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ORIGINAL ARTICLE

The Effectiveness of Conducting Home Visits by Medical Students among Malaysians with Type 2 Diabetes: A Retrospective Analysis

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Abstract

Background. Medical students at the International Medical University (IMU), Seremban, Malaysia were required to assess patients at home over a period of two years as a part of their curriculum. The students conducted six visits to educate their patients and help them utilize available resources to manage their disease.

This study aims to examine whether patients with diabetes visited improve their control of their disease, specifically in terms of their HbA1c measurement.

Methodology. We used a retrospective, matched before and after study design to prevent biased levels of effort by students conducting the home visits over two years. Information was obtained through reports written by IMU students. Convenient sampling was used to select outpatients undergoing treatment 'as usual' from a health clinic and were subsequently matched as controls.

Results. There was a significant decrease in the mean HbA1c among 57 patients with diabetes who were CFCS subjects [from 8.4% (68 mmol/mol) to 7.3% (57 mmol/mol) $p<0.001$], while the mean HbA1c levels among 107 matched control subjects rose significantly from 7.9% (63 mmol/mol) to 8.3% (67 mmol/mol) ($p=0.019$) over a similar period. The two groups were controlled for most biological and socioeconomic variables except for comorbidities, diabetic complications and medication dose changes between groups.

Conclusion. Behavioural intervention in the form of home visits conducted by medical students is an effective tool with a dual purpose, first as a student educational initiative, and second as a strategy to improve outcomes for patients with diabetes.

Key words: home visits, medical students, type 2 diabetes, glycated hemoglobin, Malaysia

INTRODUCTION

Out of the 17% of Malaysian adults who suffer from type 2 diabetes mellitus (T2DM), only 20% of these patients achieve optimal control of their disease.[1] There is growing evidence that home visits focusing on patient education and behavioral intervention help improve glycemic control in patients with diabetes.[2] The initiatives undertaken by community health workers among African Americans, Latinos[3] and Mexican Americans[4] appear to support the need for home visits. Similar success was seen in home visits conducted by nurses[5,6,7] or pharmacy students.[8] Home visits are used often in conjunction with telephone calls,[3,5,9] newsletters[4] and group discussion or classes.[3,7] A systematic analysis of these studies show there is significant improvement in glycemic control,[2] with longer intervention programs (2 years)[4,8] showing a bigger decrease in HbA1c values than shorter (3 months) ones.[5,6] These studies have been done across countries and cultures from the United States[3,4,8] to Thailand[7] (Table 1).

Medical students at the International Medical University (IMU) undergo a Community and Family Case Study (CFCS) program as a part of their curriculum.[10] This program emphasizes holistic patient care from a family-oriented and communal perspective. Students, in pairs or rarely, a team of three, select a patient, with any disease, from the hospital or primary care clinic. Subsequently, these patients are followed up at their own homes. These visits span a period of 2 years, commencing from the third year of medical studies; during which these patients continue regular clinic follow-up. During the six periodic home visits, in addition to discussing the progress of the patient's illnesses, the students explore several behavioral themes that are relevant to their patients. Each visit lasts an average of 1.5 hours in the relaxed atmosphere of the patient's residence.

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Table 1. Results of previous studies on the effectiveness of home visits on HbA1c level of patients with diabetes

Authors	Estey AL, Tan MH, Mann K	Couper JJ, Taylor J, et.al.	Stroup J, Kane MP, Busch RS, et al	Taylor KI, Oberly KM	Wattana C, Srisuphan W, Pothiban L, et al	Spencer MS, Rosland AM, Kieffer EC, et al	Rothschild SK, Martin MA, Swider SM, et al
Journal	Diabetes Educ 1990; 16: 291–295.	Diabetes Care 1999 22:1933-37	Am J Pharm Educ 2003; 67: 91	Biol Res Nurs 2005; 6: 207–215	Nurs Health Sci 2007; 9: 135–141	Am J Public Health 2011; 101: 2253–2260	Am J Public Health 2014; 104: 1540–1548
Type of patients	T2DM	T1DM	T2DM	T2DM	T2DM	T2DM African and Latino Americans	T2DM Mexican Americans
Location of study	Halifax, Canada	South Australia	Albany, New York	Calgary, Canada	Eastern Thailand	Detroit, Michigan	Chicago
Population studied	Patients referred for diabetes education who completed 3 day education program	Adolescents with a mean HbA_{1c} of >9.0 %	HbA_{1c} of >10.0 %	Excluded those pending surgery, recently hospitalized and with severe complications	>35 years Excluded those with severe complications and changed treatment during program	>18 years Exclude serious diabetic complications	>18 years Exclude major end-organ complications
Sample size	N=28 control=25	N=37 control=32	N=30 control=40	N=20 control =19	N=75 control=72	N=72 control =92	N=73 control =71
Intervention agent	Registered nurse	Diabetes educator	Pharmacy students	Nurse	Nurse researcher	Community health worker	Community health workers
Type of Intervention	four telephone calls (6 min) and one home visit (38 min)	monthly home visits (45-60 min) weekly phone contact (5-10 min)	Students observed the faculty member during the first interaction and conducted the second meeting themselves under the supervision of the faculty member then conducted the remainder of their home visits without supervision	4-5 nurse visits (30-45 min) 1 dietician visit 1 exercise specialist (optional) consult In home or place of patient's choosing	small group diabetes education class (120 min), four small group discussions (90 min), two individual home visit sessions from the researcher (45 min), and a patient education manual	(1) diabetes education classes, (2) 2 home visits of about 60 minutes each in length per month to address participants' specific self-management goals (3) 1 clinic visit with the participant and his or her primary care provider (4) phone call once every 2 weeks	36 home visits, or a bilingual control newsletter delivering the same information on the same schedule
Study duration	3-months	6 month	2 years	3 months	24 weeks	6 months	2 years
Mean pre-HbA1c level	6.3±1.1%	11.1±1.3%	11.2±1.3%	7.69%	8.08±1.87%	8.6 (8.1, 9.2)%	8.5±2.2%
Mean post-HbA1c level	5.6±0.7%	9.7±1.6%	10.0±2.0%	7.40%	7.40±1.25%	7.8 (7.3, 8.3)%	7.64%

The themes for each of the visits are: 1) family structure and life cycle, 2) illness behavior, self-care, complementary medicine and cultural aspect of health care, 3) epidemiological study of biological, physical and social environment affecting the illness, 4) preventive care, 5) hospitalization and illness experience and 6) community resources.

Throughout these visits, students observe how their patients cope with their illness in their home environment and their challenges.[10] They were also tasked to assess their patients' needs, plan/carry out suitable interventions, and evaluate the outcomes of their initiative. They prepare individual reports and present their findings to their respective mentors. The CFCS program was designed not only to have an impact on the students' learning process, but also to contribute to the overall care of the patients who may benefit from these student encounters. The patients gain more insight and this improved their self-efficacy to care for themselves.

A large number of the selected patients had type 2 diabetes mellitus (T2DM) in view of the increased prevalence of this disease in Malaysia.[11] Therefore, this study explored the influence of student visits on the control of diabetes among such patients.

METHODOLOGY

Study Population

We undertook a retrospective, matched before and after study,[12] examining the portfolios of students who had completed their CFCS reports. We included only patients diagnosed with T2DM. These patients were followed up for 2 years with home visits beginning 2013-2015 and ending 2015-2017. During this time they continue their T2DM follow up at outpatient government clinics. These reports were then compared with controls taken from a government health clinic. Patients who died before the end of study were excluded. As these patients lived within a 15 km radius from Seremban, a municipality 60 km south of Kuala Lumpur, we matched them with controls conveniently sampled from a public outpatient health clinic, Klinik Kesihatan Seremban, matching T2DM patients with HbA1c readings at least 18 months apart for gender, age (±5 years) and years since diagnosis (±3 years).

Both CFCS patients and matched controls continue their follow-up with their outpatient clinic doctors at frequencies decided by their doctors.

Instruments

Glycated hemoglobin (HbA1c) was chosen as an indicator for glycaemic control as it is a widely used index determining blood glucose control of diabetic patients.[13] It also serves as a strong predictor of diabetic complications.[14]

A data extraction sheet was designed and used to obtain salient patient information. Besides demographic data and HbA1c readings, the information sheet also collected information about co-morbid conditions, medications, diabetic complications, pre- and post-weight (kg), body mass index (kg/m^2), random blood glucose (mmol/L) and blood pressure (mmHg). Data were obtained anonymously from patients attending follow-up consultations at the primary care clinic without any identifying information.

The Students' CFCS study guide is available as an Appendix. It details the objectives, process, activities and learning references of the programme which cover many areas that impact on the patient's knowledge and attitude on health. In addition, the actual conversation during the visit impacts the patients emotionally individually.

Statistical Analyses

The data collected were coded and entered into Statistical Package for Social Science for statistical analysis (SPSS Version 19.0, IBM Corp, USA). Chi-Square test was used to analyze categorical data in the study. Independent and paired T-test, Wilcoxon rank test or Kruskal-Wallis test was employed as appropriate. A power analysis was done through the G*Power software (version 3.1.9, University of Kiel, Germany).

Based on what other educational and behavioral interventions of similar duration have produced, we estimated an HbA1c difference of 0.9% between the groups,[3,4,8,9] and calculated the sample size needed to give a result with a confidence interval (CI) of 95%, 5% margin of error and power of 80%, with a baseline HbA1c of 8.0% (64 mmol/mol) with a standard deviation of 1.3% and found we required a sample size target of 75, half as intervention patients and half as controls. However, we targeted twice the number of controls to CFCS patients to better represent patients undergoing usual outpatient care, as they were readily available.

Ethical Considerations

This study was approved by the International Medical University Joint Ethics and Research Committee (CSc-sem6 (38)2016) and registered in the National Medical Research Registry (NMRR-16-2782-31914).

RESULTS

Population Characteristics

We obtained a total of 197 CFCS reports. Of these, 73 (37%) were patients diagnosed with T2DM. The drop-out rate was 21.9%. This attrition rate was due to the exclusion of sixteen (16) of these reports as there was an absence of two HbA1c readings more than 18 months apart, despite effort being made to trace the details from their respective follow-up clinic. We included 106 controls.

The demographic profile of the CFCS patients and controls are given in Table 2. Race is noted and analyzed because risk factors and prevalence of many diseases in Malaysia are associated with ethnicity. Not all patients had complete glucose, BMI, BP, medication, co-morbid and complications data. Co-morbidities recorded included hypertension, obesity, dyslipidemia, coronary artery disease, stroke and a range of others including gout, rheumatoid arthritis and asthma. For analysis, patients were grouped into those with two co-morbid or

Table 2. Characteristics of study patients and control group, Seremban, Malaysia 2013-2017

	CFCS patients (%) n=57	Controls (%) n=106	*p* value
Age (mean)	61.3±8.5 y	61.8±8.0 y	0.70*
Gender			
Males	29(50.9)	54(50.9)	1.0†
Females	28(49.1)	52(49.1)	
Race			
Malays	14(24.6)	29(27.4)	
Chinese	18(31.6)	35(33.0)	0.60**
Indians	25(43.9)	42(39.6)	
Years since diagnosis (mean)	14.5±9.0 y	12.5±8.3 y	0.14*
Medication			
Oral agents only	31 (54.4)	59 (55.7)	
Insulin only	12 (21.1)	10 (9.4)	0.08**
Oral agents + Insulin	14 (24.6)	37 (34.9)	
Co-morbidities	(n=56)	(n=106)	
0-2	44	102	<0.001**
3 and more	12	4	
Complications	(n=54)	(n=106)	
0-1	41	101	0.01**
2-3	13	5	
Mean Values±SD			
HbA1c	8.4±1.5% (n=57)	7.9±1.6% (n=106)	0.07*
Glucose(mmol/l)	11.1±4.3 (n=46)	9.9±3.7 (n=87)	0.08*
BMI(kg/m^2)	27.9±5.2 (n=43)	27.6±4.9 (n=102)	0.71*
Systolic BP(mmHg)	136±14 (n=50)	137±19 (n=104)	0.71*
Diastolic BP(mmHg)	80±10	75±15	0.002*

less and those with three or more. Diabetic complications included nephropathy, eye disease and neuropathy. Patients were grouped into those with one or no complication, or, two or more. The two groups were well matched for age (p=0.70), gender (p=1.0) and race (p=0.60) but less so for years of diabetes (p=0.14). The groups were also not different for initial blood glucose (p=0.08), BMI (p=0.71) and systolic blood pressure (p=0.71). They were however not similar for diastolic blood pressure (p=0.002), co-morbidities (p<0.001) and complications (p=0.01). The initial HbA1c for the two groups was approaching significant difference (p=0.07).

Outcome

Paired t-tests showed a significant decrease in the HbA1c and glucose level of CFCS patients (p<0.001) (Table 3). The effect size of 0.96 at a CI of 95% and the margin of error of 5% was obtained. This gave a statistical power of 99%. There was also a small decrease in BMI (p=0.08) and systolic blood pressure (p=0.06) approaching significance. On the other hand, control patients showed a significant rise in HbA1c (p=0.019) over the follow up period. There was no significant change in glucose, BMI (p=0.62) and blood pressure (systolic, p=0.22 diastolic p=0.96) in the control group.

Subgroup analysis

Table 4 examines the change in HbA1c within the two groups. Gender, race, age, medication patients were on, prevalence of co-morbidities or complications were not significantly associated with the change in HbA1c in either group over the study period.

DISCUSSION

Main Findings

This study demonstrates a significant improvement in HbA1c and blood glucose over the two-year period during which the patients were visited by the students. We could not identify any correlation with factors such as gender, race, age, the patient's current medications, and prevalence of co-morbid or associated complications to account for the HbA1c change. Therefore, factors such as

Table 3. Outcome measures of the patients and control group, Seremban, Malaysia 2013-2017

CFCS	Before±SD (n)	After±SD (n)	*p* value
HbA1c	8.4±1.5% (57)	7.3±1.3% (57)	<0.001
Glucose (mmol/l)	11.1±4.3 (46)	7.9±2.9 (45)	<0.001
BMI (kg/mm2)	27.9±5.2 (43)	27.8±6.6 (30)	0.08
Systolic BP(mmHg)	136±14(50)	132±11(50)	0.06
Diastolic BP(mmHg)	80±10 (50)	79±8 (50)	0.37
Controls	**Before±SD (n)**	**After±SD (n)**	***p* value**
HbA1c	7.9±1.6% (106)	8.3±1.8% (106)	0.02
Glucose (mmol/l)	9.9±3.7 (87)	10.3±3.9 (87)	0.35
BMI (kg/mm2)	27.6±4.9 (102)	27.6±4.7 (102)	0.62
Systolic BP(mmHg)	137±19(104)	139±19 (104)	0.22
Diastolic BP(mmHg)	75±11 (104)	75±11 (104)	0.96

Paired t-test

Table 4. Change and correlation of HbA1c within patients and control group, Seremban, Malaysia 2013-2017

	CFCS patients (n) Mean % change of HbA1c±SD	*p* value	Controls (n) Mean % change of HbA1c±SD	*p* value
Gender				
Male	-1.08±1.5 (29)	***0.82****	0.32±1.2 (54)	***0.76****
Female	-1.04±1.6 (28)		0.36±1.7 (52)	
Race				
Malay	-0.75±1.8 (14)		0.42±1.7 (29)	
Chinese	-1.22±1.5 (18)	***0.65****	0.08±1.0 (35)	***0.53****
Indian	-1.11±1.4 (25)		0.50±1.7 (42)	
Duration of diabetes				
1 - 10	-0.86±1.5 (22)		0.29±1.2 (55)	
11–20	-1.44±1.8 (21)	***0.25****	0.33±1.7 (32)	***0.48****
21– 30	-0.87±1.1 (10)		0.60±1.9 (19)	
31- 40	-1.22±0.2 (4)		0.20 (1)	
Age group				
36- 45 y	-1.5±2.0 (4)		-0.25±1.8 (4)	
46-55 y	-0.55±2.1 (8)		0.63±1.6 (19)	
56-65 y	-0.91±1.4 (23)	***0.62****	0.40±1.4 (48)	***0.51****
66-75 y	-1.35±1.4 (21)		0.17±1.6 (30)	
76-85 y	-0.5 (1)		0.22±1.3 (5)	
Diabetes medication				
Oral	-0.99±1.6 (31)		0.38±1.4 (59)	
Insulin	-0.75±1.3 (12)	***0.46****	0.77±2.1 (10)	***0.70****
Oral+insulin	-1.48±1.5 (14)		0.16±1.4 (37)	
Complication				
0-2	-0.95±1.4 (44)	***0.88****	0.29±1.4 (101)	***0.45****
2-3	-1.32±1.7 (12)		0.55±2.6 (5)	
Co-morbidities				
0-1	-0.75±1.6 (13)	***0.44****	0.27±1.2 (44)	***0.66****
2-3	-1.11±1.3 (41)		0.39±1.6 (64)	

* Wilcoxon test, **Kruskal-Wallis test

individual preparedness to listen and change, as well as how the team of students communicated with the patients arguably played a major role.

Among the notable features of the CFCS program was the home setting in which the intervention was conducted. Patients more likely felt they could inquire about any uncertainties without the time limitation inherent in a visit to a doctor's clinic. An average of 1.5 hours was spent by students for each home visit, which is much longer than the consultation time during follow-ups in the clinic. One unhurried visit cannot be compared to many short visits. In addition, the home setting may also contribute to better reception of knowledge, as patients may feel more comfortable and relaxed in their own environment.

Students were not authorized to change the patients' medication dosage. They were only responsible for advice on medication compliance. Having clear instructions to assess, plan, execute and evaluate self-care interventions, the students were able to effect a change in behavior over this period. The components of the students' engagement with patients were mentioned in the introduction, but it would not be possible to identify specifically which were the most important; one important factor may have been simply the rapport that was built up. Nevertheless, any changes of medication in the two-year period were not recorded in this study in either group; this may have impacted the results.

The increase in mean HbA1c levels among control patients was unexpected. Nevertheless, in any cohort, patients with diabetes often start with a mild to moderately elevated HbA1c value which increases over time due to poor control and disease progression;[15] therefore, snapshots over two years can show that decline, which has been also noted in a similar study.[4]

Strengths

A case-control design is arguably a more suitable method to explore the objectives of this study compared to a randomized controlled trial. Klein reasons that it is more appropriate for observing decision making in action naturally.[16] If the students knew that the HbA1c of their patients was an outcome measure of a study, or even that their case was being specially observed, they might have put in extra effort to get their patient to do well. A retrospective study observes the intervention as is normally is. Unlike other studies where intervention arm includes home visits but also other tools, such as telephone calls to counsel patients or small group meetings, this study consists only of home visits and nothing else besides a phone call by the students to arrange the visit.

Limitations

The two groups were fairly well matched except for the prevalence of co-morbidities and diabetic complications, factors that were not considered in the matching process. The difference in co-morbidities and complications was not anticipated. However, it was not unexpected, as many students recruited their CFCS patients from among patients who had been admitted to the Seremban Hospital; such patients might have more co-morbidities and complications compared to patients recruited conveniently from an outpatient clinic. The control group was thus not ideal but it would have been technically very difficult to match for hospital admissions.

The recordings of parameters in the two groups were taken over a range of time and not at exactly the same time and in the same setting for each patient. While readings such as BMI and HbA1c are not likely to vary, more labile readings, such as glucose and blood pressure might be more prone to variation. There are minor biological sample variations between different HbA1c machines. All control patients at Klinik Kesihatan Seremban would have been tested using the same machine (Bio Rad Laboratories); however, CFCS patients were seen in different clinics using different machines but likely of the same make. Not all patients carried out self blood glucose monitoring at home, hence this could not be studied. Increments in patients' medication dosage in both groups during the study period were not taken into account in this study and this could be a confounder. The sample size was not large enough for subgroup analysis as the study was not designed with that in mind, and could not have been, because we had no clue which factors might show a trend of being significant and to what measure.

CONCLUSION

Given that diabetes mellitus is one of the most common chronic diseases, it is important that we understand how to improve compliance to prescribed medication and lifestyle changes. Home visits can make a difference and students can be an important part of the process.

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