Impact of written information on control and adherence in type 2 diabetes

Inês Rosendo Carvalho e Silva Caetano[1]* ⓘ, Luiz Miguel Santiago[2], Margarida Marques[3]

[1]Unidade de Saúde Familiar (USF) Coimbra Centro, Faculdade de Medicina da Universidade de Coimbra, Coimbra, Portugal
[2]PhD Professor. USF Topázio, Faculdade de Medicina da Universidade de Coimbra, Coimbra, Portugal
[3]Biostatistics Laboratory, Faculdade de Medicina da Universidade de Coimbra, Coimbra, Portugal

Summary

Introduction: Diabetes therapeutic education and information by leaflets is important. This study aimed to understand the effectiveness of written information to diabetic patients, after six months, in the control of diabetes and medication adherence.
Method: Non-pharmacological clinical trial. Randomized sample of diabetic patients of 65 volunteer doctors, distributed among the five health regions in Portugal. At the first appointment, patients were randomized in four groups (three intervention with validated leaflets and one control), leaflet reading being reinforced at the follow-up appointments in a 6-months period. Variables collected: HbA_{1c}, home blood glucose, weight, waist circumference, blood pressure, cigarettes smoked, physical activity level, adherence to medication, medication, height, diabetes progression, age, sex and educational background. Descriptive and inferential statistics.
Results: From the 709 patients recruited, 702 were studied in this 6-months period with no statistical differences in the baseline variables studied. After six months of intervention, the adherence to medication improved in the leaflet group (p=0.034). This was noticed in those under 65 years of age (p=0.027), with diabetes for ≤ 5 years (p=0.010), with educational background up to 4 years (p=0.030) and 9 years (p=0.006) and with $HbA_{1c} \geq 7\%$ at the beginning of the study.
Conclusion: Interventions with leaflets handed in primary healthcare to people with diabetes type 2 can bring benefits in what concerns adherence to therapeutics, namely in younger people with a less studies.

Keywords: Diabetes Mellitus. Medication Adherence. Patient Education as Topic.

Introduction

Diabetes may become one of the leading causes of morbidity and total/partial disability in the 21st century, with an estimated 642 million diabetics by 2040.[1]

Good glycemic control in diabetes is essential for retarding microvascular and neuropathic complications and, if initiated in time, macrovascular complications as well.[2-9] In diabetes, decreasing blood pressure values decreases mortality, the risk of cardiovascular events, albuminuria and retinopathy.[5,10,11] Other cardiovascular risk factors with an impact on mortality include dyslipidemia[12] and smoking habits, with an NNT of 11 to 10 years in reducing mortality.[13]

It is known that many people with diabetes do not achieve the goals recommended for controlling their disease.[14-16] Following health professionals' recommendations[17,18] and patients' adherence to pharmacological measures,[19,20] as well as their lifestyles,[21-23] are far from desirable.

A structured educational intervention appears to be beneficial to people with diabetes in the short term in improving not only their knowledge, but also markers such as glycated hemoglobin (HbA_{1c}),[24,25] blood pressure, and blood lipids.[26,27] Interventions targeted at multiple behaviors and done in primary health care seem to be promising.[28] Leaflet intervention seems to have a positive effect on knowledge,[29-31] adherence to treatment in short-term treatments[32] and physician-person communication, leading to greater shared discussion.[33]

There are few published studies on written information given to people with diabetes, particularly in primary care. Those that do exist refer to improvement in HbA_{1c} levels,[34-37] postprandial glycemia[38] and adherence to treatment.[39]

We thus carried out this study to evaluate the effectiveness of the information given to the person with diabetes by means of leaflets and compare the results with those of a control group that only received the usual advice given during medical visits. Our objective was also to check whether there are differences among leaflets about diabetes, its treatment and the importance of physical activity in controlling the disease. We also sought to determine if the impact of the intervention was anyhow influenced by gender, age, academic background, diabetes progression time and initial control of HbA_{1c}.

METHOD

Non-pharmacological clinical trial conducted as a prospective, randomized, controlled, non-blind and multicenter study with type 2 diabetes patients receiving primary care. Those who agreed to participate were included if they could read or had someone in the household who could read the leaflet to them. Persons who already had a relative or cohabitant participating in the study, those under 18, pregnant, bedridden or wheelchair-bound, and all those with a diagnosis of depression were excluded.

The sample size calculation (n=1,170) was based on a previous study done in the central region of Portugal,[40] with significance level [α] = 0.05, [β] = 0.20, study power 1 - [β] = 0.80 (n = 175 for each group), including a 10% margin for dropouts. The sample consisted of the first 18 people with type 2 diabetes who had a consultation with their general practitioner (family physician), as from October 15, 2014. The individuals were randomized according to their order of arrival by using random numbers generated by computer software in four groups: 585 sample units were given a validated leaflet (195 on diabetes, 195 on diabetes treatment, 195 on the importance of physical activity in diabetes management), and the other 585 were not given any of the leaflets and received the usual care.

General practitioners were invited over social media. Voluntaries were accepted until they reached 65 doctors from continental Portugal, distributed across the five areas (25 in the North, 11 in the Center, 23 in Lisbon and Vale do Tejo, three in Alentejo, and three others in Algarve).

The intervention was done at the first visit: the leaflet was delivered and the person receiving it was asked to read it or to have someone else read it to them at home. They were asked to try and understand the information contained therein. At each subsequent visit, the request for reading the brochure was reinforced and any queries were answered.

The variables collected throughout the visits were: HbA_{1c} (%), capillary glycemia was recorded in the outpa-tient clinic over the past four months both while fasting and in the postprandial period – the readings were then classified as controlled (all those within the 70-130 mg/dL were classified as fasting and all others < 180mg /dL as postprandial) or uncontrolled; weight (kg); abdominal perimeter along the iliac crests in the horizontal position (AP, cm); blood pressure (BP, mmHg); smoking habits (number of cigarettes/day); physical activity (PACE instrument scale, validated in Portuguese);[41] adherence to the pharmacological treatment of diabetes (MAT scale, validated in Portuguese,[42] consisting of seven questions 1-6, with the total score of 42 corresponding to maximum adherence); medications for diabetes and high blood pressure; insulin medication; reading of the leaflet. The variables collected at the beginning and end were: height (meters), diabetes progression time (years), age (years), sex, education (number of school years).

The leaflets were previously validated following content development according to the existing recommendations,[43,44] reviewed by 14 scientific experts and one Portuguese-language expert. Subsequently, they were qualitatively evaluated by ten people with type 2 diabetes having different levels of education.

Statistical analysis was performed with the purpose of analyzing the impact of six months following the intervention: we compared the beginning-end differences between the intervention and control groups, by using the Mann-Whitney U test, and among the various groups of leaflets, by using the Kruskal-Wallis test. We performed the same analysis of the intervention's impact at the six months across subgroups by sex, age, level of schooling, diabetes duration, and initial HbA_{1c} levels. The significance level we adopted in all tests was 0.05.

A text about the study was previously made available to each participant user, whose informed consent was requested in writing. We then gave them two copies of the form, one of which we requested in return once the participants had signed it. Our study received a positive opinion from the ethics committees of Faculdade de Medicina at Universidade de Coimbra, from continental Portugal's Regional Health Administrations (Administrações Regionais de Saúde, ARS) and from the National Commission on Data Protection (Comissão Nacional de Proteção de Dados).

RESULTS

Initial sample

The initial sample consisted of 709 people with diabetes recruited by 41 general practitioners throughout Portugal. In it, 60.2% of the people were males, the average age was

66.12 ± 10.47 years, and the mean number of school years was 6.26 ± 3.90, whereas 1.7% were illiterate. They had had diabetes for 9.25 ± 7.83 years on average, 13.0% were insulin-treated, the mean HbA_{1c} was 6.79% ± 1.04%, and 65.7% had a controlled disease (HbA_{1c} < 7%). There were no outpatient records for glycemia in 41.6% of participants while fasting versus 52% of them postprandially. Total adherence to treatment was found in 34.4% of them (42 points on the MAT scale),[42] with 90% adhering to medication (value ≥ 5).[45-47] Blood pressure was controlled (BP < 140/90) in 54.6% of participants, the mean BMI was 29.39 ± 4.87 kg/m², BP was high in 88.3% of females and 72.1% of males. Relative to their lifestyle, 71.1% reported practicing physical activity, 26.2% of them five or more times per week, 10.6% were smokers with an average of 16.39 ± 10.11 cigarettes/day.

Intervention
Of the 709 people recruited, follow-up of 702 continued up to six months (Figure 1). There were no significant

differences between the initial and final samples, as well as no differences between the intervention and control groups, across groups according to the type of leaflet distributed (p=0.991) or among those who reported either having read the leaflet at home or not (p=0.691).

Comparing the intervention group with the control group, after six months, we found a significant improvement in adherence to treatment (p=0.034), as shown in Table 1. There were no significant differences between the variables at the beginning and end across the various groups of leaflets.

Complementary analysis
We repeated the analysis including only those who reported having read the leaflets and the results were similar across groups for changes in antidiabetic and antihypertensive medication.

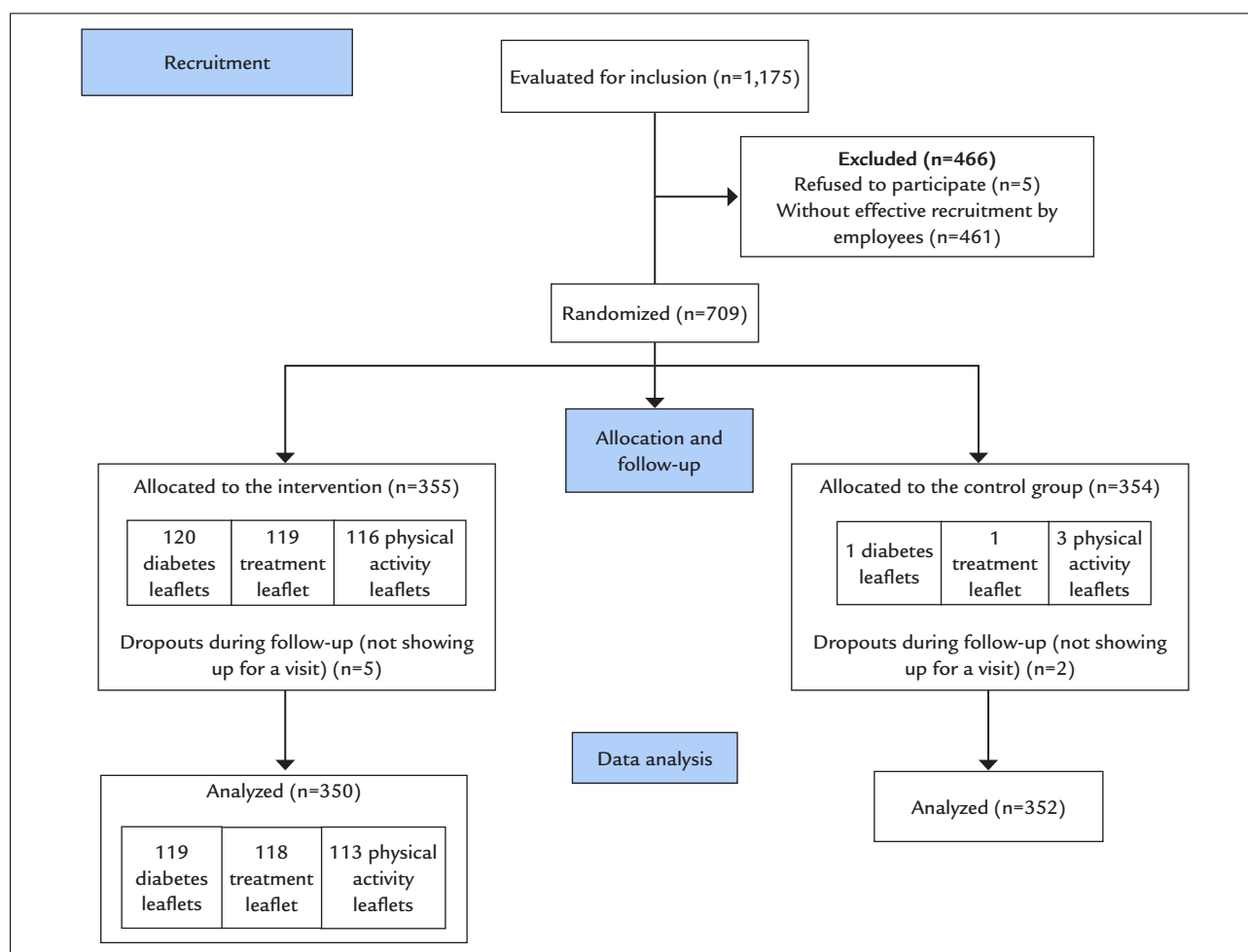In the subgroup analysis, we found improvement in adherence to treatment in the intervention group: in the

FIGURE 1 CONSORT diagram used to the study.

TABLE 1 Mean±SD and percentage of variables in the control and intervention groups at the beginning of the study and six months later, and results from the comparison of the beginning-end differences between the two groups.

Variable	Time	Control group	Intervention group	Total	n	p*
HbA$_{1c}$ (%)	Baseline	6.74±0.97	6.85±1.10	6.79±1.04	633	0.898
	Final	6.84±1.04	6.85±0.99	6.85±1.02		
Systolic BP (mmHg)	Baseline	137.41±17.09	136.77±15.83	137.09±16.47	693	0.078
	Final	134.75±16.02	136.29±17.16	135.51±16.60		
Diastolic BP (mmHg)	Baseline	76.50±10.90	76.60±10.31	76.55±10.61	689	0.522
	Final	75.43±10.81	76.22±10.42	75.83±10.61		
BMI (kg/m^2)	Baseline	29.50±4.75	29.25±5.00	29.37±4.88	686	0.627
	Final	29.31±4.79	29.14±4.94	29.23±4.86		
Abdominal perimeter (cm)	Baseline	102.89±11.29	102.30±11.67	102.60±11.47	563	0.783
	Final	102.48±11.97	101.84±11.75	102.16±11.85		
Treatment adherence	Baseline	39.80±2.76	39.63±2.92	39.72±2.84	608	0.034
	Final	40.22±2.63	40.22±2.47	40.22±2.56		
Physical activity	Baseline	3.43±1.67	3.59±1.69	3.51±1.68	654	0.943
	Final	3.31±1.55	3.57±1.71	3.44±1.63		
Controlled outpatient fasting blood glucose	Baseline	45.5%	41.8%	43.8%	409	0.482
	Final	46.9%	45.1%	46%	389	
Controlled outpatient post-prandial blood glucose	Baseline	40.3%	34%	37.3%	335	0.270
	Final	40.8%	42.3%	41.5%	337	
Number of cigarettes/day (smokers only)	Baseline	15.92±9.47	16.64±10.83	16.33±10.183	54	0.739
	Final	14.09±11.07	13.74±12.15	13.89±11.60		

*Mann-Whitney U test (for non-normal distribution).
HbA$_{1c}$: glycated hemoglobin (HbA$_{1c}$); BMI: body mass index; BP: blood pressure.

population under 65 years of age (p=0.027), in the population having up to four school years and also in those with up to nine years of formal education (p=0.030 and p=0.006, respectively). We also observed this improvement in participants who had had diabetes for ≤ 5 years (p=0.010), but not in the other diabetes duration subgroups nor in those with uncontrolled HbA$_{1c}$ at the beginning of the study (HbA$_{1c}$ ≥ 7%) (p=0.008).

Systolic blood pressure decreased more notably in the control group (p=0.046). The same observation applies to the individuals who had had DM2 for ≤ 5 years and ≤ 7 years (p=0.025 and p=0.018, respectively) and also in those with controlled HbA$_{1c}$ (< 7%) at the beginning of the study (p=0.046).

Among leaflets, as shown in Table 2, we found differences among participants with up to nine years of formal education, whose adherence to treatment improved upon receiving the leaflets about the disease compared to others (p=0.023). In people with more than nine years of formal education, postprandial capillary glycemia results progressed more positively among outpatient participants than it did among those who received the leaflet about physical activity leaflet (p=0.023).

DISCUSSION

One of our study's limitations is interobserver bias, as there were 41 investigators involved in taking measurements, using scales and administering the intervention. An attempt to minimize this was made by means of on-site face-to-face meetings and detailed written instructions. The choice of variables was limited, and no other sociodemographic or risk factors were included. Neither were factors that could characterize the participants' dietary and nutritional habits, diabetes complications, polypharmacy or multimorbidity that could influence adherence to treatment and control of the disease so as to avoid work overload among investigators, who contributed to our study as volunteers. Still, there were many who did not report recruitment data, as there were also participants with diabetes who did not show up for a visit. All things being considered, at the end of six months, we obtained only 60% of the initially calculated sample.

The study is performance-biased due to its non-blinded method, which is inherent in a non-pharmacological clinical trial with educational intervention in the real world. The control group itself always receives some sort of educational intervention (it would be unethical if it

TABLE 2 Differences across the various groups of leaflets under analysis of subgroups of people having more than or fewer than nine years of formal education at the beginning of the study and at six months.

Variable	Time	Control group	Diabetes leaflet group	Treatment leaflet group	Physical activity leaflet group	Total	n	p* (among groups)
Treatment adherence	Baseline	39.84±2.60	39.72±2.77	39.53±2.76	39.86±2.60	39.78±2.65	497	0.023
(≤ 9 years of formal education)	Final	40.18±2.49	40.23±2.47	40.29±2.29	40.28±2.22	40.22±2.41		
Controlled outpatient	Baseline	26.7%	33.3%	66.7%	14.3%	34.5%	53	0.023
post-prandial blood glucose	Final	35.7%	33.3%	45.5%	57.1%	40%		
(> 9 years of formal education)								

*Kruskal-Wallis test (for non-normal distribution).

did not), even if such intervention is not structured exactly the same way. This consequently limits the magnitude of the results and the drawing of conclusions.[48,49] In addition, the study was carried out during a period of six months of observation only, which therefore prevents any assessments of the consequences diabetes has on health.

This methodology led to losses as far as control of variables was concerned, but allowed for gains in perceiving the applicability of the intervention. It was a simple and replicable intervention, as recommended elsewhere in the literature,[26,28,50] of low intensity and medium duration, and is more likely to have an impact on the health of populations.[51] On the other hand, more complex or group interventions, in turn, imply more motivated people failing to reach the general population.[52,53]

This was the first national clinical trial in primary health care to be conducted in Portugal and, although the sample did not have the desired size at six months, the groups did have a distribution with no significant differences, which increases the power of the conclusions we can draw.

Intervention results

Six months after intervention, adherence to pharmacological therapy improved significantly in the leaflet group (p=0.034). Other studies, analyzing the impact of written information given out to people with diabetes on adherence pharmacological treatment at three months, also showed improvements.[37,39,54] A review by Cochrane[32] also states that written information is useful in short-term treatments. It would be presumably logical that these results implied improvement in glycemic control.[15,55-60] In our study, glycemic control worsened in the control group (from 6.74% to 6.84% HbA$_{1c}$), whereas it remained unchanged in the intervention group (mean 6.85%), but without any difference (p=0.888). This was also observed in other studies.[61] We are left to wonder what the level of adherence to be achieved will be in order to improve metabolic control and to what extent other factors may

have influenced this control, such as adherence to physical activity (which worsened over six months) or to diet (which has not been studied). These are some of the questions that should still be resolved. It is known that, regardless of metabolic control, nonadherence to medication seems to have more micro- and macrovascular complications,[62] as well as increased risk of hospitalization and death.[52,62-65] Thus, it is important to consider interventions such as this one in populations like younger people, with diabetes for a shorter period of time, with less formal education, and with uncontrolled HbA$_{1c}$.

The fact that older people did not experience an improvement can be explained by multimorbidity and chronic polypharmacy and less literacy. The leaflet on treatment appeared to be specifically more beneficial for people with less schooling. Among people with more schooling, in turn, the leaflet on physical activity was the one with the greatest impact on postprandial glycemias, which were shown to be more related to the complications from diabetes and cardiovascular mortality than were HbA$_{1c}$ and fasting glycemia.[66] In addition, physical exercise proved to specifically and effectively decrease postprandial glycemias.[67] This difference in impact on people with more schooling may be due to a greater ease in perceiving the relation between exercise and postprandial glycemia.

As limiting factors of more robust results, we can mention the low level of literacy,[68,69] even though we do not yet know which type of intervention would be the most beneficial to the Portuguese population.[70,71] The use of written materials seems to improve literacy and health behaviors.[72] In order to analyze the results, it is not necessary to neglect the fact that the intervention was done by the general practitioner who is already familiar to the person with diabetes and with whom he or she has an established relationship. It is known that educational interventions, when made by a single person, seem to yield better results. There are studies showing that there is no relation between knowledge and better metabolic

control[73-75] in diabetes. Nevertheless, educational interventions are related to this control,[52] which suggests that there is more to influencing this variable than solely transmitted knowledge.[24,25]

The leaflets' lack of customization to the needs of each person[76,77] and the short contact time between educator and the person with diabetes (because the leaflet was read at home) may have led to lesser efficacy of the intervention.[24] There also appears to be greater effectiveness of educational interventions when these are more often repeated over time, at short intervals.[49,78] Accordingly, the fact that the leaflets were delivered only at the beginning of our study may have triggered a poorer effect on its potential benefit.

It will be important to conduct longer follow-up studies to perceive the impact of educational interventions on morbidity and mortality and also studies with more frequent and ongoing interventions that can help identify the most effective type of intervention in populations with low health literacy.

CONCLUSION

Written information given to people with diabetes by their general practitioner did not have a statistically significant impact on metabolic control. However, it did increase adherence to pharmacological treatment six months later compared to usual counseling given at the visits (p=0.034).

We found differences among people with diabetes who received the various leaflets and also in those individuals with up to nine years of formal education. Improvement in adherence to treatment was significantly greater in those who received the leaflet (p=0.023).

In those with more than nine years of formal education, the outpatient postprandial glycemias were better than in those who received leaflets on physical activity (p=0.023). Leaflet impact was influenced by age, academic background, duration of diabetes, and glycemic control at the beginning of the study. It improved adherence to treatment in people younger than 65 years (p=0.027), who had had diabetes for five years or less (p=0.010), with up to four (p=0.030) and up to nine years of formal education (p=0.006), and with $HbA_{1c} \geq 7\%$ at the beginning of the study (p=0.008).

In Portugal, it will be interesting to have validated leaflets to be distributed by health professionals during the follow-up visits to this population.

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RESUMO

Impacto da informação escrita no controle e adesão na diabetes tipo 2

Introdução: A educação terapêutica e a informação dada à pessoa com diabetes parece ser importante nesta doença de prevalência crescente. Estudar a efetividade da informação escrita dada ao utente diabético, após 6 meses, no controle e na adesão terapêutica.

Método: Ensaio clínico não farmacológico. Amostra aleatorizada de diabéticos de 65 médicos de família voluntários, distribuídos pelas cinco regiões de Portugal continental. Na primeira consulta, as pessoas foram aleatorizadas (em grupos de intervenção com folhetos validados e grupo controle) e foi reforçada a leitura do folheto nas consultas de seguimento até 6 meses. Foram recolhidas as seguintes informações: HbA_{1c}, glicemias em domicílio, peso, altura, perímetro abdominal, pressão arterial, cigarros fumados, atividade física praticada, adesão terapêutica, medicamentos tomados, tempo de evolução da diabetes, idade, sexo e educação. Estatística descritiva e inferencial.

Resultados: Das 709 pessoas recrutadas, foram estudadas 702, sem diferenças significativas para as variáveis epidemiológicas medidas. Aos seis meses da intervenção, a adesão à terapêutica farmacológica melhorou mais no grupo que recebeu folheto (p=0,034), nas pessoas com menos de 65 anos (p=0,027), com diabetes há cinco anos ou menos (p=0,010), com formação de até quatro anos (p=0,030) e até nove anos (p=0,006) e com a $HbA_{1c} \geq 7\%$ no início do estudo (p=0,008).

Conclusão: Folhetos dados nos cuidados de saúde primários a pessoas com diabetes tipo 2 podem beneficiar a

adesão terapêutica a curto prazo, nomeadamente em pessoas mais novas e com menor formação.

Palavras-chave: Diabetes Mellitus. Adesão à Medicação. Educação de Pacientes como Assunto.

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