CHAPTER FIVE:

DISCUSSION
5.0. Discussion

Diabetes mellitus is a common, costly condition associated with significant morbidity and mortality\textsuperscript{8,16}. Recent studies have found an increase in diabetes during the last decade\textsuperscript{141}. Diabetes is especially projected to be a significant burden in developing countries. Diabetes Self-Management Education (DSME) has been examined in several studies all over the world\textsuperscript{1,25,29,33,35,38,40-45,57,62,71,74,78,81,83,88-89,100,105-108,126,128-129,132,136,148,153,165-167,179,181,184-185,188,192-193,199,204,207-209,212,219,226,231-232,235-236,241-242,247,253}. The data showed that DSME plays an important role in management of diabetes mellitus. In Yemen, where health resources are limited, DSME is likely to be one of the major tools in the management of diabetes. Thus, goal of this study was to determine the impact of DSME on three parameters, knowledge about diabetes and its management, blood glucose levels and body mass index.

1. Knowledge about diabetes and its management

Knowledge about diabetes and its management was gathered from all subjects through pre and post-intervention questionnaires. The scoring schedule and the rationale for categorization of the subjects as having good, moderate or poor knowledge has been discussed in section 3.0. Baseline data obtained from diabetic patients enrolled in the study, revealed that the
majority of patients (65.3%) had poor knowledge about diabetes and its management. Only 11.3% had good knowledge, while 23.3% of the subjects could be categorized as having moderate knowledge about diabetes and its management. After allotment of subjects into control and intervention groups, no statistically significant difference between both these groups was observed pre-intervention groups ($\chi^2=3.211; df=2; p>0.05$) and ($Z$ value $=0.324; p>0.05$). Post-diabetes education, the results revealed a statistically significant improvement in the intervention group as compared to the control group ($\chi^2=14.601; df=2; p<0.001$) and ($Z$ value $=6.825; p<0.001$).

The observations of this study are similar to the findings of many other studies to evaluate the effectiveness of education program in improving diabetes knowledge and self-care in order to achieve long-term control of diabetes mellitus. For example, Bloomgarden et al. (1987) conducted a randomized control trial to evaluate effect of diabetes education on diabetes knowledge and blood glucose. The findings of this study showed that the knowledge scores increased from 5.3±1.6 to 5.8±1.3 in the education group as compared to no change in the control group. Blood glucose levels also improved significantly in the intervention group compared to the control group. Brown (1988) conducted a meta-analysis study to examine the effects of educational interventions in diabetes care. The results of this
study suggested that patient education appeared to be more effective and had positive outcomes on knowledge about diabetes. Paulozzi et al. (1989) evaluated diabetes knowledge and participants attitudes before and three months after the education program. The data revealed that DSME resulted in significant improvement in knowledge. Moreover, random blood glucose and glycosylated hemoglobin levels were significantly lower in the intervention group at the 3-month follow-up as compared to control group. These authors thus concluded that diabetes education offered a significant strategy to improve diabetic control. Dunn et al. (1990) conducted a study to examine the impact of a formal diabetes education program on diabetes-specific knowledge and attitude. The findings of this study showed that mean knowledge scores increased by 25% \( (p<0.001) \). Beeney (1990) found similar results in their study to examine effect of diabetes education on knowledge and metabolic control in diabetic patients. The results showed that the total diabetes knowledge scores increased significantly by 18%. Lennon et al. (1990) reported that patients who completed a diabetes education program showed greater knowledge than patients who dropped out of the programme \( (p<0.001) \). Brown (1992) studied the impact of educational interventions and outcomes in diabetic adults. She reported that post-education knowledge effects ranged from 0.49 to 1.05, self-care behavior effects from 0.17 to
0.57, with insulin injection and weight loss association with small effect size, metabolic control from 0.16 to 0.41 and psychological outcomes 0.27. She concluded that diabetes patient education is effective in improving patient outcomes. Fernando et al. (1993) performed a study to evaluate diabetes education on knowledge and metabolic control. The results of this study showed that improved knowledge about diabetes and metabolic control. Tu et al. (1993) examined the effects of diabetes education program on diabetes self-care knowledge, behaviors and metabolic control of older adults. The results of the study showed that a significant difference was observed in reduction of self-care behavior deficits \( p<0.001 \) but there were no significant difference in glycosylated hemoglobin values. The study of Tan et al. (1997) showed that the intervention group had significant and greater improvement in the knowledge of diabetes and self-care and in the dietary practice when compared with control group. The results of the study also showed that DSME alone moderately but significantly improved glycosylated hemoglobin levels in short-term although its long-term effects could not be verified. Pranoto et al. (1997) reported incremental increase in knowledge among participants from pre-intervention scores of 55.0±20.77 to post-intervention values of 74.92±21.11 \( p<0.05 \). Similar results were found by Abid et al. (1997) and Salazar (1997) and Arguedas. The results of the latter study showed
that after the educational program patients tend to increase knowledge about their disease (group A 13% before and 56% after, group B 18% before and 38% after and group C 69% before and 70% after). Hf et al. (1997)\textsuperscript{126} studied the effect of diet and exercise education on patients with Type 2 diabetes. The results showed that there was statistically significant difference in the daily caloric intake ($p<0.05$), diabetes knowledge, attitude and behavior in intervention group and also found there was improvement in glycosylated hemoglobin levels. Similar result found by Shih et al. (1999)\textsuperscript{219} who reported that the diabetes education program improve not only patient’s knowledge but also their glycaemic control. Improvement in the mean scores of knowledge was from 16.2±3.3 to 39.4±4.4 ($p=0.001$). Mean GHb decreased from 10.6±2.5% to 8.7±1.8% ($p=0.001$). Ward et al. (1999)\textsuperscript{242} conducted a study to evaluate an intensive diabetes foot education program for veterans at high risk for foot ulcer. The result of this study showed that there is statistically significant improvement in knowledge scores during first visit, improvement in satisfaction with foot care but no change in general satisfaction.

McCLean et al. (2000)\textsuperscript{167} found in their study that diabetes education and increased patient participation in their disease management lead to increased diabetes knowledge ($p=0.05$). Similar results were reported by Barcelo et al. (2001)\textsuperscript{35} who showed that in the intervention group,
compliance with dietary recommendations increased from 57.5% at the beginning of the study to 82.5% at the end \((p<0.001)\) as compared to control group. Also the average HbA\(_1c\) concentration declined significantly in the intervention group \((-0.4\%\pm1.1\%, \ p=0.001)\) but not in the control group \((-0.1\% \pm0.1\%).\) Norris et al. (2001)\(^{179}\) demonstrated the positive effects of self-management training on knowledge, frequency and accuracy of self-monitoring of blood glucose, self-reported dietary habits and glycaemic control in a study with a short follow-up of less than 6 months. Effect of interventions on lipids, physical activity, weight and blood pressure were variable. From these evidences, the authors concluded that self-management training in Type 2 diabetes was effective, particularly in short-term.

2. Fasting blood glucose and 2-hours post-prandial blood glucose

In this study, baseline fasting blood glucose values pre-diabetes education for both intervention and control groups revealed that the majority of patients in both groups (69.3%) had poor control of fasting blood glucose. Only 20% had good control and 10.6% had moderate control of fasting blood glucose. There was no statistically significant difference between both groups pre-intervention \((\chi^2 = 4.479; df=2; p>0.05)\) and \((Z \text{ value } =0.481; p>0.05)\). Post-diabetes education resulted in a statistically
significant improvement in blood glucose control in the intervention group, as compared to control group ($\chi^2 = 11.608; df = 2; p < 0.05$) and ($Z$ value = -6.640; $p < 0.001$).

The results of 2-hours post-prandial blood glucose levels pre-education in both intervention and control group showed identical results, that is majority of patients (69.3%) had poor control of fasting blood glucose. Only 20% had good control and 10.6% had moderate control of fasting blood glucose. There was no statistically significant difference between both groups ($\chi^2 = 5.146; df = 2; p > 0.05$) and ($Z$ value = 0.793; $p > 0.05$). Post-diabetes education resulted in a statistically significant difference between both groups ($\chi^2 = 11.772; df = 2; p < 0.05$) and ($Z$ value = -7.312; $p < 0.001$). Control of blood glucose levels had significantly improved in the intervention group, suggesting that diabetes education positively affected blood glucose control.

These results are similar to those obtained from numerous other studies. Like this study, Mazzuca et al. (1986) examined the effect of diabetes education on diabetes control. Post-intervention assessment revealed that the intervention group experienced significant greater reductions in fasting blood glucose (-27.5mg/dL versus -2.8mg/dL, $p < 0.05$) and glycosylated hemoglobin (-0.43% versus + 0.35 %, $p < 0.05$) as compared with control.
group. Kaplan et al. (1987)\textsuperscript{136} showed improvement in glycemic control in intervention group with follow-up of less than 6 months. They concluded that improved glycemic control was associated with weight loss. Raz et al. (1988)\textsuperscript{199} evaluated the efficacy of diabetes education on NIDDM patients on improving their knowledge of the disease and on disease management. After a 12-month follow-up of the intervention group the mean fasting, post-prandial blood glucose levels and HbA\textsubscript{1c} improved significantly in comparison with the control group. The same tendency was evident with the weight and lipoprotein profile. They concluded that educational group therapy can improve diabetes control in patients with NIDDM. Rost et al. (1991)\textsuperscript{207} found similar results in their study. Improvement in metabolic control was statistically significant only for intervention group ($p<0.02$). Rubin et al. (1991)\textsuperscript{208} and (1993)\textsuperscript{209} found a significant improvement in glycosylated hemoglobin ($p<0.001$) in the intervention group. They concluded that diabetes education can promote long-term benefits in metabolic control, self-care and emotional status. Similar result were reported by Redhead et al. (1993)\textsuperscript{204}. They studied the efficacy of a primary care-based diabetes education for Type 2 diabetes patients. The result of the study showed that the mean hemoglobin at baseline was 10.7\%, which decreased after 6 months to 9.6\% ($p<0.01$). Starostinu et al. (1994)\textsuperscript{226} reported significant decrease of HbA\textsubscript{1c} value in the intervention group.
(12.9% pre, 9.3% post one year, 9.2% after two year \(p<0.001\)) compared to no change in the control group (12.2% pre, 12.3% post one year). Frost et al. (1994)\(^{100}\) showed improvement in glycemic control in intervention group with follow-up of less than 6 months. Anderson et al. (1995)\(^{25}\) found similar significant reduction in glycosylated hemoglobin level in the intervention group. Japer et al. (1996)\(^{132}\) and Donzaler-Barcena et al. (1997)\(^{62}\) reported similar results. The latter authors studied the effect of diabetes education program on metabolic control. The results of the study showed that excellent metabolic control and less hypoglycemia or insulin use in the intervention group (pre-intervention FBG 237mg/dL and after 2 months 122mg/dL) (pre-intervention HbA\(_{1c}\) 9.41 % and after 2 months 7.7%). Insulin dose reduction was observed from 35 u/day to 20% after intervention. Similar results were found by Erdogan et al. (1997)\(^{83}\). They conducted a study to evaluate efficacy of an eight-day structured patient education program on non-insulin dependent diabetic subjects. The results of this study showed that the average fasting blood glucose fell from 10.1±4mmol/L to 7.1±2.9mmol/L \(p<0.01\) and 2-hours post-prandial plasma glucose levels decreased from 13±4.9mmol/L to 10±3.9 mmol/L \(p<0.01\), HbA\(_{1c}\) levels also declined (6.4±1 versus 8.7±2%; \(p<0.001\)). A study conducted by Ozer et al. (1997)\(^{185}\) to investigate the efficacy of intensive group education program on diabetes knowledge and metabolic...
control showed that HbA1c level was found to be significantly lower at 3rd, 6th, 9th months than the levels at entry ($p<0.001$, $p<0.001$, $p<0.05$ respectively) and also found that diabetes knowledge level at the 12th month was increased significantly ($p<0.0001$). Similar result was found by Tankova et al. (1997) who reported that metabolic control (HbA1c level) improved significantly from 9.1\% to 8.0\% after six months and 7.8\% after one year ($p<0.05$). There was a significant increase in diabetes related knowledge at the end of five-day program (81\% versus 52\%; $p<0.01$). This study also demonstrated that structured patient education improved the quality of life of diabetic patients and their metabolic control and significantly reduced the rate of acute complications. Bandurska et al. (1997) showed that the levels of glycemia were lowered from 253 mg\% to 168 mg\% after two years and HbA1c from 10.1\% to 8.5\%. The study reported that the level of patients' knowledge had increased after 6 months by 33\% and after 12 months by 41\% and BMI had lowered from 30.1 to 27.7. Nosari et al. (1997) found in their study that there was no reduction in the tested parameters after 2 months, but significant reduction occurred after four months in fasting blood glucose (170±49 versus 257±43mg/dL, $p<0.01$) and HbA1c (8.3±0.8 versus 9.7±1.4\%; $p<0.01$). The study reported that fasting blood glucose decrease was also maintained after 12 months (201.8±42.6, $p<0.05$). Feng-Hsuan et al. (1997)
investigated whether short-term admission for diabetes education improved glycaemic control in those outpatients with poor sugar control. The result of this study showed that the mean HbA1c was 10.4±1.7% before and after short-term admission and education, HbA1c level decreased to 8.9±1.7% (p<0.05). A meta-analysis performed by Brown (1999) showed that post-education, glycosylated hemoglobin levels reduced dramatically (up to 2.7% points) as did other outcomes such as weight loss. Mazzuca et al. (1999) conducted study to evaluate knowledge and attitude change as predictors of metabolic improvement in diabetes education. The result showed improved in glycemic control.

Norris et al. (2002) conducted a study to evaluate the efficacy of self-management education on glycemic control in adults with Type 2 diabetes. The results indicated that the intervention group experienced a significant decrease in GHb by 0.76% (95% CI, 0.34-1.18) more than the control group at immediate follow-up; by 0.26% (0.21% increase, -0.73% decrease) at 1-3 months of follow-up and by 0.26% (0.05–0.48) at greater than 4 months of follow-up. GHb decreased more with additional contact time between participant and educator. A decrease of 1% was noted for every additional 23.6 hour (13.3-105.4) of contact. The authors concluded that self-management education improved GHb levels at immediate follow-up and increased contact time increased the effect. Hirohito et al. (2002)
found small but significant differences in HbA1c levels between the intervention group and control group that were still maintained 3 years after the start of intervention (control group 7.78±1.27% versus intervention group 7.62±1.2%, \( p=0.0023 \)). They concluded that the moderate but significant improvement effected by self-management education on the glycaemic control of adults with Type 2 diabetes is maintained even in long-term intervention. Cook et al. (2002)\(^57\) conducted a study to determine if adolescents with Type 1 diabetes can become better problem solvers and improve metabolic control after diabetes education. The study showed that the intervention group had significant improvements in problem solving scores and in HbA1c values over baseline. However they did not reach significant difference over controls. Diane (2002)\(^78\) studied the impact of outpatient diabetes management on serum lipids in urban African-Americans with Type 2 diabetes who attended a structured diabetes care program. The results showed decrease in HbA1c from 9.3% at the initial visit to 8.2% at 1 year \( (p<0.001) \) and significant decrease in total and LDL cholesterol and triglyceride levels and increase in HDL cholesterol levels. Brown et al (2002)\(^44\) conducted a study on cultural competent of diabetes self-management education for Mexican Americans. The results indicated that the intervention group showed significantly lowered HbA1c and fasting blood glucose at 6 months and 12 months and
higher diabetes knowledge scores. At 6 months, the mean HbA1c of intervention group was 1.4% below the mean of control group. Wilson et al. (2003)\textsuperscript{253} assessed the effectiveness of clinical nutrition education in reducing HbA1c levels. They found that clinical nutrition education is associated with change in HbA1c levels ($p<0.001$).

3. Body mass index

Base-line pre-intervention data on body weight revealed that in both intervention and control groups majority of patients (67.3%) had normal weight, 26% were obese while 6.66% were under weight. There was no statistically significant difference between intervention and control groups in terms of body weight ($\chi^2=4.339; df=2; p>0.05$) and ($Z$ value=$0.113; p>0.05$). Post-diabetes education a statistically significant difference between both groups ($\chi^2=6.098; df=2; p<0.05$) and Z value =-$2.003; p<0.05$) was observed since post-intervention, 9 of subjects in the intervention group had shown reduction in body weight ($1.6\pm0.5$).

A randomized control trial performed by De Bont et al. (1981)\textsuperscript{71} showed that the intervention group had a significant reduction in weight loss. A randomized controlled trial performed by Werdier et al. (1984)\textsuperscript{247} showed the positive effects of weight loss in intervention group with follow-up of less than 6 months. The average weight loss was -2 kg (range 1.3-3.1). Our
results are also in agreement with the results of a number of other studies.

In a study on diabetes education and peer support as a facilitator of weight loss and glycaemic control in elderly patients, Pratt et al (1987)\(^1\) reported that weight loss and reduction in level of glycaemic control occurred within the group receiving diabetes education and peer support. A meta-analysis performed by Brown (1990)\(^4\) examined educational intervention and outcomes in diabetic adults. The results of this study showed that composite knowledge on diabetes and its management showed the largest effect size for a number of variables, including weight loss (ES: 0.17, CI: 0.08–0.27), improved metabolic control (HbA\(_1c\) measurement) (ES: 0.41, CI: 0.31–0.52), blood sugar (ES: 0.34), urine sugar (ES: 0.39), behavior change including skill performance (ES: 0.23–0.44), dietary compliance/adherence (ES: 0.57, CI: 0.44–0.70) and decrease medical cost (ES: 0.35). Other studies have also reported observations identical to our study. D'Eramo-Melkus et al. (1992)\(^7\) evaluated the impact of a model program of diabetes education and weight reduction on diabetes control and weight loss in obese individuals with non-insulin dependent diabetes mellitus. The results of this study indicated that by 6 months the intervention groups had a significant weight loss (\(p<0.01\)). The mean weight loss (approximately 10 lb) was independent of intervention group and was maintained over the duration of the study. Significant
Improvement in metabolic control was associated with participation in diabetes education-weight reduction intervention. Similar results were found by Glasgow et al. (1992)\textsuperscript{106}. They conducted a study to evaluate the effects of educational program among older patients with Type 2 diabetes. The results of this study showed that post-education, the subject in the intervention group showed significantly greater reduction in body weight as compared with control subjects. Uusitupa et al. (1993)\textsuperscript{236} reported that after short-term follow-up, intervention group had significant weight loss. Kurashvili et al. (1997)\textsuperscript{48} found that after diabetes education, the body weight dropped from 84.5kg to 77.2kg in the intervention group. HbA\textsubscript{1c} levels dropped from 11.2±0.32% to 8.1±0.2% as compared with control group. Vanden (1997)\textsuperscript{241} observed that the body mass index decreased from baseline 28.7 to follow-up 28.2 (p<0.05), concomitant with an improved mean knowledge score change from 8.5 at baseline to 12.4 and further to 23.6 at follow-up (p<0.001). Moreover, the patients showed an improvement of metabolic control after following the program (mean HbA\textsubscript{1c} decreased from 9.3% at baseline to 8.9%; p<0.05 to 9.1% in the follow-up). Agurs-Collins et al (1997)\textsuperscript{29} conducted a randomized controlled trial of weight reduction and exercise for diabetes. The results of this study showed that post-diabetes education, the subjects in the intervention
group showed significantly greater reduction in body weight as compared with control subjects.

4. Investigation of factors leading to improved knowledge

Since this study showed a positive impact on diabetes knowledge and management, blood glucose level control and body mass index, an attempt was made to identify the factors that were responsible for improvement. Only one parameter, that is the factors influencing improvement in knowledge about diabetes and its management was investigated. The variables that were tested included, age, sex, marital status, education, occupation, family income, duration of diabetes, visit frequency, type of treatment and family history. However, no characteristic was found to be significantly associated with improvement in knowledge.
5.1. Conclusions and implications

The efficacy of diabetes self-management education no longer needs to be debated. The findings of this study clearly demonstrate patient education has positive outcomes in diabetic adults. Diabetes education was observed to have significant improvements through increased knowledge regarding diabetes and its management, promoting proper body weight and improved fasting blood glucose and 2-hours post-prandial blood glucose in the intervention group.

This study has important implications for current clinical and public health practice and research. Acquired knowledge and skills are a predictor of improved glycaemic control and body weight.\(^{89,165,235}\) Glycaemic control is an important predictor of many of the chronic complications of diabetes.\(^{24,179,233}\) According to the UK prospective diabetes study (UKPDS),\(^{237}\) each 1% reduction in HbA\(_{1c}\) over 10 years is associated with reductions in risk by 21% for any endpoint related to diabetes, 21% for death related to diabetes, 14% for myocardial infarctions and 37% for microvascular complications. Weight loss\(^{86,139}\) was significantly associated with better management of patients, since those patients who reduced their weight by 12 to 30 pounds initially could be managed without anti-diabetic medications, or at least improved glucose tolerance, reducing the likelihood of comorbid conditions.\(^{178}\) However, the diminishing effects
of self-management education interventions with longer follow-up intervals after the end of the intervention is consistent with the literature in diabetes. This argues for diabetes education program being an essential part of the management of diabetes mellitus.
5.2. Recommendations

1. Integration of diabetes self-management education as a component of diabetes management and care:

This study and others referred to above, have shown that diabetes self-management education has an important impact in the management of diabetes mellitus. Thus, DSME should be made available to all diabetic patients. DSME can would also be an effective tool in controlling and preventing the chronic complication of diabetes. This would result in alleviation of personal suffering and economic burden at the level of the patient and family, as well as reduction in the demands made on public health resources as a result of these complications.

2. Appropriate education of health care providers

In order that DSME has an effective impact, appropriate education of the health team (nurse, dietitian, counselors, physician, exercise therapist etc.) is required. Education should not only focus on the basic aspect of understanding of diabetes and its management, but should also include advice and training in educational methods.

3. DSME as a continuous activity

It is known that the effects of DSME diminish over time. Thus in order to
have significant impact, DSME must be a continuous and not a one-time activity.

4. Expansion of educational activity to include the family

Education of patient’s family will be indispensable to keep patient in well-controlled condition. Thus, the education programme has to be expanded to include the family. Of critical importance here, is the understanding about diabetes nutrition, that is appropriate caloric intake. The family should also be aware of the management of acute complications of hyperglycemia and hypoglycemia.

5. Education of community to prevent diabetes

Education of community is an essential part of any education program for the prevention of diabetes. Diabetes education whose focus is on prevention or modification of dietary habits and other life-style behaviors that are linked with the development of glucose tolerance are the primary strategy to prevent diabetes.

6. Further researches are needed particularly to assess the long-term effectiveness of diabetes self-management education on sustained glycaemic control, body weight, microvascular and cardiovascular disease.