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Diabetes education and health insurance: How they affect the quality of care provided to people with type 1 diabetes in Latin America. Data from the International Diabetes Mellitus Practices Study (IDMPS)

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ABSTRACT

Aims: This study aimed to evaluate the impact of diabetes education and access to healthcare coverage on disease management and outcomes in Latin America.
Methods: Data were obtained from a sub-analysis of 2693 patients with type 1 diabetes mellitus recruited from 9 Latin American countries as part of the International Diabetes Mellitus Practices Study (IDMPS), a multinational, observational survey of diabetes treatment in developing regions.
Results: Results from the Latin American cohort show that only 25% of participants met HbA1c target value (< 7% [53 mmol/mol]). Attainment of this target was significantly higher among participants who had received diabetes education than those who hadn't (28% *vs.* 19%, $p < 0.001$), and among those who practiced self-management (27% *vs.* 21% no self-management, $p = 0.001$). Multivariate analysis showed that participants who had received diabetes education were more likely to manage their diabetes (OR: 1.65 [95% CI: 1.24,

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2.19]; p = 0.001), and to attain HbA1c target values (OR: 1.48 [95% CI: 1.14, 1.93]; p = 0.003).
Conclusions: Given the association between uncontrolled diabetes and long-term complications, health authorities and care providers should increase efforts to ensure widespread healthcare coverage and access to self-management education to reduce the socioeconomic and humanistic burden of type 1 diabetes.

1. Introduction

Care for people with diabetes and its chronic complications represents a substantial social and economic burden for national healthcare systems and society overall [1]. Healthcare systems in Latin America face the challenge of increasing prevalence of chronic diseases such as diabetes and hypertension without a parallel growth of their budget [2]. In 2013, care for adults with diabetes in South and Central America accounted for approximately 13% of total healthcare expenditure [3]. In order to optimize the use of finite resources, a shift towards preventative medicine is required [2].

Within the last decade, most Latin American countries have introduced new schemes of universal health insurance which have substantially improved access to healthcare services [2]. Despite these schemes, the quality of diabetes care in Latin America remains suboptimal. Many patients were not monitored for risk factors and complications at the recommended intervals while fasting blood glucose, HbA1c, triglyceride and cholesterol levels are generally outside target ranges [4]. Furthermore, access to insulin in the region is often limited and, even when available, it is not always prescribed and used appropriately, and most patients do not meet glycemic targets [5].

Care for people with type 1 diabetes mellitus (T1DM) presents a particular challenge since the provision of multidisciplinary care, essential for management of this complex disease, is scarce in Latin America [5]. Effective control of T1DM requires patients' active participation in making day-to-day decisions related to the control and treatment of their disease. In order to do so effectively, they need to understand how to adjust their insulin doses in response to self-measured blood glucose levels, carbohydrate intake, exercise load and illness. It has been shown that diabetes education is the most appropriate strategy to promote effective self-management [6,7]. Several reports have demonstrated the beneficial effect of education for people with type 2 diabetes mellitus (T2DM) in Latin America [8–10] but data are scarce for T1DM.

In order to address this lack of information, we have analyzed data from the Latin American cohort of the International Diabetes Mellitus Practices Study (IDMPS). Since 2005, the International Diabetes Mellitus Practices Study (IDMPS) has been seeking to understand the challenges of managing diabetes in the real world. IDMPS is the largest ever observational study program that describes patient profiles, management and patterns of care across time in developing regions, and is conducted on a yearly basis in real-world settings. Using data from these surveys, we have reported multidimensional factors related to glycemic control including clinical characteristics, healthcare coverage, care processes and access to diabetes education [11]. Since its initiation in 2005, we have conducted six waves, each within a 12-month period, enrolling patients from diverse clinical settings. Data from the first wave showed that people with T1DM were more likely to attain HbA1c if they practiced self-monitoring of blood glucose (SMBG) and had access to diabetes education [11,12]. For the current analysis, we focused on people with T1DM in Latin America from four successive waves and explored associations between glycemic control and diabetes education, self-management and healthcare coverage.

2. Materials and methods

The design and objectives of the IDMPS study have been described previously [11]. Briefly, IDMPS is an observational, multinational study to assess the therapeutic management of people with diabetes in real-world medical practice. The study was conducted in six waves (Wave 1: 2005; Wave 2: 2006; Wave 3: 2008; Wave 4: 2010; Wave 5: 2011–12; Wave 6: 2013–14), each of which included a cross-sectional survey. Data from the Latin American cohort, Waves 1–4, are reported here.

2.1. *Study implementation*

The study was coordinated by Sanofi-Diabetes Intercontinental and a steering committee of international diabetologists. Ethics approval was obtained from institutional review boards in each participating country and the study was conducted in accordance with the Declaration of Helsinki. All participants provided written informed consent.

2.2. *Selection of centers/physicians and sample size estimation*

Participating investigators included endocrinologists, diabetologists and general practitioners with experience in initiation and titration of insulin therapy [11]. Investigators/centers for each study wave were selected independently and investigators could participate in more than one wave. Sample sizes

were determined for each country to attain the primary study endpoint, which was to establish the percentage of people with T2DM treated with insulin.

2.3. Participants

Physicians enrolled the first five adults (aged ≥ 18 years) with T1DM and ten adult patients with T2DM who attended their clinic during the 2-week recruitment period. Patients only participated in one wave. Patients who were actively participating in another clinical study, or were receiving temporary insulin treatment (e.g. for gestational diabetes or pancreatic cancer) were excluded.

2.4. Data collection and outcome measures

Before each study wave, attributes of the participating investigator and center were recorded, including their specialist status, years of experience, nature of healthcare organization and medical coverage. All patient data were collected on case report forms which included demographics, socio-economic profile, types of diabetes, disease duration, co-existing complications and cardiovascular risk factors, glycemic control, history of hypoglycemia, frequency of physical activity, current insulin treatment regimen. Patients' attendance of diabetes education programs (including type and modality of education received) and self-care practices (including SMBG and insulin dose self-adjustment [ISA]) were also recorded. Self-management was defined as practice of both SMBG and ISA. Glycemic control target was defined as HbA1c < 7% (53 mmol/mol).

2.5. Statistical analysis

Unless specified, data from all waves were pooled for analysis. For variables with two modalities, Wilcoxon signed-rank (quantitative variables) or Chi-squared (qualitative variables) tests were used; for variables with more than two modalities, Kruskal-Wallis (quantitative variables) or Fisher's exact (qualitative variables) tests were used. Univariate and logistic regression analyses were performed to identify predictive factors for: self-management, receipt of diabetes education and glycemic control. For the logistic regression, age was divided into three classes: < 40 years old, 40–64 years old and ≥ 65 years old. Continuous variables included in the model were: total daily insulin dose, time since diagnosis, time on insulin treatment and waist circumference.

All predictors with a p-value < 0.20 in univariate analysis were included in a logistic regression model. Then, a stepwise procedure was used to select the most relevant model. Starting from a full model with all independent variables selected based on the univariate analysis, all non-significant variables were removed one by one until all parameters reached a level of significance of at least 0.05. Interactions between independent variables were not considered. Odds ratios were provided with 95% confidence intervals.

In all data analyses, participants with missing data were not considered when reporting proportions of participants in categories described.

3. Results

Across Waves 1–4, a total of 2693 participants with T1DM were recruited in Latin America (Table 1). Almost all participants (96%) lived in an urban setting, and 70% were recruited by diabetes specialists. Most participants (56%) attended clinics that cared for a mixture of public and private patients.

Of the patients recruited, 44% were male, with a mean age of 38 years (standard deviation [SD]: 16 years). Mean time since diagnosis of T1DM was 14.1 years (SD: 10.7 years). Almost half (48%) of the participants received university or higher level education. Overall, 83% of participants were covered by health insurance.

Basal plus prandial insulin was the most frequently used treatment regimen (65%) while 24% used basal insulin alone. Approximately half (52%) of participants who used a basal plus prandial regimen used analog insulin. Basal plus prandial insulin regimen was more frequently used by participants with healthcare coverage than those without insurance (68% *vs.* 53%, p < 0.001).

3.1. Diabetes education

The majority of patients (65%) had received diabetes education, mainly on an individual basis. Attendance to diabetes education was more common among participants recruited by diabetes specialists than those recruited by a general practitioner, (67% *vs.* 61%, p = 0.009) and among those with health insurance (67% *vs.* 56% among those without insurance, p < 0.001). Rates of diabetes education differed between countries with the highest rate reported in Chile (82%) and the lowest in the Dominican Republic (29%, Table 1).

3.2. Diabetes self-management activities

Most participants (82%) performed SMBG, but only 63% practiced ISA while 58% of participants practiced both SMBG and ISA (i.e. self-management). Rates of diabetes self-management differed between countries with the highest rate reported in Chile (84%) and the lowest in the Dominican Republic (29%).

Self-management (SMBG + ISA) was more common among participants who had received diabetes education (65% *vs.* 46% of participants without diabetes education, p < 0.001), with health insurance (62% *vs.* 40% without insurance, p < 0.001) and among those recruited by a diabetes specialist (68% *vs.* 35% of participants recruited by a general practitioner, p < 0.001).

3.3. Glycemic control

Overall, 25% of participants met HbA1c target (< 7% [53 mmol/mol]) and 28% had HbA1c > 9% (75 mmol/mol). Rates of HbA1c target attainment were similar in participants managed by a specialist or a general practitioner (24.7% *vs.* 24.9%, respectively; p = 0.932). Target attainment was numerically higher among participants with health insurance coverage than those without (26% *vs.* 21%, respectively; p = 0.061; Fig. 1).

Table 1 – Participant baseline characteristics, overall and according to diabetes education.

	Overall (N = 2693)[a]	Diabetes education status N = 2659[b]		Significance (test used)
		Educated n = 1735 (65%)	Not educated n = 924 (35%)	
Country, *n* (%)	N = 2693	N = 1735	N = 924	< 0.001 (F)
Argentina	830 (31)	519 (64)	295 (36)	
Chile	119 (4)	98 (82)	21 (18)	
Colombia	450 (17)	345 (78)	98 (22)	
Dominican Republic	49 (2)	14 (29)	34 (71)	
Ecuador	30 (1)	24 (80)	6 (20)	
Guatemala	55 (2)	30 (57)	23 (43)	
Mexico	733 (27)	431 (59)	300 (41)	
Panama	13 (1)	8 (62)	5 (38)	
Venezuela	414 (15)	266 (65)	142 (35)	
Ethnicity, *n* (%)	N = 2287	N = 1473	N = 791	0.179 (F)
Caucasian	728 (32)	459 (31)	257 (33)	
Native Latin	1492 (65)	961 (65)	520 (66)	
Black	8 (< 1)	5 (< 1)	3 (< 1)	
Japanese	2 (< 1)	2 (< 1)	0	
Oriental, Arab, Persian	1 (< 1)	1 (< 1)	0	
Other Asian	3 (< 1)	2 (< 1)	1 (< 1)	
Other	53 (2)	43 (3)	10 (1)	
Gender, *n* (%)	N = 2625	N = 1697	N = 894	
Male	1143 (44)	743 (44)	387 (43)	0.809 (C)
Mean age, years (SD)	37.7 (15.8)	36.7 (15.4)	39.4 (16.3)	< 0.001 (W)
Mean time since diabetes diagnosis, years (SD)	14.1 (10.7)	14.5 (10.7)	13.3 (10.6)	0.002 (W)
Mean body mass index, kg/m^2 (SD)	24.7 (4.5)	24.4 (4.1)	25.1 (5.1)	0.027 (W)
Physician specialty, *n* (%)	N = 2536	N = 1647	N = 889	0.009 (C)
Diabetes specialist	1782 (70)	1186 (72)	596 (67)	
General practitioner	754 (30)	461 (28)	293 (33)	
Covered by health insurance, *n* (%)	N = 2644	N = 1705	N = 907	< 0.001 (C)
	2207 (83)	1461 (86)	719 (79)	
Glycemic control, *n* (%)	N = 2188	N = 1495	N = 688	< 0.001 (C)
HbA1c < 7%	546 (25)	412 (28)	128 (19)	
Insulin regimen, *n* (%)	N = 2602	N = 1670	N = 898	< 0.001 (C)
Basal alone	618 (24)	324 (19)	285 (32)	
Basal + prandial	1701 (65)	1181 (71)	498 (54)	
Prandial alone	39 (2)	31 (2)	8 (1)	
Premix alone	172 (7)	94 (6)	76 (8)	
Others	72 (3)	40 (2)	31 (3)	
Mean number of daily injections by insulin regimen (SD)				< 0.001 (C)
Basal alone	1.57 (0.55)	1.62 (0.52)	1.52 (0.57)	0.016 (W)
Basal + prandial	4.18 (0.97)	4.21 (0.97)	4.09 (1.00)	0.031 (W)
Prandial alone	2.42 (0.90)	2.46 (0.78)	2.33 (1.21)	0.853 (W)
Premix alone	2.10 (0.46)	2.12 (0.42)	2.08 (0.51)	0.610 (W)
Diabetes management strategy used, *n* (%)				
No self-management	N = 2584	N = 1688	N = 896	< 0.001 (C)
	333 (13)	150 (9)	183 (20)	
Self-monitoring blood glucose (SMBG)[c]	N = 2655	N = 1715	N = 910	< 0.001 (C)
	2186 (82)	1499 (87)	667 (73)	
Self-management (practices both SMBG and ISA)	N = 2648	N = 1706	N = 912	< 0.001 (C)
	1538 (58)	1109 (65)	416 (46)	

C, Chi-squared test; F, Fisher exact test; W, Wilcoxon test.

[a] Participants with missing data were not considered when reporting proportions of participants in categories listed.

[b] Data on diabetes education status were not available for 34 participants.

[c] Includes all patients who practice SMBG, some of whom are included among those who practice self-management.

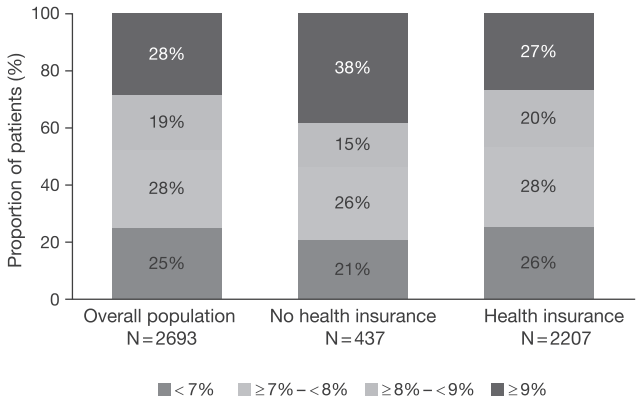


Fig. 1 – HbA1c percentage distribution according to health insurance. NS, not significant.

HbA1c target attainment was significantly higher among those with diabetes education (28% *vs.* 19% without diabetes education, $p < 0.001$), and those who practiced self-management (27% *vs.* 21% no self-management, $p = 0.001$). Diabetes education was also important for effective self-management practice. In those who practiced self-management, the rate of HbA1c target attainment was significantly higher among those who had also received diabetes education than those who had not (30% *vs.* 22%, respectively; $p = 0.003$). Conversely, HbA1c values > 9% (75 mmol/mol) were significantly more frequently recorded in participants without diabetes education than in those who had received it (36% *vs.* 25%, respectively; $p < 0.001$).

3.4. *Multivariate analysis*

After controlling for confounders, lack of complications, lower insulin dosage (< 1 unit/kg), receipt of diabetes education and having a glucometer were independent predictors for attaining HbA1c target (Fig. 2A). Predictors for diabetes education included having a glucometer and seeing a specialist (Fig. 2B). Independent predictors for self-management included younger age, higher education level, treatment with basal-bolus regimen, long time since diagnosis, having private medical insurance and access to diabetes education and seeing a specialist (Fig. 2C). Odds ratios for these effect sizes ranged from 1.1 to 1.82 for positive associations and from 0.28 to 0.92 for negative associations (Fig. 2A–C).

4. Discussion

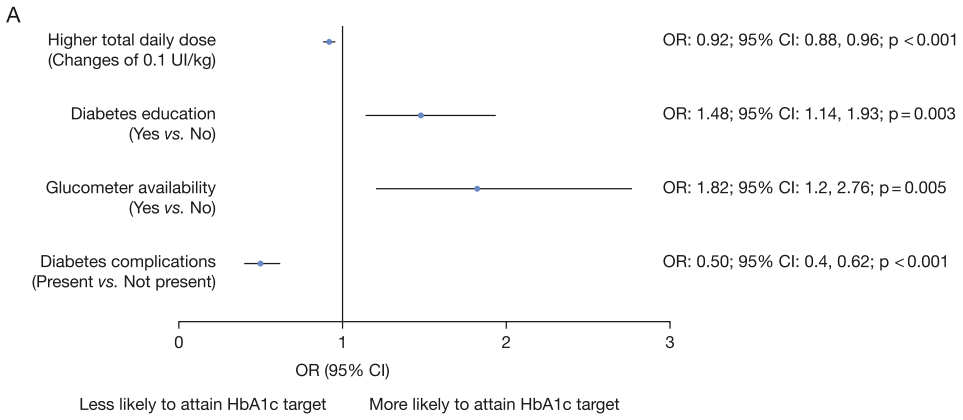
In this analysis of a large cohort of people with T1DM from Latin America, we confirm the multidimensional nature of factors determining attainment of HbA1c target; factors identified included insulin dosage, lack of complications, access to diabetes education and to a glucometer: the latter being essential tools for SMBG and ISA. Our analysis also highlights a need to improve glycometabolic control for people with T1DM in Latin America, since only 25% of participants attained HbA1c target values (< 7.0% [53 mmol/mol]). Poor metabolic control is associated with increased risk for the development and progression of chronic complications of T1DM [13–16] and a decrease in quality of life [17,18].

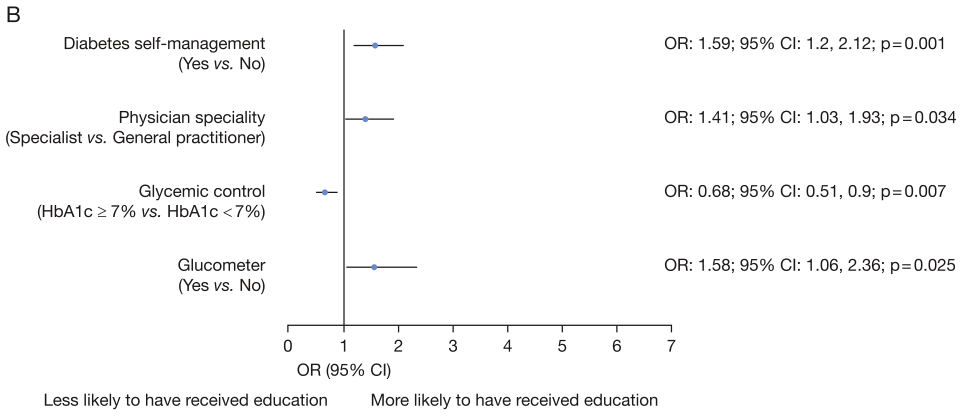
Many studies have confirmed the utility of diabetes education in empowering patients with T1DM to take effective control of their disease with clinical, metabolic and economic benefits [19,20]. Based on this large body of evidence, widespread implementation of diabetes education programs is recommended by a number of national organizations [20,21]. Supporting these recommendations, our data showed that participants who had received diabetes education were more likely to practice self-management and to attain HbA1c values < 7% (53 mmol/mol), than those without education. In the Middle East population of IDMPS, self-management was a significant independent predictor of glycemic control [22]. This was not the case in the current study, though glucometer availability was a predictor of glycemic control, and this was also strongly linked with self-monitoring of blood glucose: 98% of patients who owned a glucometer practiced SMBG compared with 1% of those without a glucometer. Participants who had received diabetes education were also more likely to receive basal and prandial insulin, than those without who most frequently received basal alone; the use of prandial insulin only will likely be a barrier for the achievement of HbA1c target.

In this Latin American population, HbA1c target attainment was higher among participants with health insurance coverage than in those without. Furthermore, participant health insurance coverage was a significant independent predictor of self-management suggesting that costs associated with diabetes care may deter people without insurance from managing their diabetes and thus attaining appropriate glycometabolic control. In fact, test strips for SMBG account for a substantial proportion of overall diabetes care costs in Latin America and attainment of HbA1c target was associated with greater strip use [23]. Although there is strong evidence that intensive treatment for people with T1DM is cost-effective overall [24], self-management without appropriate diabetes education can incur substantial costs (e.g. through increased use of SMBG strips), without any improvement in metabolic outcomes. This is illustrated by our finding that the rate of target attainment in participants who practiced self-management without diabetes education was similarly low to the rate in participants who did not practice any self-management (22% *vs.* 21%, respectively). Thus, diabetes education may help patients to optimize their use of SMBG strips and learn how to carry out ISA in order to maximize the cost-effectiveness of self-management.

Participants recruited by diabetes specialists were more likely to have received diabetes education than those recruited by general practitioners. This indicates one of the benefits of specialist care, and suggests that efforts may be needed in the region to promote the importance of diabetes education to general practitioners in the region.

In summary, these findings from Waves 1–4 in Latin America, and those reported previously from the IDMPS study for other waves and regions, have proved the strong relationships between diabetes education, self-management and attainment of HbA1c target [11,22]. Our results suggest that health authorities, policymakers, insurers, healthcare administrators and providers should increase efforts to ensure widespread healthcare coverage and access to education about diabetes self-management in order to decrease the heavy





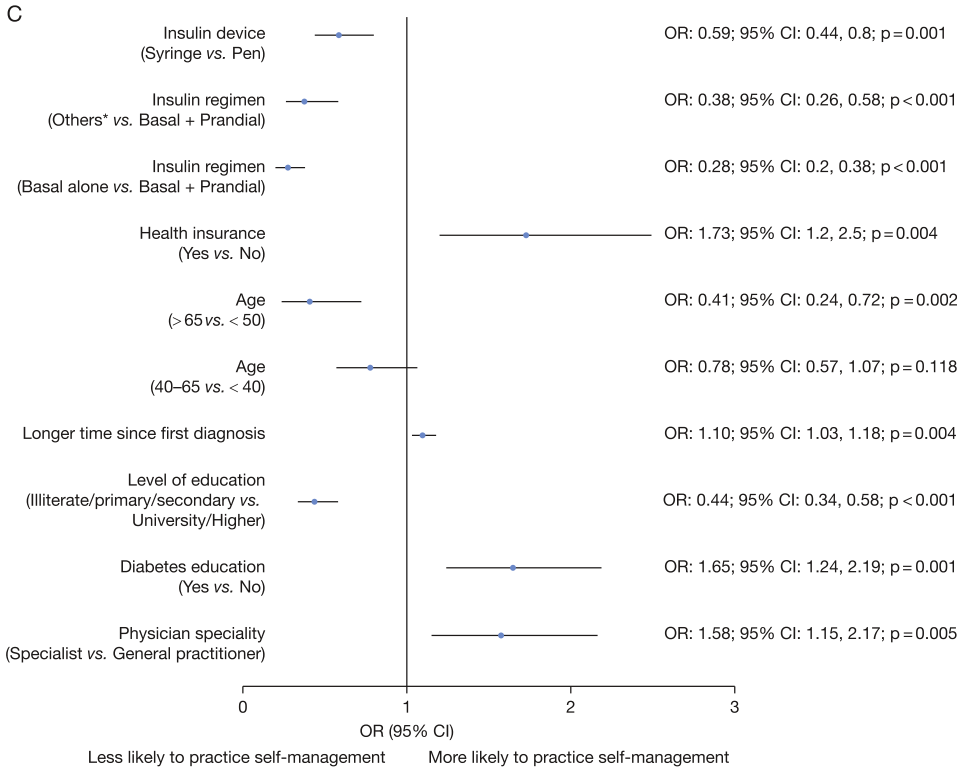


Fig. 2 – (A) Predictive factors for HbA1c target attainment. (B) Predictive factors for receipt of diabetes education. (C) Predictive factors for diabetes self-management. *"Others" includes any regimen other than Basal + Prandial, Basal alone, Prandial alone or Premix alone. CI, confidence interval; OR, odds ratio.

burden of T1DM for patients, the healthcare budget and society overall.

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Disclosures

CD and JMC are employees of Sanofi.

All of the other authors are members of the IDMPS Steering Committee and have received honoraria and traveling sponsorships in relation to the IDMPS. No other potential conflicts of interest relevant to this article were reported.

Author contributions

All authors interpreted the results, revised the manuscript, and approved the final version of the manuscript. JJG is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

REFERENCES

[1] Barcelo A, Aedo C, Rajpathak S, Robles S. The cost of diabetes in Latin America and the Caribbean. Bull World Health Organ 2003;81:19–27.

[2] Arredondo A. Type 2 diabetes and health care costs in Latin America: exploring the need for greater preventive medicine. BMC Med 2014;12:136. https://doi.org/10.1186/s12916-014-0136-z.

[3] International Diabetes Federation. Diabetes atlas, 6th ed., Regional Overviews, http://www.idf.org/sites/default/files/EN_6E_Ch3_Regional_Overviews.pdf; 2013 [accessed 24 April 2014].

[4] Commendatore V, Dieuzeide G, Faingold C, Fuente G, Lujan D, Aschner P, et al. Registry of people with diabetes in three Latin American countries: a suitable approach to evaluate the quality of health care provided to people with type 2 diabetes. Int J Clin Pract 2013;67:1261–6. https://doi.org/10.1111/ijcp.12208.

[5] Aschner P, Aguilar-Salinas C, Aguirre L, Franco L, Gagliardino JJ, de Lapertosa SG, et al. Diabetes in South and Central America: an update. Diabetes Res Clin Pract 2014;103:238–43. https://doi.org/10.1016/j.diabres.2013.11.010.

[6] Elliott J, Jacques RM, Kruger J, Campbell MJ, Amiel SA, Mansell P, et al. Substantial reductions in the number of diabetic ketoacidosis and severe hypoglycaemia episodes requiring emergency treatment lead to reduced costs after structured education in adults with Type 1 diabetes. Diabet Med 2014;31:847–53. https://doi.org/10.1111/dme.12441.

[7] Lemozy-Cadroy S, Crognier S, Gourdy P, Chauchard MC, Chale JP, Tauber Dagger JP, et al. Intensified treatment of type 1 diabetes: prospective evaluation at one year of a therapeutic patient education programme. Diabetes Metab 2002;28:287–94.

[8] Gagliardino JJ, Arrechea V, Assad D, Gagliardino GG, Gonzalez L, Lucero S, et al. Type 2 diabetes patients educated by other patients perform at least as well as patients trained by professionals. Diabetes Metab Res Rev 2013;29:152–60. https://doi.org/10.1002/dmrr.2368.

[9] Gagliardino JJ, Etchegoyen G. A model educational program for people with type 2 diabetes: a cooperative Latin American implementation study (PEDNID-LA). Diabetes Care 2001;24:1001–7.

[10] Gagliardino JJ, Lapertosa S, Pfirter G, Villagra M, Caporale JE, Gonzalez CD, et al. Clinical, metabolic and psychological outcomes and treatment costs of a prospective randomized trial based on different educational strategies to improve diabetes care (PRODIACOR). Diabet Med 2013;30:1102–11. https://doi.org/10.1111/dme.12230.

[11] Chan JC, Gagliardino JJ, Baik SH, Chantelot JM, Ferreira SR, Hancu N, et al. Multifaceted determinants for achieving glycemic control: the International Diabetes Management Practice Study (IDMPS). Diabetes Care 2009;32:227–33. https://doi.org/10.2337/dc08-0435.

[12] Gagliardino JJ, Aschner P, Baik SH, Chan J, Chantelot JM, Ilkova H, et al. Patients' education, and its impact on care outcomes, resource consumption and working conditions: data from the International Diabetes Management Practices Study (IDMPS). Diabetes Metab 2012;38:128–34. https://doi.org/10.1016/j.diabet.2011.09.002.

[13] Group TDCaCTR. The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. N Engl J Med 1993;329:977-86. http://dx.doi.org/10.1056/NEJM199309303291401.

[14] Nathan DM. The diabetes control and complications trial/epidemiology of diabetes interventions and complications study at 30 years: overview. Diabetes Care 2014;37:9–16. https://doi.org/10.2337/dc13-2112.

[15] Orchard TJ, Nathan DM, Zinman B, Cleary P, Brillon D, Backlund JY, et al. Association between 7 years of intensive treatment of type 1 diabetes and long-term mortality. JAMA 2015;313:45–53. https://doi.org/10.1001/jama.2014.16107.

[16] Schnell O, Cappuccio F, Genovese S, Standl E, Valensi P, Ceriello A. Type 1 diabetes and cardiovascular disease. Cardiovasc Diabetol 2013;12:156. https://doi.org/10.1186/1475-2840-12-156.

[17] Fisher L, Polonsky WH, Hessler DM, Masharani U, Blumer I, Peters AL, et al. Understanding the sources of diabetes distress in adults with type 1 diabetes. J Diabetes Complications 2015;29:572–7. https://doi.org/10.1016/j.jdiacomp.2015.01.012.

[18] Joensen LE, Almdal TP, Willaing I. Associations between patient characteristics, social relations, diabetes management, quality of life, glycaemic control and emotional burden in type 1 diabetes. Prim Care Diabetes 2015. https://doi.org/10.1016/j.pcd.2015.06.007.

[19] Boren SA, Fitzner KA, Panhalkar PS, Specker JE. Costs and benefits associated with diabetes education: a review of the literature. Diabetes Educ 2009;35:72–96. https://doi.org/10.1177/0145721708326774.

[20] Heller S, Lawton J, Amiel S, Cooke D, Mansell P, Brennan A, et al. Improving management of type 1 diabetes in the UK: the Dose Adjustment For Normal Eating (DAFNE) programme

as a research test-bed A mixed-method analysis of the barriers to and facilitators of successful diabetes self-management, a health economic analysis, a cluster randomised controlled trial of different models of delivery of an educational intervention and the potential of insulin pumps and additional educator input to improve outcomes. Southampton (UK); 2014.

[21] Funnell MM, Brown TL, Childs BP, Haas LB, Hosey GM, Jensen B, et al. National standards for diabetes self-management education. Diabetes Care 2012;35(Suppl 1):S101–8. https://doi.org/10.2337/dc12-s101.

[22] Gagliardino JJ, Chantelot JM, Domenger C, Aschner P, Chan J, Ilkova H, et al. Impact of diabetes education and self-management on the quality of care for people with type 1 diabetes in the Middle East (The International Diabetes Mellitus Practices Study, IDMPS); 2016 [in preparation].

[23] Elgart JF, Gonzalez L, Prestes M, Rucci E, Gagliardino JJ. Frequency of self-monitoring blood glucose and attainment of HbA1c target values. Acta Diabetol 2015. https://doi.org/10.1007/s00592-015-0745-9.

[24] Li R, Zhang P, Barker LE, Chowdhury FM, Zhang X. Cost-effectiveness of interventions to prevent and control diabetes mellitus: a systematic review. Diabetes Care 2010;33:1872–94. https://doi.org/10.2337/dc10-0843.