Results from the First Culturally Tailored, Multidisciplinary Diabetes Education in Lebanese Adults with Type 2 Diabetes: Effects on Self-Care and Metabolic Outcomes.

Ola Sukkarieh-Haraty

Lebanese American University Byblos Campus <https://orcid.org/0000-0001-9971-1563>

Leonard egede

Medical College of Wisconsin

George Khazen

Lebanese American University

Joelle AbiKharma

Lebanese American University

Natali Farran

American University of Beirut

Maya Bassil (✉ mbassil@lau.edu.lb)

Lebanese American University <https://orcid.org/0000-0001-9996-1300>

Research

Keywords: diabetes self-care, culture, multidisciplinary intervention, education, Lebanon, Type 2 Diabetes, Lebanon.

Posted Date: September 8th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-801164/v1>

License: This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Version of Record: A version of this preprint was published at BMC Research Notes on February 10th, 2022. See the published version at <https://doi.org/10.1186/s13104-022-05937-0>.

Abstract

Background: Diabetes self-management education (DSME) is an essential component of lifestyle management needed for diabetes care. Despite ranking second in the world in the prevalence of diabetes, there is no reported intervention addressing diabetes self-care in the Arab world. This pilot-study tested the effect of culturally-tailored education targeting diabetes self-care on glycaemia and cardiovascular risk factors of Lebanese with type 2 diabetes (T2DM).

Methods: A sample of 27 adults (Age: 61 ± 10 yrs, 59% males, HbA1c: $8.98 \pm 1.38\%$) with T2DM was recruited from primary health care centers in Beirut. Participants received culturally tailored, multidisciplinary education. Scales assessing self-care, social support, fatalism, and diabetes knowledge, as well as anthropometric measures, and blood samples were collected at baseline, 3-months and 6-months post- intervention.

Results: Diabetes self-care (Diet, Self-Monitoring Blood Glucose and foot care) improved after 6 months, which was reflected in a significant drop in glycemic level (HbA1c: -0.5%; FPG: -38 mg/dl), and cholesterol/HDL ratio (4.45 ± 1.39 vs. 4.06 ± 1.29). Waist circumference decreased at 6 months compared to 3 months ($p < 0.05$).

Conclusions: This is the first effective culturally-tailored intervention that improved self-care, glycemic control, body adiposity and blood lipids of Lebanese with T2DM. Larger scale implementation with representative sample is warranted.

Introduction And Background

Type 2 Diabetes mellitus (T2DM) is a chronic progressive disease in nature, whereby effective treatment requires various self-care activities by the patient (American Diabetes Association [ADA], 2020). Diabetes self-care includes medication adherence, exercise, healthy nutrition, self-monitoring of blood glucose (SMBG), and foot care. Adequate self-care has been reported to reduce micro and macrovascular complications, which in turn decreases costs

(Abujudeh, Abu Al Rub, Al-Faouri & Gharaibeh, 2012; Skyler et al., 2009). Thus, the American Association of Diabetes Educators (AADE) considers educating patients on self-management/care a core component of diabetes care (Beck et al., 2017). Effectively, diabetes self-care education has been shown to improve glycemic levels, dietary habits, body anthropometrics (weight, BMI and waist circumference) (Magkos, Yannakoulia, Chan & Mantzoros, 2009; Miller, Kristeller, Headings, Nagaraja & Miser, 2012), and blood lipids (Gao, Wang, Zhu & Yu, 2013). Despite the vast body of evidence on the importance of diabetes self-care, adhering to and maintaining it, especially on the long term, is challenging (Shrivastava, Shrivastava & Ramasamy, 2013). Guidelines do not endorse a “one-size fits all” educational program. Instead, they recommend cultural tailoring of educational program, taking into consideration ethnic and cultural beliefs and practices to ensure optimal self-care adherence and glycemic outcomes (Beck et al., 2017; ADA, 2020). One important cultural barrier that is commonly reported to impede diabetes self-care behavior is

diabetes fatalism, which is described as “a complex psychological cycle characterized by perceptions of despair, hopelessness, and powerlessness” (Egede & Ellis, 2010). Specifically, diabetes fatalism is linked to inadequate medication adherence, poor diet and lifestyle behaviors, uncontrolled glycemic levels, and decreased quality of life (Egede & Ellis, 2010; Walker et al., 2012; Osborn, Brains & Egede, 2010).

Lebanon is a country in the Middle East where diabetes prevalence has been increasing over the years, and it is currently estimated at 12.2% (IDF, 2019). Generally, the Lebanese T2DM population also has a high prevalence of cardiovascular risk factors such as smoking, obesity, and physical inactivity (Nasrallah et al., 2017). Another local study that examined medical reports retrospectively concluded that addressing blood pressure and glycemic control without physical activity cannot reverse overall/cardiovascular risk in people with diabetes and hypertension (Safar et. Al., 2017). Lebanese patients with diabetes were found to exhibit fatalistic attitudes that was related to poor diabetes self-management (Sukkarieh-Haraty & Howard, 2015). In a qualitative study conducted with Lebanese patients with breast cancer, participants compared cancer to diabetes, inferring that both diseases are God sent (Doumit, Abu-Saad Huijjer, & Kelley, 2007). Younger and heavier Lebanese T2DM patients with lower levels of education and no diabetes co-morbidities were shown to exhibit more fatalistic attitudes, which in return was significantly associated with uncontrolled glycemic levels (Sukkarieh-Haraty et. al., 2017 (a) (b)). Other studies concluded that Lebanese patients with diabetes demonstrated low levels of diabetes self-care specifically physical exercise (Karaoui et al., 2018) and the majority do not receive complete therapeutic/safety laboratory-test monitoring recommended for patients on chronic medication in the Lebanese community (Ramia & Zeeny, 2014). Additionally, a recent randomized control trial consisting of 100 participants with T2DM that used therapeutic patient education found improvement in diabetes self-care activities as well as glycemic outcomes, three months after the intervention compared to baseline (El Gerges, 2020).

Despite the documented importance of educating patients on diabetes self-care in optimizing glycemic outcomes and minimizing the complications of T2DM, diabetes education programs that targets self-care in Lebanon are scarce. Therefore, this pilot study aims to investigate the effectiveness of a diabetes educational program on diabetes self-care, glycaemia, and cardiovascular risk factors in a Lebanese population with T2DM.

Methods

Design: one group quasi experimental design.

Sample

A convenience sample of 30 adults with T2DM, of which 27 completed the study, was recruited from two primary health care centers (PHCs) in Beirut. Inclusion criteria included being Lebanese, aged 18 years or older, diagnosed with T2DM for at least one year, on oral hypoglycemic therapy, and having an HbA1c level above 7.5% within the past three months (cobas b123-ROCHE HbA1c analyzer). All participants

could speak, read and write Arabic. Participants who did not meet the inclusion criteria or those reported to have mental or psychiatric illness were excluded from the study. A total of 28 subjects were required to achieve a power of 80% and a level of significance of 5% (two sided) (Rosner,1995), with an effect size $d=0.5$ and standard deviation $SD=2.11$ for HbA1c based on Abdi, Sadiya, Ali, Varghese & Abusnana, 2015

Data Collection

The participants completed the following previously validated instruments:

Summary of Diabetes Self-Care Activities Scale (SDSCA)

SDSCA consists of 12 items that assess diabetes self-care, divided into four self-care activities: diet, exercise, foot care, self-monitoring of blood glucose and diabetes medication taking. SDSCA is scored by taking the raw score from each set of self-care tasks and converting it to a standardized score with a mean of zero and standard deviation of 1. The overall inter-item correlation was above .5 demonstrating .59 to .74 for diet subscale, .74 to .78 for exercise and .38 to .76 for glucose testing (Toobert, Hampson & Glasgow, 2000). The instrument has been translated to Arabic (Sukkarieh-Haraty & Howard, 2016) and its average inter-item reliability ranged between $-.11$ and $.79$.

Diabetes Knowledge Test (DKT)

DKT is a 23-item scale that measures diabetes knowledge. It is divided into two sections: 14-item general test and 9-item insulin scale. The highest score is 23 points and lowest is zero, whereby higher scores designate better knowledge of diabetes and its care. The revised version that combined coefficient alpha, of different samples, demonstrated reliability for both the general test ($.77$) and the insulin use subscale ($.84$) (Fitzgerald, et. Al., 2016). In an Arabic speaking adolescent population, reliability analyses of the 2 subscales and the total resulted in 0.3, 0.25, and 0.49 respectively (Al-Akour, 2003). For the purpose of this study, the 14-item general test was used only as selected participants were on oral hypoglycemic treatment.

Diabetes Fatalism Scale (DFS)

DFS is a 12-item scale that measures diabetes fatalism. The higher the score of the scale, the greater the individual's belief in diabetes fatalism would be. Reliability analysis resulted in 0.804 (Egede & Ellis, 2009). There is no published Arabic version of the tool. The authors translated the instrument to Arabic using back translation and validated it in a Lebanese population with T2DM (Cronbach's alpha of 0.77).

Demographic Information

Demographic characteristics, including gender, age, marital status, education, employment status, income, and medical insurance coverage, as well as other health-related characteristics (weight, height, body mass index, diabetes duration, treatment, family history, complications and smoking status) were collected from participants.

Glycemic control and lipid profile

Blood samples were drawn to measure Glycosylated hemoglobin (HbA1c), Fasting Plasma Glucose (FPG) and blood lipids (Total-Cholesterol, LDL-C, HDL-C and Triglycerides) using international standard procedures (International Expert Committee, 2009). HbA1c and

FPG were used as a measure of glycemic control.

Anthropometric Measures

Weight (kg), height (cm) and waist circumference (cm) were collected using standard procedures (Fryar et al., 2012), while body mass index (BMI) was computed (kg/m^2). Body composition including body fat mass (kg) and fat free mass (kg) was measured using bioelectrical impedance (Tanita BC-418, Tanita Corporation, Tokyo, Japan).

Procedures

Recruitment

The researchers obtained approval from the Institutional Review Board (IRB) of the academic institution and the directors of the PHCs to conduct the study. The researchers informed the general practitioners and the administrative officer in the PHCs about the study and the inclusion criteria of the participants. Administrative officers reviewed the medical charts for potential patients and informed the researchers thereafter of the selected ones. The researcher contacted the selected participants during their clinical visits in the waiting room and told them about the study. Interested participants were taken to a private room and asked to give their informed consent to participate in the study. A total of 68 individuals were screened but only 27 participants completed the study (Figure 1)

Description of the intervention

The intervention was based on ADA's National Standards for Diabetes Self-Management Education and Support (Beck et al., 2017). Two educational sessions (3 to 4 hours each) were administered at the PHC for a group of 10 patients over 2 days. The sessions covered the pathophysiology of diabetes, its

nutritional management, integration of physical exercise, self-monitoring of blood glucose, adherence to medication, foot care, as well as vascular complications and psychosocial issues such as fatalism that is pertinent to the Lebanese culture. The education program was interdisciplinary as it was provided by diabetes educators and counselors in the relevant fields. The diabetes educators explained in lay terms the mechanisms underlying development and complications of diabetes, the short and long term of diabetes outcomes, as well as diabetes medications. The Nurse Diabetes Educator provided skills for adequate foot care and glucose self-monitoring. The Dietitian Diabetes Educator covered portion sizes and the different food groups (my-plate) and explained the importance of exercise. The social worker addressed fatalism and its effect on diabetes self-care contextually. The education program embraced culturally sensitive core principles, as all educators understood the culture profoundly. Myths and misconceptions around diabetes conception, management and medication adjustment were tackled. USDA My-plate was tailored based on participants food affordability as well as norms of traditional cooking. Exercise was based on understanding of participants environmental facilitators and barriers as well as encouraging women's engagement given their overwhelming role of being primary care givers. The social worker who was recruited from the PHC, had profound understanding of the participants' backgrounds, beliefs and systems values especially regarding fatalism. Patients were encouraged to bring their spouses to the education sessions and were instructed to keep daily logs of glucose self-monitoring. Printed and presented material and information were culturally-specific such as meal plans with examples from local foods. Every patient was provided a personalized diet based on his/her needs and asked to adhere to it for the duration of the study. Breakfast and lunch were offered as incentives on both days before and after the education session, respectively. Data collection consisted of surveys (SDSCA, DFS, SS, DKT, participant information form), fasting blood samples (HbA1c, Fasting Plasma Glucose, lipid profile) and anthropometric measures (weight, height, BMI, waist Circumference & body composition) collected on the day of the intervention (baseline), three months and six months, post-intervention. Following the intervention, researchers conducted phone calls using a phone script, on monthly basis till end of study (six months) to check on participants' status, adherence to diabetes self-care and address any concerns or issues participants would voice. The researchers provided guidance and support where needed.

Data Analysis

Descriptive statistics were computed for the demographic and physiologic characteristics of the participants as well as the scores of SDSCA, DKT and SS questionnaires, with means and standard deviations (SD) for continuous variables and percent for nominal variables. Paired t-test was used to compare continuous variables between baseline and 6 months, while repeated measures ANOVA was used for comparisons at 3 different time points. Post-hoc Tukey's test was computed when significance was obtained. Level of significance was set as $p < 0.05$. SPSS version 23 was used to analyze the data.

Results

Demographic and other characteristics of the study participants are presented in Table 1. Mean age was 60.7 ± 10.3 years with an age range of 29 to 75 years, while mean number of diabetes complications was 2 ± 2 . Out of the participants who completed the study, 59.3% were men, 85.2% were married, 55.5% had less than 11 years of education, 77.8% were unemployed and 70.4% reported that they “do not have enough to make ends meet”. Also, most of them (59.3%) had diabetes for more than 10 years, family history of diabetes (70.4 %) and previously received education about diabetes management (70.37 %) (Table 1).

TABLE 1: *Characteristics of study participants*

	<i>M</i>	<i>SD</i>
Age	61.9	8.2
Number of comorbid conditions	2.2	1.6
	N	%
Gender		
Male	16	59.3%
Marital status		
Married	23	85.2%
Unmarried	4	14.8 %
Level of education		
< 11 years	15	55.6%
High school and above	12	44.4%
Occupation		
Employed	6	22.2%
Unemployed	21	77.8%
Insurance		
Yes	14	51.9%
Income		
Have enough to make ends meet	8	29.6%
Do not have enough to make ends meet	19	70.4%
Diabetes duration		
≥ 10 years	11	40.7%
10 years	16	59.3%
Family History		
Yes	20	74.1%
Smoking		
Yes	19	44.4%

Data is presented as mean and standard deviation (SD) for continuous variables and N and percentage (%) for categorical variables

At the end of the study (6-month post-intervention), glycaemia was improved compared to baseline, whereby both HbA1c and fasting glucose decreased by 4% and 19%, respectively

(Table 2). This was consistent with enhanced diabetes self-care activities, with significantly ($p < 0.05$) higher scores for diet (5.00 vs. 2.38), SMBG (5.15 vs. 1.61) and foot care (5.48 vs. 3.56) at 6 months compared to baseline (Table 1). Diabetes knowledge test and fatalism scores did not change post-intervention, while social support scores increased slightly (46.37 vs. 39.63, $p = 0.07$) (Table 2).

Table 2
Glycemic control, diabetes knowledge, self-care, fatalism, and social support at baseline and 6 months, post intervention

	Baseline		6 months		95% CI for Mean difference	p-value
	M	SD	M	SD		
Glycemic control	8.98	1.38	8.63	1.11	- 0.98; 0.26	0.24
HbA1c %						
FPG mg/dl	203.96	69.14	165.33	53.98	-70.42; - 6.84	0.02*
DKT score	8.14	2.19	8.44	2.37	- 0.85; 1.45	0.61
SDSCA scores	2.38	2.35	5.00	2.43	1.33; 3.91	0.0003**
General Diet						
Exercise	2.52	2.48	3.11	2.04	-0.62; 1.81	0.32
SMBG	1.61	2.24	5.15	1.98	2.33; 4.76	< 0.001**
Foot Care	3.56	3.14	5.48	2.75	0.32; 3.52	0.02*
Medication	6.48	1.81	7	0	-0.22; 1.26	0.16
Compliance						
DFS score	27.59	7.83	26.31	8.02	- 3.90; 1.52	0.373
SS score	39.63	13.59	46.37	13.28	- 0.56; 14.05	0.069
Data is presented as mean and standard deviation (SD); * $p < 0.05$ ** $p < 0.001$ (paired t-test). FPG:						
Fasting plasma Glucose; DKT: Diabetes Knowledge Test; SDSCA: Summary of Diabetes SelfCare Activities; SMBG: self-monitoring of blood glucose; DFS: diabetes fatalism scale; SS: Social Support Scale.						

Table 3 reports anthropometric measures and blood lipids at baseline and 6 months postintervention. Weight, height, BMI and body composition at 6 months post-intervention did not differ from baseline. As for the lipid profile, ratios of Total Cholesterol/HDL-C and LDL-C/HDL-C were significantly ($p < 0.05$)

improved at 6 months post-intervention, which was mainly driven by an increase in HDL-C (45.59 vs. 42.91, $p = 0.1$) (Table 3).

Table 3
Anthropometric parameters and blood lipid profile at baseline and 6 months, post intervention

Baseline			6 months	hs	95% CI for Mean difference	<i>p-value</i>
M	SD		M	SD		
Anthropometric Parameters		18.49	81.70	19.43	-2.08; 0.32	0.15
Weight Kg	81.41					
BMI Kg/m ²	31.28	5.47	31.00	5.66	-0.76; 0.20	0.24
Waist circumference cm	107.52	12.91	106.59	12.01	-3.24; 1.39	0.42
Fat %	35.19	7.03	34.53	5.99	-2.11; 0.82	0.37
Fat mass kg	30.86	11.53	29.89	10.09	- 2.41; 0.47	0.18
Fat Free mass kg	53.93	9.36	54.5	10.62	-0.90; 2.04	0.44
Blood Lipids	181.96	90.28	177.59	96.12	-32.74; 23.99	0.75
Triglycerides mg/dl						
Total Cholesterol mg/dl	182.03	37.44	175.96	31.27	-18.86; 6.71	0.34
HDL-C mg/dl	42.91	10.21	45.59	10.13	- 0.6; 5.97	0.11
Total-C/HDL-C	4.44	1.39	4.06	1.29	-0.73; -0.06	0.02*
LDL-C mg/dl	107.48	32.38	102.63	27.00	- 15.03; 5.32	0.34
LDL-C/HDL-C	2.64	1.07	2.37	.84	-0.53; -0.003	0.047*
Data is presented as mean and standard deviation (SD); * p < 0.05 paired t-test; BMI: Body mass index; Total-C: Total cholesterol; HDL-C: High-density lipoprotein cholesterol; LDL-C: Low density lipoprotein cholesterol.						

Trends of change for diabetes self-care activities, fasting plasma glucose, HbA1c, waist circumference and blood lipids across the three time points (repeated measures ANOVA with post hoc tukey's test), from baseline to 3 months and from 3 months to 6 months are presented in Fig. 2. Improvements in glycemia (HbA1c and FPG), diet and SMBG were evident at 3-month post-intervention ($p < 0.05$ vs. baseline) and these changes were maintained at 6 months. Conversely, foot care did not change at 3 months and was only improved at 6 months ($p < 0.05$ vs. baseline). Waist circumference decreased at 6 months compared to 3 months ($p < 0.05$) but not to baseline, while Total Cholesterol/HDL-C and LDL-C/HDL-C improved only at 6 months compared to baseline (Fig. 2).

Discussion

Despite the fact that this was a pilot study, it was the first interventional trial that provides initial evidence of the effectiveness of diabetes education intervention on glycaemia, self-care behavior and cardiovascular risk factors in Lebanese population with type 2 diabetes. The improvement in glycemic control was not only statistically but also clinically significant (Little, Rohlfing & Sacks, 2011). Specifically, HbA1c was decreased by more than 0.5% at three months, post intervention and this was maintained at six months. These findings are in line with studies conducted on other populations with T2DM, where glycemic control was enhanced following the use of a culturally tailored education (Utz et al., 2008; Gao et al., 2013; Osborn et al., 2010).

Diabetes Self-Care

Consistent with our hypothesis, some but not all aspects of diabetes self-care changed over time, which could explain the improved glycemic outcomes. Self-care is not adopted at the same level in all areas (Williams et al., 2014). Specifically, the educational program resulted in significantly healthier dietary habits at three months and six months, post intervention. These findings suggest that patients adhered early on to the diabetes regimen. The latter was tailored individually to their anthropometric measures, glucose and lipid profile and this behavior was maintained after 6 months. Our findings are relatively consistent with the sole reported study from Lebanon (El Gerjes, 2020) where participants in the experimental group had better diabetes self-care practices as well as well improvement in glycemic outcomes at three months following the intervention. Our result are also comparable to those of a culturally tailored educational study in African Americans, where the study group was able to modify their dietary habits and adhere to their food plan (Utz et al., 2008). Similarly, another study conducted on Emirati patients revealed changes in carbohydrate consumption after the delivery of the intervention (Abdi et al., 2015).

Another dimension of diabetes self-care that showed substantial improvement in our intervention was self-monitoring of blood glucose (SMBG), where differences were observed at three months and six months, post intervention compared to baseline. Glucose self-monitoring may ensure involvement of the patient in controlling their glycemia, hence shifting more responsibility to the patient (Shivashankar et al., 2014). Additionally, SMBG shows real-time results about glycemic levels, enabling for accurate alterations in lifestyle and medication. A study in Scotland revealed that the health care provider has a pivotal role in patients' interpretation of the changes in their glycemic levels with an appropriate correction to their selfcare (Lawton, Peel, Parry, & Douglas, 2008).

Amelioration in foot care was only evident at six months, post intervention which might be due to the resistance to comply that was observed during the education sessions. The follow up calls and reminders about the importance of feet hygiene and examination were needed to eventually obtain significant change at 6 months. On the other hand, exercise and medication adherence did not differ from baseline practices in our study. These results are comparable to those from diabetes education interventional

study delivered to Emirati patients with T2DM, whereby patients did not adhere to exercise regimen as prescribed (Abdi et al., 2015). With regards to medication compliance, no change was observed since baseline scores were high (6.48 over 7) possibly indicating that participants were already adherent to the medication intake.

Diabetes Knowledge

The reported improvement in some diabetes self-care activities was not paralleled by an increase in diabetes knowledge from baseline values. It should be noted that the DKT scale used in the present study did not show good reliability scores in Arabic-speaking populations (Al-Akour, 2003). Also, participants scored fairly (8.14 over 14) on the test at baseline. In addition, while behavioral research strived globally to find the exact means of delivering knowledge that favors behavioral change and optimal health outcomes, it is well established that knowledge does not guarantee practice. Indeed, diabetes knowledge is not the sole predictor of self-care behaviors (Osborn et al., 2010; Walker et al., 2012) since other factors influence the decision making of adhering to the set of diabetes self-care activities. Common constructs of adult education theories and health-behavior change focus on learning as a “continuous process grounded in experience” that is influenced by emotions, social factors and cognition (Cooper, Booth & Grill, 2003). Therefore, it may be difficult to separate the complex interrelated self-management activities (Dunning, 2010). In the present study, this is supported by the fact that the multidisciplinary diabetes education program equipped participants with tools and skills needed (SMBG and foot care), addressed the cognitive barriers to motivation (fatalism), and mobilized social support (inviting spouses to attend the education).

Diabetes Fatalism

Although targeted by our education program, diabetes fatalism and its 3 subscales (despair, hopelessness, and powerlessness) (Egede & Ellis, 2010) did not change from baseline, which might indicate that fatalism in this population is a constant trait (as opposed to a state like depression), a culturally grounded belief that is non-modifiable by such intervention. We have previously demonstrated in a larger scale study that diabetes fatalism is widespread in

Lebanon and is associated with poor glycemic control (Sukkarieh-Haraty, Egede, Abi Kharma, & Bassil, 2017, 2018). Thus, as a clinical implication, diabetes fatalism can be assessed as an additional non-modifiable risk factor for poor diabetes outcomes in this population. Alternatively, other intervention measures might be needed to address such construct, like involving religious authorities in the education program since fatalism in the Arab world is closely related to religious beliefs (Nabolsi & Carson, 2011).

Lipid profile

Recognition of overall risks associated with cardiovascular disease and type 2 diabetes, including abdominal obesity and lipid disorders, has widened the focus for diabetes treatment strategies (Serrano-Gil & Jacob, 2010). The present intervention resulted in statistically significant differences in total cholesterol/HDL-C as well as LDL-C/HDL-C ratio post six months, concomitant with a decrease in waist

circumference. We suggest that while improvements in diabetes self-care, especially with regards to healthier dietary habits, had an earlier positive impact on glycemic control (3 months post-intervention), favorable effects on lipid profile were only evident at 6 months, the time it took for abdominal obesity to improve. There is scarce evidence of diabetes education interventional studies conducted in Arab region that targeted cardiovascular assessment. A randomized controlled study conducted in Jordan (Abujudeh et al., 2012) obtained statistically significant differences in body weight and BMI one year postintervention. Similarly, another randomized controlled study conducted in Qatar (Mohamed, AlLenjawi, Amuna, Zotor, & Elmahdi, 2013) found statistically significant reduction in BMI one year post-intervention. No changes in other lipid profile parameters or anthropometric measures were observed in the present study, which is comparable to findings of interventions conducted with non-Arab populations (Rosal et al., 2011; Williams et al., 2014).

Summary And Conclusions

In summary, this is the first intervention study showing the effectiveness of a culturally-tailored, multidisciplinary education program in improving glycemic control, cardiovascular risk factors and diabetes self-care behavior of Lebanese patients with T2DM. It sets the stage for larger scale implementation with more representative sample. The main strength of our study is that it is the first published report that provides evidence of a translational design where it aimed to examine a culturally tailored diabetes educational program that could be incorporated into standard care practices based on previous findings (Sukkarieh-Haraty et al., 2017 (a) (b)). Dietary plans and exercise recommendations were also factored in the cultural beliefs as well as the financial status of the participants. Despite the promising results shown in the current study, there are also few limitations to note, hence we provide interpretations of findings with reservations. First, the study is a pilot quasi-experimental design, hence participants were not randomized and there was no control group. Additionally, the sample was recruited from two PHCs only, thus the generalizability of our findings to other health care settings still needs to be investigated.

In conclusion, we believe that the findings from the present study are promising and provide new evidence to justify larger scale testing of this culturally sensitive educational program. Culturally tailored education can help patients adhere early on to the diabetes regimen that is personalized to their anthropometric measures, glucose and lipid profile. Diabetes educators have the utmost role in assessing and addressing diabetes context through tailoring culturally sensitive interventions.

Declarations

Ethical Approval and Consent to participate

This study was approved by the Lebanese American University Institutional Review Board:

LAU.SON.OH1.2013.R1.1 Subjects provided written consent before participating in the study.

Consent for publication:

All the authors have made a significant contribution to this manuscript, have seen and approved the final manuscript, and have agreed to its submission to “Globalization and Health”.

Availability of data and materials

The data and materials generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare no conflict of interest.

Funding

This work was supported by the Lebanese American University-intramural fund granted to the first author. *Roche Diagnostics Middle East* provided screening tools for HbA1c levels and *LifeScan MEA* donated the glucometers and test strips. The companies did not have any role in the design of the study, data analyses, or decision to publish.

Authors' contributions

- Study conception and Design: OSH, LEE and MB.
- Data Collection: NF OSH and MB delivered the intervention.
- Data analyses and interpretation: GK, JAK, NF
- Drafting and Critical revision of the article: All of the authors.

Acknowledgements

We would like to thank Mar Antonios dispensary and Makassed Primary Health Care Centers in Beirut and all the patients for making this study feasible.

References

1. Abdi, S., Sadiya, A., Ali, S., Varghese, S., & Abusnana, S. (2015). Behavioural Lifestyle Intervention Study (BLIS) in patients with type 2 diabetes in the United Arab Emirates: A randomized controlled trial. *BMC Nutrition*, 1.
2. Abujudeh, B. A., Abu Al Rub, R. F., Al-Faouri, I. G., & Gharaibeh, M. K. (2012). The impact of lifestyle modification in preventing or delaying the progression of type 2 diabetes mellitus among high-risk people in Jordan. *Journal of Research in Nursing*, 17(1), 32-44. doi: 10.1177/1744987110387482
3. Al-Akour, N. (2003). The relationships among the Knowledge of Diabetes, Attitude towards Diabetes, family and friends' support, benefits of and barriers to treatment and compliance with health

- regimens of Jordanian adolescents with Insulin Dependent Diabetes Mellitus. Widener University
4. American Diabetes Association. (2020). Standards of medical care in diabetes—2020 abridged for primary care providers. *Clinical diabetes: a publication of the American Diabetes Association*, 38(1), 10.
 5. Beck J, Greenwood DA, Blanton L, et al. 2017 National Standards for Diabetes Self-Management Education and Support. *Diabetes Care* 2017 Oct; 40(10): 1409-1419. <https://doi.org/10.2337/dci17-0025>
 6. Cooper, H. C., Booth, K., & Gill, G. (2003). Patients' perspectives on diabetes health care education. *Health Education Research*, 18(2), 191-206. doi: 10.1093/her/18.2.191
 7. Doumit, M. A. A., Abu-Saad Huijjer, H., & Kelley, J. H. (2007). The lived experience of lebanese oncology patients receiving palliative care. *European Journal of Oncology Nursing*, 11(4), 309-319. doi:10.1016/j.ejon.2007.02.008
 8. Dunning, T. (2010). Editorial: Chronic disease self-management: what do we measure? *Journal of Nursing & Healthcare of Chronic Illnesses*, 2(4), 251-253. doi: 10.1111/j.17529824.2010.01073.x
 9. Egede, L.E., Ellis, C.: Development and psychometric properties of the 12-item diabetes fatalism scale. *J. Gen. Intern. Med.* 25, 61-66 (2010)
 10. El Gerges, N.S. Effects of therapeutic education on self-efficacy, self-care activities and glycemic control of type 2 diabetic patients in a primary healthcare center in Lebanon. *J Diabetes Metab Disord* (2020). <https://doi.org/10.1007/s40200-020-00567-4>
 11. Fitzgerald, J. T., Funnell, M. M., Anderson, R. M., Nwankwo, R., Stansfield, R. B., & Piatt, G. A. (2016). Validation of the Revised Brief Diabetes Knowledge Test (DKT2). *The Diabetes educator*, 42(2), 178–187. <https://doi.org/10.1177/0145721715624968>
 12. Fryar, C. D., Gu, Q., & Ogden, C. L. (2012). Anthropometric reference data for children and adults; United States, 2007-2010.
 13. Gao, J. Wang, J., Zhu, Y., & Yu, J. (2013). Validation of an information-motivation-behavioral skills model of self-care among Chinese adults with type 2 diabetes, *BMC Public Health*, 13 (100), doi:<http://dx.doi.org/10.1186/1471-2458-13-100>.
 14. Karaoui, L. R., Deeb, M. E., Nasser, L., & Hallit, S. (2018). Knowledge and practice of patients with diabetes mellitus in lebanon: A cross-sectional study. *BMC Public Health*, 18 doi:<http://dx.doi.org.ezproxy.lau.edu.lb:2048/10.1186/s12889-018-5416-7>
 15. International Diabetes Federation. IDF Diabetes, 9 ed. Brussels, Belgium: International Diabetes Federation, 2019. <http://www.diabetesatlas.org>
 16. International Expert Committee. (2009). International Expert Committee report on the role of the A1C assay in the diagnosis of diabetes. *Diabetes Care*, 32(7), 1327-1334.
 17. Lawton, J., Peel, E., Parry, O., & Douglas, M. (2008). Patients' perceptions and experiences of taking oral glucose-lowering agents: a longitudinal qualitative study. *Diabetic medicine : a journal of the British Diabetic Association*, 25(4), 491-495. doi: 10.1111/j.1464-5491.2008.02400.x

18. Little, R. R., Rohlfing, C. L., & Sacks, D. B. (2011). Status of hemoglobin A1c measurement and goals for improvement: from chaos to order for improving diabetes care. *Clinical chemistry*, 57(2), 205214.
19. Magkos, F., Yannakoulia, M., Chan, J. L., & Mantzoros, C. S. (2009). Management of the metabolic syndrome and type 2 diabetes through lifestyle modification. *Annual review of nutrition*, 29, 223256.
20. Miller, C. K., Kristeller, J. L., Headings, A., Nagaraja, H., & Miser, W. F. (2012). Comparative effectiveness of a mindful eating intervention to a diabetes self-management intervention among adults with type 2 diabetes: a pilot study. *Journal of the Academy of Nutrition and Dietetics*, 112(11), 1835-1842.
21. Mohamed, H., Al-Lenjawi, B., Amuna, P., Zotor, F., & Elmahdi, H. (2013). Culturally sensitive patientcentred educational programme for self-management of type 2 diabetes: A randomized controlled trial. *Primary Care Diabetes*, 7(3), 199-206. doi: <https://doi.org/10.1016/j.pcd.2013.05.002>
22. Nasrallah, M. P., Nakhoul, N. F., Nasreddine, L., Mouneimne, Y., Abiad, M. G., Ismaeel, H., & Tamim, H. (2017). Prevalence of diabetes in greater Beirut area: worsening over time. *Endocrine Practice*, 23(9), 1091-1100.
23. Nabolsi, M. M., & Carson, A. M. (2011). Spirituality, illness and personal responsibility: the experience of Jordanian Muslim men with coronary artery disease. *Scandinavian journal of caring sciences*, 25(4), 716-724.
24. Noureddine, H., Nakhoul, N., Galal, A., Soubra, L., & Saleh, M. (2014). Level of A1C control and its predictors among Lebanese type 2 diabetic patients. *Therapeutic Advances in Endocrinology and Metabolism*, 5(3), 43-52. doi: 10.1177/2042018814544890
25. Osborn, C. Y., Bains, S. S., & Egede, L. E. (2010). Health literacy, diabetes self-care, and glycemic control in adults with type 2 diabetes. *Diabetes Technology and Therapeutics*, 12(11), 913-919. doi: 10.1089/dia.2010.0058
26. Powers, M. A., Bardsley, J., Cypress, M., Duker, P., Funnell, M. M., Hess Fischl, A., . . . Vivian, E. (2015). Diabetes Self-management Education and Support in Type 2 Diabetes: A Joint Position Statement of the American Diabetes Association, the American Association of Diabetes Educators, and the Academy of Nutrition and Dietetics. *Diabetes Care*, 38(7), 1372-1382. doi: 10.2337/dc15-0730
27. Ramia, E., & Zeenny, R. (2014). Completion of therapeutic and safety monitoring tests in lebanese outpatients on chronic medications: A cross-sectional study. *Patient Preference and Adherence*, 8, 1195-1204. doi:<http://dx.doi.org.ezproxy.lau.edu.lb:2048/10.2147/PPA.S69250>
28. Rosal, M. C., Ockene, I. S., Restrepo, A., White, M. J., Borg, A., Olendzki, B., . . . Reed, G. (2011). Randomized trial of a literacy-sensitive, culturally tailored diabetes self-management intervention for low-income Latinos: Latinos en control. *Diabetes Care*, 34(4), 838-844. doi: 10.2337/dc10-1981
29. Rosner B. *Fundamentals of Biostatistics*. 4th ed. Duxbury Press; 1995. Page 221.
30. Safar, M. E., Gnakaméné, J., Bahous, S. A., Yannoutsos, A., & Thomas, F. (2017). Longitudinal study of hypertensive subjects with type 2 diabetes mellitus: Overall and cardiovascular risk. *Hypertension (Dallas, Tex. 1979)*, 69(6), 1029-1035. doi:10.1161/HYPERTENSIONAHA.116.08962

31. Shrivastava, S. R., Shrivastava, P. S., & Ramasamy, J. (2013). Role of self-care in management of diabetes mellitus. *Journal of Diabetes & Metabolic Disorders*, 12(1), 14. doi: 10.1186/2251-6581-12-14
32. Shivashankar, R., Kirk, K., Kim, W. C., Rouse, C., Tandon, N., Venkat Narayan, K. M., & Ali, M. K. (2014). Quality of diabetes care in low- and middle-income Asian and Middle Eastern countries (1993–2012) – 20-Year systematic review. *Diabetes Research and Clinical Practice*, 107(2), 203-223. doi: 10.1016/j.diabres.2014.11.004
33. Sukkarieh-Haraty, O., & Howard, E. (2015). Is social support universally adaptive in diabetes? A correlational study in an Arabic-speaking population with type 2 diabetes. *Holist Nurs Pract*, 29(1), 37-47.
34. Sukkarieh-Haraty, O., Egede, L. E., Abi Kharma, J., & Bassil, M. (2017)(a). Diabetes fatalism and its emotional distress subscale are independent predictors of glycemic control among Lebanese patients with type 2 diabetes. *Ethnicity & Health*, 1-12. doi:10.1080/13557858.2017.1373075
Sukkarieh-Haraty, O., Egede, L. E., Abi Kharma, J., & Bassil, M. (2017)(b). Predictors of Diabetes Fatalism Among Arabs: A Cross-Sectional Study of Lebanese Adults with Type 2 Diabetes. *Journal of Religion and Health*, 1-11. doi:10.1007/s10943-017-0430-0
35. Toobert, D. J., Hampson, S. E., & Glasgow, R. E. (2000). The summary of diabetes self-care activities measure: results from 7 studies and a revised scale. *Diabetes care*, 23(7), 943-950.
36. Utz, S. W., Williams, I. C., Jones, R., Hinton, I., Alexander, G., Yan, G., . . . Oliver, M. N. (2008).
37. Culturally tailored intervention for rural African Americans with type 2 diabetes. *The Diabetes Educator*, 34(5), 854-865. doi: 10.1177/0145721708323642
38. Walker, R. J., Smalls, B. L., Hernandez-Tejada, M. A., Campbell, J. A., Davis, K. S., & Egede, L. E. (2012). Effect of diabetes fatalism on medication adherence and self-care behaviors in adults with diabetes. *General Hospital Psychiatry*, 34(6), 598-603. doi: 10.1016/j.genhosppsych.2012.07.005
39. Williams, I. C., Utz, S. W., Hinton, I., Yan, G., Jones, R., & Reid, K. (2014). Enhancing Diabetes Selfcare Among Rural African Americans With Diabetes. *The Diabetes Educator*, 40(2), 231-239. doi: 10.1177/0145721713520570.

Figures

Figure 1

Patient Recruitment

Figure 2

SDSCA parameters, glucose control, waist circumference and blood lipids at baseline, 3 months and 6 months, post-intervention. a significant change between baseline and 3 months, b significant change between 3 and 6 months, c significant change between baseline and 6 months (Repeated measure-ANOVA with tukey's posthoc test)