Effect of an educational intervention on the metabolic control of people with type 2 diabetes

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The incidence of diabetes has increased worldwide due to a number of factors, including increasing age, dietary habits, obesity and sedentary lifestyles. This study evaluated the effects of educational activities on metabolic control in people with hypertension and diabetes. After the educational intervention, knowledge improved significantly in all areas examined and there was greater reduction in mean blood pressure, waist circumference, and HbA_{1c} in the intervention group ($P<0.05$). In intragroup analysis, only the intervention group showed a significant reduction in all the variables. The educational intervention improved knowledge about the disease and this was reflected in better metabolic control.

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Article points

1. Health education is one of the recommended strategies to help lower the high rate of complications in people with diabetes.
2. The objective of this study was to evaluate the effect of diabetes education on metabolic control in people with both hypertension and type 2 diabetes at a general hospital of a Brazilian University.
3. The study showed that the educational programme was effective in disease control and self-care management.

Key words

- Education
- Glycaemic control
- Self-care

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The incidence of type 2 diabetes (T2D) has increased worldwide, due to increasing age, dietary habits, obesity, and sedentary lifestyles (Organização Pan-Americana da Saúde, 2003). In Brazil the prevalence of diabetes in the population over 18 years of age is 5.2% (Brazilian Society of Diabetes, 2007). With arterial hypertension, T2D is the leading cause of mortality, hospitalisations and lower limb amputations (Furtado and Polanczyk, 2007; Schaan and Reis, 2007; Cesse et al, 2009).

Treatment of diabetes should include both pharmacological and nonpharmacolgical measures, alongside associated lifestyle changes. Health education is one of the recommended strategies to help lower the high rate of complications in people with diabetes (Brazilian Society of Diabetes, 2007; Fitzner et al, 2008).

The objective of this study was to evaluate the impact of educational activities about diabetes on metabolic control in people with both hypertension and diabetes at a general hospital of a Brazilian University.

Method

This randomised, controlled clinical trial was conducted at an arterial hypertension treatment referral centre for people diagnosed with arterial hypertension.

Sample

One thousand people registered with hypertension were identified. Of these, there were 279 (27.9%) individuals with diabetes and of these, 47 (16.8%) used insulin. The sample was calculated on the basis of the population of 232 non-insulin dependent T2D individuals, with a 3% margin of error for mean glycated haemoglobin. Seventy-six individuals with hypertension and diabetes were invited to participate in the study. Randomisation was accomplished using a simple drawing of two subject groups: the control group (CG) and the intervention group (IG). Each group had 38 participants. People with hypertension and

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1. The intervention group participated in 12, fortnightly educational meetings over six months, and it was a requirement that they participated in at least eight educational meetings.
2. The Diabetes Knowledge Questionnaire was used to evaluate diabetes knowledge, which is a validated measure for the type 2 diabetes population. The questionnaire was administered to all participants at two points in the study process.
3. The control variables were: weight; body mass index; waist circumference; blood pressure, capillary glycaemia and HbA_{1c}.

T2D, but who did not have grade 3 obesity (BMI ≥40 kg/m²) were included in this study. The project was approved by the Research Ethics Committee, University Hospital, Federal University of Goias, Brazil. All participants signed an informed consent form. The study was conducted from March–October 2010 and data collection occurred at three time points: baseline (T1); after 3 months of intervention (T2) and after 6 months of intervention at the end of the study (T3). Sociodemographic and anthropometric data were collected from all groups, along with blood pressure and blood glucose data. The glycated haemoglobin test (HbA_{1c}) was performed at the central laboratory of the hospital.

Diabetes knowledge

To evaluate knowledge about the disease, the Diabetes Knowledge Questionnaire was used, which is a validated measure for the T2D population (Otero, 2005). The questionnaire was administered at T1 and T3 to each participant during their nursing consultation. Knowledge was evaluated using the proportion of correct answers on each topic of the questionnaire at different times (T1 and T3).

Educational intervention

The IG participated in 12, fortnightly educational meetings over six months and it was a requirement that they participated in at least eight educational meetings. The CG did not participate in educational meetings. Both groups were accompanied by a nurse or other healthcare professional to routine outpatient visits, with consultations every three months.

Problem-posing pedagogical methodology was used in the intervention (Freire, 1989). The first two educational meetings involved a group discussion about the topics that would be covered in the educational programme. Participants were encouraged to indicate which topics they would find most useful (Freire, 1987). The contents of the discussions were tape-recorded, transcribed, and interpreted, and the central issues were highlighted. The words and phrases that occurred most frequently and that could be used in educational activities were selected, grouped into thematic units, and used as topics in subsequent meetings (Minayo, 2004).

An educational plan was prepared for each of the generating themes derived from the discussion circles, taking the responses to the disease knowledge questionnaire into account: diabetes anatomy and pathophysiology; self-care: glycaemic control of diabetes; self-care: diet plan; self-care: physical activity; self-care: medicines; chronic diabetes complications; obesity; and quality of life assessment.

The research group was present at all meetings and coordinated the educational activities. Written materials and slides were used to facilitate learning.

Table 1. Sociodemographic characteristics of both groups.

	Intervention group	Control group	*P*-value
Age	65.4 ± 9.4	66.1 ± 10.6	0.778
Gender	14.3% male 85.7% female	30.3% male 69.7% female	0.138
Low educational level* (%)	71.4	67.6	0.105
Treatment time (years)	8.1 ± 8.0	7.4 ± 5.0	0.898

Values expressed as mean ± standard deviation or percentage. Student's *t*-test and χ^2 test
*Did not complete schooling

Control variables

A glucometer was used for the capillary glycaemia test and recommended levels in the postprandial state (2 hours after meals) were below 140 mg/dL (Brazilian Society of Diabetes, 2007; American Diabetes Association, 2008). For indirect measurement of blood pressure (BP), a mercury sphygmomanometer was used. Blood pressure was considered under control for participants if less than 130/80 mmHg (Schaan and Reis, 2007; Brazilian Society of Cardiology, 2010).

Weight, height and waist circumference were performed using standard procedures. Waist circumference reference values of ≥88 cm for women and ≥102 cm for men were considered

abnormal. Body mass index (BMI) was calculated and the World Health Organization's BMI classification was used (Lohman et al, 1988; World Health Organization, 1995; World Health Organization, 1997). Control parameters for HbA_{1c} were lower than 48 mmol/mol (6.5%; Brazilian Society of Diabetes, 2007).

Statistical analysis

The statistical analysis was performed using SPSS version 15.0. Data were compared between the two groups and at three time points: T1, T2, and T3. The Shapiro-Wilk test, Student's *t*-test and Wilcoxon test were used and the relationships between the variables were examined by Pearson's correlation. The level of significance was P <0.05 and the confidence interval was 95%.

Results

A total of 62 people completed the study, 28 in the IG and 34 in the CG. Fourteen people were excluded from the study as they did not attend the meetings. The mean age of the study population was 65.8 years (SD ± 10.02), and 75.8% were female (*Table 1*).

At T1, the two groups had similar knowledge when answering the Diabetes Knowledge Questionnaire. The average percentage of total correct answers in the IG was 20.7% (106 points). At T3, at the end of the intervention, knowledge about the disease among people in the IG had increased significantly (P <0.01).

At baseline (T1), the two groups' anthropometric, clinical and laboratory variables were similar (*Table 2*). At the end of the intervention (T3), the waist circumference and HbA_{1c} variables had decreased significantly in the IG, while in the CG there was no change in these variables. There were reductions in weight, BMI, BP and capillary glycaemia in both groups at all time points, but this was not statistically significant (*Table 2*). When the values of variables were compared between the two groups in regards to percentage of control, there was an increase in the IG in the percentage of control for all variables, with statistical significance for systolic BP at T2, and mean BP, diastolic BP, and HbA_{1c} at T3 (P <0.05; *Figure 1*).

Table 2. Comparison of control and intervention group variable means at different time points.

Variables	Times	Intervention group	Control group	*P* value
Weight (kg)	T1	71.6 ± 10.8	75.4 ± 13.3	ns
	T2	71.0 ± 11.0	74.6 ± 13.4	ns
	T3	70.1 ± 11.1	74.7 ± 13.7	ns
Body mass index (kg/m^2)	T1	29.6 ± 3.8	30.1 ± 4.6	ns
	T2	29.3 ± 3.8	30.0 ± 4.6	ns
	T3	29.3 ± 3.8	30.2 ± 4.5	ns
Waist circumference (cm)*	T1	100.1 ± 10.3	101.2 ± 10.9	ns
	T2	99.8 ± 10.4	103.0 ± 11.1	ns
	T3	97.4 ± 9.1	103.3 ± 11.3	0.028
Systolic blood pressure (mmHg)	T1	137.1 ± 25.5	136.7 ± 22.2	ns
	T2	127.4 ± 12.6	135.9 ± 26.1	ns
	T3	124.4 ± 11.7	132.6 ± 25.7	ns
Diastolic blood pressure	T1	83.8 ± 13.2	82.2 ± 13.6	ns
	T2	77.5 ± 6.8	79.3 ± 10.6	ns
	T3	75.7 ± 6.7	80.4 ± 13.4	ns
Mean blood pressure (mmHg)	T1	101.6 ± 16.0	82.2 ± 13.6	ns
	T2	94.1 ± 6.4	79.3 ± 10.6	ns
	T3	92.0 ± 7.4	80.4 ± 13.4	ns
Capillary glycaemia (mg/dL)	T1	170.0 ± 54.8	177.6 ± 63.3	ns
	T2	146.8 ± 66.4	153.3 ± 63.0	ns
	T3	139.6 ± 59.8	162.1 ± 89.7	ns
HbA_{1c} (%)	T1	6.0 ± 1.4	6.4 ± 1.4	ns
	T2	6.5 ± 1.4	7.0 ± 1.6	ns
	T3	6.2 ± 1.0	7.0 ± 1.7	0.004

Values expressed as mean ± standard deviation or percentage. Student *t*-test and χ^2 test. *Adjusted for sex; ns=not significant

Most people in both groups started the study with HbA_{1c} under control (63.35%). At T2, the same percentage of people in the IG, and a smaller percentage of those in CG (44.1%), had HbA_{1c} under control. At T3, the percentage of people in the IG with HbA_{1c} under control rose to 71.4% (P < 0.05), while the percentage in CG remained at 44.1%.

The participants' length of treatment did not influence the behaviour of the variables studied. When the means of the control variables in the

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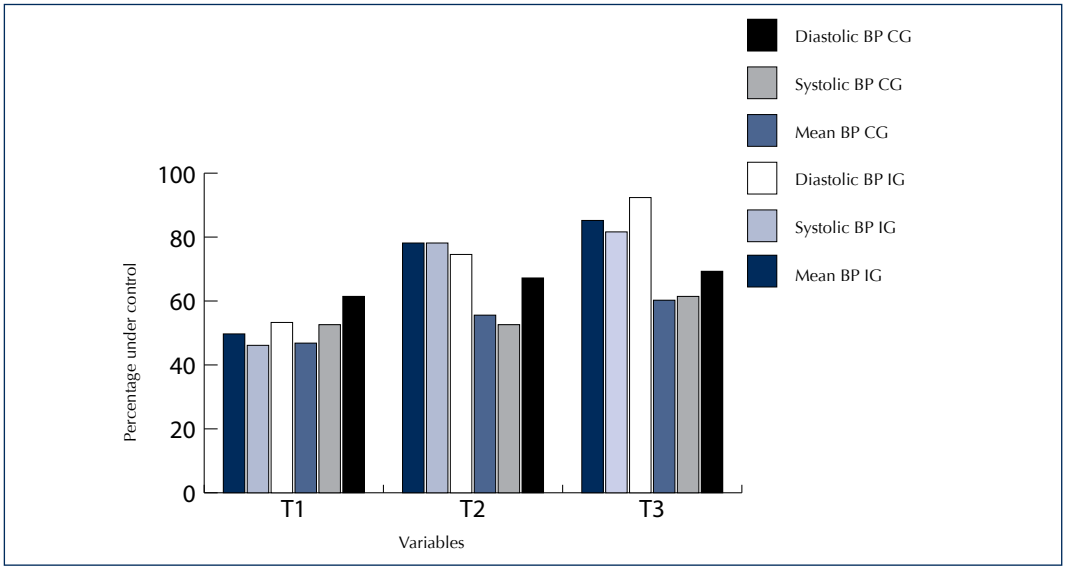

Figure 1. Distribution of the proportion of individuals under control, considering the variables mean blood pressure, systolic blood pressure and diastolic blood pressure in the control group (CG) and intervention group (IG) at the three evaluation times (T1, T2 and T3).

Table 3. Comparison of the means of control variables investigated in the intervention group at the three time points.

Variables	IG T1	IG T2	IG T3	*P* value T1/T2	*P* value T1/T3	*P* value T2/T3
Weight (kg)	71.62 ± 10.85	71.02 ± 11.00	70.12 ± 11.10	ns	0.013	0.008
Body mass index (kg/m^2)	29.60 ± 3.83	29.35 ± 3.76	29.00 ± 3.83	ns	0.014	0.008
Waist circumference (cm)	100.33 ± 10.41	99.78 ± 10.39	97.36 ± 9.05	ns	0.001	0.001
Systolic blood pressure (mmHg)	137.14 ± 25.50	127.36 ± 12.56	124.43 ± 11.70	ns	0.011	ns
Diastolic blood pressure (mmHg)	83.80 ± 14.17	77.46 ± 6.81	75.71 ± 6.69	0.006	0.002	ns
Mean blood pressure (mmHg)	101.57 ± 15.96	94.10 ± 6.43	91.95 ± 7.39	0.015	0.002	ns
Capillary glycaemia (mg/dL)	169.26 ± 57.06	154.47 ± 68.63	138.89 ± 65.1	ns	0.024	ns
HbA_{1c} (%)	6.00 ± 1.42	6.55 ± 1.38	6.22 ± 1.04	ns	ns	0.021

Values expressed as mean ± standard deviation or percentage. Student *t*-test and χ^2 test; ns=not significant

IG at the three time points were compared, there was a significant body weight reduction in the IG and BMI changed in the same way (*Table 3*).

In the IG, the mean HbA_{1c} at T1 was <48 mmol/mol (6.5%), which is considered normal. At T3, HbA_{1c} had decreased to 44 mmol/mol (6.22%) in the CG; HbA_{1c} increases occurred at all time points and were significant from T1 to T2 and from T2 to T3.

Discussion

The education intervention generated a satisfactory increase in disease knowledge, and stimulated participants to reflect on their condition, which translated into significant improvement in several control variables. The change in eating behaviour is very important for evaluating the diabetes group education programme, and shows an improvement in knowledge and a change in attitudes about the disease (Torres et al, 2009).

The study population consisted of older people with T2D and hypertension. The majority of participants were women and most had not completed school education. The mean treatment period was 8 years and most participants' HbA_{1c} levels were within normal limits at baseline. This latter figure differs from those reported in other literature, where it has been reported that only 20% of all people with diabetes have HbA_{1c} levels below 53 mmol/mol (7%; Brazilian Society of Diabetes, 2007; Torres et al, 2009; Gimenes et al, 2009).

In a meta-analysis of 24 studies reviewing diabetes management programmes, with follow-up time varying from 37 days to 30 months, a significant reduction of HbA_{1c} in the study group was found in 38% of the studies. Overall, the results showed a significant reduction in HbA_{1c} ranging from 3.3 mmol/mol (0.3%) to 6.6 mmol/mol (0.6%; Knight et al, 2005). In this current study, a 3.3 mmol/mol (0.3%) reduction in HbA_{1c} was obtained when the T2 measurement was compared with that at T3.

The length of follow-up, along with the educational approach, may have been the factors that caused the differences in behaviour between the two groups. The IG, who participated in educational activities where they learned about self-management of the disease, showed greater adherence to treatment, which resulted in better levels of glycaemic control.

Length of follow-up has been shown to be a limiting factor in studies of educational strategies (Torres et al, 2009) to change behaviour, and therefore, diabetes control in people with diabetes. The current findings are consistent with the literature, since such measurements usually show improvement only after a prolonged educational process (American Diabetes Association, 2007; Torres et al, 2009).

The BMI levels found in the study population were of obese or overweight individuals. These data are reinforced by a Brazilian multi-centre study of people with T2D, in which 75% of the subjects were overweight and 33% were obese (de Castro et al, 2006; Gomes et al, 2006). The current study also showed that there was a decrease in waist circumference in the IG and this may help to reduce risk of mortality from cardiovascular disease, as suggested in two epidemiological studies (Koster et al, 2008; Czernichow et al, 2011). Individuals with diabetes are at a significantly higher risk of coronary heart disease than healthy individuals, according to a meta-analysis of prospective cohort studies (Huxley et al, 2006). In the present study, mean BP decreased significantly in the IG. Data from the UKPDS (United Kingdom Prospective Diabetes Study) showed that each 10 mmHg reduction in systolic BP brings a 12% decrease in the occurrence of any T2D-related complication, including cardiovascular disease (Siqueira et al, 2007).

In this study, the attempt was to follow problem-posing and consciousness-raising methodology (Freire 1987; 1989), which led to satisfactory results in increasing awareness of the disease. This made it possible for participants in the IG to take self-care measures that translated into behavioural change, the adoption of healthy habits and physical activity. The construction of new knowledge leads to the acquisition of preventive behaviours and encourages individuals with diabetes to

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3. The current study also showed hat there was a decrease in waist circumference in the intervention group and this may help to reduce risk of mortality from cardiovascular disease.

"The educational programme used as an instrument for intervention was effective in disease control and self-care management."

understand their problems and choose the appropriate solution for managing care of the disease (Funnell and Anderson, 2004).

Study limitations

The small IG sample size and the project's time constraints should be considered as limitations of this study. With a longer intervention period, the differences arising out of the research would be clearer.

Conclusion

The educational programme used as an instrument for intervention was effective in disease control and self-care management. In addition to a significant improvement in knowledge about diabetes, the programme was shown, by an analysis of metabolic control variables, to provide significant results in the control of mean BP, waist circumference and glycaemia. ■

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