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A "before-after" study on the effects of the First Line Diabetes Care (FiLDCare) self-management education and support project in the Northern Philippines on project participants' knowledge, attitudes, perceptions, practices and glycemic control

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ABSTRACT

Objectives. To investigate the effects of a context-adapted diabetes self-management education and support (DSME/S) project based on chronic care models in the Northern Philippines, on knowledge, attitudes, perceptions (KAP), practices, adiposity/obesity and glycemia of people with diabetes.

Design. Prospective quasi-experimental "before-after" study.

Participants. 203 people with type 2 diabetes mellitus from two local government units in the Northern Philippines fulfilling set criteria.

Primary and secondary outcome measures. Context-adapted DSME/S was given to project participants by trained pre-existing local government healthcare personnel. Changes in KAP, practices, body mass index, waist circumference, waist-hip ratio (WHR) and glycosylated hemoglobin (HbA1c) were measured one year after full project implementation. Wilcoxon's signed-rank test, test of proportions, Mann-Whitney test and logistic regression analyses were done.

Results. Complete data was collected from 164 participants. Improvements in glycemia, waist circumference, WHR, knowledge, some perceptions and adherence to medications and exercise, and an increase in fear of diabetes were significant. Reductions in HbA1c regardless of level of control were noted in 60.4%. Significant increase in knowledge ($p<0.001$), positive attitude ($p=0.013$), perceived ability to control blood glucose ($p=0.004$) and adherence to medications ($p=0.001$) were noted among those whose glycemia improved. Significant differences in the subgroup whose HbA1c improved as against those whose HbA1c deteriorated include male gender ($p=0.042$); shorter duration of diabetes ($p=0.001$) and increased

perceived ability to control blood glucose (p=0.042). Significant correlates to improved glycemia were male gender (OR=2.655;p=0.034), duration of diabetes >10years (OR=0.214;p=0.003) and fear of diabetes (OR=0.490;p=0.048).

Conclusion. Context-adapted DSME/S introduced in resource-constrained settings and making use of established human resources for health may improve knowledge, attitudes, perceptions, practices, and glycemia of recipients. Further investigations on addressing fear of diabetes and tailoring DSME/S to females and those who have had diabetes for a longer period of time may help to indicate ways to further improve glycemia.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- This study is one of the few conducted regarding:
    1. Integrating chronic care with current healthcare activities making use of pre-existing healthcare staff to introduce/improve quality of chronic care in public first line health care services of a low-to-middle-income country such as the Philippines; and
    2. Analyzing changes in knowledge, attitudes, perceptions and practices and demonstrating correlations with improving glycemic control
- Logistic regression analysis identifies significant correlates towards improving glycemia.
- Comparative analysis of those with improvements in glycemia against those with deteriorations identifies factors that may have contributed towards blood glucose lowering.
- The absence of a control group limits the strength of this study in attributing the identified significant outcomes solely to the intervention.

INTRODUCTION

It has been shown that early interventions prevent or delay the onset of diabetes complications, and good control of the condition is a key.[1-3] Interventions may involve assuring adequate access to diabetes care, medications, laboratory examinations, and the support needed to ensure delivery of health services. Aside from these, a vital role has to be played by the person with diabetes as the condition affects and is affected by daily activities throughout life. People with diabetes must be equipped and supported to manage their condition. The need for self-management education and training for chronic conditions in general and diabetes in particular has long been recognized as an integral part of good quality health care[4, 5] and diabetes self-management education and support (DSME/S) is already deemed a right for all concerned.[6] Since more than 2 decades ago, self-management education has slowly been incorporated into standards of chronic disease care in high income countries.[7, 8]

The concepts of self-care in general and diabetes self-management in particular are not yet fully embraced in low-to-middle income countries (LMIC). However, these LMIC also need to utilize all possible opportunities to prevent and control diabetes: DSME/S may be a cost-effective measure that may help control diabetes and prevent its complications in these countries where 70% of the total global current cases of diabetes occur [9] and where it affects men and women at younger ages.[10]

The need for such a shift is also a relevant issue in the Philippines where the leading causes of mortality for the past 10 years have been chronic conditions[11] but public health is still generally oriented to acute and infectious diseases.

Previous studies have demonstrated that self-management education programs designed to increase knowledge and bring about behavior change are more

successful in improving glycemia[12, 13] but there is a dearth of publications demonstrating any relationships between glycemic control and specific attitudes and perceptions related to diabetes.

Although a number of aspects in the provision of DSME/S require expertise, skills, and specialized personnel that LMIC may not have the capacity to supply, there are certain DSME/S activities that can be translated to low resource settings. In the Philippines, we implemented the context-adapted chronic care model-based First Line Diabetes Care (FiLDCare) Project where we organized primary care for diabetes in two local government units. The project focused mainly on primary health care providers and the person with chronic condition, concentrating on decision support to the healthcare workers, minor re-organization of the health service, delivery system re-design and self-care development through DSME/S. The possible effects of the FiLDCare Project DSME/S on the knowledge, attitudes, perceptions, practices, obesity/adiposity and glycemic control of people with diabetes are explored in this paper.

Background

Public health care in the Philippines was devolved in 1992. The responsibility of providing basic health care services for the people was handed down to local government units, specifically municipalities and cities.[14] A decade before health care devolution, the country implemented a primary health care policy which created a large cadre of community-based health workers locally called barangay (village) health workers (BHW) who are selected to work in their respective areas of residence .[15] Organizationally, the BHW fall under the governance of the barangay and are selected to work in their respective areas of residence; functionally, they are under the local government health units (LGHU). A BHW is assigned approximately 10-20 families, is responsible for dissemination of health information and health promotion

activities, and conducts other health-related undertakings to any member of the families being attended to. At present, a typical LGHU would be composed of one or more municipal or city health centers and a number of barangay health stations, and would have at least one municipal/city health officer, at least one nurse, several midwives, and the BHW.

Batac (population=53,542 as of 2010[16]) is a non-highly urbanized component city in the island of Luzon composed of 43 barangays with two government health centers and their barangay health stations. Other health care services include a tertiary-level Department of Health-operated hospital, a primary-level private hospital, a number of private multi-specialty clinics and clinical laboratories, and several private drugstores/pharmacies.

Pagudpud (population=21,877 as of 2010[16]), the northernmost settlement in Luzon, is a rural municipality classified to be very low in economic development. Composed of 16 barangays, it only has a basic government health center and barangay health stations for health care. There are no laboratory facilities, nor any private clinics or drugstores/pharmacies.

As in many LMIC, most healthcare expenditures are out-of-pocket.

In these LGHU, the chronic condition-related activities are limited to informative posters on stroke, high blood pressure, diabetes, chronic lung diseases, smoking cessation, and the benefits of exercise and a healthy diet. There are also one-day annual campaigns on specific conditions, healthy lifestyle, tobacco control, etc., as programmed by the Department of Health.[17] Similar to most LGHU in the Philippines, organized care aiming at self-management education and support for

chronic conditions is non-existent in both the Batac City and Pagudpud government health units.

METHODOLOGY

This was a prospective quasi-experimental before-after multicenter study involving two purposively selected LGHU and a cohort of people with diabetes, conducted from May 2011 to February 2013. The intervention was a context-adapted chronic disease care model-based DSME/S. The outcomes of interest were changes in diabetes knowledge, attitudes, perceptions, practices, body mass index (BMI), waist circumference, waist-hip ratio (WHR) and glycosylated hemoglobin (HbA1c) levels of the project participants.

Selected LGHU staff including BHW participated in a 32 hours training workshop on primary diabetes care and DSME/S, results of which will be discussed elsewhere.

Inclusion / exclusion criteria

The LGHU staff were requested to enrol people with diabetes from their localities to the FiLDCare Project. Criteria for inclusion in the FiLDCare Project were: diagnosis of type 2 diabetes, age $\geq$ 20 years, and willingness to participate in the project. The trained healthcare workers provided primary diabetes care and DSME/S to the project participants.

Data gathered from the project participants were further screened for inclusion in statistical analysis. Inclusion criteria for analysis were: completeness of interview data, pre- and post-implementation HbA1c values and pre- and post-implementation anthropometric measurements. Exclusion criteria were: pregnancy and a positive medical history of anemia (sickle cell, iron deficiency) and end-stage renal disease.

Interview of project participants (Diabetes knowledge, attitudes, perceptions and practices)

The principal investigator and/or trained field researchers, one of which was the FiLDCare Project nurse, provided full project information and obtained written informed consent from each of the participants. The researchers conducted one-on-one interviews using a structured questionnaire inquiring on knowledge, attitudes, perceptions and practices and took measurements for the BMI, waist circumference, and WHR. They likewise tested for HbA1c making use of *A1CNow* (Bayer HealthCare, Makati City, Philippines), a point-of-care test that conforms to the National Glycohemoglobin Standardization Program protocol. Interviews and measurements were done prior to and one year after the start of project implementation. Knowledge was tested making use of a 20-question diabetes knowledge test based on the Fitzgerald et al. Diabetes Knowledge Test [18] and the Garcia et al. Diabetes Knowledge Questionnaire [19]. Questions on attitudes and perceptions were adapted from the survey questionnaires of the University of Michigan Diabetes Research and Training Center.[20, 21] The attitude and perception questions were formulated as statements and made use of a Likert scale for answers, with 1 (“never”) as the lowest and 5 (“always”) as the highest rating. Negative and positive attitudes were measured separately. A straight statement on fear “I am afraid of my diabetes” was used to measure fear of diabetes. Perceived support needs and support received were directed towards support a person with diabetes needs and receives from family and friends. Questions on perceived support attitudes probed the perceptions of how a person with diabetes is being treated, accepted and supported by family and friends. Questions on medication adherence inquired on medications prescribed by healthcare providers and if the respondents were taking the right medications at the right dosages at the right time; these were transposed to “no” or “yes” answers and summarized as “no” if any of the questions were answered with “no” and “yes” if all the questions were answered with

"yes". The question on diet adherence was answerable by "no", "sometimes", or "yes/always"; these answers were transformed to "not/sometimes adherent" and "yes/fully adherent". For exercise, questions were asked on the type of exercise done, frequency, and duration; the answers were then transformed to "no" or "yes" based on the criteria of doing 150 minutes of moderate-intensity aerobic physical activity or at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week.[22] Medical records were reviewed for any co-morbid illnesses.

FiLDCare Project DSME/S strategy

One-on-one diabetes self-management education (DSME) was initiated either by the city/municipal health officer or the LGHU nurse, assisted by the principal investigator and/or the FiLDCare Project nurse during consultations at the government health unit. Consultations and the concomitant DSME sessions were done at least once every three months. The DSME sessions focused on: information on diabetes and diabetes medications, adoption of self-care behavior, gaining control over the condition through problem solving skills, and goal setting. DSME was conducted in a conversational and interactive manner, embedded in the clinical consultation. Duration of the initial DSME session ranged from 20 to 30 minutes and the succeeding sessions from 5 to 15 minutes. Written materials on healthy eating, exercise, and glycemic goals were given out during the sessions. Community-based diabetes self-management support (DSMS) was continued by the BHW and the midwives. DSMS concentrated more on behavioral support with reinforcement of self-care (taking medications, diet, exercise and foot care) and problem solving. DSMS was provided informally through home visits where the BHW would drop by the house of the person with diabetes and introduce pieces of information on diabetes and diabetes care in the conversation. Also, DSMS sessions were conducted in the barangay health stations where the BHW and midwives would be found on specific days two to four times a month and where people with diabetes

could go if and when they had any questions or would want to talk to these healthcare workers. DSMS was conducted at least once a month. The frequency and duration of DSME/S depended primarily on the demand of the person with diabetes. The DSME/S approach was collaborative and interactive rather than rigidly structured. After the opening DSME where the different aspects for self-care were discussed, the opinion and choices of the person with diabetes on the topics to be tackled in succeeding DSME/S sessions were considered. Active listening skills (introduced in the initial training workshop) were employed.

Statistics

Statistical analyses were done making use of the statistical package Stata/IC version 11.0.[23] Wilcoxon signed-rank test was used to compare the pre- and post-implementation median values of the outcomes. Test of proportions was used to compare the pre- and post- implementation proportions of people adherent to medications, diet and exercise and people with good glycemic control.

Mann-Whitney test was used to compare the differences of the changes of the outcomes between “decreased/unchanged HbA1c” and “increased HbA1c”.

Logistic regression analysis was done using “decreased/unchanged HbA1c” against “increased HbA1c” to determine significant correlates in improving glycemic control. Independent variables were transformed into categorical variables. Bivariate logistic regression was initially done. An alpha of 0.10 was used as the cut-off to consider for multivariate logistic regression. Multivariate logistic regression of independent variables with alpha of 0.05 or less was done and variables with an alpha>0.05 were removed in a stepwise fashion. The remaining variables having an alpha of $\leq$0.05 were considered statistically significant correlates.

Definitions

Good control of diabetes was defined as having HbA1c ≤7.0% (≤53mmol/mol).[24]

For the classification of changes in HbA1c pre- and post-implementation, it should be noted that, without any interventions, the natural history of diabetes is deterioration of glycemic control through time.[25] Unchanged HbA1c levels may thus be viewed as a favorable result. Following this logic, unchanged HbA1c levels were grouped with decreased HbA1c levels against those with increased HbA1c levels.

Post-implementation changes in ratings were determined by subtracting pre-implementation ratings from the post-implementation values. No and negative changes were grouped together against positive changes to create categorical variables. Increase was defined as a positive change.

Duration of diabetes was categorized as ≤2 years, >2-10 years, and >10years; education was categorized based on the number of years in school, namely 0-6 years, 7-10 years and >10 years.

RESULTS

A total of 203 people with diabetes were enrolled to the FiLDCare Project; 134 in Batac City and 69 in Pagudpud. Statistical analysis was conducted on data collected from 164 (80.8%) participants, 108 in Batac City and 56 in Pagudpud. Of the 39 participants whose data were not included in the statistical analysis, five refused any A1C testing from the outset, four died, eight migrated, two refused post-implementation interview, and 20 refused any further A1C testing. None were found to have any of the exclusion criteria for statistical analysis stated above.

Demographic data of the project participants are listed in Table 1.

A year after full implementation, analysis of the median values showed significant decrease in the HbA1c ($p<0.001$), waist circumference ($p=0.007$), WHR ($p<0.001$), and the “perceived support received from family and friends” ($p<0.001$). Significant increases were noted in the correct answers to the knowledge test ($p<0.001$), the “perceived ability to control blood glucose” ($p=0.036$), the “perceived ability to adhere to diet and exercise” ($p=0.022$), and the “fear of diabetes” ($p<0.001$). Analysis of proportions showed significant increase in people adherent to medications ($p=0.001$) and adherent to exercise ($p<0.001$), but a significant decrease in those adherent to diet ($p<0.001$) (Table 2).

There was a significant increase ($p=0.014$) in the proportion of project participants with optimal glycemic control from 37.2% to 50.6%. Regardless of level of control, HbA1c decreased in 60.4% of the participants (99/164), remained the same in 7.9% and increased in 31.7% (58/164). Among those with reduced HbA1c, the average reduction was -1.44 HbA1c percentage points (-15.7 mmol/mol); when combined with those with unchanged HbA1c, the average reduction was -1.3 HbA1c percentage points (-14.2 mmol/mol). Among those with increased HbA1c, the average increase was +1.21 HbA1c percentage points (+13.2 mmol/mol).

Table 3 stratifies the pre- and post-implementation HbA1c values of the project participants. Among those who have optimal pre-implementation HbA1c levels, HbA1c decreased in 60.3% (41/68). HbA1c remained the same in 8.8% and increased in 30.9% (21/68). The increase was marked in 5.9% reclassifying them to have sub-optimal HbA1c levels post-implementation. Among the project participants having sub-optimal pre-implementation HbA1c levels (>7.0% / >53mmol/mol), HbA1c decreased in 60.4% (58/96) with 19.8% achieving good glycemic control post-implementation. HbA1c remained the same in 7.3% and increased in 32.3% (31/96).

The mean average changes were -2.16 HbA1c percentage points among those whose HbA1c decreased and +1.60 HbA1c percentage points among those whose HbA1c increased.

Results of analysis of the endpoints based on the changes in HbA1c categorized as "increased" and "decreased/unchanged" are listed in Table 4. Overall values are presented in Table 4a; values disaggregated by gender are listed in Table 4b. The main differences between the groups "increased HbA1c" and "decreased/unchanged HbA1c" are the significant increase in correct answers to the knowledge test ($p<0.001$), increased ratings of positive attitude ($p=0.013$) and "perceived ability to control blood glucose" ($p=0.004$), and the increased proportion of people adherent to medication ($p=0.001$) in favor of those whose glycemia improved. There is a significant increase in the ratings of fear ($p=0.010$), positive and negative attitudes($p=0.008$; 0.009), and the perceived ability to control blood glucose ($p=0.007$) among the male participants whose glycemia improved, which was not observed among the female participants. Mann-Whitney test revealed significant difference in gender ($p=0.042$), duration of diabetes ($p=0.001$), and the change in the "perceived ability to control blood glucose" ($p=0.028$) between those with "decreased/unchanged HbA1c" against "increased HbA1c".

Bivariate logistic regression of correlates for improved glycemia identified the male gender ($p=0.049$), duration of diabetes >10years ($p=0.001$), increased fear of diabetes ($p=0.050$), increased perceived ability to control blood glucose ($p=0.030$), and better adherence to diet suitable to diabetes ($p=0.049$) as having an alpha of ≤ 0.10. These were entered in multivariate logistic regression to arrive at the final model composed of the male gender as a positive correlate to improved glycemia ($p=0.034$), and duration of diabetes >10 years ($p=0.003$) and increased fear of diabetes ($p=0.048$) as strong negative correlates (Table 5).

DISCUSSION

Patient education has evolved through the years from merely informing patients regarding their illnesses to involving them in the care of their conditions, especially in chronic cases.[9] In diabetes, usual self-management education activities aim to provide information on the disease process and its pathophysiology, and instructions on self-care behaviours which may cover diet, physical activity, monitoring, medications, risk reduction, problem solving, and coping.[26-29] Several published individual articles and meta-analyses of trials evaluating the effectiveness of DSME have demonstrated the efficacy of DSME for people with diabetes in terms of improvements in glycemic control, knowledge, selfcare behavior, and the psychological and behavioral aspects of selfcare. The settings, techniques, and types of interventions used in these DSME programs were diverse and involved a combination of a number of providers that included at least any 3 of the following: medical specialists, dietitians, psychologists, managers, and pharmacists aside from primary care physicians, nurses, and the occasional community-based health care workers.[13, 28-37] No specific structural variations seem to be constantly superior over others.

For the FiLDCare Project, one-on-one collaborative DSME/S sessions were conducted both in a clinical and a community setting, and aimed mainly to provide information and basic knowledge on diabetes, and instructions and reminders for diabetes self-care. The project made use of existing LGHU staff and took advantage of the large cadre of BHW (In the Philippines, these community workers are generally highly educated), shifting tasks that were standardizable and required less expertise, so as not to overburden the LGHU physician and nurse. Furthermore, self-care development actively involved the person with diabetes. Actively involving the person

with chronic condition in self-care and decision making increases the likelihood of adherence to the recommended plan of care.[38]

One year after full project implementation, significant improvements were noted: the participants' level of diabetes-related knowledge, the perceptions of "ability to control blood glucose" and "ability to adhere to diet and exercise regimens", and reported adherence to medications and exercise increased. Adiposity/obesity as measured through the WHR and waist circumference decreased. More than these, glycemic control of the FiLDCare Project participants significantly improved. However, the fear of diabetes increased and the "perceived support received from family and friends" decreased, as did reported adherence to diet.

Changes in glycemia and measures of obesity/adiposity

The effects of DSME/S on clinical endpoints such as glycemia and obesity/adiposity have been well-documented in the past.[13,14, 28-37] These were also observed in our study. Overall, the noted reduction in HbA1c of the FiLDCare project participants was significant. There was also a significant increase in the proportion of people with optimal glycemic control. In depth analysis of the changes in HbA1c levels shows reductions in HbA1c regardless of the level of pre-implementation glycemic control. The proportion of people with reductions in HbA1c, whether among those with optimal or with sub-optimal control, approached 60%, with higher reductions in HbA1c levels among those classified to have sub-optimal control at baseline. Significant changes in obesity/adiposity were noted through the WHR and the waist circumference measurements, but not through the BMI. These reductions in the indirect measures for obesity/adiposity were noted regardless of glycemic control.

Changes in knowledge, attitudes and perceptions

Akin to aforementioned studies on DSME where changes in knowledge were measured,[12, 13] knowledge of the project participants increased. The increase in knowledge may have increased perceptions of self-efficacy. Possessing the essential knowledge about the condition and the care for the condition may increase the level of confidence of people with diabetes on their abilities to perform self-care, i.e. ability to control blood glucose, ability to adhere to diet and exercise regimen. Positive feelings of self-efficacy may consequently lead them to perform and adhere to better self-care practices.[39] In our study, this could be construed as an increase in knowledge leading to increased perceived ability to control blood glucose and adhere to diet and exercise regimen, leading to an increase in self-reported adherence to medications and exercise of our project participants. The changes in self-reported adherence to diet may have been an effect of the participants having learned of the specific diet they should be adhering to, which they were taught during the DSME/S sessions. The negative change noted could be attributable to their change in perception of what a diabetic diet consists of rather than a change in eating behavior; hence the decrease in the number answering “yes” in the post-implementation interview. Multivariate regression analysis identified increased fear as the lone modifiable correlate significantly associated with glycemic control. In this study, its effect on glycemia improvement was negative. Although a number of health campaigns have made use of the fear factor, such may not necessarily trigger a positive response; fear may bring about negative self-care behavior.[40] Fear of diabetes as well as other psychological aspects may have been inadequately addressed in the DSME/S sessions due to the limited training and composition of the health care team. Such fear may have negatively influenced self-care behavior and other known and unknown factors that may have contributed to improved glycemic control.

The two other correlates significantly associated to improved glycemia are non-modifiable. Nevertheless, this information may be used in tailoring DSME/S. In our study, the female gender and those who have had diabetes for 10 years or more were identified to be negatively correlated to improvements in glycemia.

Gender

Gender differences in glycemic control have been studied in the past with females either having equal or poorer but not a superior glycemic control compared to males.[41, 42] This may be partly attributed to differences in glucose metabolism and homeostasis between sexes.[43] With regard to our study, we noted gender differences in comparing some pre- and post-implementation attitude and perception ratings. However, the male population in our sample is not substantial enough to subject this to further and more rigorous statistical analysis. Thus, we can only speculate how, in consonance with the theory of perceived self-efficacy, the increase in knowledge, fear, and positive and negative attitudes in our male population may positively affect perceived self-efficacy to control blood glucose, stimulate positive self-care behavior, and thereby improve glycemia.

Duration of diabetes

It has been observed that much of the instructions on diabetes care is given to the person when the diagnosis is first made and there may be a need to re-train people who have had diabetes for a number of years so as to maintain better glycemic control.[44] However, it seems that in spite of DSME/S given to the whole cohort in our study, glycemia still had the tendency to deteriorate in the subgroup of people with known diabetes for >10 years. Other factors undoubtedly influence this negative

correlation, aside from the need of re-training in people who have had diabetes for a number of years.

Conclusions

This research has shown that some basic elements of DSME/S may be introduced making use of pre-existing health care personnel and produce favorable results. The provision of context-adapted DSME/S may improve diabetes-related knowledge, some attitudes, perceptions and practices, adiposity/obesity, and glycemia of its recipients. The FiLDCare Project may be implemented in other areas of the Philippines to find out if it yields comparable outcomes. Other LMIC may draw inspiration from this study to apply similar context-adapted measures to implement DSME/S.

Explorations on ways by which to handle psychological aspects in general and address fear of diabetes in particular in resource-constrained settings where a complete professional health care team is unavailable would be useful.

Special attention may be needed in designing appropriate DSME/S for the female gender and those who have been known to have diabetes for a number of years now.

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FOOTNOTES

Ethical considerations

This research was approved by the Institutional Review Boards of the University of Antwerp and the Institute of Tropical Medicine in Belgium (Belgian Reg. No. B30020109490), and the Ethics Committee of the Mariano Marcos Memorial Hospital and Medical Center in the Philippines. It was conducted with permission from the governments of the Province of Ilocos Norte, the City of Batac and the Municipality of Pagudpud and their respective health offices.

Conflict of interest statement

Neither of the authors has any financial competing interests regarding this research.

Authors' contributions

GMVK contributed to the design of the research, participated in data collection, did the statistical analysis and drafted the manuscript. GK provided substantial contributions in the concept and design, data analysis, and in the drafting of the manuscript. Both authors read and approved the final manuscript.

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Table 1. Demographics of people enrolled in the FiLDCare Project

			Male	Female
			N=42 (25.6%)	N=122 (74.4%)
Age		Average	57.9	56.5
		Median	58.5	57
		Range	36 – 83	27 – 80
Number of years with diabetes	Summary statistics	Average	5	4.7
		Median	2.5	2
		Range	0.5 – 28	0.5 – 22
	Distribution	0.5 – 2 years	85 (51.8%)	
		>2 – 10 years	53 (32.3%)	
		>10 years	26 (15.9%)	
Level of education (number of years in school)		0-6 years	43 (26.2%)	
		7-10 years	63 (38.4%)	
		>10 years	58 (35.4%)	

Table 2. Pre- and post-implementation values of measured endpoints, in medians and proportions

	Overall, n=164				Male, n=42				Female, n=122			
Variable	Before implementation	After implementation	P value	change	Before implementation	After implementation	P value	change	Before implementation	After implementation	P value	change
	Median values, (binomial interpolation of confidence intervals / interquartile range)		Wilcoxon signed-rank test	Mean change	Median values, (binomial interpolation of confidence intervals / interquartile range)		Wilcoxon signed-rank test	Mean change	Median values, (binomial interpolation of confidence intervals / interquartile range)		Wilcoxon signed-rank test	Mean change
HbA1c, % mmol/mol	7.7 (7.2-8.2 / 6.5-10.4) 61 (55 -56 / 48-90)	6.9 (6.8-7.5 / 6.2-9.3) 52 (51-58 / 44-78)	<0.001	-0.49 -5.4	7.5 (6.7-8.7 / 6.3-10.7) 58 (50-72 / 45-93)	6.8 (6.2-7.7 / 6.1-8.7) 51 (44-61 / 43-72)	0.001	-0.92 -10.1	7.8 (7.2-8.5 / 6.5-10.4) 62 (55-69 / 48-90)	7.2 (6.8-8.0 / 6.3-9.5) 55 (51-64 / 45-80)	0.057	-0.34 -3.7
BMI, kg/m^2	23.7 (23.1-24.1 / 21.8-26.1)	23.3 (22.6-23.8 / 21.2-25.6)	0.075	-0.40	23.8 (22.8-24.7 / 22.0-25.8)	23.6 (21.9-24.7 / 21.2-25.1)	0.395	-0.37	23.6 (23.0-24.0 / 21.6-26.2)	23.2 (22.4-24.1 / 21.0-25.7)	0.122	-0.41
Waist circumference, in cm	85.0 (83.9-86.4 / 81.0-91.2)	83.0 (82.0-85.0 / 79.0-89.0)	0.007	-1.37	89.0 (84.3-91.5 / 81.0-94)	80.0 (83.0-89.9 / 81.0-94.0)	0.026	-2.09	84.0 (82.8-85.2 / 80.0-88.9)	82.8 (81.0-85.0 / 78.7-88.0)	0.054	-1.13
Waist-hip ratio	0.90 (0.89-0.91 / 0.87-0.95)	0.89 (0.88-0.90 / 0.85-0.92)	<0.001	-0.02	0.93 (0.90-0.95 / 0.89-0.96)	0.91 (0.88-0.93 / 0.87-0.95)	0.025	-0.03	0.90 (0.88-0.91 / 0.86-0.93)	0.88 (0.87-0.90 / 0.85-0.92)	0.001	-0.20
Knowledge, % correct answers	60.0 (60.0-65.0 / 50.0-75.0)	67.5 (65.0-70.0 / 60.0-75.0)	<0.001	+7.59	50.0 (50.0-64.3 / 45.0-70.0)	65.0 (60.0-70.0 / 60.0-75.0)	0.006	+9.52	62.5 (60.0-65.0 / 50.0-75.0)	70.0 (65.0-70.0 / 60.0-75.0)	<0.001	+6.93
Perceived fear of diabetes	4.0 (4.0-4.0 / 2.0-4.0)	4.0 (4.0-4.0 / 3.0-5.0)	<0.001	+0.46	2.0 (2.0-4.0 / 1.0-4.0)	4.0 (3.0-4.0 / 2.0-5.0)	0.003	+0.81	4.0 (4.0-4.0 / 2.4-4.0)	4.0 (4.0-4.0 / 3.0-4.0)	0.018	+0.34
Positive attitude	3.4 (3.2-3.4 / 2-8-3.9)	3.4 (3.2-3.6 / 3.0-4.0)	0.071	+0.14	3.2 (2.8-3.4 / 2.6-3.6)	3.5 (3.2-4.0 / 3.2-4.0)	0.025	+0.36	3.4 (3.2-3.6 / 2.8-4.0)	3.4 (3.2-3.6 / 3.0-3.8)	0.479	+0.07
Negative attitude	3.0 (2.8-3.4 / 2.2-4.0)	3.2 (3.0-3.4 / 2.6-3.8)	0.115	+0.15	2.4 (2.0-2.8 / 1.8-3.6)	3.0 (2.8-3.2 / 2.6-3.6)	0.027	+0.42	3.2 (2.8-3.6 / 2.4-4.0)	3.2 (3.0-3.5 / 2.6-3.8)	0.631	+0.06

Attitude towards self-care adherence	3.2 (3.0-3.5 / 2.8-3.8)	3.5 (3.2-3.5 / 3.0-4.0)	0.139	+0.13	3.0 (3.0-3.2 / 2.8-3.5)	3.4 (3.0-3.5 / 2.8-4.0)	0.087	+0.28	3.2 (3.2-3.5 / 2.0-5.0)	3.5 (3.3-3.5 / 3.0-4.0)	0.454	+0.08
Perceived ability to control blood glucose	3.0 (3.0-4.0 / 3.0-4.0)	3.0 (3.0-4.0 / 3.0-5.0)	0.036	+0.24	3.0 (3.0-3.0 / 3.0-4.0)	4.0 (3.0-4.0 / 3.0-4.0)	0.016	+0.43	3.0 (3.0-4.0 / 2.8-4.0)	3.0 (3.0-4.0 / 3.0-5.0)	0.0279	+0.17
Perceived ability to control weight	3.0 (3.0-4.0 / 3.0-4.0)	3.0 (3.0-4.0 / 3.0-4.0)	0.349	+0.12	3.0 (3.0-4.0 / 3.0-4.0)	3.5 (3.0-4.0 / 3.0-4.0)	0.289	+0.021	3.0 (3.0-4.0 / 3.0-4.0)	3.0 (3.0-4.0 / 3.0-4.0)	0.649	+0.08
Perceived ability to adhere to diet and exercise regimens	4.0 (3.0-4.0 / 3.0-5.0)	4.0 (4.0-4.0 / 3.0-5.0)	0.022	+0.26	3.0 (3.0-4.0 / 3.0-4.0)	4.0 (3.0-4.0 / 3.0-5.0)	0.071	+0.35	4.0 (3.0-4.0 / 3.0-5.0)	4.0 (4.0-4.0 / 3.0-5.0)	0.107	+0.23
Perceived ability to handle feelings about diabetes	3.0 (3.0-4.0 / 3.0-4.0)	3.0 (3.0-4.0 / 3.0-4.5)	0.653	-0.01	4.0 (3.0-4.0 / 3.0-4.0)	3.5 (3.0-4.0 / 3.0-5.0)	0.592	+0.17	3.0 (3.0-4.0 / 3.0-4.0)	3.0 (3.0-3.3 / 3.0-4.0)	0.391	-0.07
Perceived support needs	5.0 (4.8-5.0 / 4.2-5)	4.8 (4.2-5.0 / 4.0-5.0)	0.193	+0.02	5.0 (4.7-5.0 / 4.3-5.0)	4.2 (4.0-5.0 / 4.0-5.0)	0.125	-0.13	5.0 (4.8-5.0 / 4.2-5.0)	5.0 (4.3-5.0 / 4.0-5.0)	0.593	+0.007
Perceived support received from family & friends	5.0 (5.0-5.0 / 4.0-5.0)	4.0 (4.0-4.0 / 3.8-4.8)	<0.001	-0.39	5.0 (4.9-5.0 / 4.0-5.0)	4.0 (4.0-4.0 / 3.8-4.3)	0.002	-0.52	5.0 (4.8-5.0 / 4.0-5.0)	4.0 (4.0-4.0 / 3.8-5.0)	<0.001	-0.34
	N (proportion, %)		**Test of pro-portions**	**Change n (%)**	**N (proportion, %)**		**Test of pro-portions**	**Change n (%)**	**N (proportion, %)**		**Test of pro-portions**	**Change n (%)**
Proportion adherent to medications	108 (65.9%)	134 (81.7%)	0.001	+26 (+15.8%)	30 (71.4%)	34 (81.0%)	0.306	+4 (+9.6%)	78 (63.9%)	100 (82.0%)	0.001	+22 (+18.1%)
Proportion adherent to exercise regimen	68 (41.5%)	110 (67.1%)	<0.001	+42 (+25.6%)	25 (59.5%)	27 (64.3%)	0.653	+2 (+4.8%)	43 (35.2%)	83 (68.0%)	<0.001	+40 (+38.2%)
Proportion adherent to prescribed diet	99 (60.4%)	66 (40.2%)	<0.001	-33 (-20.2%)	19 (45.2%)	14 (33.3%)	0.264	-5 (-11.9%)	80 (65.6%)	52 (42.6%)	<0.001	-28 (-23.0%)

Table 3. Stratification of FiLDCare Project Participants based on pre-implementation and post-implementation levels of glycemic control

		Pre-implementation						Total (post-implementation)
		Good control HbA1c≤7%			Not in good control HbA1c>7%			
Change in HbA1c		decreased	increased	unchanged	decreased	increased	unchanged	
Post-implementation	Good control	41	17	6	19			83
	Not in good control		4		39	31	7	81
Total (pre-implementation)		41	21	6	58	31	7	164
		68			96			

Table 4a. Pre-implementation & post-implementation median values of HbA1c, anthropometric measurements, diabetes knowledge, attitudes and perceptions, and proportions of self-care practices stratified according to "Increased HbA1c" and "Decreased or Unchanged HbA1c", and p values of comparisons of changes in measured endpoints among those with "Increased HbA1c" against "Decreased or Unchanged HbA1c"

Change in A1C	Increased HbA1c, n=52				Decreased/Unchanged HbA1c, n=112				P value Mann Whitney Test, Increased HbA1c vs Decreased / Unchanged HbA1c
	Pre	Post	P value	Change	Pre	Post	P value	Change	
	Median		Wilcoxon signed-rank test	Mean change	Median		Wilcoxon signed-rank test	Mean change	
HbA1c, % (mmol/mol)	7.5 (58)	9.2 (76)	<0.001	+1.21 (+13.2)	7.8 (62)	6.8 (51)	<0.001	-1.3 (-14.2)	<0.001
BMI, kg/m^2	24.5	23.3	0.115	-0.72	23.5	23.2	0.281	-0.24	0.446
Waist circumference, cm	85	83	0.006	-2.32	84.5	83.9	0.140	-0.93	0.190
WHR	0.90	0.89	0.028	-0.01	0.90	0.89	0.001	-0.03	0.816
Knowledge test rating, %	65	65	0.060	+4.20	60	70	<0.001	+9.0	0.182
Perceived fear of diabetes	4.0	4.0	0.004	+0.69	4.0	4.0	0.024	+0.35	0.165
Positive attitude	3.3	3.4	0.441	+0.18	3.4	3.4	0.013	+0.13	0.787
Negative attitude	3.0	3.1	0.415	+0.23	3.0	3.2	0.164	+0.12	0.896
Attitude towards self-care adherence	3.1	3.4	0.967	+0.04	3.2	3.5	0.090	+0.17	0.379
Perceived ability to control blood glucose	3.0	3.0	0.516	-0.08	3.0	4.0	0.004	+0.38	0.028
Perceived ability to control weight	3.0	3.5	0.340	+0.17	3.0	3.0	0.618	+0.09	0.604
Perceived ability to adhere to diet and exercise regimens	4.0	4.0	0.006	+0.31	4.0	4.0	0.083	+0.24	0.825
Perceived ability to handle feelings about diabetes	3.5	3.0	0.328	-0.17	3.0	3.0	0.870	+0.07	0.334
Perceived support needs	4.8	5.0	0.978	+0.16	5.0	4.6	0.123	-0.04	0.427
Perceived support received	4.8	4.0	0.035	-0.25	5.0	4.0	<0.001	-0.45	0.372
	N (proportion, %)		Test of proportions	Change n (%)	N (proportion, %)		Test of proportions	Change n (%)	
Adherence to medications	38 (73.1%)	42 (80.8%)	0.352	+4 (+7.7%)	70 (62.5%)	92 (82.1%)	0.001	+22 (+19.6%)	
Adherence to exercise regimen	19 (36.5%)	33 (63.5%)	0.006	+14 (+27.0%)	49 (43.8%)	77 (68.8%)	<0.001	+28 (+25.0%)	
Adherence to diabetes diet	37 (71.2%)	24 (46.2%)	0.010	-13 (-25.0%)	62 (55.4%)	42 (37.5%)	0.007	-20 (-17.9%)	

Table 4b. Pre-implementation & post-implementation median values of HbA1c, anthropometric measurements, diabetes knowledge, attitudes and perceptions, and proportions of self-care practices stratified according to "Increased HbA1c" and "Decreased or Unchanged HbA1c" and according to gender

Change in A1c	Increased HbA1c, n=52								Decreased/Unchanged HbA1c, n=112							
Gender	Male, n=8				Female, n=44				Male, n=34				Female, n=78			
	Pre	Post	P value	Change	Pre	Post	P value	Change	Pre	Post	P value	Change	Pre	Post	P value	Change
	Median		Wilcoxon signed-rank test	Mean change	Median		Wilcoxon signed-rank test	Mean change	Median		Wilcoxon signed-rank test	Mean change	Median		Wilcoxon signed-rank test	Mean change
HbA1c, % (mmol/mol)	6.3 (50)	8.5 (69)	0.012	+1.51 (+16.5)	7.7 (61)	9.2 (77)	<0.001	+1.16 (+12.7)	7.7 (61)	6.6 (49)	<0.001	-1.49 (-16.3)	8.1 (65)	6.8 (51)	<0.001	-1.18 (-12.9)
BMI, kg/m^2	24.6	23.7	0.124	-1.10	24.5	23.0	0.401	-0.66	23.7	23.5	0.986	-0.20	23.4	23.3	0.234	-0.27
Waist circumference, cm	90.2	87.0	0.014	-4.60	84.5	82.0	0.063	-1.91	87.8	86.0	0.188	-1.50	84.0	83.0	0.284	-0.69
WHR	0.95	0.94	0.069	-0.03	0.90	0.88	0.093	-0.11	0.92	0.90	0.106	-0.04	0.90	0.89	0.006	-0.02
Knowledge test rating, %	62.5	60.0	1.00	+3.75	65.0	65.0	0.021	+4.32	55.0	65.0	0.001	+10.88	60.0	70.0	<0.001	+8.40
Perceived fear of diabetes	2.0	3.0	0.107	+1.0	4.0	4.0	0.013	+0.64	2.0	4.0	0.010	+0.76	4.0	4.0	0.311	+0.18
Positive attitude	3.4	3.2	0.725	+0.03	3.2	3.2	0.365	+0.20	3.2	3.8	0.008	+0.44	3.5	3.4	0.842	-0.01
Negative attitude	2.5	2.6	0.726	-0.13	3.0	3.2	0.315	+0.29	2.4	3.2	0.009	+0.55	3.2	3.1	0.893	-0.07
Attitude towards self-care adherence	3.0	2.8	0.831	-0.09	3.2	3.5	0.902	+0.07	3.0	3.5	0.092	+0.37	3.4	3.4	0.420	+0.09
Perceived ability to control blood glucose	3.5	3.0	0.879	-0.12	3.0	3.0	0.547	-0.07	3.0	4.0	0.007	+0.56	3.0	4.0	0.080	+0.31
Perceived ability to control weight	3.5	3.0	0.879	-0.25	3.0	4.0	0.260	+0.25	3.0	4.0	0.198	+0.32	3.0	3.0	0.773	-0.01
Perceived ability to adhere to diet and exercise regimens	3.0	3.0	0.162	+0.50	4.0	4.0	0.263	+0.27	3.0	4.0	0.161	+0.32	4.0	4.0	0.241	+0.21
Perceived ability to handle feelings about diabetes	3.5	3.0	0.611	-0.12	3.5	3.0	0.406	-0.18	4.0	4.0	0.449	+0.24	3.0	3.0	0.694	0
Perceived support needs	5.0	4.7	0.320	-0.29	4.8	5.0	0.716	+0.24	5.0	4.0	0.192	-0.09	5.0	4.9	0.352	-0.02
Perceived support received	5.0	3.8	0.161	-0.85	4.8	4.0	0.172	-0.14	5.0	4.0	0.012	-0.45	5.0	4.0	<0.001	-0.45
	N, (Proportion)		Test of pro-portions	Change n (%)	N, (Proportion)		Test of pro-portions	Change n (%)	N, (Proportion)		Test of pro-portions	Change n (%)	N, (Proportion)		Test of pro-portions	Change n (%)
Adherence to medications	5 (62.5%)	7 (87.5%)	0.248	+2 (+25.0%)	33 (75.0%)	35 (79.6%)	0.611	+2 (+4.6%)	25 (73.5%)	27 (79.4%)	0.568	+2 (+5.9%)	45 (57.7%)	65 (83.3%)	<0.001	+20 (+25.6%)
Adherence to exercise regimen	5 (62.5%)	5 (62.5%)	1.00	0	14 (31.8%)	28 (63.6%)	0.003	+14 (+31.8%)	20 (58.8%)	22 (64.7%)	0.618	+2 (+5.9%)	29 (37.2%)	55 (70.5%)	<0.001	+26 (+33.3%)
Adherence to diabetes diet	4 (50.0%)	2 (25.0%)	0.302	-2 (-25.0%)	33 (75.0%)	22 (50.0%)	0.015	-11 (-25.0%)	15 (44.0%)	12 (35.3%)	0.457	-3 (-8.7%)	47 (60.3%)	30 (38.5%)	0.006	-17 (-21.8%)

Table 5. Results of logistic regression analysis of improved glycemia: Correlates with alpha≤0.10 identified on bivariate regression analysis of categorical variables and the final model with the significant correlates (alpha≤0.05) of improved glycemia identified on multivariate regression.

Correlate	Odds Ratio	P value	95% confidence interval
Bivariate logistic regression			
Male gender	2.460	0.049	1.020 – 5.633
Duration of diabetes > 10 years	0.200	0.001	0.074 – 0.537
Increased fear of diabetes	0.513	0.050	0.264 – 0.999
Increased perceived ability to control blood glucose	2.250	0.030	1.083 – 4.673
Better adherence to diet suitable for diabetes	2.460	0.049	1.000 – 6.036
Multivariate logistic regression (Final model)			
Male gender	2.655	0.034	1.078 – 6.537
Duration of diabetes > 10 years	0.214	0.003	0.078 – 0.587
Increased fear of diabetes	0.490	0.048	0.242 – 0.994

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract - YES
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found - YES
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported - YES
Objectives	3	State specific objectives, including any prespecified hypotheses - YES
Methods		
Study design	4	Present key elements of study design early in the paper - YES
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection - YES
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up - YES *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed – NOT APPLICABLE *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable - YES
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group - YES
Bias	9	Describe any efforts to address potential sources of bias - YES
Study size	10	Explain how the study size was arrived at - YES
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why - YES
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding - YES
		(*b*) Describe any methods used to examine subgroups and interactions - YES
		(*c*) Explain how missing data were addressed - YES
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed – NOT APPLICABLE *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy
		(*e*) Describe any sensitivity analyses

Continued on next page

Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed - YES
		(b) Give reasons for non-participation at each stage - YES
		(c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders - YES
		(b) Indicate number of participants with missing data for each variable of interest – THERE WERE NO MISSING DATA
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount) - YES
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time - YES
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included - YES
		(*b*) Report category boundaries when continuous variables were categorized - YES
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses - YES
Discussion		
Key results	18	Summarise key results with reference to study objectives - YES
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias - YES
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence - YES
Generalisability	21	Discuss the generalisability (external validity) of the study results - YES
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based - YES

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Effects of the First Line Diabetes Care (FiLDCare) self-management education and support project on knowledge, attitudes, perceptions, self-management practices and glycemic control: A quasi-experimental study conducted in the Northern Philippines

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Effects of the First Line Diabetes Care (FiLDCare) self-management education and support project on knowledge, attitudes, perceptions, self-management practices and glycemic control: A quasi-experimental study conducted in the Northern Philippines

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ABSTRACT

Objectives. To investigate the effects of implementing a context-adapted diabetes self-management education and support (DSME/S) project based on chronic care models in the Philippines, on knowledge, attitudes, self-management practices, adiposity/obesity and glycemia of people with diabetes.

Design. Prospective quasi-experimental before-after study.

Participants. 203 people with type 2 diabetes mellitus from two local government units in the Northern Philippines fulfilling set criteria.

Outcome measures. Context-adapted DSME/S was given to a cohort of people with diabetes by trained pre-existing local government healthcare personnel. Changes in knowledge, attitudes and self-management practices, body mass index, waist circumference, waist-hip ratio (WHR) and glycosylated hemoglobin (HbA1c) were measured one year after full project implementation. Non-parametric and parametric descriptive and inferential statistics including logistic regression analysis were done.

Results. Complete data was collected from 164 participants. Improvements in glycemia, waist circumference, WHR, knowledge, some attitudes, and adherence to medications and exercise, and an increase in fear of diabetes were significant. Reductions in HbA1c regardless of level of control were noted in 60.4%. Significant increase in knowledge ($p<0.001$), positive attitude ($p=0.013$), perceived ability to control blood glucose ($p=0.004$) and adherence to medications ($p=0.001$) were noted among those whose glycemia improved. Significant differences between the subgroup whose HbA1c improved and those whose HbA1c deteriorated include male gender ($p=0.042$); shorter duration of diabetes ($p=0.001$) and increased perceived

ability to control blood glucose (p=0.042). Significant correlates to improved glycemia were male gender (OR=2.655;p=0.034), duration of diabetes >10years (OR=0.214;p=0.003) and fear of diabetes (OR=0.490;p=0.048).

Conclusion. Context-adapted DSME/S introduced in resource-constrained settings and making use of established human resources for health may improve knowledge, attitudes, self-management practices, and glycemia of recipients. Further investigations on addressing fear of diabetes and tailoring DSME/S to female persons with diabetes and those who have had diabetes for a longer period of time may help improve glycemia.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- This study is one of the few conducted regarding:
    1. Integrating chronic care with current healthcare activities making use of pre-existing healthcare staff to introduce/improve care for chronic conditions in public first line health care services of a low-to-middle-income country such as the Philippines; and
    2. Analyzing changes in knowledge, attitudes, perceptions and self-management practices and demonstrating correlations with improving glycemia
- Logistic regression analysis identifies significant correlates towards improving glycemia.
- Comparative analysis of those with improvements in glycemia against those with deteriorations identifies factors that may have contributed towards blood glucose lowering.
- The absence of a control group limits the strength of this study in attributing the identified significant outcomes solely to the intervention.

INTRODUCTION

It has been shown that early interventions prevent or delay the onset of diabetes complications, and good control of the condition is a key.[1-3] Interventions may involve assuring adequate access to diabetes care, medications, laboratory examinations, and the support needed to ensure delivery of health services. Aside from these, a vital role has to be played by the person with diabetes as the condition affects and is affected by daily activities throughout life. People with diabetes must be equipped and supported to manage their condition. The need for self-management education and training for chronic conditions in general and diabetes in particular has long been recognized as an integral part of good quality health care,[4, 5] and diabetes self-management education and support (DSME/S) is already deemed a right for all concerned.[6] Since more than 2 decades ago, self-management education has slowly been incorporated into standards of chronic disease care in high income countries.[7, 8]

The concepts of self-care in general and diabetes self-management in particular are not yet fully embraced in low-to-middle income countries (LMIC). However, these LMIC also need to utilize all possible opportunities to prevent and control diabetes: DSME/S may be a cost-effective measure that may help control diabetes and prevent its complications in these countries where 70% of the total global current cases of diabetes occur[9] and where it affects men and women at younger ages.[10] The need for such a shift is also a relevant issue in the Philippines where the leading causes of mortality for the past 10 years have been chronic conditions[11] but public health is still generally oriented to acute and infectious diseases.

Previous studies in high-income countries have demonstrated that self-management education programs designed to increase knowledge and bring about behavior change are successful in improving glycemia[12, 13]. A number of these studies

have explored factors that may be associated with glycemic control, which may be an effect of the program (such as increased diabetes knowledge) or not (such as level of education, gender and duration of diabetes) but there is a dearth of publications demonstrating any relationships between changes in glycemia and specific attitudes and perceptions related to diabetes, especially in LMIC.

Although a number of aspects in the provision of DSME/S require expertise, skills, and specialized personnel that LMIC may not have the capacity to supply, there are certain DSME/S activities that can be translated to low resource settings. We hypothesized that integrating certain DSME/S activities in first line health systems of LMIC can improve knowledge and attitudes of people with diabetes, which may stimulate better self-management practices and improve glycemia as measured by a decrease in glycosylated hemoglobin (HbA1c).

In the Philippines, we implemented the context-adapted chronic care model-based First Line Diabetes Care (FiLDCare) Project where we organized primary care for diabetes in two local government units. The project focused mainly on primary health care providers and the people with a chronic condition, concentrating on decision support to the healthcare workers, minor re-organization of the health service, delivery system re-design and self-care development through DSME/S. The possible effects of the FiLDCare Project DSME/S on the knowledge, attitudes, perceptions, self-management practices, obesity/adiposity and glycemic control of people with diabetes are explored in this paper.

Background

The Philippine public primary health care system

Public health care in the Philippines was devolved in 1992. The responsibility of providing basic health care services for the people was handed down to local

government units, specifically municipalities and cities.[14] A decade before health care devolution, the country implemented a primary health care policy which created a large cadre of community-based health workers locally called barangay (village) health workers (BHW).[15] Organizationally, the BHW fall under the governance of the barangay and are selected to work in their respective areas of residence; functionally, they are under the local government health units (LGHU). A BHW is assigned approximately 10-20 families, is responsible for dissemination of health information and health promotion activities, and conducts other health-related undertakings to any member of the families being attended to. At present, a typical LGHU would be composed of one or more municipal or city health centers and a number of barangay health stations, and would have at least one municipal/city health officer, at least one nurse, several midwives, and the BHW.

Routinely, chronic condition-related activities in the LGHU are limited to informative posters on stroke, high blood pressure, diabetes, chronic lung diseases, smoking cessation, and the benefits of exercise and a healthy diet. There are also one-day annual campaigns on specific conditions, healthy lifestyle, tobacco control, etc., as programmed by the Department of Health.[16] Organized care aiming at self-management education and support for chronic conditions is non-existent in most LGHU. Before the presently reported FiLDCare project, this was also the case in the study sites.

Diabetes in the Philippines

The Philippines is predicted to be among the 10 countries worldwide with the highest numbers of people with diabetes mellitus type 2 (type 2 DM) by 2030.[17] Based on regular epidemiologic surveys conducted by the Philippine Food and Nutrition Research Institute, the prevalence of “new” type 2 DM as tested by a single fasting blood glucose (FBG) of ≥7.0mmol/L increased from 3.4% in 2003 to 4.8% in 2008

together with an increase in the prevalence of known diabetes from 2.6% to 4.0%.[18,19] A rise in diabetes complications has also been noted. For renal complications alone, it is seen that 55% of people with diabetes in the Philippines will eventually develop kidney disease; in 2007 there was an increase of more than 2800 diabetic nephropathy patients requiring dialysis.[20] The rapidly increasing prevalence of type 2 DM, and the poor control of disease progression and emergence of complications only show that current case management of diabetes mellitus in the Philippines is below optimum.

We previously conducted a cross-sectional KAP study on 549 people with diabetes from three different urban and rural sites in the Philippines, exploring and documenting the associations of diabetes knowledge and some attitudes and perceptions with perceived self-efficacy and the self-management practices of adherence to medications, diet and exercise and proper utilization of healthcare services.[21] A study on the knowledge, attitudes, and practices of people with diabetes in a single rural site, which concentrated on characterizing the respondents' diabetes knowledge, beliefs in patient autonomy, self-monitoring of blood sugar, and frequency of clinical consultations was published a few years earlier.[22] We were not able to find any publications regarding longitudinal KAP studies conducted on people with diabetes in the Philippines.

METHODOLOGY

This was a prospective quasi-experimental before-after multicenter study involving two purposively selected LGHU and a cohort of people with diabetes, conducted from May 2011 to February 2013. The intervention was a context-adapted chronic disease care model-based DSME/S. The outcomes of interest were changes in diabetes knowledge, attitudes, perceptions, practices, body mass index (BMI), waist circumference, waist-hip ratio (WHR) and HbA1c levels of the project participants.

Selected LGHU staff including BHW participated in a 32 hours training workshop on primary diabetes care and DSME/S, results of which will be discussed elsewhere.

The study sites

Batac (population=53,542 as of 2010[23]) is a non-highly urbanized component city in the island of Luzon composed of 43 barangays with two government health centers and their barangay health stations. Other health care services include a tertiary-level Department of Health-operated hospital, a primary-level private hospital, a number of private multi-specialty clinics and clinical laboratories, and several private drugstores/pharmacies.

Pagudpud (population=21,877 as of 2010[23]), the northernmost settlement in Luzon, is a rural municipality classified to be very low in economic development. Composed of 16 barangays, it only has a basic government health center and barangay health stations for health care. There are no laboratory facilities, nor any private clinics or drugstores/pharmacies.

As in many LMIC, most healthcare expenditures are out-of-pocket.

Inclusion / exclusion criteria

The LGHU staff were requested to enrol people with diabetes from their localities to the FiLDCare Project. Criteria for inclusion in the FiLDCare Project were: diagnosis of type 2 diabetes, age $\geq$ 20 years, and willingness to participate in the project. The trained healthcare workers provided primary diabetes care and DSME/S to the project participants.

Data gathered from the project participants were further screened for inclusion in statistical analysis. Inclusion criteria for analysis were: completeness of interview data, pre- and post-implementation HbA1c values and pre- and post-implementation anthropometric measurements. Exclusion criteria were: pregnancy and a positive medical history of anemia (sickle cell, iron deficiency), and end-stage renal disease.

Interview of project participants (Diabetes knowledge, attitudes, perceptions and practices)

The principal investigator and/or trained field researchers, one of which was the FiLDCare Project nurse, provided full project information and obtained written informed consent from each of the participants. The researchers conducted one-on-one interviews using a structured questionnaire inquiring on knowledge, attitudes, perceptions and practices and took measurements for the BMI, waist circumference, and WHR. They likewise tested for HbA1c making use of *A1CNow* (Bayer HealthCare, Makati City, Philippines), a point-of-care test that conforms to the National Glycohemoglobin Standardization Program protocol. Interviews and measurements were done prior to and one year after the start of project implementation. Knowledge was tested making use of a 20-question diabetes knowledge test based on the Fitzgerald et al. Diabetes Knowledge Test[24] and the Garcia et al. Diabetes Knowledge Questionnaire[25]. Questions on attitudes and perceptions were adapted from the survey questionnaires of the University of Michigan Diabetes Research and Training Center.[26, 27] The attitude and perception questions were formulated as statements and made use of a Likert scale for answers, with 1 (“never”) as the lowest and 5 (“always”) as the highest rating. Negative and positive attitudes were measured separately. A straight statement on fear “I am afraid of my diabetes” was used to assess fear of diabetes. Perceived support needs and support received were directed towards support a person with diabetes needs and receives from family and friends. Questions on perceived

support attitudes probed the perceptions of how a person with diabetes is being treated, accepted and supported by family and friends. The internal reliability consistency of these sets of questions were previously tested in our cross-sectional KAP study, with Cronbach's alpha of 0.72-0.94.[21] Questions on medication adherence inquired on medications prescribed by healthcare providers and if the respondents were taking the right medications at the right dosages at the right time; these were transposed to "no" or "yes" answers and summarized as "no" if any of the questions were answered with "no" and "yes" if all the questions were answered with "yes". The question on diet adherence was answerable by "no", "sometimes", or "yes/always"; these answers were transformed to "not/sometimes adherent" and "yes/fully adherent". For exercise, questions were asked on the type of exercise done, frequency, and duration; the answers were then transformed to "no" or "yes" based on the criteria of doing 150 minutes of moderate-intensity aerobic physical activity or at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week.[28] Medical records were reviewed for any co-morbid illnesses.

FiLDCare Project DSME/S strategy

One-on-one diabetes self-management education (DSME) was initiated either by the city/municipal health officer or the LGHU nurse, assisted by the principal investigator and/or the FiLDCare Project nurse during consultations at the government health unit. Consultations and the concomitant DSME sessions were done at least once every three months. The DSME sessions focused on: information on diabetes and diabetes medications, adoption of self-care behavior, gaining control over the condition through problem solving skills, and goal setting. DSME was conducted in a conversational and interactive manner, embedded in the clinical consultation. Duration of the initial DSME session ranged from 20 to 30 minutes and the succeeding sessions from 5 to 15 minutes. Written materials on healthy eating, exercise, and glycemic goals were given out during the sessions. Community-based

diabetes self-management support (DSMS) was continued by the BHW and the midwives. DSMS concentrated more on behavioral support with reinforcement of self-management (taking medications, diet, exercise and foot care) and problem solving. DSMS was provided informally through home visits where the BHW would drop by the house of the person with diabetes and introduce pieces of information on diabetes and diabetes care in the conversation. Also, DSMS sessions were conducted in the barangay health stations where the BHW and midwives would be found on specific days two to four times a month and where people with diabetes could go if and when they had any questions or would want to talk to these healthcare workers. DSMS was provided at least once a month. The frequency and duration of DSME/S depended primarily on the demand of the person with diabetes. The DSME/S approach was collaborative and interactive rather than rigidly structured. After the opening DSME where the different aspects for self-management were discussed, the opinion and choices of the person with diabetes on the topics to be tackled in succeeding DSME/S sessions were considered. Active listening skills (introduced in the initial training workshop) were employed.

Statistics

Statistical analyses were done making use of the statistical package Stata/IC version 11.0.[29] Wilcoxon signed-rank test was used to compare the pre- and post-implementation median values of the outcomes. Test of proportions was used to compare the pre- and post- implementation proportions of people adherent to medications, diet and exercise and people with good glycemic control.

Comparisons of collected demographic data and the changes in measured endpoints were done using the stratifications “decreased/unchanged HbA1c” and “increased HbA1c; “in good glycemic control” and “not in good glycemic control” on both pre- and post-implementation determinations; and “in good glycemic control” on the pre-

implementation and “in good glycemic control” on the post-implementation determination. Mann-Whitney test was used for the collected demographic data and two independent samples T-test was used for the computed changes in the measured outcomes.

Logistic regression analysis was done using “decreased/unchanged HbA1c” against “increased HbA1c” to determine significant correlates in improving glycemic control. Independent variables were transformed into categorical variables. Bivariate logistic regression was initially done. An alpha of 0.10 was used as the cut-off to consider for multivariate logistic regression. Multivariate logistic regression of independent variables with alpha of 0.05 or less was done and variables with an alpha>0.05 were removed in a stepwise fashion. The remaining variables having an alpha of ≤0.05 were considered statistically significant correlates.

Definitions

Good control of diabetes was defined as having HbA1c ≤7.0% (≤53mmol/mol).[30] This cut-off was considered as the optimal level in both pre-implementation and post-implementation determinations.

For the classification of changes in HbA1c pre- and post-implementation, it should be noted that, without any interventions, the natural history of diabetes is deterioration of glycemic control through time.[31] Unchanged HbA1c levels may thus be viewed as a favorable result. Following this logic, unchanged HbA1c levels were grouped with decreased HbA1c levels against those with increased HbA1c levels.

Post-implementation changes in ratings were determined by subtracting pre-implementation ratings from the post-implementation values. No and negative

changes were grouped together against positive changes to create categorical variables. Increase was defined as a positive change.

Changes in adherence were classified as “did not deteriorate/improved” and “deteriorated/did not improve”. The classification “did not deteriorate/improved” includes those who reported to be adherent in both pre- and post-implementation interviews or who reported to be not adherent in the pre-implementation interview but became adherent post-implementation. Those who reported to be not adherent in the post-implementation interview were classified “deteriorated/did not improve” regardless of adherence reported in the pre-implementation interview.

Duration of diabetes was categorized as ≤2 years, >2-10 years, and >10years; education was categorized based on the number of years in school, namely 0-6 years, 7-10 years and >10 years.

RESULTS

A total of 203 people with diabetes were enrolled to the FiLDCare Project; 134 in Batac City and 69 in Pagudpud. Statistical analysis was conducted on data collected from 164 (80.8%) participants, 108 in Batac City and 56 in Pagudpud. Of the 39 participants whose data were not included in the statistical analysis, five refused any A1C testing from the outset, four died, eight migrated, two refused post-implementation interview, and 20 refused any further A1C testing. None were found to have any of the exclusion criteria for statistical analysis stated. Demographic data of the project participants are listed in Table 1.

Baseline results

In the pre-implementation phase, 68 (41.5%) of the study participants had good glycemic control. Statistical analyses of the baseline data did not identify any

significant differences between those in “good glycemic control” and those “not in good glycemic control” in any of the variables measured during the pre-implementation interview.

Post-implementation results

Post-implementation data showed an increase in the number of study participants with good glycemic control (n=83, 50.6%). However, aside from age (median age, in good control=59, not in good control=55; p=0.010), no other significant differences in the endpoints measured post-implementation were noted among those with “good glycemic control” against those “not in good glycemic control”.

Changes in measured endpoints

A year after full implementation, analysis of the median values showed significant decrease in the HbA1c (p<0.001), waist circumference (p=0.007), WHR (p<0.001), and the “perceived support received from family and friends” (p<0.001). Significant increases were noted in the correct answers to the knowledge test (p<0.001), the “perceived ability to control blood glucose” (p=0.036), the “perceived ability to adhere to diet and exercise” (p=0.022), and the “fear of diabetes” (p<0.001). Analysis of proportions showed significant increase in people adherent to medications (p=0.001) and adherent to exercise (p<0.001), but a significant decrease in those adherent to diet (p<0.001) (Table 2).

There was a significant increase (p<0.001) in the proportion of project participants with optimal glycemic control from 41.5% to 50.6%. Regardless of level of control, HbA1c decreased in 60.4% of the participants (99/164), remained the same in 7.9% (13/164) and increased in 31.7% (52/164). Among those with reduced HbA1c, the average reduction was -1.44 HbA1c percentage points (-15.7 mmol/mol); when combined with those with unchanged HbA1c, the average reduction was -1.3 HbA1c

percentage points (-14.2 mmol/mol). Among those with increased HbA1c, the average increase was +1.21 HbA1c percentage points (+13.2 mmol/mol).

Table 3 stratifies the pre- and post-implementation HbA1c values of the project participants. Among those who had optimal pre-implementation HbA1c levels, HbA1c decreased in 60.3% (41/68), remained the same in 8.8% and increased in 30.9% (21/68). The increase was marked in 5.9% (4/68) reclassifying them to have sub-optimal HbA1c levels post-implementation. Among the project participants having sub-optimal pre-implementation HbA1c levels (>7.0% / >53mmol/mol), HbA1c decreased in 60.4% (58/96) with 19.8% achieving good glycemic control post-implementation. HbA1c remained the same in 7.3% and increased in 32.3% (31/96). The mean average changes were -2.16 HbA1c percentage points (-23.6mmol/mol) among those whose HbA1c decreased and +1.60 HbA1c percentage points (+17.5mmol/mol) among those whose HbA1c increased. There were no reported incidences of hypoglycemia among the study participants.

Analysis of the changes in measured endpoints based on glycemic control prior to and one year after project implementation showed a higher decrease in HbA1c ($p=0.016$) and an increase in positive attitude ratings ($p=0.006$) among those with pre-implementation HbA1c>7%. As expected, a decrease in HbA1c was noted among those classified to be “in good glycemic control” in the post-implementation determination ($p=0.033$). The decrease in HbA1c among those “in good glycemic control” post-implementation was significantly higher than the decrease in HbA1c among those “in good glycemic control” pre-implementation ($p<0.001$). None of the other measured changes in endpoints showed statistically significant differences according to pre- and post-implementation glycemic control status (Table 4).

Wilcoxon signed-rank test showed a significant difference in gender (p=0.042), duration of diabetes (p=0.005), and the change in the "perceived ability to control blood glucose" (p=0.034) between those with "decreased/unchanged HbA1c" against "increased HbA1c". Results of analysis of the endpoints based on the changes in HbA1c are listed in Table 5. Overall values are presented in Table 5a. Since logistic regression showed a significant difference in gender associated with improved glycemia, values were disaggregated by gender as listed in Table 5b. The main differences between the groups "increased HbA1c" and "decreased/unchanged HbA1c" are the significant increase in correct answers to the knowledge test (p<0.001), increased ratings of positive attitude (p=0.013) and "perceived ability to control blood glucose" (p=0.004), and the increased proportion of people adherent to medication (p=0.001) in favor of those whose glycemia improved. There is a significant increase in the ratings of fear (p=0.010), positive and negative attitudes(p=0.008; 0.009), and the perceived ability to control blood glucose (p=0.007) among the male participants whose glycemia improved, which was not observed among the female participants.

Bivariate logistic regression of correlates for improved glycemia identified the male gender (p=0.049), duration of diabetes >10years (p=0.001), increased fear of diabetes (p=0.050), increased perceived ability to control blood glucose (p=0.030), and better adherence to diet suitable to diabetes (p=0.049) as having an alpha of $\leq$0.10. These were entered in multivariate logistic regression to arrive at the final model composed of the male gender as a positive correlate to improved glycemia (p=0.034), and duration of diabetes >10 years (p=0.003) and increased fear of diabetes (p=0.048) as strong negative correlates (Table 6).

DISCUSSION

Patient education has evolved through the years from merely informing patients regarding their illnesses to involving them in the care of their conditions, especially in chronic cases.[9] In diabetes, usual self-management education activities aim to provide information on the disease process and its pathophysiology, and instructions on self-management behavior which may cover diet, physical activity, monitoring, medications, risk reduction, problem solving, and coping.[32-35] Several published individual articles and meta-analyses of trials evaluating the effectiveness of DSME have demonstrated the efficacy of DSME for people with diabetes in terms of improvements in glycemic control, knowledge, self-management behavior, and the psychological and behavioral aspects of self-management. The settings, techniques, and types of interventions used in these DSME programs were diverse and involved a combination of a number of providers that included at least any 3 of the following: medical specialists, dietitians, psychologists, managers, and pharmacists aside from primary care physicians, nurses, and the occasional community-based health care workers. [13, 34-43] No specific structural variations seem to be constantly superior over others.

For the FiLDCare Project, one-on-one collaborative DSME/S sessions were conducted both in a clinical and a community setting, and aimed mainly to provide information and basic knowledge on diabetes, and instructions and reminders for diabetes self-management. The project made use of existing LGHU staff and took advantage of the large cadre of BHW (In the Philippines, these community workers are generally highly educated), shifting tasks that were standardizable and required less expertise, so as not to overburden the LGHU physician and nurse. Furthermore, selfcare development actively involved the person with diabetes. Actively involving the person with chronic condition in self-management and decision making increases the likelihood of adherence to the recommended plan of care.[44]

One year after full project implementation, significant improvements were noted: the participants' level of diabetes-related knowledge, the perceptions of "ability to control blood glucose" and "ability to adhere to diet and exercise regimens", and reported adherence to medications and exercise increased. Adiposity/obesity as measured through the WHR and waist circumference decreased. More than these, glycemic control of the FiLDCare Project participants significantly improved. However, the fear of diabetes increased and the "perceived support received from family and friends" decreased, as did reported adherence to diet.

Changes in glycemia and measures of obesity/adiposity

The effects of DSME/S on clinical endpoints such as glycemia and obesity/adiposity have been well-documented in the past.[13,14, 34-43] These were also observed in our study. Overall, the noted reduction in HbA1c of the FiLDCare project participants was significant. There was also a significant increase in the proportion of people with optimal glycemic control. In depth analysis of the changes in HbA1c levels shows reductions in HbA1c regardless of the level of pre-implementation glycemic control. The proportion of people with reductions in HbA1c, whether among those with optimal or with sub-optimal control, approached 60%, with higher reductions in HbA1c levels among those classified to have sub-optimal control at baseline. Significant changes in obesity/adiposity were noted through the WHR and the waist circumference measurements, but not through the BMI. These significant reductions in the indirect measures for obesity/adiposity were noted regardless of glycemic control.

Changes in knowledge, attitudes and perceptions

Akin to aforementioned studies on DSME where changes in knowledge were measured[12, 13], knowledge of the project participants increased. The increase in

knowledge may have increased perceptions of self-efficacy. Possessing the essential knowledge about the condition and the care for the condition may increase the level of confidence of people with diabetes in their selfcare abilities, i.e. ability to control blood glucose, ability to adhere to diet and exercise regimen. Positive feelings of self-efficacy may consequently lead them to perform and adhere to better self-management practices.[45] In our study, this could be construed as an increase in knowledge leading to increased perceived abilities to control blood glucose and to adhere to diet and exercise regimen, leading to an increase in self-reported adherence to medications and exercise of our project participants. The changes in self-reported adherence to diet may have been an effect of the participants having learned of the specific diet they should be adhering to, which they were taught during the DSME/S sessions. The negative change noted could be attributable to their change in perception of what a diet suitable for diabetes consists of rather than a change in eating behavior; hence the decrease in the number answering “yes” in the post-implementation interview. Another possible effect of the DSME/S sessions is the recognition of things that have to be done for the condition which could trigger the person to seek for social support in order to accomplish some of these. As the person with the condition learns of the various activities to be undertaken for self-care and self-management, previously perceived adequate support given by family and friends may now be perceived as inadequate, hence the negative change in this rating. Involvement of the family and friends in the DSME/S sessions was limited, and strategies to include the people around the person with diabetes in future DSME/S activities need to be developed further. Multivariate regression analysis identified increased fear as the lone modifiable correlate significantly associated with glycemic control. In this study, its effect on glycemia improvement was negative. Although a number of health campaigns have made use of the fear factor, such may not necessarily trigger a positive response; fear may bring about negative self-management behavior.[46] Fear of diabetes as well as other psychological aspects

may have been inadequately addressed in the DSME/S sessions due to the limited training and composition of the health care team. Such fear may have negatively influenced self-management behavior and other known and unknown factors that may have contributed to improved glycemic control.

The two other correlates significantly associated to improved glycemia are non-modifiable. Nevertheless, this information may be used in tailoring DSME/S. In our study, the female gender and duration of diabetes of 10 years or more were identified to be negatively correlated to improvements in glycemia.

Gender

Gender differences in glycemic control have been studied in the past with females either having equal or poorer but not a superior glycemic control compared to males.[47, 48] This may be partly attributed to differences in glucose metabolism and homeostasis between sexes.[49] With regard to our study, we noted gender differences comparing some pre- and post-implementation attitude and perception ratings. However, the male population in our sample is not substantial enough to subject this to further and more rigorous statistical analysis. Thus, we can only speculate how, in consonance with the theory of perceived self-efficacy, the increase in knowledge, fear, and positive and negative attitudes in our male population may positively affect perceived self-efficacy to control blood glucose, stimulate positive self-management behavior, and thereby improve glycemia.

Duration of diabetes

It has been observed that much of the instruction on diabetes care is given to the person when the diagnosis is first made and there may be a need to re-train people who have had diabetes for a number of years so as to maintain better glycemic control.[50] However, it seems that in spite of DSME/S given to the whole cohort in our study, glycemia still had the tendency to deteriorate in the subgroup of people with known diabetes for 10 years or more. Other factors undoubtedly influence this negative correlation, aside from the need of re-training in people who have had diabetes for a number of years.

Conclusions

This research has shown that some basic elements of DSME/S may be introduced making use of pre-existing health care personnel and produce favorable results. The provision of context-adapted DSME/S may improve diabetes-related knowledge, some attitudes, perceptions and practices, adiposity/obesity, and glycemia of its recipients. The FiLDCare Project, with some improvements, may be implemented in other areas of the Philippines to find out if it yields comparable, if not better, outcomes. Other LMIC may draw inspiration from this study to apply similar context-adapted measures to implement DSME/S.

Explorations on ways by which to handle psychological aspects in general and address fear of diabetes in particular in resource-constrained settings where a complete professional health care team is unavailable would be useful. Special attention may be needed in designing appropriate DSME/S for the female gender and those who have been known to have diabetes for a number of years now. Inclusion of and a more active participation of family and friends as well as other

members of the community in DSME/S activities should be considered, as this may help improve the social support that most people with diabetes need.

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FOOTNOTES

Reporting guideline

This is a quasi-experimental study and no specific reporting guidelines are listed.

Ethical considerations

This research was approved by the Institutional Review Boards of the University of Antwerp and the Institute of Tropical Medicine in Belgium (Belgian Reg. No. B30020109490), and the Ethics Committee of the Mariano Marcos Memorial Hospital and Medical Center in the Philippines. It was conducted with permission from the governments of the Province of Ilocos Norte, the City of Batac and the Municipality of Pagudpud and their respective health offices.

Authors' contributions

GMVK contributed to the design of the research, participated in data collection, did the statistical analysis and drafted the manuscript. GK provided substantial contributions in the concept and design, data analysis, and in the drafting of the manuscript. Both authors read and approved the final manuscript.

Conflict of interest statement

Neither of the authors has any financial competing interests regarding this research.

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Data sharing statement

Additional data may be obtained by sending an e-mail to gracemariekumd@yahoo.com.

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Table 1. Demographics of people enrolled in the FiLDCare Project

			Male	Female
			N=42 (25.6%)	N=122 (74.4%)
Age		Average	57.9	56.5
		Median	58.5	57
		Range	36 – 83	27 – 80
Number of years with diabetes	Summary statistics	Average	5	4.7
		Median	2.5	2
		Range	0.5 – 28	0.5 – 22
	Distribution	0.5 – 2 years	85 (51.8%)	
		>2 – 10 years	53 (32.3%)	
		>10 years	26 (15.9%)	
Level of education (number of years in school)		0-6 years	43 (26.2%)	
		7-10 years	63 (38.4%)	
		>10 years	58 (35.4%)	

Table 2. Pre- and post-implementation values of measured endpoints, in medians and proportions

	Overall, n=164				Male, n=42				Female, n=122			
Variable	Before implementation	After implementation	P value	change	Before implementation	After implementation	P value	change	Before implementation	After implementation	P value	change
	Median values, (binomial interpolation of confidence intervals / interquartile range)		Wilcoxon signed-rank test	Mean change	Median values, (binomial interpolation of confidence intervals / interquartile range)		Wilcoxon signed-rank test	Mean change	Median values, (binomial interpolation of confidence intervals / interquartile range)		Wilcoxon signed-rank test	Mean change
HbA1c, % mmol/mol	7.7 (7.2-8.2 / 6.5-10.4) 61 (55 -56 / 48-90)	6.9 (6.8-7.5 / 6.2-9.3) 52 (51-58 / 44-78)	<0.001	-0.49 -5.4	7.5 (6.7-8.7 / 6.3-10.7) 58 (50-72 / 45-93)	6.8 (6.2-7.7 / 6.1-8.7) 51 (44-61 / 43-72)	0.001	-0.92 -10.1	7.8 (7.2-8.5 / 6.5-10.4) 62 (55-69 / 48-90)	7.2 (6.8-8.0 / 6.3-9.5) 55 (51-64 / 45-80)	0.057	-0.34 -3.7
BMI, kg/m^2	23.7 (23.1-24.1 / 21.8-26.1)	23.3 (22.6-23.8 / 21.2-25.6)	0.075	-0.40	23.8 (22.8-24.7 / 22.0-25.8)	23.6 (21.9-24.7 / 21.2-25.1)	0.395	-0.37	23.6 (23.0-24.0 / 21.6-26.2)	23.2 (22.4-24.1 / 21.0-25.7)	0.122	-0.41
Waist circumference, in cm	85.0 (83.9-86.4 / 81.0-91.2)	83.0 (82.0-85.0 / 79.0-89.0)	0.007	-1.37	89.0 (84.3-91.5 / 81.0-94)	80.0 (83.0-89.9 / 81.0-94.0)	0.026	-2.09	84.0 (82.8-85.2 / 80.0-88.9)	82.8 (81.0-85.0 / 78.7-88.0)	0.054	-1.13
Waist-hip ratio	0.90 (0.89-0.91 / 0.87-0.95)	0.89 (0.88-0.90 / 0.85-0.92)	<0.001	-0.02	0.93 (0.90-0.95 / 0.89-0.96)	0.91 (0.88-0.93 / 0.87-0.95)	0.025	-0.03	0.90 (0.88-0.91 / 0.86-0.93)	0.88 (0.87-0.90 / 0.85-0.92)	0.001	-0.20
Knowledge, % correct answers	60.0 (60.0-65.0 / 50.0-75.0)	67.5 (65.0-70.0 / 60.0-75.0)	<0.001	+7.59	50.0 (50.0-64.3 / 45.0-70.0)	65.0 (60.0-70.0 / 60.0-75.0)	0.006	+9.52	62.5 (60.0-65.0 / 50.0-75.0)	70.0 (65.0-70.0 / 60.0-75.0)	<0.001	+6.93
Perceived fear of diabetes	4.0 (4.0-4.0 / 2.0-4.0)	4.0 (4.0-4.0 / 3.0-5.0)	<0.001	+0.46	2.0 (2.0-4.0 / 1.0-4.0)	4.0 (3.0-4.0 / 2.0-5.0)	0.003	+0.81	4.0 (4.0-4.0 / 2.4-4.0)	4.0 (4.0-4.0 / 3.0-4.0)	0.018	+0.34
Positive attitude	3.4 (3.2-3.4 / 2-8-3.9)	3.4 (3.2-3.6 / 3.0-4.0)	0.071	+0.14	3.2 (2.8-3.4 / 2.6-3.6)	3.5 (3.2-4.0 / 3.2-4.0)	0.025	+0.36	3.4 (3.2-3.6 / 2.8-4.0)	3.4 (3.2-3.6 / 3.0-3.8)	0.479	+0.07
Negative attitude	3.0 (2.8-3.4 / 2.2-4.0)	3.2 (3.0-3.4 / 2.6-3.8)	0.115	+0.15	2.4 (2.0-2.8 / 1.8-3.6)	3.0 (2.8-3.2 / 2.6-3.6)	0.027	+0.42	3.2 (2.8-3.6 / 2.4-4.0)	3.2 (3.0-3.5 / 2.6-3.8)	0.631	+0.06

Attitude towards self-care adherence	3.2 (3.0-3.5 / 2.8-3.8)	3.5 (3.2-3.5 / 3.0-4.0)	0.139	+0.13	3.0 (3.0-3.2 / 2.8-3.5)	3.4 (3.0-3.5 / 2.8-4.0)	0.087	+0.28	3.2 (3.2-3.5 / 2.0-5.0)	3.5 (3.3-3.5 / 3.0-4.0)	0.454	+0.08
Perceived ability to control blood glucose	3.0 (3.0-4.0 / 3.0-4.0)	3.0 (3.0-4.0 / 3.0-5.0)	0.036	+0.24	3.0 (3.0-3.0 / 3.0-4.0)	4.0 (3.0-4.0 / 3.0-4.0)	0.016	+0.43	3.0 (3.0-4.0 / 2.8-4.0)	3.0 (3.0-4.0 / 3.0-5.0)	0.0279	+0.17
Perceived ability to control weight	3.0 (3.0-4.0 / 3.0-4.0)	3.0 (3.0-4.0 / 3.0-4.0)	0.349	+0.12	3.0 (3.0-4.0 / 3.0-4.0)	3.5 (3.0-4.0 / 3.0-4.0)	0.289	+0.021	3.0 (3.0-4.0 / 3.0-4.0)	3.0 (3.0-4.0 / 3.0-4.0)	0.649	+0.08
Perceived ability to adhere to diet and exercise regimens	4.0 (3.0-4.0 / 3.0-5.0)	4.0 (4.0-4.0 / 3.0-5.0)	0.022	+0.26	3.0 (3.0-4.0 / 3.0-4.0)	4.0 (3.0-4.0 / 3.0-5.0)	0.071	+0.35	4.0 (3.0-4.0 / 3.0-5.0)	4.0 (4.0-4.0 / 3.0-5.0)	0.107	+0.23
Perceived ability to handle feelings about diabetes	3.0 (3.0-4.0 / 3.0-4.0)	3.0 (3.0-4.0 / 3.0-4.5)	0.653	-0.01	4.0 (3.0-4.0 / 3.0-4.0)	3.5 (3.0-4.0 / 3.0-5.0)	0.592	+0.17	3.0 (3.0-4.0 / 3.0-4.0)	3.0 (3.0-3.3 / 3.0-4.0)	0.391	-0.07
Perceived support needs	5.0 (4.8-5.0 / 4.2-5)	4.8 (4.2-5.0 / 4.0-5.0)	0.193	+0.02	5.0 (4.7-5.0 / 4.3-5.0)	4.2 (4.0-5.0 / 4.0-5.0)	0.125	-0.13	5.0 (4.8-5.0 / 4.2-5.0)	5.0 (4.3-5.0 / 4.0-5.0)	0.593	+0.007
Perceived support received from family & friends	5.0 (5.0-5.0 / 4.0-5.0)	4.0 (4.0-4.0 / 3.8-4.8)	<0.001	-0.39	5.0 (4.9-5.0 / 4.0-5.0)	4.0 (4.0-4.0 / 3.8-4.3)	0.002	-0.52	5.0 (4.8-5.0 / 4.0-5.0)	4.0 (4.0-4.0 / 3.8-5.0)	<0.001	-0.34
	N (proportion, %)		**Test of pro-portions**	**Change n (%)**	**N (proportion, %)**		**Test of pro-portions**	**Change n (%)**	**N (proportion, %)**		**Test of pro-portions**	**Change n (%)**
Proportion adherent to medications	108 (65.9%)	134 (81.7%)	0.001	+26 (+15.8%)	30 (71.4%)	34 (81.0%)	0.306	+4 (+9.6%)	78 (63.9%)	100 (82.0%)	0.001	+22 (+18.1%)
Proportion adherent to exercise regimen	68 (41.5%)	110 (67.1%)	<0.001	+42 (+25.6%)	25 (59.5%)	27 (64.3%)	0.653	+2 (+4.8%)	43 (35.2%)	83 (68.0%)	<0.001	+40 (+38.2%)
Proportion adherent to prescribed diet	99 (60.4%)	66 (40.2%)	<0.001	-33 (-20.2%)	19 (45.2%)	14 (33.3%)	0.264	-5 (-11.9%)	80 (65.6%)	52 (42.6%)	<0.001	-28 (-23.0%)

Table 3. Stratification of FiLDCare Project Participants based on pre-implementation and post-implementation levels of glycemic control

		Pre-implementation						Total (post-implementation)
		Good control HbA1c≤7%			Not in good control HbA1c>7%			
Change in HbA1c		decreased	increased	unchanged	decreased	increased	unchanged	
Post-implementation	Good control HbA1c≤7%	41	17	6	19			83
	Not in good control HbA1c>7%		4		39	31	7	81
Total (pre-implementation)		41	21	6	58	31	7	164
		68			96			

Table 4. Mean change (SD) of measured endpoints according to pre-implementation and post-implementation control of glycemia

Glycemic control	Pre-implementation (Baseline)			Post-implementation			Pre-implementation "in good control" vs post-implementation "in good control", P value
	In good control (n=68)	Not in good control (n=96)	P value	In good control (n=83)	Not in good control (n=81)	P value	
	Mean change, (SD)	Mean change, (SD)	Independent samples T-test	Mean change, (SD)	Mean change, (SD)	Independent samples T-test	Two independent samples T-test
HbA1c, % (mmol/mol)	-0.065 (0.766)	-0.786 (2.367)	0.016	-0.800 (2.116)	-0.167 (1.629)	0.033	<0.001
BMI, kg/m^2	-0.892 (1.812)	-0.181 (3.112)	0.067	-0.702 (2.944)	-0.245 (1.809)	0.234	0.539
Waist circumference, cm	-2.714 (7.888)	-0.706 (5.709)	0.060	-2.317 (7.820)	-0.740 (5.374)	0.135	0.633
WHR	-0.025 (0.110)	+0.016 (0.063)	0.511	-0.028 (0.106)	-0.012 (0.057)	0.215	0.518
Knowledge test rating, %	+7.00 (20.40)	+8.00 (19.00)	0.739	+8.10 (20.68)	+7.00 (18.84)	0.721	0.542
Perceived fear of diabetes	+0.618 (1.630)	+0.354 (1.741)	0.328	+0.542 (1.748)	+0.383 (1.647)	0.549	0.727
Positive attitude	-0.091 (0.872)	+0.308 (0.928)	0.006	+0.039 (0.920)	+0.249 (0.921)	0.144	0.074
Negative attitude	+0.218 (1.085)	+0.106 (1.342)	0.572	+0.161 (1.203)	+0.143 (1.284)	0.925	0.709
Attitude towards self-care adherence	+0.040 (0.911)	+0.918 (0.944)	0.287	+0.069 (0.940)	+0.198 (0.923)	0.379	0.707
Perceived ability to control blood glucose	+0.103 (1.199)	+0.333 (1.359)	0.263	+0.157 (1.204)	+0.321 (1.386)	0.418	0.640
Perceived ability to control weight	-0.015 (1.203)	+0.208 (1.428)	0.295	+-0.024 (1.334)	+0.259 (1.340)	0.177	0.781
Perceived ability to adhere to diet and exercise regimens	+0.103 (1.174)	+0.375 (1.394)	0.191	+0.217 (1.279)	+0.309 (1.348)	0.655	0.468
Perceived ability to handle feelings about diabetes	-0.206 (1.451)	+0.135 (1.396)	0.131	-0.120 (1.383)	+0.111 (1.466)	0.300	0.201
Perceived support needs	+0.093 (0.973)	-0.030 (1.155)	0.476	+0.040 (0.925)	+0.002 (1.227)	0.822	0.907
Perceived support received	-0.179 (1.191)	-0.535 (1.236)	0.067	+0.229 (1.194)	+0.549 (1.246)	0.094	0.573
	N (proportion, %)		**Test of proportions**	**N (proportion, %)**		**Test of proportions**	
Adherence to medications (improved / did not deteriorate)	57 (83.8%)	77 (80.2%)	0.683	71 (85.5%)	63 (77.8%)	0.229	
Adherence to exercise (improved / did not deteriorate)	47 (69.1%)	63 (65.6%)	0.736	56 (67.5%)	54 (66.7%)	1.00	
Adherence to diet (improved / did not deteriorate)	32 (47.1%)	34 (35.4%)	0.148	38 (45.8%)	28 (34.6%)	0.155	

Table 5a. Pre-implementation & post-implementation median values of HbA1c, anthropometric measurements, diabetes knowledge, attitudes and perceptions, and proportions of self-care practices stratified according to "Increased HbA1c" and "Decreased or Unchanged HbA1c", and p values of comparisons of changes in measured endpoints among those with "Increased HbA1c" against "Decreased or Unchanged HbA1c"

Change in A1C	Increased HbA1c, n=52				Decreased/Unchanged HbA1c, n=112				P value Two independent samples T-test of mean change, Increased HbA1c vs Decreased / Unchanged HbA1c
	Pre	Post	P value	Change	Pre	Post	P value	Change	
	Median		Wilcoxon signed-rank test	Mean change	Median		Wilcoxon signed-rank test	Mean change	
HbA1c, % (mmol/mol)	7.5 (58)	9.2 (76)	<0.001	+1.21 (+13.2)	7.8 (62)	6.8 (51)	<0.001	-1.3 (-14.2)	<0.001
BMI, kg/m^2	24.5	23.3	0.115	-0.72	23.5	23.2	0.281	-0.24	0.379
Waist circumference, cm	85	83	0.006	-2.32	84.5	83.9	0.140	-0.93	0.314
WHR	0.90	0.89	0.028	-0.01	0.90	0.89	0.001	-0.03	0.226
Knowledge test rating, %	65	65	0.060	+4.20	60	70	<0.001	+9.0	0.134
Perceived fear of diabetes	4.0	4.0	0.004	+0.69	4.0	4.0	0.024	+0.35	0.240
Positive attitude	3.3	3.4	0.441	+0.18	3.4	3.4	0.013	+0.13	0.748
Negative attitude	3.0	3.1	0.415	+0.23	3.0	3.2	0.164	+0.12	0.602
Attitude towards self-care adherence	3.1	3.4	0.967	+0.04	3.2	3.5	0.090	+0.17	0.404
Perceived ability to control blood glucose	3.0	3.0	0.516	-0.08	3.0	4.0	0.004	+0.38	0.034
Perceived ability to control weight	3.0	3.5	0.340	+0.17	3.0	3.0	0.618	+0.09	0.711
Perceived ability to adhere to diet and exercise regimens	4.0	4.0	0.006	+0.31	4.0	4.0	0.083	+0.24	0.763
Perceived ability to handle feelings about diabetes	3.5	3.0	0.328	-0.17	3.0	3.0	0.870	+0.07	0.308
Perceived support needs	4.8	5.0	0.978	+0.16	5.0	4.6	0.123	-0.04	0.275
Perceived support received	4.8	4.0	0.035	-0.25	5.0	4.0	<0.001	-0.45	0.342
	N (proportion, %)		Test of pro - portions	Change n (%)	N (proportion, %)		Test of pro- portions	Change n (%)	
Adherence to medications	38 (73.1%)	42 (80.8%)	0.352	+4 (+7.7%)	70 (62.5%)	92 (82.1%)	0.001	+22 (19.6%)	
Adherence to exercise regimen	19 (36.5%)	33 (63.5%)	0.006	+14 (+27.0%)	49 (43.8%)	77 (68.8%)	<0.001	+28 (25.0%)	
Adherence to diabetes diet	37 (71.2%)	24 (46.2%)	0.010	-13 (-25.0%)	62 (55.4%)	42 (37.5%)	0.007	-20 (17.9%)	

Table 5b. Pre-implementation & post-implementation median values of HbA1c, anthropometric measurements, diabetes knowledge, attitudes and perceptions, and proportions of self-care practices stratified according to "Increased HbA1c" and "Decreased or Unchanged HbA1c" and according to gender

Change in A1c	Increased HbA1c, n=52								Decreased/Unchanged HbA1c, n=112							
Gender	Male, n=8				Female, n=44				Male, n=34				Female, n=78			
	Pre	Post	P value	Change	Pre	Post	P value	Change	Pre	Post	P value	Change	Pre	Post	P value	Change
	Median		Wilcoxon signed-rank test	Mean change	Median		Wilcoxon signed-rank test	Mean change	Median		Wilcoxon signed-rank test	Mean change	Median		Wilcoxon signed-rank test	Mean change
HbA1c, % (mmol/mol)	6.3 (50)	8.5 (69)	0.012	+1.51 (+16.5)	7.7 (61)	9.2 (77)	<0.001	+1.16 (+12.7)	7.7 (61)	6.6 (49)	<0.001	-1.49 (-16.3)	8.1 (65)	6.8 (51)	<0.001	-1.18 (-12.9)
BMI, kg/m^2	24.6	23.7	0.124	-1.10	24.5	23.0	0.401	-0.66	23.7	23.5	0.986	-0.20	23.4	23.3	0.234	-0.27
Waist circumference, cm	90.2	87.0	0.014	-4.60	84.5	82.0	0.063	-1.91	87.8	86.0	0.188	-1.50	84.0	83.0	0.284	-0.69
WHR	0.95	0.94	0.069	-0.03	0.90	0.88	0.093	-0.11	0.92	0.90	0.106	-0.04	0.90	0.89	0.006	-0.02
Knowledge test rating, %	62.5	60.0	1.00	+3.75	65.0	65.0	0.021	+4.32	55.0	65.0	0.001	+10.88	60.0	70.0	<0.001	+8.40
Perceived fear of diabetes	2.0	3.0	0.107	+1.0	4.0	4.0	0.013	+0.64	2.0	4.0	0.010	+0.76	4.0	4.0	0.311	+0.18
Positive attitude	3.4	3.2	0.725	+0.03	3.2	3.2	0.365	+0.20	3.2	3.8	0.008	+0.44	3.5	3.4	0.842	-0.01
Negative attitude	2.5	2.6	0.726	-0.13	3.0	3.2	0.315	+0.29	2.4	3.2	0.009	+0.55	3.2	3.1	0.893	-0.07
Attitude towards self-care adherence	3.0	2.8	0.831	-0.09	3.2	3.5	0.902	+0.07	3.0	3.5	0.092	+0.37	3.4	3.4	0.420	+0.09
Perceived ability to control blood glucose	3.5	3.0	0.879	-0.12	3.0	3.0	0.547	-0.07	3.0	4.0	0.007	+0.56	3.0	4.0	0.080	+0.31
Perceived ability to control weight	3.5	3.0	0.879	-0.25	3.0	4.0	0.260	+0.25	3.0	4.0	0.198	+0.32	3.0	3.0	0.773	-0.01
Perceived ability to adhere to diet and exercise regimens	3.0	3.0	0.162	+0.50	4.0	4.0	0.263	+0.27	3.0	4.0	0.161	+0.32	4.0	4.0	0.241	+0.21
Perceived ability to handle feelings about diabetes	3.5	3.0	0.611	-0.12	3.5	3.0	0.406	-0.18	4.0	4.0	0.449	+0.24	3.0	3.0	0.694	0
Perceived support needs	5.0	4.7	0.320	-0.29	4.8	5.0	0.716	+0.24	5.0	4.0	0.192	-0.09	5.0	4.9	0.352	-0.02
Perceived support received	5.0	3.8	0.161	-0.85	4.8	4.0	0.172	-0.14	5.0	4.0	0.012	-0.45	5.0	4.0	<0.001	-0.45
	N, (Proportion)		Test of pro-portions	Change n (%)	N, (Proportion)		Test of pro-portions	Change n (%)	N, (Proportion)		Test of pro-portions	Change n (%)	N, (Proportion)		Test of pro-portions	Change n (%)
Adherence to medications	5 (62.5%)	7 (87.5%)	0.248	+2 (+25.0%)	33 (75.0%)	35 (79.6%)	0.611	+2 (+4.6%)	25 (73.5%)	27 (79.4%)	0.568	+2 (+5.9%)	45 (57.7%)	65 (83.3%)	<0.001	+20 (+25.6%)
Adherence to exercise regimen	5 (62.5%)	5 (62.5%)	1.00	0	14 (31.8%)	28 (63.6%)	0.003	+14 (+31.8%)	20 (58.8%)	22 (64.7%)	0.618	+2 (+5.9%)	29 (37.2%)	55 (70.5%)	<0.001	+26 (+33.3%)
Adherence to diabetes diet	4 (50.0%)	2 (25.0%)	0.302	-2 (-25.0%)	33 (75.0%)	22 (50.0%)	0.015	-11 (-25.0%)	15 (44.0%)	12 (35.3%)	0.457	-3 (-8.7%)	47 (60.3%)	30 (38.5%)	0.006	-17 (-21.8%)

Table 6. Results of logistic regression analysis of improved glycemia: Correlates with alpha≤0.10 identified on bivariate regression analysis of categorical variables and the final model with the significant correlates (alpha≤0.05) of improved glycemia identified on multivariate regression.

Correlate	Odds Ratio	P value	95% confidence interval
Bivariate logistic regression			
Male gender	2.460	0.049	1.020 – 5.633
Duration of diabetes > 10 years	0.200	0.001	0.074 – 0.537
Increased fear of diabetes	0.513	0.050	0.264 – 0.999
Increased perceived ability to control blood glucose	2.250	0.030	1.083 – 4.673
Better adherence to diet suitable for diabetes	2.460	0.049	1.000 – 6.036
Multivariate logistic regression (Final model)			
Male gender	2.655	0.034	1.078 – 6.537
Duration of diabetes > 10 years	0.214	0.003	0.078 – 0.587
Increased fear of diabetes	0.490	0.048	0.242 – 0.994

Effects of the First Line Diabetes Care (FiLDCare) self-management education and support project on knowledge, attitudes, perceptions, self-management practices and glycemic control: A quasi-experimental study conducted in the Northern Philippines

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ABSTRACT

Objectives. To investigate the effects of implementing a context-adapted diabetes self-management education and support (DSME/S) project based on chronic care models in the Philippines, on knowledge, attitudes, self-management practices, adiposity/obesity and glycemia of people with diabetes.

Design. Prospective quasi-experimental before-after study.

Participants. 203 people with type 2 diabetes mellitus from two local government units in the Northern Philippines fulfilling set criteria.

Outcome measures. Context-adapted DSME/S was given to a cohort of people with diabetes by trained pre-existing local government healthcare personnel. Changes in knowledge, attitudes and self-management practices, body mass index, waist circumference, waist-hip ratio (WHR) and glycosylated hemoglobin (HbA1c) were measured one year after full project implementation. Non-parametric and parametric descriptive and inferential statistics including logistic regression analysis were done.

Results. Complete data was collected from 164 participants. Improvements in glycemia, waist circumference, WHR, knowledge, some attitudes, and adherence to medications and exercise, and an increase in fear of diabetes were significant. Reductions in HbA1c regardless of level of control were noted in 60.4%. Significant increase in knowledge ($p<0.001$), positive attitude ($p=0.013$), perceived ability to control blood glucose ($p=0.004$) and adherence to medications ($p=0.001$) were noted among those whose glycemia improved. Significant differences between the subgroup whose HbA1c improved and those whose HbA1c deteriorated include male gender ($p=0.042$); shorter duration of diabetes ($p=0.001$) and increased perceived

ability to control blood glucose (p=0.042). Significant correlates to improved glycemia were male gender (OR=2.655;p=0.034), duration of diabetes >10years (OR=0.214;p=0.003) and fear of diabetes (OR=0.490;p=0.048).

Conclusion. Context-adapted DSME/S introduced in resource-constrained settings and making use of established human resources for health may improve knowledge, attitudes, self-management practices, and glycemia of recipients. Further investigations on addressing fear of diabetes and tailoring DSME/S to female persons with diabetes and those who have had diabetes for a longer period of time may help improve glycemia.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- This study is one of the few conducted regarding:
    1. Integrating chronic care with current healthcare activities making use of pre-existing healthcare staff to introduce/improve care for chronic conditions in public first line health care services of a low-to-middle-income country such as the Philippines; and
    2. Analyzing changes in knowledge, attitudes, perceptions and self-management practices and demonstrating correlations with improving glycemia
- Logistic regression analysis identifies significant correlates towards improving glycemia.
- Comparative analysis of those with improvements in glycemia against those with deteriorations identifies factors that may have contributed towards blood glucose lowering.
- The absence of a control group limits the strength of this study in attributing the identified significant outcomes solely to the intervention.

INTRODUCTION

It has been shown that early interventions prevent or delay the onset of diabetes complications, and good control of the condition is a key.[1-3] Interventions may involve assuring adequate access to diabetes care, medications, laboratory examinations, and the support needed to ensure delivery of health services. Aside from these, a vital role has to be played by the person with diabetes as the condition affects and is affected by daily activities throughout life. People with diabetes must be equipped and supported to manage their condition. The need for self-management education and training for chronic conditions in general and diabetes in particular has long been recognized as an integral part of good quality health care,[4, 5] and diabetes self-management education and support (DSME/S) is already deemed a right for all concerned.[6] Since more than 2 decades ago, self-management education has slowly been incorporated into standards of chronic disease care in high income countries.[7, 8]

The concepts of self-care in general and diabetes self-management in particular are not yet fully embraced in low-to-middle income countries (LMIC). However, these LMIC also need to utilize all possible opportunities to prevent and control diabetes: DSME/S may be a cost-effective measure that may help control diabetes and prevent its complications in these countries where 70% of the total global current cases of diabetes occur[9] and where it affects men and women at younger ages.[10] The need for such a shift is also a relevant issue in the Philippines where the leading causes of mortality for the past 10 years have been chronic conditions[11] but public health is still generally oriented to acute and infectious diseases.

Previous studies in high-income countries have demonstrated that self-management education programs designed to increase knowledge and bring about behavior change are successful in improving glycemia[12, 13]. A number of these studies

have explored factors that may be associated with glycemic control, which may be an effect of the program (such as increased diabetes knowledge) or not (such as level of education, gender and duration of diabetes) but there is a dearth of publications demonstrating any relationships between changes in glycemia and specific attitudes and perceptions related to diabetes, especially in LMIC.

Although a number of aspects in the provision of DSME/S require expertise, skills, and specialized personnel that LMIC may not have the capacity to supply, there are certain DSME/S activities that can be translated to low resource settings. We hypothesized that integrating certain DSME/S activities in first line health systems of LMIC can improve knowledge and attitudes of people with diabetes, which may stimulate better self-management practices and improve glycemia as measured by a decrease in glycosylated hemoglobin (HbA1c).

In the Philippines, we implemented the context-adapted chronic care model-based First Line Diabetes Care (FiLDCare) Project where we organized primary care for diabetes in two local government units. The project focused mainly on primary health care providers and the people with a chronic condition, concentrating on decision support to the healthcare workers, minor re-organization of the health service, delivery system re-design and self-care development through DSME/S. The possible effects of the FiLDCare Project DSME/S on the knowledge, attitudes, perceptions, self-management practices, obesity/adiposity and glycemic control of people with diabetes are explored in this paper.

Background

The Philippine public primary health care system

Public health care in the Philippines was devolved in 1992. The responsibility of providing basic health care services for the people was handed down to local

government units, specifically municipalities and cities.[14] A decade before health care devolution, the country implemented a primary health care policy which created a large cadre of community-based health workers locally called barangay (village) health workers (BHW).[15] Organizationally, the BHW fall under the governance of the barangay and are selected to work in their respective areas of residence; functionally, they are under the local government health units (LGHU). A BHW is assigned approximately 10-20 families, is responsible for dissemination of health information and health promotion activities, and conducts other health-related undertakings to any member of the families being attended to. At present, a typical LGHU would be composed of one or more municipal or city health centers and a number of barangay health stations, and would have at least one municipal/city health officer, at least one nurse, several midwives, and the BHW.

Routinely, chronic condition-related activities in the LGHU are limited to informative posters on stroke, high blood pressure, diabetes, chronic lung diseases, smoking cessation, and the benefits of exercise and a healthy diet. There are also one-day annual campaigns on specific conditions, healthy lifestyle, tobacco control, etc., as programmed by the Department of Health.[16] Organized care aiming at self-management education and support for chronic conditions is non-existent in most LGHU. Before the presently reported FiLDCare project, this was also the case in the study sites.

Diabetes in the Philippines

The Philippines is predicted to be among the 10 countries worldwide with the highest numbers of people with diabetes mellitus type 2 (type 2 DM) by 2030.[17] Based on regular epidemiologic surveys conducted by the Philippine Food and Nutrition Research Institute, the prevalence of “new” type 2 DM as tested by a single fasting blood glucose (FBG) of ≥7.0mmol/L increased from 3.4% in 2003 to 4.8% in 2008

together with an increase in the prevalence of known diabetes from 2.6% to 4.0%.[18,19] A rise in diabetes complications has also been noted. For renal complications alone, it is seen that 55% of people with diabetes in the Philippines will eventually develop kidney disease; in 2007 there was an increase of more than 2800 diabetic nephropathy patients requiring dialysis.[20] The rapidly increasing prevalence of type 2 DM, and the poor control of disease progression and emergence of complications only show that current case management of diabetes mellitus in the Philippines is below optimum.

We previously conducted a cross-sectional KAP study on 549 people with diabetes from three different urban and rural sites in the Philippines, exploring and documenting the associations of diabetes knowledge and some attitudes and perceptions with perceived self-efficacy and the self-management practices of adherence to medications, diet and exercise and proper utilization of healthcare services.[21] A study on the knowledge, attitudes, and practices of people with diabetes in a single rural site, which concentrated on characterizing the respondents' diabetes knowledge, beliefs in patient autonomy, self-monitoring of blood sugar, and frequency of clinical consultations was published a few years earlier.[22] We were not able to find any publications regarding longitudinal KAP studies conducted on people with diabetes in the Philippines.

METHODOLOGY

This was a prospective quasi-experimental before-after multicenter study involving two purposively selected LGHU and a cohort of people with diabetes, conducted from May 2011 to February 2013. The intervention was a context-adapted chronic disease care model-based DSME/S. The outcomes of interest were changes in diabetes knowledge, attitudes, perceptions, practices, body mass index (BMI), waist circumference, waist-hip ratio (WHR) and HbA1c levels of the project participants.

Selected LGHU staff including BHW participated in a 32 hours training workshop on primary diabetes care and DSME/S, results of which will be discussed elsewhere.

The study sites

Batac (population=53,542 as of 2010[23]) is a non-highly urbanized component city in the island of Luzon composed of 43 barangays with two government health centers and their barangay health stations. Other health care services include a tertiary-level Department of Health-operated hospital, a primary-level private hospital, a number of private multi-specialty clinics and clinical laboratories, and several private drugstores/pharmacies.

Pagudpud (population=21,877 as of 2010[23]), the northernmost settlement in Luzon, is a rural municipality classified to be very low in economic development. Composed of 16 barangays, it only has a basic government health center and barangay health stations for health care. There are no laboratory facilities, nor any private clinics or drugstores/pharmacies.

As in many LMIC, most healthcare expenditures are out-of-pocket.

Inclusion / exclusion criteria

The LGHU staff were requested to enrol people with diabetes from their localities to the FiLDCare Project. Criteria for inclusion in the FiLDCare Project were: diagnosis of type 2 diabetes, age $\geq$ 20 years, and willingness to participate in the project. The trained healthcare workers provided primary diabetes care and DSME/S to the project participants.

Data gathered from the project participants were further screened for inclusion in statistical analysis. Inclusion criteria for analysis were: completeness of interview data, pre- and post-implementation HbA1c values and pre- and post-implementation anthropometric measurements. Exclusion criteria were: pregnancy and a positive medical history of anemia (sickle cell, iron deficiency), and end-stage renal disease.

Interview of project participants (Diabetes knowledge, attitudes, perceptions and practices)

The principal investigator and/or trained field researchers, one of which was the FiLDCare Project nurse, provided full project information and obtained written informed consent from each of the participants. The researchers conducted one-on-one interviews using a structured questionnaire inquiring on knowledge, attitudes, perceptions and practices and took measurements for the BMI, waist circumference, and WHR. They likewise tested for HbA1c making use of *A1CNow* (Bayer HealthCare, Makati City, Philippines), a point-of-care test that conforms to the National Glycohemoglobin Standardization Program protocol. Interviews and measurements were done prior to and one year after the start of project implementation. Knowledge was tested making use of a 20-question diabetes knowledge test based on the Fitzgerald et al. Diabetes Knowledge Test[24] and the Garcia et al. Diabetes Knowledge Questionnaire[25]. Questions on attitudes and perceptions were adapted from the survey questionnaires of the University of Michigan Diabetes Research and Training Center.[26, 27] The attitude and perception questions were formulated as statements and made use of a Likert scale for answers, with 1 (“never”) as the lowest and 5 (“always”) as the highest rating. Negative and positive attitudes were measured separately. A straight statement on fear “I am afraid of my diabetes” was used to assess fear of diabetes. Perceived support needs and support received were directed towards support a person with diabetes needs and receives from family and friends. Questions on perceived

support attitudes probed the perceptions of how a person with diabetes is being treated, accepted and supported by family and friends. The internal reliability consistency of these sets of questions were previously tested in our cross-sectional KAP study, with Cronbach's alpha of 0.72-0.94.[21] Questions on medication adherence inquired on medications prescribed by healthcare providers and if the respondents were taking the right medications at the right dosages at the right time; these were transposed to "no" or "yes" answers and summarized as "no" if any of the questions were answered with "no" and "yes" if all the questions were answered with "yes". The question on diet adherence was answerable by "no", "sometimes", or "yes/always"; these answers were transformed to "not/sometimes adherent" and "yes/fully adherent". For exercise, questions were asked on the type of exercise done, frequency, and duration; the answers were then transformed to "no" or "yes" based on the criteria of doing 150 minutes of moderate-intensity aerobic physical activity or at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week.[28] Medical records were reviewed for any co-morbid illnesses.

FiLDCare Project DSME/S strategy

One-on-one diabetes self-management education (DSME) was initiated either by the city/municipal health officer or the LGHU nurse, assisted by the principal investigator and/or the FiLDCare Project nurse during consultations at the government health unit. Consultations and the concomitant DSME sessions were done at least once every three months. The DSME sessions focused on: information on diabetes and diabetes medications, adoption of self-care behavior, gaining control over the condition through problem solving skills, and goal setting. DSME was conducted in a conversational and interactive manner, embedded in the clinical consultation. Duration of the initial DSME session ranged from 20 to 30 minutes and the succeeding sessions from 5 to 15 minutes. Written materials on healthy eating, exercise, and glycemic goals were given out during the sessions. Community-based

diabetes self-management support (DSMS) was continued by the BHW and the midwives. DSMS concentrated more on behavioral support with reinforcement of self-management (taking medications, diet, exercise and foot care) and problem solving. DSMS was provided informally through home visits where the BHW would drop by the house of the person with diabetes and introduce pieces of information on diabetes and diabetes care in the conversation. Also, DSMS sessions were conducted in the barangay health stations where the BHW and midwives would be found on specific days two to four times a month and where people with diabetes could go if and when they had any questions or would want to talk to these healthcare workers. DSMS was provided at least once a month. The frequency and duration of DSME/S depended primarily on the demand of the person with diabetes. The DSME/S approach was collaborative and interactive rather than rigidly structured. After the opening DSME where the different aspects for self-management were discussed, the opinion and choices of the person with diabetes on the topics to be tackled in succeeding DSME/S sessions were considered. Active listening skills (introduced in the initial training workshop) were employed.

Statistics

Statistical analyses were done making use of the statistical package Stata/IC version 11.0.[29] Wilcoxon signed-rank test was used to compare the pre- and post-implementation median values of the outcomes. Test of proportions was used to compare the pre- and post- implementation proportions of people adherent to medications, diet and exercise and people with good glycemic control.

Comparisons of collected demographic data and the changes in measured endpoints were done using the stratifications “decreased/unchanged HbA1c” and “increased HbA1c; “in good glycemic control” and “not in good glycemic control” on both pre- and post-implementation determinations; and “in good glycemic control” on the pre-

implementation and “in good glycemic control” on the post-implementation determination. Mann-Whitney test was used for the collected demographic data and two independent samples T-test was used for the computed changes in the measured outcomes.

Logistic regression analysis was done using “decreased/unchanged HbA1c” against “increased HbA1c” to determine significant correlates in improving glycemic control. Independent variables were transformed into categorical variables. Bivariate logistic regression was initially done. An alpha of 0.10 was used as the cut-off to consider for multivariate logistic regression. Multivariate logistic regression of independent variables with alpha of 0.05 or less was done and variables with an alpha>0.05 were removed in a stepwise fashion. The remaining variables having an alpha of ≤0.05 were considered statistically significant correlates.

Definitions

Good control of diabetes was defined as having HbA1c ≤7.0% (≤53mmol/mol).[30] This cut-off was considered as the optimal level in both pre-implementation and post-implementation determinations.

For the classification of changes in HbA1c pre- and post-implementation, it should be noted that, without any interventions, the natural history of diabetes is deterioration of glycemic control through time.[31] Unchanged HbA1c levels may thus be viewed as a favorable result. Following this logic, unchanged HbA1c levels were grouped with decreased HbA1c levels against those with increased HbA1c levels.

Post-implementation changes in ratings were determined by subtracting pre-implementation ratings from the post-implementation values. No and negative

changes were grouped together against positive changes to create categorical variables. Increase was defined as a positive change.

Changes in adherence were classified as “did not deteriorate/improved” and “deteriorated/did not improve”. The classification “did not deteriorate/improved” includes those who reported to be adherent in both pre- and post-implementation interviews or who reported to be not adherent in the pre-implementation interview but became adherent post-implementation. Those who reported to be not adherent in the post-implementation interview were classified “deteriorated/did not improve” regardless of adherence reported in the pre-implementation interview.

Duration of diabetes was categorized as ≤2 years, >2-10 years, and >10years; education was categorized based on the number of years in school, namely 0-6 years, 7-10 years and >10 years.

RESULTS

A total of 203 people with diabetes were enrolled to the FiLDCare Project; 134 in Batac City and 69 in Pagudpud. Statistical analysis was conducted on data collected from 164 (80.8%) participants, 108 in Batac City and 56 in Pagudpud. Of the 39 participants whose data were not included in the statistical analysis, five refused any A1C testing from the outset, four died, eight migrated, two refused post-implementation interview, and 20 refused any further A1C testing. None were found to have any of the exclusion criteria for statistical analysis stated. Demographic data of the project participants are listed in Table 1.

Baseline results

In the pre-implementation phase, 68 (41.5%) of the study participants had good glycemic control. Statistical analyses of the baseline data did not identify any

significant differences between those in “good glycemic control” and those “not in good glycemic control” in any of the variables measured during the pre-implementation interview.

Post-implementation results

Post-implementation data showed an increase in the number of study participants with good glycemic control (n=83, 50.6%). However, aside from age (median age, in good control=59, not in good control=55; p=0.010), no other significant differences in the endpoints measured post-implementation were noted among those with “good glycemic control” against those “not in good glycemic control”.

Changes in measured endpoints

A year after full implementation, analysis of the median values showed significant decrease in the HbA1c (p<0.001), waist circumference (p=0.007), WHR (p<0.001), and the “perceived support received from family and friends” (p<0.001). Significant increases were noted in the correct answers to the knowledge test (p<0.001), the “perceived ability to control blood glucose” (p=0.036), the “perceived ability to adhere to diet and exercise” (p=0.022), and the “fear of diabetes” (p<0.001). Analysis of proportions showed significant increase in people adherent to medications (p=0.001) and adherent to exercise (p<0.001), but a significant decrease in those adherent to diet (p<0.001) (Table 2).

There was a significant increase (p<0.001) in the proportion of project participants with optimal glycemic control from 41.5% to 50.6%. Regardless of level of control, HbA1c decreased in 60.4% of the participants (99/164), remained the same in 7.9% (13/164) and increased in 31.7% (52/164). Among those with reduced HbA1c, the average reduction was -1.44 HbA1c percentage points (-15.7 mmol/mol); when combined with those with unchanged HbA1c, the average reduction was -1.3 HbA1c

percentage points (-14.2 mmol/mol). Among those with increased HbA1c, the average increase was +1.21 HbA1c percentage points (+13.2 mmol/mol).

Table 3 stratifies the pre- and post-implementation HbA1c values of the project participants. Among those who had optimal pre-implementation HbA1c levels, HbA1c decreased in 60.3% (41/68), remained the same in 8.8% and increased in 30.9% (21/68). The increase was marked in 5.9% (4/68) reclassifying them to have sub-optimal HbA1c levels post-implementation. Among the project participants having sub-optimal pre-implementation HbA1c levels (>7.0% / >53mmol/mol), HbA1c decreased in 60.4% (58/96) with 19.8% achieving good glycemic control post-implementation. HbA1c remained the same in 7.3% and increased in 32.3% (31/96). The mean average changes were -2.16 HbA1c percentage points (-23.6mmol/mol) among those whose HbA1c decreased and +1.60 HbA1c percentage points (+17.5mmol/mol) among those whose HbA1c increased. There were no reported incidences of hypoglycemia among the study participants.

Analysis of the changes in measured endpoints based on glycemic control prior to and one year after project implementation showed a higher decrease in HbA1c ($p=0.016$) and an increase in positive attitude ratings ($p=0.006$) among those with pre-implementation HbA1c>7%. As expected, a decrease in HbA1c was noted among those classified to be “in good glycemic control” in the post-implementation determination ($p=0.033$). The decrease in HbA1c among those “in good glycemic control” post-implementation was significantly higher than the decrease in HbA1c among those “in good glycemic control” pre-implementation ($p<0.001$). None of the other measured changes in endpoints showed statistically significant differences according to pre- and post-implementation glycemic control status (Table 4).

Wilcoxon signed-rank test showed a significant difference in gender (p=0.042), duration of diabetes (p=0.005), and the change in the "perceived ability to control blood glucose" (p=0.034) between those with "decreased/unchanged HbA1c" against "increased HbA1c". Results of analysis of the endpoints based on the changes in HbA1c are listed in Table 5. Overall values are presented in Table 5a. Since logistic regression showed a significant difference in gender associated with improved glycemia, values were disaggregated by gender as listed in Table 5b. The main differences between the groups "increased HbA1c" and "decreased/unchanged HbA1c" are the significant increase in correct answers to the knowledge test (p<0.001), increased ratings of positive attitude (p=0.013) and "perceived ability to control blood glucose" (p=0.004), and the increased proportion of people adherent to medication (p=0.001) in favor of those whose glycemia improved. There is a significant increase in the ratings of fear (p=0.010), positive and negative attitudes(p=0.008; 0.009), and the perceived ability to control blood glucose (p=0.007) among the male participants whose glycemia improved, which was not observed among the female participants.

Bivariate logistic regression of correlates for improved glycemia identified the male gender (p=0.049), duration of diabetes >10years (p=0.001), increased fear of diabetes (p=0.050), increased perceived ability to control blood glucose (p=0.030), and better adherence to diet suitable to diabetes (p=0.049) as having an alpha of $\leq$0.10. These were entered in multivariate logistic regression to arrive at the final model composed of the male gender as a positive correlate to improved glycemia (p=0.034), and duration of diabetes >10 years (p=0.003) and increased fear of diabetes (p=0.048) as strong negative correlates (Table 6).

DISCUSSION

Patient education has evolved through the years from merely informing patients regarding their illnesses to involving them in the care of their conditions, especially in chronic cases.[9] In diabetes, usual self-management education activities aim to provide information on the disease process and its pathophysiology, and instructions on self-management behavior which may cover diet, physical activity, monitoring, medications, risk reduction, problem solving, and coping.[32-35] Several published individual articles and meta-analyses of trials evaluating the effectiveness of DSME have demonstrated the efficacy of DSME for people with diabetes in terms of improvements in glycemic control, knowledge, self-management behavior, and the psychological and behavioral aspects of self-management. The settings, techniques, and types of interventions used in these DSME programs were diverse and involved a combination of a number of providers that included at least any 3 of the following: medical specialists, dietitians, psychologists, managers, and pharmacists aside from primary care physicians, nurses, and the occasional community-based health care workers. [13, 34-43] No specific structural variations seem to be constantly superior over others.

For the FiLDCare Project, one-on-one collaborative DSME/S sessions were conducted both in a clinical and a community setting, and aimed mainly to provide information and basic knowledge on diabetes, and instructions and reminders for diabetes self-management. The project made use of existing LGHU staff and took advantage of the large cadre of BHW (In the Philippines, these community workers are generally highly educated), shifting tasks that were standardizable and required less expertise, so as not to overburden the LGHU physician and nurse. Furthermore, selfcare development actively involved the person with diabetes. Actively involving the person with chronic condition in self-management and decision making increases the likelihood of adherence to the recommended plan of care.[44]

One year after full project implementation, significant improvements were noted: the participants' level of diabetes-related knowledge, the perceptions of "ability to control blood glucose" and "ability to adhere to diet and exercise regimens", and reported adherence to medications and exercise increased. Adiposity/obesity as measured through the WHR and waist circumference decreased. More than these, glycemic control of the FiLDCare Project participants significantly improved. However, the fear of diabetes increased and the "perceived support received from family and friends" decreased, as did reported adherence to diet.

Changes in glycemia and measures of obesity/adiposity

The effects of DSME/S on clinical endpoints such as glycemia and obesity/adiposity have been well-documented in the past.[13,14, 34-43] These were also observed in our study. Overall, the noted reduction in HbA1c of the FiLDCare project participants was significant. There was also a significant increase in the proportion of people with optimal glycemic control. In depth analysis of the changes in HbA1c levels shows reductions in HbA1c regardless of the level of pre-implementation glycemic control. The proportion of people with reductions in HbA1c, whether among those with optimal or with sub-optimal control, approached 60%, with higher reductions in HbA1c levels among those classified to have sub-optimal control at baseline. Significant changes in obesity/adiposity were noted through the WHR and the waist circumference measurements, but not through the BMI. These significant reductions in the indirect measures for obesity/adiposity were noted regardless of glycemic control.

Changes in knowledge, attitudes and perceptions

Akin to aforementioned studies on DSME where changes in knowledge were measured[12, 13], knowledge of the project participants increased. The increase in

knowledge may have increased perceptions of self-efficacy. Possessing the essential knowledge about the condition and the care for the condition may increase the level of confidence of people with diabetes in their selfcare abilities, i.e. ability to control blood glucose, ability to adhere to diet and exercise regimen. Positive feelings of self-efficacy may consequently lead them to perform and adhere to better self-management practices.[45] In our study, this could be construed as an increase in knowledge leading to increased perceived abilities to control blood glucose and to adhere to diet and exercise regimen, leading to an increase in self-reported adherence to medications and exercise of our project participants. The changes in self-reported adherence to diet may have been an effect of the participants having learned of the specific diet they should be adhering to, which they were taught during the DSME/S sessions. The negative change noted could be attributable to their change in perception of what a diet suitable for diabetes consists of rather than a change in eating behavior; hence the decrease in the number answering “yes” in the post-implementation interview. Another possible effect of the DSME/S sessions is the recognition of things that have to be done for the condition which could trigger the person to seek for social support in order to accomplish some of these. As the person with the condition learns of the various activities to be undertaken for self-care and self-management, previously perceived adequate support given by family and friends may now be perceived as inadequate, hence the negative change in this rating. Involvement of the family and friends in the DSME/S sessions was limited, and strategies to include the people around the person with diabetes in future DSME/S activities need to be developed further. Multivariate regression analysis identified increased fear as the lone modifiable correlate significantly associated with glycemic control. In this study, its effect on glycemia improvement was negative. Although a number of health campaigns have made use of the fear factor, such may not necessarily trigger a positive response; fear may bring about negative self-management behavior.[46] Fear of diabetes as well as other psychological aspects

may have been inadequately addressed in the DSME/S sessions due to the limited training and composition of the health care team. Such fear may have negatively influenced self-management behavior and other known and unknown factors that may have contributed to improved glycemic control.

The two other correlates significantly associated to improved glycemia are non-modifiable. Nevertheless, this information may be used in tailoring DSME/S. In our study, the female gender and duration of diabetes of 10 years or more were identified to be negatively correlated to improvements in glycemia.

Gender

Gender differences in glycemic control have been studied in the past with females either having equal or poorer but not a superior glycemic control compared to males.[47, 48] This may be partly attributed to differences in glucose metabolism and homeostasis between sexes.[49] With regard to our study, we noted gender differences comparing some pre- and post-implementation attitude and perception ratings. However, the male population in our sample is not substantial enough to subject this to further and more rigorous statistical analysis. Thus, we can only speculate how, in consonance with the theory of perceived self-efficacy, the increase in knowledge, fear, and positive and negative attitudes in our male population may positively affect perceived self-efficacy to control blood glucose, stimulate positive self-management behavior, and thereby improve glycemia.

Duration of diabetes

It has been observed that much of the instruction on diabetes care is given to the person when the diagnosis is first made and there may be a need to re-train people who have had diabetes for a number of years so as to maintain better glycemic control.[50] However, it seems that in spite of DSME/S given to the whole cohort in our study, glycemia still had the tendency to deteriorate in the subgroup of people with known diabetes for 10 years or more. Other factors undoubtedly influence this negative correlation, aside from the need of re-training in people who have had diabetes for a number of years.

Conclusions

This research has shown that some basic elements of DSME/S may be introduced making use of pre-existing health care personnel and produce favorable results. The provision of context-adapted DSME/S may improve diabetes-related knowledge, some attitudes, perceptions and practices, adiposity/obesity, and glycemia of its recipients. The FiLDCare Project, with some improvements, may be implemented in other areas of the Philippines to find out if it yields comparable, if not better, outcomes. Other LMIC may draw inspiration from this study to apply similar context-adapted measures to implement DSME/S.

Explorations on ways by which to handle psychological aspects in general and address fear of diabetes in particular in resource-constrained settings where a complete professional health care team is unavailable would be useful. Special attention may be needed in designing appropriate DSME/S for the female gender and those who have been known to have diabetes for a number of years now. Inclusion of and a more active participation of family and friends as well as other

members of the community in DSME/S activities should be considered, as this may help improve the social support that most people with diabetes need.

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FOOTNOTES

Reporting guideline

This is a quasi-experimental study and no specific reporting guidelines are listed.

Ethical considerations

This research was approved by the Institutional Review Boards of the University of Antwerp and the Institute of Tropical Medicine in Belgium (Belgian Reg. No. B30020109490), and the Ethics Committee of the Mariano Marcos Memorial Hospital and Medical Center in the Philippines. It was conducted with permission from the governments of the Province of Ilocos Norte, the City of Batac and the Municipality of Pagudpud and their respective health offices.

Authors' contributions

GMVK contributed to the design of the research, participated in data collection, did the statistical analysis and drafted the manuscript. GK provided substantial contributions in the concept and design, data analysis, and in the drafting of the manuscript. Both authors read and approved the final manuscript.

Conflict of interest statement

Neither of the authors has any financial competing interests regarding this research.

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Data sharing statement

Data collected on healthcare workers' training on the provision of primary diabetes care with emphasis on self-care development and the project participants' patients' assessment of chronic illness care (PACIC) will be presented and discussed elsewhere.

Additional data may be obtained by sending an e-mail to the corresponding author.

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Table 1. Demographics of people enrolled in the FiLDCare Project

			Male	Female
			N=42 (25.6%)	N=122 (74.4%)
Age		Average	57.9	56.5
		Median	58.5	57
		Range	36 – 83	27 – 80
Number of years with diabetes	Summary statistics	Average	5	4.7
		Median	2.5	2
		Range	0.5 – 28	0.5 – 22
	Distribution	0.5 – 2 years	85 (51.8%)	
		>2 – 10 years	53 (32.3%)	
		>10 years	26 (15.9%)	
Level of education (number of years in school)		0-6 years	43 (26.2%)	
		7-10 years	63 (38.4%)	
		>10 years	58 (35.4%)	

Table 2. Pre- and post-implementation values of measured endpoints, in medians and proportions

	Overall, n=164				Male, n=42				Female, n=122			
Variable	Before implementation	After implementation	P value	change	Before implementation	After implementation	P value	change	Before implementation	After implementation	P value	change
	Median values, (binomial interpolation of confidence intervals / interquartile range)		Wilcoxon signed-rank test	Mean change	Median values, (binomial interpolation of confidence intervals / interquartile range)		Wilcoxon signed-rank test	Mean change	Median values, (binomial interpolation of confidence intervals / interquartile range)		Wilcoxon signed-rank test	Mean change
HbA1c, % mmol/mol	7.7 (7.2-8.2 / 6.5-10.4) 61 (55 -56 / 48-90)	6.9 (6.8-7.5 / 6.2-9.3) 52 (51-58 / 44-78)	<0.001	-0.49 -5.4	7.5 (6.7-8.7 / 6.3-10.7) 58 (50-72 / 45-93)	6.8 (6.2-7.7 / 6.1-8.7) 51 (44-61 / 43-72)	0.001	-0.92 -10.1	7.8 (7.2-8.5 / 6.5-10.4) 62 (55-69 / 48-90)	7.2 (6.8-8.0 / 6.3-9.5) 55 (51-64 / 45-80)	0.057	-0.34 -3.7
BMI, kg/m^2	23.7 (23.1-24.1 / 21.8-26.1)	23.3 (22.6-23.8 / 21.2-25.6)	0.075	-0.40	23.8 (22.8-24.7 / 22.0-25.8)	23.6 (21.9-24.7 / 21.2-25.1)	0.395	-0.37	23.6 (23.0-24.0 / 21.6-26.2)	23.2 (22.4-24.1 / 21.0-25.7)	0.122	-0.41
Waist circumference, in cm	85.0 (83.9-86.4 / 81.0-91.2)	83.0 (82.0-85.0 / 79.0-89.0)	0.007	-1.37	89.0 (84.3-91.5 / 81.0-94)	80.0 (83.0-89.9 / 81.0-94.0)	0.026	-2.09	84.0 (82.8-85.2 / 80.0-88.9)	82.8 (81.0-85.0 / 78.7-88.0)	0.054	-1.13
Waist-hip ratio	0.90 (0.89-0.91 / 0.87-0.95)	0.89 (0.88-0.90 / 0.85-0.92)	<0.001	-0.02	0.93 (0.90-0.95 / 0.89-0.96)	0.91 (0.88-0.93 / 0.87-0.95)	0.025	-0.03	0.90 (0.88-0.91 / 0.86-0.93)	0.88 (0.87-0.90 / 0.85-0.92)	0.001	-0.20
Knowledge, % correct answers	60.0 (60.0-65.0 / 50.0-75.0)	67.5 (65.0-70.0 / 60.0-75.0)	<0.001	+7.59	50.0 (50.0-64.3 / 45.0-70.0)	65.0 (60.0-70.0 / 60.0-75.0)	0.006	+9.52	62.5 (60.0-65.0 / 50.0-75.0)	70.0 (65.0-70.0 / 60.0-75.0)	<0.001	+6.93
Perceived fear of diabetes	4.0 (4.0-4.0 / 2.0-4.0)	4.0 (4.0-4.0 / 3.0-5.0)	<0.001	+0.46	2.0 (2.0-4.0 / 1.0-4.0)	4.0 (3.0-4.0 / 2.0-5.0)	0.003	+0.81	4.0 (4.0-4.0 / 2.4-4.0)	4.0 (4.0-4.0 / 3.0-4.0)	0.018	+0.34
Positive attitude	3.4 (3.2-3.4 / 2-8-3.9)	3.4 (3.2-3.6 / 3.0-4.0)	0.071	+0.14	3.2 (2.8-3.4 / 2.6-3.6)	3.5 (3.2-4.0 / 3.2-4.0)	0.025	+0.36	3.4 (3.2-3.6 / 2.8-4.0)	3.4 (3.2-3.6 / 3.0-3.8)	0.479	+0.07
Negative attitude	3.0 (2.8-3.4 / 2.2-4.0)	3.2 (3.0-3.4 / 2.6-3.8)	0.115	+0.15	2.4 (2.0-2.8 / 1.8-3.6)	3.0 (2.8-3.2 / 2.6-3.6)	0.027	+0.42	3.2 (2.8-3.6 / 2.4-4.0)	3.2 (3.0-3.5 / 2.6-3.8)	0.631	+0.06

Attitude towards self-care adherence	3.2 (3.0-3.5 / 2.8-3.8)	3.5 (3.2-3.5 / 3.0-4.0)	0.139	+0.13	3.0 (3.0-3.2 / 2.8-3.5)	3.4 (3.0-3.5 / 2.8-4.0)	0.087	+0.28	3.2 (3.2-3.5 / 2.0-5.0)	3.5 (3.3-3.5 / 3.0-4.0)	0.454	+0.08
Perceived ability to control blood glucose	3.0 (3.0-4.0 / 3.0-4.0)	3.0 (3.0-4.0 / 3.0-5.0)	0.036	+0.24	3.0 (3.0-3.0 / 3.0-4.0)	4.0 (3.0-4.0 / 3.0-4.0)	0.016	+0.43	3.0 (3.0-4.0 / 2.8-4.0)	3.0 (3.0-4.0 / 3.0-5.0)	0.0279	+0.17
Perceived ability to control weight	3.0 (3.0-4.0 / 3.0-4.0)	3.0 (3.0-4.0 / 3.0-4.0)	0.349	+0.12	3.0 (3.0-4.0 / 3.0-4.0)	3.5 (3.0-4.0 / 3.0-4.0)	0.289	+0.021	3.0 (3.0-4.0 / 3.0-4.0)	3.0 (3.0-4.0 / 3.0-4.0)	0.649	+0.08
Perceived ability to adhere to diet and exercise regimens	4.0 (3.0-4.0 / 3.0-5.0)	4.0 (4.0-4.0 / 3.0-5.0)	0.022	+0.26	3.0 (3.0-4.0 / 3.0-4.0)	4.0 (3.0-4.0 / 3.0-5.0)	0.071	+0.35	4.0 (3.0-4.0 / 3.0-5.0)	4.0 (4.0-4.0 / 3.0-5.0)	0.107	+0.23
Perceived ability to handle feelings about diabetes	3.0 (3.0-4.0 / 3.0-4.0)	3.0 (3.0-4.0 / 3.0-4.5)	0.653	-0.01	4.0 (3.0-4.0 / 3.0-4.0)	3.5 (3.0-4.0 / 3.0-5.0)	0.592	+0.17	3.0 (3.0-4.0 / 3.0-4.0)	3.0 (3.0-3.3 / 3.0-4.0)	0.391	-0.07
Perceived support needs	5.0 (4.8-5.0 / 4.2-5)	4.8 (4.2-5.0 / 4.0-5.0)	0.193	+0.02	5.0 (4.7-5.0 / 4.3-5.0)	4.2 (4.0-5.0 / 4.0-5.0)	0.125	-0.13	5.0 (4.8-5.0 / 4.2-5.0)	5.0 (4.3-5.0 / 4.0-5.0)	0.593	+0.007
Perceived support received from family & friends	5.0 (5.0-5.0 / 4.0-5.0)	4.0 (4.0-4.0 / 3.8-4.8)	<0.001	-0.39	5.0 (4.9-5.0 / 4.0-5.0)	4.0 (4.0-4.0 / 3.8-4.3)	0.002	-0.52	5.0 (4.8-5.0 / 4.0-5.0)	4.0 (4.0-4.0 / 3.8-5.0)	<0.001	-0.34
	N (proportion, %)		**Test of pro-portions**	**Change n (%)**	**N (proportion, %)**		**Test of pro-portions**	**Change n (%)**	**N (proportion, %)**		**Test of pro-portions**	**Change n (%)**
Proportion adherent to medications	108 (65.9%)	134 (81.7%)	0.001	+26 (+15.8%)	30 (71.4%)	34 (81.0%)	0.306	+4 (+9.6%)	78 (63.9%)	100 (82.0%)	0.001	+22 (+18.1%)
Proportion adherent to exercise regimen	68 (41.5%)	110 (67.1%)	<0.001	+42 (+25.6%)	25 (59.5%)	27 (64.3%)	0.653	+2 (+4.8%)	43 (35.2%)	83 (68.0%)	<0.001	+40 (+38.2%)
Proportion adherent to prescribed diet	99 (60.4%)	66 (40.2%)	<0.001	-33 (-20.2%)	19 (45.2%)	14 (33.3%)	0.264	-5 (-11.9%)	80 (65.6%)	52 (42.6%)	<0.001	-28 (-23.0%)

Table 3. Stratification of FiLDCare Project Participants based on pre-implementation and post-implementation levels of glycemic control

		Pre-implementation						Total (post-implementation)
		Good control HbA1c≤7%			Not in good control HbA1c>7%			
Change in HbA1c		decreased	increased	unchanged	decreased	increased	unchanged	
Post-implementation	Good control HbA1c≤7%	41	17	6	19			83
	Not in good control HbA1c>7%		4		39	31	7	81
Total (pre-implementation)		41	21	6	58	31	7	164
		68			96			

Table 4. Mean change (SD) of measured endpoints according to pre-implementation and post-implementation control of glycemia

Glycemic control	Pre-implementation (Baseline)			Post-implementation			Pre-implementation "in good control" vs post-implementation "in good control", P value
	In good control (n=68)	Not in good control (n=96)	P value	In good control (n=83)	Not in good control (n=81)	P value	
	Mean change, (SD)	Mean change, (SD)	Independent samples T-test	Mean change, (SD)	Mean change, (SD)	Independent samples T-test	Two independent samples T-test
HbA1c, % (mmol/mol)	-0.065 (0.766)	-0.786 (2.367)	0.016	-0.800 (2.116)	-0.167 (1.629)	0.033	<0.001
BMI, kg/m^2	-0.892 (1.812)	-0.181 (3.112)	0.067	-0.702 (2.944)	-0.245 (1.809)	0.234	0.539
Waist circumference, cm	-2.714 (7.888)	-0.706 (5.709)	0.060	-2.317 (7.820)	-0.740 (5.374)	0.135	0.633
WHR	-0.025 (0.110)	+0.016 (0.063)	0.511	-0.028 (0.106)	-0.012 (0.057)	0.215	0.518
Knowledge test rating, %	+7.00 (20.40)	+8.00 (19.00)	0.739	+8.10 (20.68)	+7.00 (18.84)	0.721	0.542
Perceived fear of diabetes	+0.618 (1.630)	+0.354 (1.741)	0.328	+0.542 (1.748)	+0.383 (1.647)	0.549	0.727
Positive attitude	-0.091 (0.872)	+0.308 (0.928)	0.006	+0.039 (0.920)	+0.249 (0.921)	0.144	0.074
Negative attitude	+0.218 (1.085)	+0.106 (1.342)	0.572	+0.161 (1.203)	+0.143 (1.284)	0.925	0.709
Attitude towards self-care adherence	+0.040 (0.911)	+0.918 (0.944)	0.287	+0.069 (0.940)	+0.198 (0.923)	0.379	0.707
Perceived ability to control blood glucose	+0.103 (1.199)	+0.333 (1.359)	0.263	+0.157 (1.204)	+0.321 (1.386)	0.418	0.640
Perceived ability to control weight	-0.015 (1.203)	+0.208 (1.428)	0.295	+-0.024 (1.334)	+0.259 (1.340)	0.177	0.781
Perceived ability to adhere to diet and exercise regimens	+0.103 (1.174)	+0.375 (1.394)	0.191	+0.217 (1.279)	+0.309 (1.348)	0.655	0.468
Perceived ability to handle feelings about diabetes	-0.206 (1.451)	+0.135 (1.396)	0.131	-0.120 (1.383)	+0.111 (1.466)	0.300	0.201
Perceived support needs	+0.093 (0.973)	-0.030 (1.155)	0.476	+0.040 (0.925)	+0.002 (1.227)	0.822	0.907
Perceived support received	-0.179 (1.191)	-0.535 (1.236)	0.067	+0.229 (1.194)	+0.549 (1.246)	0.094	0.573
	N (proportion, %)		**Test of proportions**	**N (proportion, %)**		**Test of proportions**	
Adherence to medications (improved / did not deteriorate)	57 (83.8%)	77 (80.2%)	0.683	71 (85.5%)	63 (77.8%)	0.229	
Adherence to exercise (improved / did not deteriorate)	47 (69.1%)	63 (65.6%)	0.736	56 (67.5%)	54 (66.7%)	1.00	
Adherence to diet (improved / did not deteriorate)	32 (47.1%)	34 (35.4%)	0.148	38 (45.8%)	28 (34.6%)	0.155	

Table 5a. Pre-implementation & post-implementation median values of HbA1c, anthropometric measurements, diabetes knowledge, attitudes and perceptions, and proportions of self-care practices stratified according to "Increased HbA1c" and "Decreased or Unchanged HbA1c", and p values of comparisons of changes in measured endpoints among those with "Increased HbA1c" against "Decreased or Unchanged HbA1c"

Change in A1C	Increased HbA1c, n=52				Decreased/Unchanged HbA1c, n=112				P value Two independent samples T-test of mean change, Increased HbA1c vs Decreased / Unchanged HbA1c
	Pre	Post	P value	Change	Pre	Post	P value	Change	
	Median		Wilcoxon signed-rank test	Mean change	Median		Wilcoxon signed-rank test	Mean change	
HbA1c, % (mmol/mol)	7.5 (58)	9.2 (76)	<0.001	+1.21 (+13.2)	7.8 (62)	6.8 (51)	<0.001	-1.3 (-14.2)	<0.001
BMI, kg/m^2	24.5	23.3	0.115	-0.72	23.5	23.2	0.281	-0.24	0.379
Waist circumference, cm	85	83	0.006	-2.32	84.5	83.9	0.140	-0.93	0.314
WHR	0.90	0.89	0.028	-0.01	0.90	0.89	0.001	-0.03	0.226
Knowledge test rating, %	65	65	0.060	+4.20	60	70	<0.001	+9.0	0.134
Perceived fear of diabetes	4.0	4.0	0.004	+0.69	4.0	4.0	0.024	+0.35	0.240
Positive attitude	3.3	3.4	0.441	+0.18	3.4	3.4	0.013	+0.13	0.748
Negative attitude	3.0	3.1	0.415	+0.23	3.0	3.2	0.164	+0.12	0.602
Attitude towards self-care adherence	3.1	3.4	0.967	+0.04	3.2	3.5	0.090	+0.17	0.404
Perceived ability to control blood glucose	3.0	3.0	0.516	-0.08	3.0	4.0	0.004	+0.38	0.034
Perceived ability to control weight	3.0	3.5	0.340	+0.17	3.0	3.0	0.618	+0.09	0.711
Perceived ability to adhere to diet and exercise regimens	4.0	4.0	0.006	+0.31	4.0	4.0	0.083	+0.24	0.763
Perceived ability to handle feelings about diabetes	3.5	3.0	0.328	-0.17	3.0	3.0	0.870	+0.07	0.308
Perceived support needs	4.8	5.0	0.978	+0.16	5.0	4.6	0.123	-0.04	0.275
Perceived support received	4.8	4.0	0.035	-0.25	5.0	4.0	<0.001	-0.45	0.342
	N (proportion, %)		Test of pro - portions	Change n (%)	N (proportion, %)		Test of pro- portions	Change n (%)	
Adherence to medications	38 (73.1%)	42 (80.8%)	0.352	+4 (+7.7%)	70 (62.5%)	92 (82.1%)	0.001	+22 (19.6%)	
Adherence to exercise regimen	19 (36.5%)	33 (63.5%)	0.006	+14 (+27.0%)	49 (43.8%)	77 (68.8%)	<0.001	+28 (25.0%)	
Adherence to diabetes diet	37 (71.2%)	24 (46.2%)	0.010	-13 (-25.0%)	62 (55.4%)	42 (37.5%)	0.007	-20 (17.9%)	

Table 5b. Pre-implementation & post-implementation median values of HbA1c, anthropometric measurements, diabetes knowledge, attitudes and perceptions, and proportions of self-care practices stratified according to "Increased HbA1c" and "Decreased or Unchanged HbA1c" and according to gender

Change in A1c	Increased HbA1c, n=52								Decreased/Unchanged HbA1c, n=112							
Gender	Male, n=8				Female, n=44				Male, n=34				Female, n=78			
	Pre	Post	P value	Change	Pre	Post	P value	Change	Pre	Post	P value	Change	Pre	Post	P value	Change
	Median		Wilcoxon signed-rank test	Mean change	Median		Wilcoxon signed-rank test	Mean change	Median		Wilcoxon signed-rank test	Mean change	Median		Wilcoxon signed-rank test	Mean change
HbA1c, % (mmol/mol)	6.3 (50)	8.5 (69)	0.012	+1.51 (+16.5)	7.7 (61)	9.2 (77)	<0.001	+1.16 (+12.7)	7.7 (61)	6.6 (49)	<0.001	-1.49 (-16.3)	8.1 (65)	6.8 (51)	<0.001	-1.18 (-12.9)
BMI, kg/m^2	24.6	23.7	0.124	-1.10	24.5	23.0	0.401	-0.66	23.7	23.5	0.986	-0.20	23.4	23.3	0.234	-0.27
Waist circumference, cm	90.2	87.0	0.014	-4.60	84.5	82.0	0.063	-1.91	87.8	86.0	0.188	-1.50	84.0	83.0	0.284	-0.69
WHR	0.95	0.94	0.069	-0.03	0.90	0.88	0.093	-0.11	0.92	0.90	0.106	-0.04	0.90	0.89	0.006	-0.02
Knowledge test rating, %	62.5	60.0	1.00	+3.75	65.0	65.0	0.021	+4.32	55.0	65.0	0.001	+10.88	60.0	70.0	<0.001	+8.40
Perceived fear of diabetes	2.0	3.0	0.107	+1.0	4.0	4.0	0.013	+0.64	2.0	4.0	0.010	+0.76	4.0	4.0	0.311	+0.18
Positive attitude	3.4	3.2	0.725	+0.03	3.2	3.2	0.365	+0.20	3.2	3.8	0.008	+0.44	3.5	3.4	0.842	-0.01
Negative attitude	2.5	2.6	0.726	-0.13	3.0	3.2	0.315	+0.29	2.4	3.2	0.009	+0.55	3.2	3.1	0.893	-0.07
Attitude towards self-care adherence	3.0	2.8	0.831	-0.09	3.2	3.5	0.902	+0.07	3.0	3.5	0.092	+0.37	3.4	3.4	0.420	+0.09
Perceived ability to control blood glucose	3.5	3.0	0.879	-0.12	3.0	3.0	0.547	-0.07	3.0	4.0	0.007	+0.56	3.0	4.0	0.080	+0.31
Perceived ability to control weight	3.5	3.0	0.879	-0.25	3.0	4.0	0.260	+0.25	3.0	4.0	0.198	+0.32	3.0	3.0	0.773	-0.01
Perceived ability to adhere to diet and exercise regimens	3.0	3.0	0.162	+0.50	4.0	4.0	0.263	+0.27	3.0	4.0	0.161	+0.32	4.0	4.0	0.241	+0.21
Perceived ability to handle feelings about diabetes	3.5	3.0	0.611	-0.12	3.5	3.0	0.406	-0.18	4.0	4.0	0.449	+0.24	3.0	3.0	0.694	0
Perceived support needs	5.0	4.7	0.320	-0.29	4.8	5.0	0.716	+0.24	5.0	4.0	0.192	-0.09	5.0	4.9	0.352	-0.02
Perceived support received	5.0	3.8	0.161	-0.85	4.8	4.0	0.172	-0.14	5.0	4.0	0.012	-0.45	5.0	4.0	<0.001	-0.45
	N, (Proportion)		Test of pro-portions	Change n (%)	N, (Proportion)		Test of pro-portions	Change n (%)	N, (Proportion)		Test of pro-portions	Change n (%)	N, (Proportion)		Test of pro-portions	Change n (%)
Adherence to medications	5 (62.5%)	7 (87.5%)	0.248	+2 (+25.0%)	33 (75.0%)	35 (79.6%)	0.611	+2 (+4.6%)	25 (73.5%)	27 (79.4%)	0.568	+2 (+5.9%)	45 (57.7%)	65 (83.3%)	<0.001	+20 (+25.6%)
Adherence to exercise regimen	5 (62.5%)	5 (62.5%)	1.00	0	14 (31.8%)	28 (63.6%)	0.003	+14 (+31.8%)	20 (58.8%)	22 (64.7%)	0.618	+2 (+5.9%)	29 (37.2%)	55 (70.5%)	<0.001	+26 (+33.3%)
Adherence to diabetes diet	4 (50.0%)	2 (25.0%)	0.302	-2 (-25.0%)	33 (75.0%)	22 (50.0%)	0.015	-11 (-25.0%)	15 (44.0%)	12 (35.3%)	0.457	-3 (-8.7%)	47 (60.3%)	30 (38.5%)	0.006	-17 (-21.8%)

Table 6. Results of logistic regression analysis of improved glycemia: Correlates with alpha≤0.10 identified on bivariate regression analysis of categorical variables and the final model with the significant correlates (alpha≤0.05) of improved glycemia identified on multivariate regression.

Correlate	Odds Ratio	P value	95% confidence interval
Bivariate logistic regression			
Male gender	2.460	0.049	1.020 – 5.633
Duration of diabetes > 10 years	0.200	0.001	0.074 – 0.537
Increased fear of diabetes	0.513	0.050	0.264 – 0.999
Increased perceived ability to control blood glucose	2.250	0.030	1.083 – 4.673
Better adherence to diet suitable for diabetes	2.460	0.049	1.000 – 6.036
Multivariate logistic regression (Final model)			
Male gender	2.655	0.034	1.078 – 6.537
Duration of diabetes > 10 years	0.214	0.003	0.078 – 0.587
Increased fear of diabetes	0.490	0.048	0.242 – 0.994