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**RESEARCH ARTICLE**

# Type 2 diabetes patients educated by other patients perform at least as well as patients trained by professionals

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## Abstract

**Background** Diabetes education can improve the quality of care of people with diabetes, but many organizations are not equipped to manage its implementation. Involving people with diabetes in the education process can overcome the problem. Thus, we compared clinical, metabolic and psychological outcomes in people with type 2 diabetes 1 year after attending a structured diabetes education programme implemented by professional educators *versus* the same programme implemented by trained peers with diabetes that also provided ongoing peer support.

**Methods** People with type 2 diabetes (25–75 years) were randomly assigned to attend a 4-week structured diabetes education course delivered by professional educators (control) or previously trained peers (peer). Peers also received continuing psychological support, including examples on how to apply diabetes knowledge in daily life via weekly peer cellular phone calls and bimonthly face-to-face interviews in small groups (ten patients), using a structured questionnaire related to the patient's clinical, metabolic and psychological progress. Identical outcome data from both groups were used for follow-up.

**Results** Both groups had a comparable positive effect on clinical, metabolic and psychological indicators immediately following the programme. Over the following year, peer-educated subjects had lower $A_{1C}$ and systolic blood pressure and showed higher adherence to physical activity and better control of hypoglycaemic episodes.

**Conclusion** The non-inferiority of the peer outcomes and the mentioned improvements in this group suggest that volunteer trained peer educators and ongoing support can be successful. This approach provides an effective alternative method of education, especially in areas with limited availability of professionals and economic resources. 

**Keywords** peer support; diabetes education; type 2 diabetes management; quality of care; patient satisfaction; psychological impact

## Introduction

Type 2 diabetes represents a serious worldwide challenge for health authorities and society overall because of the increasing costs of care and the associated impaired quality of life due to the development of chronic complications [1,2]. Although diabetes complications can be significantly reduced by control of blood glucose and associated cardiovascular risk factors [3–7], such control

is difficult to achieve and the care provided to people with diabetes is frequently far from optimal [8–11]. Lack of adherence to self-care behaviours is an obstacle to optimal care. In their review, Cramer *et al*. demonstrated that many people with diabetes had difficulty adhering to treatment regimens, including both oral anti-diabetic agents and insulin [12]. A major contributor to this low adherence is regimen complexity [13,14]. Moreover, low treatment adherence is frequently under-diagnosed by caregivers. Thus, more acceptable alternatives are neither discussed/suggested nor implemented [15].

Diabetes self-management education (DSME) is an ongoing process for facilitating the knowledge and self-management skills patients need for day-to-day diabetes care, becoming a cornerstone for the care of diabetes and other chronic diseases [16]. DSME is effective for improving clinical outcomes and the quality of life of people with diabetes, at least in the short term [17–24].

Although DSME and ongoing support can be effectively provided by health professionals through educational and case management programmes [25,26], many health professionals and systems are not equipped to provide the type of education and/or the behavioural and psychosocial support needed for long-term self-management. Involving people with diabetes in the delivery of education and support has been suggested as a reasonable approach to address this issue. Lorig *et al*. pioneered the participation of lay tutors in the management of a chronic disease such as arthritis over 20 years ago [27]. Thereafter, the recognition that other chronic diseases share many similar attributes to arthritis led to the development of the Chronic Disease Self-Management Program [28]. Following these principles, Peers for Progress, a global initiative of the American Academy of Family Physicians Foundation, developed in collaboration with the World Health Organization (WHO) a Consultative Conference on Peer Support Programs in Diabetes as a strategic approach to promote best practices in peer support for health around the world [29]. Peers for Progress has a defined functional framework for peer support's core functions and is supporting the evaluation of the scope and impact of interventions based on this framework and a set of consensus evaluation measures in order to define the appropriate application of peer support in the process of implementing DSME.

To test the feasibility and effectiveness of peers' activity in the field of diabetes, we implemented this study to compare multiple outcomes in people with type 2 diabetes educated by a professional team with another group in which trained peers with diabetes conducted the initial education process and provided ongoing support to the patients directed at improving and sustaining self-care behaviours for a 1-year post-course follow-up.

# Materials and methods

We implemented a randomized, controlled clinical trial of peer education and continuing support consisting of (a) a patient diabetes education group and (b) a patient education group with peers implementing the diabetes education programme and providing continuing peer support.

## Statistical power and sample size

It was calculated based upon a change in $A_{1C}$ from baseline to the end of the study as the primary outcome variable. From past experiences, we assumed the correlation would be very low (from 0.2 to 0.30); accordingly, we estimated the sample size required to detect effects assuming independence, using a two-sided test at the 5% level of significance and 80% power using a paired *t*-test. Thereafter, we increased the sample size by 25% considering the possible dropout or failure to follow-up. On the basis of PEDNID-LA baseline data [23], we used 1.5% as the standard deviation of $A_{1C}$, so that we would need 75 patients in each group at the first step to detect a decrease of 0.5%. This gave 94 patients for each group after adjusting for correlation and dropout or failure of follow-up.

## Physicians

Physicians were invited to participate and recruited from IPENSA – a local primary care institution with an adequate type 2 diabetes population, accessible patient records and central laboratory facilities – and CEDIAB, another local care institution with similar characteristics. Once professionals from both institutions accepted participation, they were asked to follow international goal and treatment algorithms.

## Patients

They were selected from a list of people with type 2 diabetes provided by physicians; eligible patients were 25–75 years old, followed for at least 2 years and with more than two diabetes encounters. Exclusion criteria were end stage renal disease, class III or IV cardiac failure, cancer, blindness, drug or alcohol addiction and inability to provide self-care. Potential volunteers received a mail a signed by their physician explaining the aims and procedures of the study. Those who were willing to participate had, thereafter, a telephone interview and were invited to attend a meeting to receive detailed information on the study aims and procedures, to obtain their signed consent. After this procedure, those who voluntarily accepted to participate in the study were randomly assigned either to the standard education or the peer education group, until at least 94 subjects in each group were recruited.

## IRB approval and informed consent

The study protocol was analysed and approved by an accredited national ethical committee. Every participant



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provided informed consent prior to being interviewed and having their health facility records examined in accordance with local regulations.

## Peers

Peers were recruited from the Houssay Centre, an organization devoted to the education of people with diabetes and health care team members, on the basis of their excellent diabetes control, self-motivation, communication and support skills and interest. Peers were matched according to sociodemographic characteristics and trained using the curriculum of the health professionals *Training Course on Diabetes Education*. This 3-day intensive, structured, small-group interactive course includes pedagogic, motivational, communication and group management techniques as well as basic diabetes control/treatment and evaluation concepts. After this training, peers delivered the four-module patient education courses for the peer group. They also had monthly meetings with one of the study coordinators (Dr Gagliardino) and the education team to share challenges and successes and prepare quarterly reports for the patients' physicians. These meetings emphasized psychological adjustment and coping skills.

## Interventions and educational facilities

The Bernardo A. Houssay Centre in the city of La Plata is a non-profit entity supported by funds from governmental organizations such as the Health Ministry of the province of Buenos Aires, the pharmaceutical industry and private organizations such as Rotary International, the International Diabetes Federation and personal donors. The Houssay Centre is a referral centre for the education of both people with diabetes and health professionals.

The Houssay Centre maintains a close relationship with CENEXA, a research centre created by an agreement between the National University of La Plata (UNLP) and the National Research Council of Argentina (CONICET). A peer with type 1 diabetes has been an active member of the education team since the Centre started its education activities.

As mentioned before, the study included two different groups. The first group is the control patient education group (control) that received the educational intervention at the Houssay Centre (details of its modality and contents have been previously reported [23]). The *Diabetes Structured Education Courses for People with T2DM* was released through trained educators to no more than ten ambulatory patients in a group setting that allowed active interaction between the educator and participants. It consisted of four weekly teaching units (90–120 min each) and a reinforcement session at 6 months. The first teaching unit included general concepts about type 2 diabetes, the symptoms of hypoglycaemia and hyperglycaemia and glucose self-monitoring, with strong emphasis on the importance of active patient participation in disease control and treatment. In the second teaching unit, the effect of obesity on insulin sensitivity and the advantages of weight reduction and of patient learning to classify and select foods according to their calorie content were discussed. The third teaching unit explained the importance of foot care and regular practice of physical activity, while during the fourth unit they learned the basic rules for 'sick days' and which were the examinations and laboratory tests necessary to have good diabetes care. Many illustrated educational materials were used, as well as a book provided to each patient that included the main contents of the programme. To test the diabetes knowledge of the participants, we used a multiple-choice questionnaire.

The second group is the peer patient education plus peer support group (peer) that received identical education plus the active participation of peers, who were integrated into the educational models and specific peer activities. The goal of the latter activities was to provide continuing psychological and behavioural support and to teach the patients how to apply in everyday life the knowledge acquired during the education course, based upon the peer's personal experience. The peer's post-course role and activity were complementary to the formal education; for that purpose, we implemented two different activities: (a) peer education and (b) peer support. Peer education was integrated into the educational units serving as 'real world living models' for the attendee. One peer worked fulltime and was responsible for the overall management of peers; he or she received a small direct compensation for his or her teaching, supervisory and administrative role.

For each educational module of the course, there was a specific set of supporting activities that the educator-peer shared with the supporting peers. To test the diabetes knowledge of participants, we used the same multiple-choice questionnaire mentioned earlier.

Following the initial education course, peers had regular and continuing scheduled contacts with their supportees. Their contacts took the combined pre-established form of scheduled face-to-face visits or whenever a specific issue warranted, and frequent interactions by mobile telephone. The face-to-face visits among peers and their supportees were scheduled every second month.

The telephone communications took place at least weekly for the first 6 months, biweekly for the next 3 months and monthly for the remaining study period. They were based on structured interviews that inquired into the patients' clinical, metabolic and psychological progress. The data requested included body weight, blood pressure, self-monitoring blood glucose (SMBG) values, psychological status, medication, meal plan and physical activity adherence and other coping mechanisms. This information was recorded and sent to the coordinator, becoming part of the patient's follow-up. In addition to these one-on-one telephone calls, we promoted monthly group calls among peers to share experiences, difficulties and alternative solutions implemented.

A critical role of the peers was to provide throughout this system the psychological support that their supportees

needed to cope with the day-to-day vicissitudes of diabetes self-care. Thus, more frequent interactions in person or by telephone were encouraged at times when more intensive psychological support was considered appropriate.

To facilitate telephone peer communication and decrease its cost, we established a contract with a local telephone company that included provision of cell phones, discounted rates, free communication between peers and their supportees, including teleconferencing among members of the network and limited text messaging. The telephone records – freely provided by the telephone company – also provided objective information regarding effective number of communications established between the peers and their supportees.

## Data collection

Data for outcomes were collected identically for each group using different instruments: (a) the QUALIDIAB data set at the beginning and at 12 months, (b) an abbreviated QUALIDIAB data collection at 6 months, (c) a Diabetes Distress Screening questionnaire [30] before and after the education courses and (d) a peer satisfaction questionnaire, using the SF-8 (http://www.sf-36.org) at the end of the follow-up period.

## Data analysis

Complete survey data were entered into the CENEXA data set using the EPI-INFO program. Data storage was password protected. Baseline clinical and demographic data of the intervention groups were compared to assess their effectiveness. Dichotomous and ordinal variables were examined using chi-square tests and continuous measures with Student's *t*-tests. The statistical analysis of the data was performed using the SAS SPSS or Stata.

For the reduction of $A_{1C}$ from baseline to the end of study, we used a multiple linear regression model to compare the effect of the two different interventions on reducing $A_{1C}$. The model included appropriate clinical and demographic covariates. Other outcome variables included body mass index, systolic blood pressure (SBP) and diastolic blood pressure, total cholesterol and patient attitudes regarding diabetes and their care. *p*-values of less than 0.05 were considered as significant (two tailed).

# Results

The control group included 105 people with type 2 diabetes, 50% female, with an average mean (±SD) age and diabetes duration of $60 \pm 10$ and $6 \pm 6$ years, respectively. The peer group included 93 people with type 2 diabetes with comparable characteristics: 53% female, with an average mean age and diabetes duration of $62 \pm 9$ and $6 \pm 7$ years, respectively.

Diabetes knowledge evaluation performed before and after the course showed that the attendees' knowledge increased significantly ($p < 0.01$) in both groups, but without any significant difference between groups (pre-course *versus* post-course: control $10 \pm 3$ *versus* $12 \pm 3$ and peer $10 \pm 3$ *versus* $13 \pm 4$ correct answers, respectively).

Participants of both groups had a comparable high opinion on the quality and usefulness of the education course they had attended (highest score 100; average 73 *versus* 77 for control and peer, respectively); thus, they did not perceive any significant difference between the course developed by professional educators and that implemented by both professional educators and previously trained peers.

The percentage of people with the classical symptoms of diabetes decreased significantly along the study period in both groups (Table 1). No significant differences were recorded between groups.

The average body mass index value recorded at baseline in both study groups corresponded to obese people (Table 2). There were no significant changes in either group in these values during the study period and/or between groups at any study point.

**Table 1. Changes in diabetes classical symptoms**

| | Baseline | 1 month | 6 months | 12 months | Baseline–12 months *p*-value |
|---|---|---|---|---|---|
| Polydipsia | | | | | |
| Control | 28 (105) | 9 (105) | 3 (104) | 4 (103) | 0.01 |
| Peer | 20 (93) | 12 (91) | 2 (92) | 1 (92) | 0.01 |
| Polyuria | | | | | |
| Control | 49 (105) | 34 (105) | 3 (104) | 4 (102) | 0.01 |
| Peer | 58 (93) | 34 (93) | 7 (92) | 4 (92) | 0.01 |
| Polyphagia | | | | | |
| Control | 36 (105) | 16 (105) | 3 (104) | 2 (103) | 0.01 |
| Peer | 32 (93) | 22 (93) | 5 (92) | 5 (92) | 0.01 |
| Pruritus | | | | | |
| Control | 42 (105) | 16 (103) | 1 (104) | 1 (101) | 0.01 |
| Peer | 38 (92) | 21 (92) | 2 (92) | 4 (90) | 0.01 |
| Asthenia | | | | | |
| Control | 61 (102) | 30 (103) | 13 (104) | 10 (101) | 0.01 |
| Peer | 51 (92) | 26 (92) | 6 (90) | 9 (88) | 0.01 |

Values represent percentage of people with positive symptoms; number of subjects observed between parentheses.



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**Table 2. Clinical and metabolic indicators**

| Indicator/period | Baseline | 1 month | 6 months | 12 months |
|---|---|---|---|---|
| BMI (kg/m$^2$) | | | | |
| Control | 33 ± 6 (103) | 32 ± 6 (103) | 32 ± 6 (103) | 32 ± 6 (103) |
| Peer | 32 ± 7 (86) | 32 ± 6 (86) | 32 ± 7 (86) | 31 ± 6 (86) |
| SBP (mm Hg) | | | | |
| Control | 130 ± 23 (103) | 130 ± 18 (103) | 128 ± 12 (104) | 127 ± 12 (104) |
| Peer | 137 ± 28 (93) | 134 ± 23 (92) | 129 ± 14 (93) | 128 ± 18 (93)* |
| DBP (mm Hg) | | | | |
| Control | 76 ± 14 (100) | 74 ± 11 (101) | 76 ± 12 (104) | 75 ± 12 (104) |
| Peer | 78 ± 14 (92) | 74 ± 12 (92) | 78 ± 8 (93) | 78 ± 10 (93) |
| FBG (mg/dL) | | | | |
| Control | 141 ± 43 (84) | 107 ± 17 (3) | 125 ± 35 (104) | 129 ± 38 (105)* |
| Peer | 136 ± 51 (66) | 104 ± 45 (2) | 124 ± 31 (93) | 121 ± 38 (93)* |
| $A_{1C}$ (%) | | | | |
| Control | 7.3 ± 1.5 (78) | — | 7.0 ± 1.1 (105) | 7.0 ± 1.1 (104) |
| Peer | 7.1 ± 1.5 (66) | — | 6.6 ± 0.9 (92)** | 6.8 ± 1.3 (93) |
| Cholesterol (mg/dL) | | | | |
| Control | 190 ± 47 (80) | — | 190 ± 40 (105) | 191 ± 31(105) |
| Peer | 195 ± 40 (67) | — | 187 ± 36 (91) | 188 ± 34 (91) |
| HDL-chol (mg/dL) | | | | |
| Control women | 46 ± 8 (36) | — | 51 ± 13 (50) | 52 ± 14 (50) |
| Control men | 43 ± 10 (39) | — | 45 ± 10 (55) | 45 ± 11 (55) |
| Peer women | 53 ± 20 (35) | — | 52 ± 11 (53) | 53 ± 10 (53) |
| Peer men | 43 ± 10 (31) | — | 49 ± 12 (40) | 46 ± 10 (40) |
| Triglyceride (mg/dL) | | | | |
| Control | 170 ± 85 (76) | — | 155 ± 84 (105) | 153 ± 73 (105) |
| Peer | 152 ± 78 (67) | — | 140 ± 49 (93) | 149 ± 58 (93) |

Data are mean ± SD; number of subjects observed between parentheses.
*$p$-value *versus* baseline $<0.02$.
**$p$-value control *versus* peer $<0.01$.
BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; FBG, fasting blood glucose; HDL-chol, high-density lipoprotein cholesterol.

Systolic blood pressure average values, either at the recruitment or along the study period, were within normal range in both groups. However, whereas there were no significant changes in the control group, values corresponding to peers showed a significant decrease ($p < 0.016$), with no significant differences between groups.

Diastolic blood pressure was also within normal range in both groups, but these values had no changes during the 1-year follow-up period in any of the groups or between them.

Baseline fasting blood glucose values were above normal range in both groups; these values decreased significantly in both groups during the follow-up period, but only attained normal range at month 1 (Table 2). There were no significant differences between groups at any study period.

Baseline $A_{1C}$ values were close to 7% in both groups; whereas no significant changes were recorded in both groups during the 1-year follow-up, those corresponding to peers were <7%. Values at 6 months were significantly lower in the peer group, but no significant differences between groups were recorded at the end of the study.

Lipid profile was normal or near normal at baseline; values in both groups were lower after the course. However, they did not show any significant difference during the study period or between groups.

At baseline, 56 and 69% of the control and peer group participants practised regular physical activity, respectively. Although the percentage of people practising physical activity regularly decreased significantly in the control group (from 56% to 37%) during the study period ($p < 0.01$), the decrease was less and not significant in the peer group (from 69% to 60%).

The yearly frequency of visits to the doctor's office decreased significantly in both groups during follow-up, without differences between groups (baseline *versus* 12 months: control $9 \pm 5$ *versus* $2 \pm 2$; $n = 105$; peer $6 \pm 5$ *versus* $3 \pm 2$; $n = 92$).

Few hospitalizations were recorded in the overall population sample, with no significant differences between groups either at baseline or during the follow-up period (data not shown). In both cases, the length of the hospitalization was short (around 1 day).

Table 3 shows drug consumption to control hyperglycaemia, hypertension and dyslipidemia at baseline and at the different study periods. Although the percentage of people treated for hyperglycaemia with a single drug in the peer group was larger than in the control one, the difference was non-significant either at baseline or at any time of the follow-up period. Similarly, no differences were observed in the use of drugs to treat either hypertension or dyslipidemia along the study period in both groups.

The evaluation of diabetes distress (Table 4) showed a significant improvement in those categories corresponding to emotional burden, physician-related distress and regimen-related distress. No differences were seen in interpersonal distress in both groups and no significant differences between groups were observed in any of these indicators.



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**Table 3. Drug treatment of hyperglycaemia, hypertension and dyslipidemia**

| | Control | | | | Peer | | | |
|---|---|---|---|---|---|---|---|---|
| Drug treatment | Baseline | 1 month | 6 months | 12 months | Baseline | 1 month | 6 months | 12 months |
| Oral anti-diabetic agents % | 91 (96) | 90 (94) | 93 (98) | 96 (101) | 91 (85) | 90 (84) | 95 (88) | 97 (90) |
| 1 drug | 53 | 53 | 50 | 51 | 69 | 68 | 72 | 70 |
| 2 drugs | 47 | 47 | 50 | 47 | 31 | 32 | 28 | 29 |
| 3 drugs | | | | 2 | | | | 1 |
| Hypertension % | 53 (56) | 53 (56) | 48 (50) | 53 (56) | 71 (66) | 68 (63) | 63 (59) | 60 (56) |
| 1 drug | 66 | 68 | 62 | 68 | 64 | 57 | 69 | 68 |
| 2 drugs | 32 | 30 | 38 | 32 | 29 | 35 | 25 | 27 |
| 3 drugs | 2 | 2 | | | 6 | 8 | 5 | 5 |
| 4 drugs | | | | | 2 | | | |
| Dyslipidemia % | 38 (40) | 38 (40) | 41(43) | 40 (42) | 33 (31) | 30 (28) | 32 (30) | 33 (31) |
| 1 drug | 95 | 95 | 93 | 95 | 90 | 89 | 90 | 94 |
| 2 drugs | 5 | 5 | 7 | 5 | 10 | 11 | 10 | 6 |

Values represent percentage of people; *n* between parentheses.

**Table 4. Diabetes distress categories**

| | Control | | Peer | | Control *versus* peer (*p*-value) | |
|---|---|---|---|---|---|---|
| | Baseline | Final | Baseline | Final | Baseline | Final |
| Total DSS score | 2.3 ± 1.1 (105) | 1.9 ± 0.9* (105) | 2.3 ± 1.2 (93) | 2.0 ±1.0 (93) | NS | NS |
| Score emotional burden | 2.4 ± 1.1 (105) | 2.0 ± 0.9* (105) | 2.2 ± 1.2 (93) | 1.8 ± 0.9* (92) | NS | NS |
| Score physician-related distress | 2.4 ± 1.,3 (102) | 2.,0 ± 1.2* (105) | 2.9 ± 2.4 (92) | 2.2 ± 1.4* (93) | NS | NS |
| Score regimen-related distress | 2.5 ± 1.2 (105) | 2.0 ± 1.0* (105) | 2.6 ± 1.4 (93) | 2.1 ± 1.2* (92) | NS | NS |
| Score interpersonal distress | 2.1 ± 1.3 (103) | 2.0 ± 1.3 (104) | 2.0 ± 1.5 (93) | 1.9 ±1.4 (92) | NS | NS |

Values are mean ± SD; n between parentheses.
*$p < 0.05$ *versus* baseline value.

**Table 5. Structured telephone calls (Well-Being survey [WHO-5 questionnaire])**

| How have you been last week? (%) | 1st quarter (720) | 2nd quarter (1371) | 3rd quarter (1026) | 4th quarter (444) | 1st *versus* 4th quarter *p*-value |
|---|---|---|---|---|---|
| Very bad | 0 | 0 | 0 | 0 | — |
| Regular | 9 | 7 | 6 | 10 | NS |
| Well | 70 | 77 | 88 | 84 | 0.00 |

Values represent percentage of responses. Figures in parentheses represent the number of phone calls.

**Table 6. Patients' attitudes regarding hypoglycaemic episodes**

| Changes recorded (% yes) | 1st quarter (701) | 2nd quarter (1348) | 3rd quarter (1017) | 4th quarter (444) | 1st *versus* 4th quarter (*p*-value) |
|---|---|---|---|---|---|
| Did you have any hypoglycaemia? (*n*) | 5 | 4 | 2 | 2 | 0.01 |
| What did you do to control it? (%) | | | | | |
| Self-monitoring blood glucose | 11 | 19 | 11 | 22 | 0.78 |
| Drink sweet beverage or sugar | 78 | 57 | 6 | 22 | 0.01 |
| Both | 11 | 24 | 83 | 56 | 0.02 |

Number of calls in parentheses.

Data from the regular telephone calls performed and collected by the peer tutor to their group members showed a significant improvement of the well-being condition (increased percentage of people answering *well*; Table 5).

The frequency of SMBG performance during the study did not show any significant changes (data not shown), but the number of hypoglycaemic episodes decreased significantly as well as the positive attitudes towards their prevention and control (Table 6).

## Discussion

Our data show that after the implementation of an education course for people with type 2 diabetes with



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comparable age, gender distribution and diabetes duration, both the control and the peer groups had a comparable and significant increase in diabetes knowledge. They also expressed a similar positive opinion about the quality and usefulness of the education course. Because similar degrees of diabetes knowledge improvement were attained by both groups after the course, it is reasonable to assume that any difference between groups could be ascribed to the peer's influence. This also suggests that in the structured environment of the study, peer education was non-inferior to health professional education.

Other outcomes showed that the percentage of people with manifested classical symptoms of diabetes decreased significantly along the study period in both groups, with no significant differences between them. On the other hand, although no significant differences were recorded in most clinical parameters measured, peers had better outcomes in SBP (no significant changes in the control group but a significant decrease in the peer group).

From the metabolic point of view, both groups decreased significantly the high baseline fasting blood glucose values during the follow-up period, but only those from the peer group attained a normal value at the first month. Similarly, baseline $A_{1C}$ values were close to 7% in both groups but although no significant changes were recorded in both groups during the 1-year follow-up, those followed by peers were $<7\%$. Despite these differences in favour of peers, no differences were recorded in drug consumption between groups. Similar data regarding improved metabolic control without changes in drug consumption were reported by Trento *et al*. [31]. These data could suggest that treatment adherence in the peer group was better than in the control group. This difference in adherence was also observed at the level of lifestyle changes, where the regular practice of physical activity decreased significantly in the control group along the study period, whereas such decrease was not significant in the peer group.

The better adherence to regular practice of physical activity recorded in the peer group merits a special comment based upon its multiple beneficial effects upon the control of diabetes and the associated cardiovascular risk factors [32,33] and the low adherence to such practice commonly reported in people with chronic diseases [34].

Although psychosocial problems are common among people with diabetes, quite frequently they are not recognized and appropriately addressed by health care providers [35,36]. Thus, the International Diabetes Federation and the American Diabetes Association have recommended to include routine monitoring of well-being as an integral part of diabetes care [37,38]. Such control is feasible, well received and promotes the recognition of the patient's psychological needs, enabling the health care team to provide effective support to overcome them [39]. In this context, diabetes distress is referred as the emotional burdens and worries that are part of the psychological impact that people with a serious and demanding disease as diabetes have [40]. High levels of such a distress are common (around 18–35%) and persistent over time [41,42] and have been significantly associated with degree of glycaemic control, diabetes-specific self-efficacy, diet and physical activity in adult people with type 2 diabetes [43]. Consequently, we measured diabetes distress in our two study groups and found a significant and comparable decrease in these values immediately after they attended the education course, thus suggesting that education itself provides some type of content to the attendees. Together with the aforementioned clinical and metabolic changes, our data support the concept that education programmes that incorporate behavioural and affective strategies are quite effective [44–46], even in a population of people with relatively baseline good control of their type 2 diabetes.

Although no significant changes were recorded in the frequency of SMBG performance along the study period, the number of hypoglycaemic episodes as well as the positive attitude towards their prevention and control decreased significantly in the peer group. Further, the small differences recorded in most indicators in favour of the Peer group also confirm that ongoing support is needed to sustain the changes made during the educational process [25,26].

The data recorded from the regular telephone calls performed by the peer tutor to his or her group showed a significant improvement of psychological problems along the study period. Consequently, they support the concept that periodic structured telephone calls are a useful and low-cost tool to motivate people with chronic diseases [47].

Altogether, our data show that well-trained peers, previously selected by their degree of metabolic control, communication skills and commitment with the study, are at least as effective as professional diabetes educators in imparting diabetes education to their peers. Although both educators are acceptable to patients as trainers, lay peer tutors require appropriate training, specifically to the education programme they have to deliver. Sufficient regular delivery of practices, role-playing activities and provision of structured programmes with proven efficacy contribute to improve their pedagogic skills. Provision of organizational and logistical support can further improve their efficacy. Certainly, the pre-study training activities and the periodic feedback meetings performed in our study provided such support, thus explaining the good outcomes obtained.

Comparable results were reported by Baksi *et al*., who implemented an approach similar to our own [48]. These authors assessed the effectiveness and acceptability of peer advisers in diabetes in delivering a programme on DSME for people with diabetes and compared their results with those obtained by specialist health professionals. They measured different outcomes at baseline and at 6 months. Knowledge scores improved significantly in both groups with no difference between groups for any of the knowledge domains. In post-session evaluations, both groups scored highly, with the health professionals significantly more so; on the other hand, the

questionnaire exploring patients' understanding and confidence in self-management of specific aspects of diabetes care at the end of the course revealed no difference between the groups. They found no difference in the diabetes care profiles or in $A_{1C}$ in any of the groups. Further, the positive outcomes obtained in our study were similar to those reported by the Cardiovascular Health Awareness Program that was successful in providing tailored health education resources addressing modifiable risk factors [49].

In summary, these data as well as our own, strongly suggest that volunteer peer educator activities can be successfully applied in diabetes and in other cardiovascular risk factors. Further, as it was suggested by Fisher *et al*. [50], peer support could play effectively different roles, such as (a) assistance in managing and living with diabetes in daily life, (b) social and emotional support and (c) linkage to clinical care. The current results showing the non-inferiority of the study outcomes in the peer group, together with the improvement of $A_{1C}$ levels and SBP, the higher adherence to physical activity and better control of hypoglycaemic episodes only recorded in this group, support this concept. Consequently, peers can provide a suitable contribution to the implementation of DSME programmes everywhere, but especially in areas with short availability of professionals and economic resources.

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## Conflict of interest

The authors have no conflicts of interest.

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