## Original Research Article

# The effect of healthcare education program on diabetic patients post cardiac surgery

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**ABSTRACT**

**Background:** Health education and lifestyle modifications re as important as pharmacotherapy in management of diabetes mellitus. It is suggested that healthcare education would aid in controlling glycaemic measures among diabetic patients especially in critical situations during postoperative periods. The aim of this study was to explore the impact of healthcare education program on diabetic patients who underwent cardiac surgery in Jeddah.

**Methods:** This was a prospective cohort study that was conducted in King Fahd armed forces hospital in Jeddah during the period 2009-2017 on 387 patients. Baseline Hemoglobin A1c was tested for all patients on regular basis (at 0, 3, 6, and 12 months), then a healthcare educational program was started followed by subsequent measurement of Hemoglobin A1c at the same time intervals. Comparisons between the Hemoglobin A1c before and after the program were made.

**Results:** There were no significant differences as regards Hemoglobin A1c levels among the studied patients before and after healthcare education (p=0.087). However, on regression analysis, educational program establishment was significantly correlated with lower Hemoglobin A1c levels among the patients (OR=0.43 (0.32-0.49), p<0.0001).

**Conclusions:** Healthcare educational programs can have a positive impact on improving Hemoglobin A1c control among diabetic patients after cardiac surgery.

**Keywords:** Cardiac surgery, Diabetes mellitus, Healthcare education, Hemoglobin A1c, Saudi Arabia

## INTRODUCTION

Diabetes mellitus is the most common metabolic disorder worldwide. It affects about 8% of population in developed countries, and higher numbers are found in developing countries. Because diabetes mellitus results in microvascular injury, macrovascular pathology, and atherosclerosis, it is prevalent among coronary heart disease patients. It is estimated that about 18-38% of coronary heart disease patients who undergo coronary heart bypass grafting (CABG) are diabetics.[1] Uncontrolled hyperglycaemia is a well-established risk factor for poor outcome after surgical myocardial revascularization.[2] In comparison to non-diabetic patients, cardiac patients with diabetes have a more severe and diffuse coronary atherosclerosis. In comparison to non-diabetic patients, cardiac patients with diabetes have a more severe and diffuse coronary atherosclerosis.[3] Diabetes also results in a higher morbidity, longer hospital stays, and later recovery after cardiac surgery in comparison to non-diabetics.[4] Furthermore, mortality rate among diabetic patients after performing cardiac surgery is higher than the rate among non-diabetics.[2] Therefore, tight control of diabetes is

fundamental for prevention of revascularization failure and reduction of mortality.

Management of diabetes requires a multidisciplinary approach consisting of pharmacological treatment, lifestyle modifications, control of risk factors, and regular healthcare education. Health education is vital for successful management of diabetes and prevention of complications. Education of diabetic patients should include information about symptoms and signs of diabetes, nutrition, exercise, ideal weight, drugs doses and side effects, regular monitoring tests and techniques, complications of the disease, and the importance of controlling various risk factors for diabetes. Healthcare education is not considered a part of the treatment program, but it is the treatment itself. Healthcare education was proved by different studies in literature to improve the outcome of diabetes, reduce the complications, and control the blood glucose levels.[5–7]

The aim of this study was to explore the impact of health education for diabetic patients who had cardiac surgery on glycaemic control during the post-operative period, which showed great outcome.

## METHODS

### Study design and site

For conducting this study, a prospective cohort design was chosen. The study was carried out in King Fahd armed forces hospital in Jeddah, Saudi Arabia. It was approved by the ethical committee of the research board. The inclusion criteria for the study were any diabetic patient who had cardiac surgery. Both genders were recruited, and different ages participated in the study. No control group was used in this research. The study was conducted during the years 2009 to 2017.

### Patients and methodology

Any diabetic patient who had cardiac surgery was followed-up for two years post-operatively. During the first year, hemoglobin A1c levels were measured at baseline and at regular intervals at 0, 3, 6, and 12 months. After that, a previously-prepared healthcare educational program was introduced to all patients in three sessions, pre-operative, post-operative and on follow up visits at the outpatient clinic. The educational program included a small booklet about diabetes mellitus home self-testing and its management, as well as flyers on what to do in case of high readings. Also, every follow up visit there was no less than 10-minute review with each patient on the process of diabetic home care. The discussed topics entitled: Surgery condition and procedure, risk factors, lifestyle modification and pharmacological treatment of diabetes mellitus. The sessions were conducted in King Fahd Armed Forces Hospital cardiothoracic surgery department and outpatient clinic. The education was conducted through PowerPoint presentations and flyers introduced by physicians and health educators.

Attendants for each session were registered, and all recruited patients for this study attended at least 90% of all the sessions. During the second year of patient follow-up, haemoglobin A1c levels were re-measured at 0, 3, 6, and 12 months. The study was conducted was conducted over a nine-year period from 2009 to 2017. During this period, a total of 387 patients were recruited.

### Statistical analysis

Data were fed to the computer and analysed using IBM SPSS software package version 20.0.[8] Qualitative data were described using number and percent. Quantitative data were described using mean and standard deviation. Significance of the obtained results was judged at the 5% level.[9] Chi-square test was used for categorical variables, to compare between different groups. Comparisons were made between males and females recruited during different years, between hemoglobin A1c levels at baseline, 3, 6, and 12 months intervals before the healthcare educational program, and between males' and females' Hemoglobin A1c levels before and after receiving the educational program. Regression analysis was then held using Odd's ratio (OR), and confidence interval (CI) for assessment of the correlation between Hemoglobin A1c and educational program and between Hemoglobin A1c and gender.

## RESULTS

During this period, a total of 387 patients were recruited. The vast majority of patients were recruited in 2009 (109 patients), followed by years 2016, 2015, and 2014, respectively. Table 1 demonstrates the number of patients recruited to the study each year distributed according to their gender. Males constituted 72.9% of the participating patients. The difference between the number of males and females participating in this study were not significant (p=0.110) (Table 1). Haemoglobin A1c levels measured at baseline, 3 months, 6 months, and 12 months intervals are demonstrated in Table 1 distributed according to the years. The differences between haemoglobin A1c levels are significantly different across the years (p<0.001).
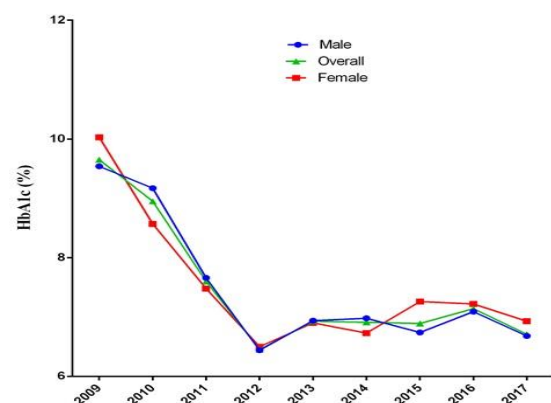


**Figure 1: Trend in HbA1c levels (12 months follow up points) before and after educational program.**

Upon comparing hemoglobin A1c levels before and after healthcare educational program among participants, it was found that the mean hemoglobin A1c level among all participants was 9.14 at baseline before receiving the educational program and 8.59 at baseline after education. Females had mean levels higher than males in all readings before and after receiving the healthcare education program. At baseline, the mean hemoglobin A1c levels were 9.41 and 9.04 among females and males, respectively. Similarly, the mean hemoglobin A1c levels after initiation of the heath education program training were 8.59 and 8.53 among females and males, respectively. After introducing the educational program, there was a decline in hemoglobin A1c levels at baseline, 3 months, 6 months, and 12 months intervals between males and females. However, the differences were not statistically significant (p=0.087). The details of hemoglobin A1c levels are demonstrated in (Table 2). The trend in hemoglobin A1c levels (12 months follow-up points) before and after educational program is depicted in (Figure 1).

**Table 1: Basic characteristics and different hemoglobin A1c levels for all patients (stratified by year).**

| Parameter | | All years | Year | | | | | | | | | P value [¥] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | |
| Total | | 387 (100) | 109 (28.2) | 41 (10.6) | 15 (3.9) | 20 (5.2) | 16 (4.1) | 46 (11.9) | 48 (12.4) | 54 (14) | 38 (9.8) | - |
| Gender N (%) | Male | 282 (72.9) | 85 (78) | 26 (63.4) | 10 (66.7) | 16 (80) | 9 (56.3) | 32 (69.6) | 34 (70.8) | 36 (66.7) | 34 (89.5) | 0.110 |
| | Female | 105 (27.1) | 24 (22) | 15 (36.6) | 5 (33.3) | 4 (20) | 7 (43.8) | 14 (30.4) | 14 (29.2) | 18 (33.3) | 4 (10.5) | |
| Hemoglobin A1c: Mean (SD) | | | | | | | | | | | | |
| Baseline | | 8.77 (1.99) | 9.09 (1.91) | 9.24 (2.42) | 9.35 (1.84) | 9.74 (2.25) | 8.37 (1.53) | 8.28 (1.81) | 8.01 (1.68) | 8.86 (2.22) | 8.22 (1.53) | |
| After 3 months | | 8.41 (2.01) | 9.52 (2.25) | 9.40 (2.25) | 8.51 (1.39) | 8.24 (1.19) | 7.41 (1.09) | 7.54 (1.32) | 7.28 (1.14) | 8.00 (1.95) | 7.67 (1.41) | <0.001** |
| After 6 months | | 8.14 (1.81) | 9.67 (1.9) | 9.15 (1.93) | 7.93 (1.09) | 7.20 (1.05) | 7.10 (0.94) | 7.11 (0.8) | 7.02 (0.75) | 7.57 (1.23) | 7.18 (1.14) | |
| After 12 months | | 7.91 (1.93) | 9.65 (2.18) | 8.95 (1.87) | 7.60 (1.15) | 6.45 (0.64) | 6.93 (0.67) | 6.91 (0.89) | 6.89 (0.81) | 7.14 (0.94) | 6.71 (0.83) | |

¥ Chi-square test; ** statistically significant (> 0.001)

**Table 2: HbA1c levels for all patients at different time points (stratified by gender).**

| Time | Before Education Program: Mean (SD) | | | After Education Program: Mean (SD) | | | P-value [a] |
|---|---|---|---|---|---|---|---|
| | Male | Female | Total | Male | Female | Total | |
| Baseline | 9.04 (1.95) | 9.41 (2.34) | 9.14 (2.06) | 8.53 (1.8) | 8.59 (2.22) | 8.54 (1.92) | 0.005 * |
| After 3 months | 9.35 (2.15) | 9.89 (2.48) | 9.49 (2.24) | 7.68 (1.46) | 7.83 (1.55) | 7.72 (1.48) | < 0.001** |
| After 6 months | 9.43 (1.91) | 9.82 (1.94) | 9.53 (1.92) | 7.24 (0.96) | 7.33 (1.2) | 7.27 (1.03) | < 0.001** |
| After 12 months | 9.45 (2.18) | 9.46 (1.94) | 9.46 (2.11) | 6.89 (0.85) | 7.05 (0.98) | 6.93 (0.89) | < 0.001** |
| P value[b] Baseline to 3 m | 0.025 | | | < 0.001** | | | |
| P value[b] Baseline to 6 m | 0.015 | | | < 0.001** | | | |
| P-value[b] Baseline to 12 m | 0.086 | | | < 0.001** | | | |

[a] Comparison between groups (before and after program)/t-test; [b] Baseline to follow-up/paired t-test; * Statistically significant (< 0.05) ** Statistically significant (< 0.001).

**Table 3: Linear regression testing association between HbA1c changes and different factors.**

| Predictors | B | S.E. | Adjusted OR (95% CI)[†] | P-value |
|---|---|---|---|---|
| Educational program establishment | 0.41 | 0.04 | 0.43 (0.32 – 0.49) | < 0.001** |
| Gender | 0.11 | 0.17 | 0.02 (-0.23 – 0.44) | 0.535 |

B= Regression coefficient; S.E.= Standard error of regression coefficient; OR= Odds Ratio; CI= Confidence Interval; ** statistically significant (<0.001).

When regression analysis was used, there was a statistically significant correlation between hemoglobin A1c levels and receiving a healthcare educational training. The Odd's ratio was 0.43 with a confidence interval of 0.32 to 0.49 (p<0.001). The correlation between hemoglobin A1c with gender was also studies and was found to be insignificant (p=0.535). The regression analysis is demonstrated in (Table 3).

## DISCUSSION

Diabetes mellitus has a major negative impact on microvascular and macrovascular structure. It predisposes to atherosclerosis and consequently vascular disorders such as coronary heart disease, cerebrovascular stroke, and peripheral vascular diseases. Diabetes is prevalent among diabetic patients who are candidates to coronary artery bypass grafting (CABG) and is associated with poor outcome.[1,2,4] The aim of this study was to explore the effect of implementing healthcare educational programs on the control of diabetic patients after performing cardiac surgery. Healthcare education in diabetes is considered the most important treatment approach for successful reduction of hyperglycaemia.[5]

Results from comparative analysis of this study showed that despite the differences between the hemoglobin A1c levels among patients before and after implementing the educational program, the differences were not statistically significant (p=0.087). However, on regression analysis, there was a significant correlation between hemoglobin A1c levels and the educational program (OR=0.43). Receiving healthcare educational program made the patients 0.64 times less liable to have high hemoglobin A1c levels (p<0.00). In agreement with these results, different researchers approved the positive impact of implementing healthcare educational program on reducing hemoglobin A1c levels.[10–12] Burke et al, in their review, stated the importance of healthcare education in management of diabetes and referred to the importance and the need for providing a larger number of diabetic educators, particularly in the United States (U.S) to match the growing prevalence in diabetes.[13] Similarly, Torimoto et al, in their prospective study showed that inpatient education of diabetic patients had significantly reduced the hemoglobin A1c level 12 weeks after discharge.[14] Didarloo et al conducted an interventional study on 90 females diagnosed with type 2 diabetes mellitus.[15] They studied the impact of an interventional educational program on hemoglobin A1c level on follow-up. They found that there was a statistically significant difference between the group who received the educational training and the control group with a probability value of <0.001. Despite the multiplicity of the studies approving the beneficial effect of health education in diabetes in general, few studies were found about the effect of health education on glycaemic control in patients who had cardiac surgery in particular. Researchers stated that poor glycaemic control increases the failure of revascularization after CABG, prolongs hospital stay, and results in higher morbidity and mortality.[16-24] This research showed that there is a significant positive impact of healthcare education on reduction of hemoglobin A1c levels after coronary artery bypass grafting (CABG) at 0, 3, 6, and 12 months.

Regarding the gender, results from this study revealed a slight increase in hemoglobin A1c levels among females in different measurement either before or after receiving healthcare educational program in comparison to males. However, the differences between the two genders were insignificant (p=0.087). Furthermore, there was no significant correlation between the gender and hemoglobin A1c levels on regression analysis (p=0.535). Bae et al reported similar findings in their research studying whether hemoglobin A1c level is affected by age and gender.[25] They noted that females had higher hemoglobin Ac levels in comparison to males, but the difference in their results was significant. In contrast, a study conducted in China between June 2014 and May 2015 reported that Hemoglobin A1c levels were higher in males than females.[26] The differences between the different studies might be attributed to different population characteristics, different sample techniques, and different methodologies used.

## CONCLUSION

Healthcare education can improve glycaemic control and reduce haemoglobin A1c level among diabetic patients after cardiac surgery in Jeddah. It should be considered for reduction of the deleterious effects of hyperglycaemia on myocardial revascularization and implementing further regional and national programs is recommended.

## ACKNOWLEDGEMENTS

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