical activity, sufficient sleep and adhering to prescribed medications can improve the health conditions of patients with CHD and MetS. Further studies are needed to document the long-term

efficacy and to determine whether courses will be necessary, along with evidence-based patient education and follow-ups that address diagnosis, treatment and self-care.

Acknowledgement

Both authors would like to thank the participants in this study and the healthcare staff of the Catheterization Unit at Sulaimani Cardiac Hospital, Iraq, for their kind assistance and support.

Ethical Statement

Ethical clearance was obtained from the Ethical Committee of the College of Nursing, University of Sulaimani, Sulaimaniyah, Iraq (No. 319 on January 2023- UoS). The study protocol adhered to the Declaration of Helsinki and its subsequent amendments. Written informed consent was obtained from participants. They felt free to leave the study without giving reasons. Their data anonymity and confidentiality were protected.

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