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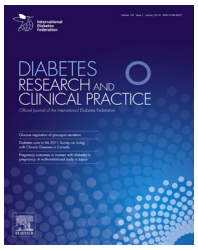

Association between socioeconomic status, type 2 diabetes and its chronic complications in Argentina

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ABSTRACT

Aim: To compare the socioeconomic status (SES) of people with type 2 diabetes (T2DM) in Argentina (Córdoba) with and without major chronic complications of diabetes, with that recorded in persons without diabetes matched by age and gender.

Methods: For this descriptive and analytic case–control study, potential candidates were identified from the electronic records of one institution of the Social Security System of the city of Córdoba. We identified and recruited 387 persons each with T2DM with or without chronic complications and 774 gender- and age-matched persons without T2DM (recruitment rate, 83%). Data were obtained by telephone interviews and supplemented with data from the institution's records. Group comparisons were performed with parametric or non-parametric tests as appropriate. We used ordinary least squares to regress household income and the difference between income and household expenses on diabetes status, age, sex, education and body mass index.

Results: Persons with T2DM, particularly those with complications, reported fewer years of general education (13.6 ± 4.2 years *vs.* 12.2 ± 4.4 years), a lower percentage of full time jobs (43.0% *vs.* 26.9%), lower salaries and monthly household income among those with full-time jobs (> 5000 ARG$: 52.6% *vs.* 24.5%), and a higher propensity to spend more money than they earned (expenditure/income ratio ≥ 1: 10.2% *vs.* 16.0%). The percentage of unmarried people was also higher among people with type 2 diabetes (7.0% *vs.* 10.9%).

Conclusion: T2DM and the development of its complications are each positively associated with lower SES and greater economic distress in Argentina.

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1. Introduction

Type 2 diabetes (T2DM) is a serious public health problem worldwide due to its progressively increasing prevalence and the frequent development of its chronic complications, which increase treatment costs and impose a heavy burden for the patient and society [1–4].

Although it has been clearly established that the development and progression of such chronic complications can be effectively prevented or delayed through tight glycemic and associated cardiovascular risk factor (CVRF) control [5–9], many people with diabetes worldwide have poor control and Latin America is no exception [10,11].

Sedentary behavior and obesity are important risk factors for these various scenarios [12], but there is also evidence that socioeconomic status (SES) increases the risk of diabetes through mechanisms such as multigenerational epigenetic programming triggered by famine [13], the stress of economic inequality [14], and inability to purchase healthy foods, get regular exercise, manage blood sugar and other risk factors, and access medicines and preventive medical care [15,16]. In a detailed meta-analysis of 23 selected references out of 5120 citations published in the period 1966–2010, Agardh et al. concluded that the risk of developing T2DM was significantly associated with low SES in high-, middle- and low-income countries and overall [17]. Supporting this concept, a study from the US showed that the increase in the prevalence of diabetes (both type 1 and type 2) between 1971 and 2002 was most prominent among individuals with low SES [18]. The higher incidence of diabetes in the group of low SES is also associated with a major risk of developing chronic complications [19–22]. However, in some countries such as China and India, higher SES predicts diabetes prevalence [23,24]. The situation in Argentina, and in many other Latin American countries, has not yet been described.

Latin America is a region expected to have a large increase of diabetes prevalence in the near future [1]. The aim of this study was to ascertain the relationships between variables describing SES and the diagnosis and complications of T2DM in Argentina. For that purpose, we performed a cross-sectional study examining SES of people with T2DM with and without complications, and compared the data with those recorded in people without diabetes paired by age and gender in Cordoba, a major city in Argentina.

2. Research design and methods

2.1. Ethical issue

The study protocol was analyzed and approved by a local independent and accredited Ethical Committee. The study was developed according to the Good Practice Recommendations (International Harmonisation Conference) and the ethical guidelines of the Helsinki Declaration. Likewise, this procedure ensured compliance with the National Personal Data Protection Law No. 25.326. This protocol was read to each participant and thereafter they were incorporated into the study, only after the provision of oral informed consent.

2.2. Study design

This is a descriptive and analytic research study carried out as a case–control study, comparing people with T2DM with or without chronic micro- and macrovascular complications (verified by clinical evaluation, laboratory and special tests) and people without the disease (non diabetic group, NDG) from similar social contexts matched by gender and age (±3 years).

We selected one institution of our Social Security System (SSS), the Hospital Privado de Córdoba (HPC). The HPC includes all medical specialties and provides health coverage to nearly 40000 people in the city of Córdoba through its health insurance plan; it also provides health care to people from other institutions that belong to the social security sector. The HPC has more than a million outpatient visits a year and approximately 900000 electronic medical records (EMR) in its database. These EMRs include personal information and diagnosis (age, gender, type of diabetes, disease duration), clinical, biochemical and therapeutic data, diagnostic procedures and treatment prescriptions. According to our National Risk Factors Survey [25], diabetes prevalence in the province of Córdoba is within the average country range and the HPC has comparable characteristics with other health care institutions located all over the country.

In the HPC records, we started identifying people with T2DM – American Diabetes Association criteria [26] – between 20 and 75 years of age on treatment for at least two years. In this population, we ranked: (i) people without chronic micro- and macrovascular complications (T2DM w/o C), and (ii) people with any chronic microvascular (retinopathy, neuropathy and nephropathy) and macrovascular (myocardium infarct, cerebrovascular accident and amputations) complications (T2DM w/C), being diagnosed using clinical, laboratory and specific tests (International Classification of Diseases [ICD-10] criteria). In a second step, we identified people without diabetes (NDG) to use as controls.

We estimated that a sample size of 275 persons in each T2DM group was necessary to assure an approximate 80% power, at an alpha and beta error of 0.05 and 20%, respectively. We increased this sample size by 25% assuming that there would be a 20% of non-responses. Accordingly, we decided to include 344 persons per T2DM group (matched one-to-one by age and gender), and 688 people without diabetes paired by age and gender to use as control.

To ensure the appropriate number of people needed for each group, we identified and randomly selected 1000 records of persons with T2DM from the HPC EMR database, 500 w/o C and 500 w/C. Using the same procedure, we thereafter selected from the database 1500 people without diabetes matched by age and gender (3:1 ratio). Age and disease duration were verified in patient records. Entire pairs were discarded if data were missing for one person in the pair of the T2DM groups or for more than two persons in the NDG.

2.3. Data collection

People from every group were telephonically invited to participate in the study (March to April 2011); a similar proportion of contacted subjects agreed to participate in each subgroup (mean, 83%). In order to understand this relatively

Table 1 – Population sample: demographic characteristics.

Variable	NDG $n = 774$	T2DM w/o C $n = 387$	T2DM w/C $n = 387$	P value
Age (years, mean ± SD)	62.4 ± 9.3	62.8 ± 9.5	63.2 ± 9.1	NS
Female (%)	54.8	54.8	54.8	NS
Diabetes duration (years, mean ± SD)		8.1 ± 8.4 (334)	10.8 ± 9.0* (362)	
Place of residence (%)				
Urban	81.5	81.4	81.2	
Suburban	17.8	17.8	17.6	
Rural	0.6	0.8	1.3	
Household members (mean ± SD)	2.7 ± 1.3 (763)	2.7 ± 1.2 (383)	2.7 ± 1.5 (381)	NS

* Significant compared to T2DM w/o C ($P < 0.05$). SD: standard deviation. Between brackets, number of cases considered.

high rate of acceptance, it has to be considered that the HPC regularly contacts telephonically its affiliates to ask their opinion about the care received and to remind them of their appointment dates.

To obtain the data, all the participants answered the same questionnaire and people with T2DM were additionally asked about diabetes specific treatment. The interview data were supplemented with data from the HPC database to assure a more precise description of resource utilization and costs of care.

For the telephone interviews, we used the questionnaire developed and used by the International Diabetes Federation (IDF) to determine the social and economic impact of diabetes [27]. For this purpose, we obtained IDF consent to use and adapt this questionnaire to our context, mainly the way to formulate the questions, as well as to have its scientific advice during the study implementation.

In the questionnaire we requested information about demographics characteristics, impact of diabetes on income, employment characteristics and education level attained, as well as about quality of life and use of medical resources. Household income and expenditure were self-reported. Education was recorded using eight levels (no formal education of any kind, incomplete primary education, complete primary education, incomplete secondary education, complete secondary education, trade school or apprenticeship, incomplete university education and complete university education) as well as years of education completed. Labor status was ranked in the following classes: full or part-time employment (self-employment, employment in the public or private sector) or non-employment (unemployment, housework, retired or pensioned).

2.4. *Data analysis*

Statistical analyses were done using the Statistical Package for Social Sciences version 15 (SPSS, Inc., Chicago, IL, USA). Descriptive statistics are presented as percentages and mean ± standard deviation (SD). Group comparisons for continuous variables were performed by ANOVA, the Student *t*-test, Mann–Whitney *U* test and Kruskall–Wallis test as well as univariate linear regression according to the data distribution profile. The Chi-squared statistic was used to test differences between proportions. Chi^2 test for linear trends was applied to evaluate the "dose/response" association between income below ARG$ 5000 and diabetes status (NDG, w/o C and w/C). Multiple regression analysis was used to identify joint predictors of household monthly income and of the difference between household income and reported monthly household expenditures. The two sided level of significance was established at $P \leq 0.05$.

3. Results

From the 2500 persons invited to participate in the study (1500 NDG, 500 T2DM w/o C and 500 T2DM w/C), 83% agreed to do so and answered the questionnaire. As previously mentioned (see Section 2.3), 527 persons were excluded for inconsistent and/or incomplete data, non-response, or refusal to participate. The clinical profile observed in their EMRs did not differ from that of patients included in the study. The final analysis sample included 774 controls and 774 persons with T2DM (387 w/o C and 387 w/C).

Fifty-five percent of persons included in the analysis were women. There was no statistical difference in average age, place of residence and number of household members in the three groups (Table 1). Most of the interviewed people lived in an urban area (81%), and only 1% in a rural one. Diabetes duration was relatively long and influenced by the need to have enough number of cases with chronic complications and relatively comparable figures in both groups. Not surprisingly diabetes duration was significantly longer in the group w/C than in the group w/o C ($P < 0.05$).

Within the group of T2DM w/C, the proportion of unmarried persons (single) was significantly higher than in the NDG and the T2DM w/o C ($P < 0.05$) (Table 2). People in the NDG had more years of formal education than those of the T2DM group w/o C or w/C ($P < 0.05$); 55% of people in the NDG had finished university studies, this proportion being significantly higher than in the T2DM groups (w/o C or w/C). These differences were larger in females than in males.

The proportion of people with full-time jobs was comparable in the NDG and in the T2DM w/o C group, but significantly higher than in the group of T2DM w/C ($P < 0.05$). However, the proportion of people with a monthly household income above AR$ 5000 in the NDG was significantly higher than in people with T2DM w/o C, and the latter was also significantly higher than in the group of T2DM w/C ($P < 0.05$ in both cases; Table 2). These differences were markedly larger among women. Consistently, in the univariate data, the risk of having a monthly income lower than ARG$ 5000 was positively

Table 2 – Population sample: socioeconomic status.

Variable	NDG $n = 774$	T2DM w/o C $n = 387$	T2DM w/C $n = 387$	P value
Marital status (%)				
Single	7.0	8.3	10.9‡	
Married	68.8	71.1	67.9	
Widow/er	12.3	13.0	14.0	
Divorced	11.9*,†	7.6	7.0	
Education				
Years of educations (mean ± SD)	13.6 ± 4.2*,† (764)	12.2 ± 4.4 (386)	12.2 ± 4.4 (384)	<0.05
Complete university education (%)	54.9*,†	44.6	43.0	<0.05
Men	58.2†	53.4†	44.8	
Women	52.2*,†	37.3	41.6	
Labor status				
Full or part-time work (%)	43.0	41.1	26.9*,‡	<0.05
Men	58.0†	65.1†	46.9	
Women	30.7*,†	21.2†	10.4	
Income (household monthly)				
≥AR$ 5000 (%)	52.6*,†	33.2†	24.5	<0.05
Men	63.3†	59.8†	41.3	
Women	43.6*,†	11.3	10.9	

* Significant compared to T2DM w/o C ($P < 0.05$).
† Significant compared to T2DM w/C ($P < 0.05$).
‡ Significant compared to control ($P < 0.05$).
SD: standard deviation. Between brackets, number of cases considered.

associated with having one or more chronic complications of diabetes (NDG, T2DM w/o C and w/C). Thus, the odds ratio of earnings less than ARG$ 5000/month increased by 124% in people with T2DM w/o C (OR: 2.24, 95% IC: 1.73–2.89) and 241% in those w/C (OR: 3.41, 95% IC: 2.60–4.47).

The analysis also showed that 27% of people with T2DM w/C had a permanent job and only 24% of them had a monthly household income above AR$ 5000, both proportions being lower than those recorded in either the NDG or the group of T2DM w/o C. Once again, the differences among groups were larger among women than among men. The monthly household income and expenditure of persons without diabetes was significantly higher than in the T2DM group (w/C or w/o C; Table 3). There was a trend toward higher incomes and expenditures among T2DM w/o C relative to T2DM w/C.

In the group of T2DM w/C, the household expenditure represented 88% of household income (expenditure/income ratio: 0.88), while in the control and in the T2DM w/o C groups that ratio was significantly lower ($P < 0.05$). Thus, T2DM w/C had a significantly lower saving capacity than the other two groups. Moreover, 16% of people with T2DM w/C had an expenditure/income ratio above 1, indicating that the person spent more than he/she had earnt. The expenditure/income ratio was significantly higher among T2DM w/C than among the other two groups ($P < 0.05$).

In the multiple regression analysis with household monthly income as the dependent variable, there was a significant negative correlation with female sex, increasing age and poorer health condition (NDG, T2DM w/o C and w/C; Table 4). Conversely, years of education showed a significant positive correlation with income; body mass index (BMI, tested but not shown) did not display any significant effect. Regarding the income–expenditure difference, while schooling showed a significant positive correlation, T2DM and its complications (as a dichotomic variable; T2DM w/C or w/o C = 1; absence of T2DM = 0) showed a significant negative one. Opposite to the model including household income as a dependent variable, in this last regression analysis (with income–expenditure difference as dependent variable) diabetes was included as a dichotomous factor. In this model, the

Table 3 – Population characteristics: socioeconomic status (2).

Variable	NDG Median [IQR] $n = 766$	T2DM w/o C Median [IQR] $n = 386$	T2DM w/C Median [IQR] $n = 383$	P value
Monthly household income (AR$)	5674*,† [3486–7111]	4000 [2906–6642]	3929 [2895–5000]	<0.05
Monthly household expenditure (AR$)	3978*,† [2995–4973]	3500 [2773–4000]	3363 [2381–4345]	<0.05
Expenditure/income ratio	0.72 [0.67–0.90]	0.81 [0.65–0.98]	0.88‡ [0.78–1.0]	<0.05
Expenditure/income ratio ≥ 1 (%)	10.2	10.1	16.0*,‡	<0.05

IQR: interquartile range.
* Significant compared to T2DM w/o C ($P < 0.05$).
† Significant compared to T2DM w/C ($P < 0.05$).
‡ Significant compared to control ($P < 0.05$).

Table 4 – Multiple linear regression analysis.

Explanatory variable	Dependent variable					
	Income[a]			Income minus expenditure[*,b,c]		
	B	SE	P value	B	SE	P value
Intercept	4583.37	1112.90	<0.001	2905,65	501.3	<0.001
Gender (male to women)	−1871.24	227.50	<0.001	372.76	66.49	<0.001
Age (years)	−24.75	11.91	0.038	−12.89	3.48	<0.001
Formal education (years)	229.91	26.04	<0.001	44.04	7.99	<0.001
Group (NDG, T2DM w/o C and w/C)	−384.64	151.84	0.012	–	–	–
Group (NDG or T2DM)[**]	–	–	–	−156,77	64,09	0.0145

B, unstandardized coefficients. SE, standard error.
[a] Adjusted $R^2 = 0.295$; $F = 38.853$; $P < 0.001$.
[b] Adjusted $R^2 = 0.7423$; $F = 883.4$; $P < 0.001$.
[c] Adjusted by income. Diabetes as a dichotomic variable: no/yes.
[*] Income–expenditure difference.
[**] T2DM includes both groups, w and w/o C; T2DM considered as 1 (yes) or 0 (no).

multivariate analysis failed to differentiate T2DM w and w/o C and gender and age did not show any significant relationship with the dependent variable.

4. Discussion

Our data provide the first Latin American estimates of differences in SES among persons with T2DM w/o C, w/C, and otherwise similar persons without diabetes.

The observed association between fewer years of formal education and T2DM – and particularly T2DM w/C – was previously reported by Fletcher et al. who described a negative effect of diabetes on years of schooling and various employment outcomes for people diagnosed fairly early in life [28]. However, the characteristics of our diabetes population (average age around 62 years and 8–10 years of disease duration), would suggest that it is more feasible that the education level affects diabetes complications development rather than *vice versa*, or that some third factor caused both.

The lower level of education together with the reduction in productivity at work associated with T2DM and its complications [29,30] could partially explain the lower percentage of full-time jobs and lower monthly household income recorded in the current and in other studies [31]. Additionally, an unfavorable ratio of household income–expenditures was also significantly associated with T2DM, thus contributing to exerting a negative effect upon their SES. Other authors' reports support this assumption [15,21,32,33].

Although its mechanism has not been completely clarified, the low SES may contribute to the development of T2DM through different and complex processes [15]. In this context, it is assumed that people with low SES have limited access to appropriate care. In fact, it has been claimed that uninsured adults with chronic diseases such as diabetes, are less likely to have seen a physician in the past 12 months, to have a source for regular care, and to use hospital emergency room for routine care [34]. This concept does not fully apply to our patient population since the SSS covers most of their care, thus a more complex mechanism must be involved. It has also been reported that adults with T2DM uninsured or utilizing Medicaid, do not have efficient diabetes self-managed education (DSME) needed to sustain successfully their active participation in the control and treatment of their disease [35]. Such DSME is considered the foundation of diabetes knowledge and skills necessary to perform self-management [36] and also to provide some type of psychological contention necessary to decrease the burden of diabetes [37,38]. In our case, probably a deficient DSME provision might play an important role in the underlying mechanism by which low SES favors the development of T2DM and its complications which in turn would increase the cost of care, s shown in the United Kingdom where treatment consumes around three quarters of direct health costs [39]. However, the association of low SES and poor quality of care is not so simple since it persists even when universal health coverage has been established in places such as Taiwan, and full coverage of ambulatory care, hospitalization, laboratory tests and prescribed medications are universally provided [40]. Consequently, other factors may play a more important role in the genesis of the association between low SES and diabetes with complications.

Our data show a significant association between diabetes and its complications and lower earnings, that was most marked in women. These data are consistent with the fact that even in people without diabetes, women's earnings are lower than men'. In fact, an analysis of the 20 most common occupations shows that women's median earnings are lower than men's within most occupations, and that women-dominated occupations tend to have lower median earnings than men-dominated occupations [41]. Further, a study performed in Spain showed that precariousness of work is significantly higher in women, and women are more likely than men to have temporary contracts [42].

It is widely documented that social network involvement is associated with both a reduced risk of mortality and better health outcomes [43]. In this context, marriage is one relationship that has been consistently found to have protective health effects and it has been demonstrated that married people have longer survival times and lower incidence of health problems compared to those unmarried [44]. In the case of a chronic disease such as T2DM, in which a complex medical regimen is involved, women (and men) may be grateful for their network members' efforts to help them

manage their condition, regardless of the type of strategy (pressure or persuasion) used [45]. Our data showing that the percentage of unmarried people was larger in the group of T2DM w/C is in keeping with such concept.

Based on the current data and those available in the literature, we can speculate that low income places vulnerable adults with T2DM at increased risk for disabling and costly complications, thus generating a heavy burden for society and the health care budget. It also poses a strong barrier for the social and economic development of people with the disease, particularly after the development of its chronic complications.

Being a descriptive and analytic rather than a prospective study, our results should not be considered definitive. Additionally, since the analysis is based entirely on self-reported measures we could expect some under-reported incomes from higher income groups. Finally, the extrapolation of results from Córdoba to Argentina should be interpreted with caution because this province has a higher economy than other cities of the country. Despite these considerations, we speculate that low SES and T2DM would establish a vicious circle, and that they tend to perpetuate and enhance their negative association. Appropriate long-term prospective studies are needed to provide definite support to our assumption. However, it seems clear that in order to overcome the problems faced by low SES, diabetes risk and poor quality of care requires not only the commitment of the health care system but also improving education and addressing labor areas.

In brief, our data support the concept that T2DM, particularly when associated with chronic complications, represents a serious challenge for SES development, being more marked in the case of women. Consequently, health planners and authorities should be aware of the long-term benefits of improving access to care and treatment as well as to DMSE [38,46] of people with T2DM to overcome their current situation and decrease the burden of T2DM.

Conflict of interest

The authors declare that they have no competing interests.

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J.F.E. and J.J.G. contributed to the research design, analyzed data, and wrote, reviewed, and edited the manuscript. J.E.C. contributed to the research design and analyzed data. S.A. participated in the analysis and interpretation of the data. J.B.B. contributed to discussion and reviewed and edited the manuscript. C.D.G. participated in the analysis and interpretation of the data, contributed to discussion and reviewed the manuscript.

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