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Original Article

Mobile care teams improve metabolic control for adults with Type II diabetes in the Southern West Bank, Palestine

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A B S T R A C T

Aim: The purpose of this study is to assess the effectiveness of the Diabetes Comprehensive Care Model (DCCM) intervention on diabetes care outcomes. We hypothesized that participants receiving diabetes care from the mobile diabetes clinic (intervention group) would demonstrate significant improvement in glycemic control compared to those receiving treatment as usual (control group).

Materials and methods: We conducted a longitudinal, quasi-experimental study in which two similar clinics were identified. From both, we recruited 100 patients diagnosed with Type II diabetes. At baseline, patients were similar in terms of both socio-demographic and diabetes health variables. The team visited patients at the Bethlehem clinic at the beginning and end of the study (control group). Mobile diabetes care teams implemented the DCCM in Hebron four times over one year (treatment group).

Results: Most participants were female (63.5%) with average diabetes duration of 7.9 years. Initial HbA1c was 9.49% on average (SD = 1.93) and 9.20% (SD = 1.92) for the control and intervention groups, respectively. Statistically significant change in HbA1c, cholesterol, creatinine and systolic BP were observed in the intervention group (differences in change between recruitment and follow-up). That is, significant improvement over time was observed for the treatment group whereas little or no change was observed for the control group.

Conclusion: The DCCM-based intervention leads to improved glycemic control parameters indicative of diabetes control. Clinically significant change was observed in treatment group only. Integrative diabetes care appears especially well suited for fragmented healthcare systems with limited resources.

1. Introduction

The world is facing an unprecedented and continued increase in the prevalence of diabetes with considerable adverse effects on the health and well-being of individuals, families, healthcare systems and societies. Much of this increase in prevalence is occurring in low-resource countries, accounting for almost 80% of the total disease burden and 88% of premature deaths [1]. For instance, countries of the Middle-East and North Africa (IDF-MENA) region, where Palestine is a member, have among the highest rates of diabetes in the world. For adults 20–79 years, prevalence was estimated to be 9.2% in 2013 climbing to 9.6% in 2017 or 38.7 million people. Prevalence is expected to increase to 12.1% or 82 million people by 2045. Of note, 49.1% of those with diabetes are undiagnosed [2,3].

Palestine is home to 5 million people residing in the West Bank, East Jerusalem and the Gaza Strip, a developing economy according to the World Bank classification [4]. In 2018, unemployment in Palestine was 27.2% overall, ranging between 13.2% in West Bank and 48.2% in Gaza [5]. These high percentages adversely impact the standards of living of Palestinians [6] and all aspects of healthcare.

Diabetes prevalence estimates have been difficult to obtain given the fragmented nature of the Palestinian healthcare system and the lack of reliable epidemiological studies. Yet a 2012 study estimated that prevalence in adults 25 + years of age was 9.7% in 2000, increasing to 15.3% by 2010; forecasts are 20.8% for 2020 and

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23.4% for 2030 [7]. Diabetes complications are predicted to be high due to poor glycemic control and huge challenges in healthcare delivery. In a recent cross-sectional study of 1308 diabetes patients, for instance, mean HbA1c was 9.2%, with only 16.1% of the sample meeting the target of HbA1c of <7.0% for diabetes control and approximately 50% had an HbA1c above 9%; 23% had blood pressure (BP) more than 140/90 mmHg, and 95.3% were overweight (BMI > 25 kg/m^2) or obese (BMI > 30 kg/m^2) with mean BMI of 33.46 (SD = 5.95). Moreover, 16.3% had a history of the macrovascular disease (myocardial infarction or stroke), and 25.9% had microvascular complications and 40 (4.9%) had advanced kidney disease with serum creatinine > 1.4 mg/dl [8]. Another study conducted in Gaza Strip reported a mean HbA1c of 8.97% (SD = 2.02) and 19.5% had HbA1c ≤ 7% [9]. While in the UNRWA clinical audit report, diabetes control rate based on the HbA1c test (i.e., <7%) was 25.2%. It was 5.3% for Type I patients, 28.3% for Type II patients and 25.0% for patients with diabetes and hypertension [10]. These statistics point to the need for comprehensive screening, lifestyle interventions including diet and weight management.

The Palestinian healthcare system is a fragmented mixture of providers: namely the Palestinian Ministry of Health (MOH); the United Nations Relief and Works Agency (UNRWA), Palestinian Non-Governmental Organizations (NGOs), Palestinian Military Medical Services (PMMS), and the private sector [7–9]. Also, Israeli healthcare networks provide services to Palestinians residing in the East Jerusalem who hold Israeli residency.

The healthcare system in Palestine faces enormous challenges at all levels that negatively affect diabetes prevention, control and care management. In 2003, Augusta Victoria Hospital (AVH) in Jerusalem with the support of the World Diabetes Foundation (WDF) and DanChurchAid (DCA) implemented the diabetes comprehensive care model (DCCM). The DCCM provided an alternative approach to the currently prevailed biomedical approach (i.e., physician-centered, focused on prescription of medications). The DCCM required that existing diabetes treatment procedures be unified into best practices protocols encompassing a holistic approach that focuses on the whole person, and modified for the local context in Palestine. This encompasses the general reduction in diets rich in sugary and fatty contents, not only for diabetes patients but to improve overall health of the general population. For diabetes patients with varying capabilities in the availability and preferences of traditional foods based on their socioeconomic status, modified diets are essential. An example is the famous desert *Kanafeh* made from cheese and dough sprinkled with nuts topped with a sugary syrup. Consuming this desert without the syrup and limiting the consumption helps to improve blood glucose. Culturally tailored lifestyle interventions and a reorientation of the healthcare system to provide comprehensive, effective, and appropriate service for chronic, long-term care may lead to improved consistent metabolic parameters and can minimize the risk of developing diabetes [11,12]. This person-centered approach also requires community engagement and participation to foster diabetes awareness and prevention. With the DCCM, the patient plays a central and active role in diabetes self-care and management. A multi-disciplinary team of clinicians provides comprehensive diabetes care including: lifestyle management, physical activity and exercise, nutrition, foot care, eye screening, individual and group counseling, standardized diabetes laboratory testing, patient, family and community education, home visits, prevention and care of complications. The psychosocial component of the intervention is intended to foster trust between patients and care providers, build patient engagement and activation [8]. The Mobile Diabetes Clinic was introduced in 2014 to facilitate the community-wide implementation of the DCCM model, to create awareness of diabetes in the community as a way to improve control and prevent complications while building the clinical capacity of front-line staff and unifying management and care protocols.

The purpose of the current study was to assess the effectiveness of a DCCM intervention on diabetes care outcomes. We hypothesized that participants receiving diabetes care from the mobile clinic would demonstrate significant improvement in glycemic control compared to those receiving treatment as usual (control condition).

2. Subjects, materials, and methods

2.1. Study design

For this longitudinal, quasi-experimental study, we first identified similar healthcare clinics in two West Bank communities. Both were operated by the Palestinian Ministry of Health (MOH) providing similar levels of services to equivalent numbers of patients. Nahalin clinic in Bethlehem served as the control clinic from which 100 Type II diabetes patients were recruited and assessed again 12-months later (i.e., treatment as usual). At the same time, 100 Type II diabetes patients were recruited from the Samou clinic in south Hebron who received the DCCM treatment from the mobile diabetes clinic (i.e., intervention group.

Mean age was 57.9 years (SD = 7.79) and 56.58 years (SD = 8.76) for the control and intervention groups, respectively (t = 1.126, p = .261). Diabetes duration was similar between groups (M = 7.9 years, t = 0.082, p = .935). HbA1c levels at recruitment were 9.50% (SD = 1.93) and 9.20% (SD = 1.92) for the control and intervention groups, respectively (t = 1.155, p = .249). Only systolic BP statistically differed between groups with M = 136.11 SD 21.17 in the intervention group and M = 125.28 with SD = 16.53 in the control group (t = −4.032, <0.001). No patients were lost at follow up (i.e., no attrition). This study was approved by the hospital's Institutional Review Board and research ethics committee.

2.2. Mobile diabetes clinic

The AVH mobile diabetes clinic is staffed by a multi-disciplinary team of healthcare professionals. The van is equipped with a non-mydriatic digital eye screening camera, foot-care equipment, an insole-making machine, blood pressure machine, scale, blood and urine collection kits. Patients visit the clinic every three months over 1-year. During each visit, the AVH mobile clinic team provides comprehensive diabetes assessment and care to patients and their families including counseling with diabetologist, nurses, and nutritionists to foster healthy lifestyle choices. Clinicians perform laboratory tests, eye screening, and foot care. AVH mobile clinic provides direct services to diabetes patients, adjusts their treatment plans as needed, and teaches the DCCM protocol to the local clinic team.

The mobile clinic visited the Nahalin clinic at recruitment to collect baseline data from the control group, and again 12-months later. The same socio-demographic and biochemical data were collected from both groups enabling us to compare change over time (i.e., DCCM intervention vs. treatment as usual).

2.3. Data collection and outcome measures

Socio-demographic and health-related information were collected at recruitment (e.g., time since diabetes diagnosis). At baseline and 12 months later, weight, height and blood pressure were measured as well as HbA1c, total cholesterol, creatinine, and microalbuminuria.

2.4. Statistical analysis

For this study, we computed Multivariate Analyses of Variance (MANOVA) to determine if change in diabetes health indices significantly differed between treatment and control groups (i.e., HbA1c1, BMI, cholesterol, blood pressure, creatinine levels). With 100 participants in both groups, the sample was sufficient to detect medium to small effect sizes. An *a priori* p value of .05 was set as the threshold for statistical significance. All statistics were performed using SPSS version 21.

We hypothesized that participants receiving mobile diabetes care would exhibit significantly more positive change in glycemic control than those receiving treatment as usual (control condition). Post hoc analyses were performed to identify which aspects of diabetes health account for this between-group difference; a Bonferroni correction was applied to adjust for multiple univariate analyses (i.e., minimize risk of capitalizing on change). Hierarchical discriminant function analyses were also performed to help clarify the relative importance of the various diabetes health indices (i.e., HbA1c1, BMI, cholesterol, blood pressure, creatinine levels).

3. Results

As previously noted, control and treatment groups were statistically indistinguishable for five of six diabetes health indices measured at baseline (all except systolic BP). We next performed multivariate analysis of variance (MANOVA) to test the hypothesis that treatment and control groups would significantly differ. This result emerged, $\lambda = 0.766$, $F(6, 193) = 9.746$, $p < .001$. Post hoc analyses indicate that this between-group difference is due to significant differences in HbA1c ($\beta = 0.074$, $p < .001$), systolic BP ($\beta = 0.037$, $p = .006$), creatinine ($\beta = 0.024$, $p = .028$), and BMI ($\beta = 0.024$, $p = .030$) Table 1.

This difference in HbA1c between the intervention and control groups can be seen as Fig. 1. For (control) participants in Bethlehem, HbA1c did not change. But for those who received the DCCM intervention, HbA1c significantly decreased over the course of the intervention. Difference scores between groups did not significantly differ for diastolic BP and cholesterol levels.

With six independent variables, however, the risk of Type I error for post hoc analyses is not 5% but 26.5% (i.e., 6/20). If we apply a Bonferroni correction, the revised threshold level required for statistical significance becomes $p < .008$ (i.e., $p < .05/6$). Although HbA1c and systolic BP remain significant; creatinine and BMI no longer attain statistical significance.

Given these positive but ambiguous findings, we also performed hierarchal discriminant function analyses to examine the relative significance of independent variables. We first entered HbA1c and systolic BP; these two variables enabled us to correctly categorize 62% of participants, $\chi^2 = 15.23$, $p < .01$. Inclusion of the remaining variables (i.e., creatinine, cholesterol, BMI, diastolic BP) increased prediction a further 6% which is also statistically significant ($\chi^2 = 29.98$, $p < .01$). Over and above differences in HbA1c and systolic BP, change scores for the remaining variables provide unique prediction (significant difference between treatment and control groups). In other words, between group differences are not attributable solely to HbA1c and systolic BP; the mobile diabetes intervention appears to also lead to significant differences in change in creatinine levels, BMI and diastolic BP.

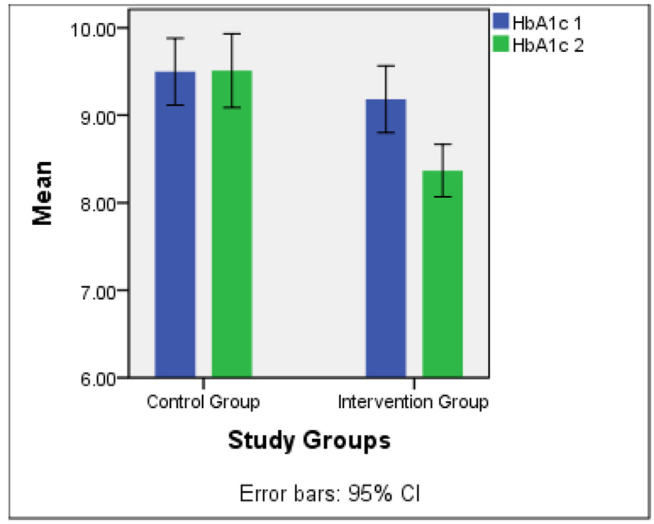

Fig. 1. HbA1c to control and intervention groups early at the beginning of the study and after one year.

4. Discussion

The results of this study indicate that community-based intervention enabled us to achieve positive change in diabetes care outcomes. We report statistically significant change in HbA1c, BMI, Serum Creatinine, and Systolic Blood Pressure for the intervention group only. The equivalence of the two communities suggests that we can attribute this change to the implementation of the DCCM intervention.

The DCCM enables multi-disciplinary teams to help patients make healthier decisions about diet, exercise, and weight; reliably monitor blood glucose, lipids, blood pressure and cholesterol; access and correctly use medications; and undergo regular screenings for diabetes-related complications [2]. The DCCM requires modification of treatment procedures and best practices to the limitations and realities of different communities. This model also strives to build clinical capacity of front-line healthcare professionals by mentorship and on the job training. Such person-centered models have been studied and shown to be effective particularly in low and middle-income countries to help surmount system fragmentation, shortage of human resources, build clinical capacity of community healthcare workers and allied health professionals to facilitate diabetes care, and enhance community engagement and ownership of the model, [12–14].

These results are germane to clinicians and other stakeholders

Table 1
Post hoc analysis of between-groups differences (control vs Intervention)

Source	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[i]
	HbA1c Difference	34.362	1	34.362	15.875	.000	.074	15.875	.978
	BMI Difference	13.050	1	13.050	4.788	.030	.024	4.788	.586
	Cholesterol Difference	621.458	1	621.458	.358	.551	.002	.358	.091
	S.Creatinine Difference	.235	1	.235	4.869	.028	.024	4.869	.593
	Sys. BP Difference	2790.045	1	2790.045	7.674	.006	.037	7.674	.787
	Dias. BP Difference	104.401	1	104.401	.837	.362	.004	.837	.149

in diabetes healthcare and policy, particularly other limited resource countries. With comparatively little initial investment and reorganization, decision makers can directly provide communities with inexpensive but necessary equipment to screen, manage and to prevent diabetes complications and build the clinical capacity of front-line healthcare providers.

5. Limitation and conclusion

This study is the first to demonstrate the efficacy of a DCCM mobile intervention within the fragmented Palestinian healthcare system. Those in Hebron receiving person-centered care demonstrated significant improvement diabetes control versus those in Bethlehem. One limitation of this study, however, was that intervention participants met with the clinical team every 3-months versus yearly treatment as usual (Bethlehem). Future research should ensure intervention and control participants receive the same clinical contact (quarterly vs. annual contact). In other words, standard randomized control research should be conducted in future to replicate and extend current study findings. For instance, future research should also include participants living in East Jerusalem and Gaza.

DCCM mobile diabetes clinics effectively deliver high quality, affordable, diabetes care in low resource countries. The DCCM is a response to the traditional biomedical (physician-centered) model of diabetes management ubiquitous in healthcare. Provision of community-based diabetes prevention and care is crucial if we are to contend with the high prevalence of diabetes and its complications, system fragmentation and resource shortage. Findings from this study suggest how the healthcare system could be restructured to enhance coordination, education, training, and standardization of diabetes care and management.

Conflicts of interest

Authors declare no conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.dsx.2018.11.066.

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