# Factors associated with treatment of patients with diabetes *mellitus*

## Fatores associados à adesão ao tratamento de pacientes com diabetes *mellitus*

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## Abstract

**Objective:** Investigating the association between adherence to treatment of type 2 diabetes *mellitus* and socio-demographic, clinical and metabolic control variables.
**Methods:** Cross-sectional study with 423 patients with diabetes *mellitus*. The *Fisher*'s exact test and logistic regression models were used to investigate the association between adherence to treatment and the studied variables.
**Results:** There was no association between adherence to treatment of T2DM and socio-demographic and clinical variables. It was found that total cholesterol and HbA1c were significantly associated with adherence to diet (p = 0.036) and exercise (p = 0.006).
**Conclusion:** The chance of a patient with cholesterol within the recommended level adhering to diet is almost five times the chance of the patient in poor lipid control. The chance of patients with poor glycemic control adhering to exercise is almost twice the chance of those who keep adequate glycemic control.

## Resumo

**Objetivo:** Investigar associação entre adesão ao tratamento do diabetes *mellitus* tipo 2 e variáveis sociodemográficas, clínicas e controle metabólico.
**Métodos:** Desenho cross seccional com 423 portadores de diabetes *mellitus*. Para verificar a associação entre adesão ao tratamento e as variáveis estudadas, utilizou-se teste exato de *Fisher* e modelos de regressão logística.
**Resultados:** Não houve associação entre adesão ao tratamento do DM2 e variáveis sociodemográficas e clínicas. Verificou-se que o colesterol total e a HbA1c apresentaram associação estatisticamente significativa com a adesão ao plano alimentar (p = 0.036) e de exercício físico (p = 0.006).
**Conclusão:** A chance do paciente com colesterol dentro do valor recomendado apresentar adesão ao plano alimentar é quase cinco vezes a chance do paciente em mau controle lipídico. A chance dos pacientes com mau controle glicêmico apresentarem adesão ao exercício físico é quase duas vezes a chance daquele sem controle adequado da glicemia.

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# Introduction

Diabetes *mellitus* is a challenge for patients, their families and health professionals when it comes to achieving good glycemic and metabolic control in order to minimize complications in the short and long term. Behavioral changes and medication adherence are essential for preventing acute and chronic complications. Professionals must negotiate priorities, monitor adherence, encourage participation and enhance patients efforts in managing self-care.[1] Even when there are behavioral changes and medication adherence, maintaining metabolic control for a long time is difficult because it depends on a variety of complex components that involve the treatment of diabetes.[2,3]

Non-adherence to treatment of diabetes *mellitus* is an issue known both in the national and international scene as it affects the physiological response to disease, doctor-patient relationship and increases direct and indirect costs of treatment.[4-8]

Most studies focus on factors associated with medication adherence.[9,10] On the other hand, there is a need for studies that concurrently investigate dietary parameters, physical exercise and medical treatment and their relation with metabolic control. This study aimed to investigate the association between adherence to treatment of type 2 diabetes *mellitus* and variables of metabolic control, clinic and socio-demographic.

# Methods

A cross-sectional study conducted in the southeastern region of Brazil. The population consisted of 1,406 individuals with type 2 diabetes *mellitus* of 17 institutions of primary care that comprise the local health care network.

Inclusion criteria were: age greater than or equal to 18 years, use of oral antidiabetic therapy, cognitive and hearing capacities preserved and being regularly monitored in the institutions selected for the study. Women diagnosed with gestational diabetes were excluded from the study. The stratified random sample was calculated using the formula for transverse studies of infinite population, based on a prevalence of conservative adherence of 50%, which allowed the largest amount possible. In addition, a 20% rate was increased considering losses, in which were included refusals, hospitalizations, dropouts, wrong and/or unavailable information.

The sample consisted of 423 diabetic patients who met the inclusion criteria. Among those, 357 joined the treatment for T2DM and 66 did not join.

Four instruments were used for data collection: a questionnaire containing socio-demographic variables (gender, age, education and family income), clinical variables (time since diagnosis, comorbidities, chronic complications) and metabolic control variables (Body Mass Index - BMI, waist circumference, blood pressure and laboratory tests), as well as Measurements of Treatment Adherence - MTA, an instrument that assesses patients behavior in relation to everyday use of prescription drugs.[11-13] A food consumption frequency questionnaire was used, as well as an International Physical Activity Questionnaire (short version) validated for the Brazilian context.[14,15]

Data collection was conducted between February and December of 2010 by field researchers previously trained. The first step consisted in applying structured interviews in the homes of patients. The second stage was conducted in 17 primary care institutions and the following data were collected: blood pressure; body weight; height; waist circumference and laboratory tests.

For data analysis descriptive statistics were used in order to determine the prevalence of adherence to treatment and characterization of the sample regarding socio-demographic, clinical and therapeutic variables.

As for the MTA, responses were obtained from a six-point ordinal scale. For scores analysis, the adherent patients were the ones who obtained value greater than or equal to five points and non-adherent, the ones with value less than five.

For the analysis of values obtained in the food consumption frequency questionnaire, patients con-

sidered adherent were the ones who attended at least three of the six nutritional recommendations advocated by the Brazilian Diabetes Society, in other words, consumption of total carbohydrates, dietary fiber and fractionation of meals.[16]

For the analysis of the International Physical Activity Questionnaire values, were considered adherent those classified in the moderately active and very active categories, and non-adherent, those included in the sedentary and insufficiently active categories.

For analysis of body mass index, waist circumference and laboratory tests values, the recommendations of the World Health Organization and the Brazilian Society of Diabetes were adopted. For the analysis of blood pressure values, the Brazilian Guidelines on Hypertension were adopted.[17,18]

To investigate the association between adherence to treatment and socio-demographic, clinical and metabolic control variables, the data were analyzed with the *Fisher*'s exact test. The quantification of this association was measured by logistic regression models. The crude *Odds ratio* (OR) was calculated with its respective confidence interval of 95% for each variable in relation to adherence. Statistical analyzes were performed with the SAS® 9.0 statistical *software*. Values of $p < 0.05$ were considered significant.

The study followed national and international standards of ethics in research involving human beings.

# Results

In the universe of 423 patients (100%), the mean age was 62.4 years (SD = 11.8) and predominantly female (66.7%). In relation to education, the average time of study was 4.3 years (SD = 3.6) and the average household income was USD 886.95 (SD = 2744.4).

In relation to clinical variables, most patients (58.4%) had less than 10 years since the time of diagnosis, with an average of nine years (SD = 6.6). The major comorbidities identified were hypertension (81.3%) and dyslipidemia (32.4%) and the chronic complications were retinopathy (37.8%) and heart disease (20.3%). As for metabolic control variables, most were overweight (78.9%) with increased values of waist circumference (76.1%) and blood pressure (73.7%). With the exception of total cholesterol (51.1%), all other laboratory parameters were altered; HbA1c (75.2%), triglycerides (60.3%), HDL-C (65.6%) and LDL-C (68.7%).

Among the 423 subjects investigated, 357 showed adherence to treatments for T2DM.

In the results obtained, 357 patients (84.4%) showed adherence to medication therapy, 58.6% to physical exercise and 3.1% to diet. Only six patients (1.4%) showed adherence to the three components that make up the treatment. On the other hand, 49.4% of the patients showed adherence to two components, and in 47.7% of patients it was observed adherence to medication and exercise. Adherence to a single component of treatment was observed in 43% of patients and adherence to none in 6.2%.

There was no association between adherence to treatment and the variables gender, age, education, family income and time since diagnosis (Table 1).

Also there was no association between adherence to drug treatment, diet and physical exercise and the clinical and metabolic control variables, except for total cholesterol and HbA1c, which were significantly associated with adherence to diet (p=0.036) and to physical exercise (p=0.006) respectively (Table 2).

The glycated hemoglobin and total cholesterol variables were significantly associated with adherence to physical exercise and diet plan, respectively. Thus, the quantification of these variables through logistic regression showed that the chance of patients with poor glycemic control adhering to physical exercise is almost twice the chance of those in adequate glycemic control. The chance of a patient with cholesterol within the recommended adhering to a diet plan is almost five times the chance of the patient in poor lipid control (Table 3).

**Table 1.** Socio-demographic variables and adherence to medication therapy, diet and physical exercise

| Variables | Adherence to medication | | Adherence to diet | | Adherence to physical exercise | |
|---|---|---|---|---|---|---|
| | n(%) | p-value* | n(%) | p-value* | n(%) | p-value* |
| Gender | | | | | | |
| Female | 236(66.1) | 0.670 | 9(2.5) | 1.000 | 172(48.1) | 0.174 |
| Male | 121(33.9) | | 4(1.1) | | 76(21.2) | |
| Age | | | | | | |
| < 60 years | 130(36.4) | 0.073 | 7(1.9) | 0.258 | 96(26.8) | 0.839 |
| ≥ 60 years | 227(63.6) | | 6(1.6) | | 152(42.5) | |
| Education | | | | | | |
| < 4 years | 150(42.0) | 0.734 | 2(0.5) | 0.061 | 107(29.9) | 0.721 |
| 4 to 8 years | 170(47.6) | | 8(2.2) | | 116(32.4) | |
| > 8 years | 37(10.4) | | 3(0.8) | | 25(7.0) | |
| Family income | | | | | | |
| < 832 usd | 229(64.1) | 1.000 | 10(2.8) | 0.359 | 192(53.9) | 0.657 |
| ≥ 832 usd | 100(28.0) | | 2(0.5) | | 68(19.0) | |
| Time of diagnosis | | | | | | |
| < 10 years | 204(57.1) | 0.276 | 6(1.6) | 0.401 | 143(40.0) | 0.764 |
| ≥ 10 years | 153(42.9) | | 7(1.9) | | 105(29.4) | |

Legend: *p-value refers to *Fisher*'s exact test

**Table 2.** Control variables and adherence to medication therapy, diet and physical exercise

| Variables | Adherence to medication | | Adherence to diet | | Adherence to physical exercise | |
|---|---|---|---|---|---|---|
| | n(%) | p-value* | n(%) | p-value* | n(%) | p-value* |
| BMI | | | | | | |
| Normal | 68(19.0) | 1.000 | 4(1.1) | 0.254 | 48(13.4) | 0.898 |
| Altered | 255(71.4) | | 7(1.9) | | 184(51.5) | |
| WC | | | | | | |
| Normal | 78(21.8) | 0.871 | 4(1.1) | 0.301 | 56(15.6) | 1.000 |
| Altered | 251(70.3) | | 7(1.9) | | 177(49.5) | |
| Blood pressure** | | | | | | |
| Normal | 87(24.3) | 0.875 | 4(1.1) | 0.523 | 63(17.6) | 0.728 |
| Altered | 246(68.9) | | 8(2.2) | | 170(47.6) | |
| Dyslipidemia*** | | | | | | |
| No | 46(12.8) | 0.538 | 2(0.5) | 0.663 | 33(9.2) | 0.546 |
| Yes | 287(80.3) | | 10(2.8) | | 200(56.0) | |
| HbA1c | | | | | | |
| ≤ 6.5% | 84(23.5) | 0.749 | 1(0.2) | 0.308 | 46(12.9) | 0.006 |
| > 6.5% | 249(69.7) | | 11(3.0) | | 187(52.4) | |
| Total cholesterol | | | | | | |
| < 200mg/dl | 176(49.2) | 0.128 | 10(2.8) | 0.036 | 127(35.5) | 0.125 |
| ≥ 200mg/dl | 157(43.9) | | 2(0.5) | | 106(29.6) | |
| Triglycerides | | | | | | |
| < 150mg/dl | 134(37.5) | 0.886 | 5(1.4) | 1.000 | 95(26.6) | 0.753 |
| ≥ 150mg/dl | 201(56.3) | | 8(2.2) | | 139(38.9) | |
| HDL-C | | | | | | |
| > 45mg/dl | 110(30.8) | 0.139 | 4(1.1) | 1.000 | 86(24.0) | 0.281 |
| ≤ 45mg/dl | 225(63.0) | | 9(2.5) | | 148(41.4) | |
| LDL-C | | | | | | |
| < 100mg/dl | 100(28.0) | 0.531 | 2(0.5) | 0.360 | 67(18.7) | 0.819 |
| ≥ 100mg/dl | 212(59.3) | | 11(3.0) | | 151(42.2) | |

Legend: *p-value refers to *Fisher*'s exact test; **Blood pressure: patients with systolic blood pressure value ≥ 130 mmHg or diastolic blood pressure value ≥ 85 mmHg were included; ***Dyslipidemia: patients with changed value in at least one of the studied lipid parameters (total cholesterol, triglycerides and/or LDL-C) were included

**Table 3.** Logistic regression of the glycated hemoglobin and adherence to exercise; and of the total cholesterol and adherence to diet

| HbA1c | Adherence to physical exercise | | | |
|---|---|---|---|---|
| | n(%) | OR | CI (95%) | p-value |
| <6.5 | 46 (12.9) | 1.00 | Reference | 0.005 |
| ≥6.5 | 187 (52.4) | 1.92 | (1.21; 3.05) | |
| Cholesterol | Adherence to diet | | | |
| | n(%) | OR | CI (95%) | p-value |
| <200mg/dl | 10 (2.80) | 1.00 | Reference | 0.04 |
| ≥200mg/dl | 2 (0.56) | 4.97 | (1.08; 23.00) | |

Legend: HbA1c: Glycated hemoglobin; OR: crude *odds ratio*; CI (95%): confidence interval of 95%

# Discussion

The limits of the results of this study refer to the survey method (cross-sectional), which does not allow the establishment of cause and effect relations, but on the other hand, it showed significant associations for the object of study.

There was no statistically significant association between socio-demographic variables and adherence to medication and non-medication treatment for type 2 diabetes *mellitus*. This finding corroborates the results of other studies, which indicate that socio-demographic variables are weak predictors of treatment adherence[19-21] and also take into consideration that approximately 85% of Brazilian patients who use diabetic oral medication have lack of social support to help them cope with diabetes *mellitus* treatment.[20]

Regarding the time of diagnosis, the results showed that patients with more than 10 years of diagnosis presented higher adherence to medication treatment, diet and physical exercise. These findings were similar to other studies findings.[22,23] In contrast, the World Health Organization shows that diabetic patients with longer time of diagnosis tend to have lower rates of adherence to treatment.

In fact, the longer the time of T2DM diagnosis, the more knowledge about the disease is expected, as well as a better understanding and management of therapeutic regimen and, consequently, greater adherence to prescribed treatment. However, health professionals should also

consider that with the aging process, a decline in cognitive and motor abilities can occur, increasing the degree of dependency to perform self-care actions like taking medication, following a diet and a routine of physical exercise.[24] Noting the increasing prevalence of type 2 diabetes *mellitus* in children and adolescents around the world, it is important that health services articulate innovative strategies to engage young people in actions for treatment adherence.[25]

Findings related to total cholesterol and HbA1c, which were significantly associated with adherence to diet and physical exercise, respectively, are in disagreement with another study results.[26]

The roles of physical exercise practice and following the diet plan in T2DM control are unquestionable, as well as in the prevention of microvascular and macrovascular complications. In Brazil, 10% of patients seen in primary care institutions reported that following the diet plan can improve disease control.[27]

In relation to following a diet plan, as eating habits are usually established within the family and during childhood, the adherence of patients to this component is still a challenge.[1] Health professionals should systematize their intervention for the empowerment of patients, considering the psychological, socio-cultural, educational and economic aspects involved in treating diabetes.

Despite evidences of the importance of a regular physical exercise practice and the adoption of a balanced eating plan, this goal is difficult to be achieved in cases of elderly patients and in those with comorbidities such as angina and arthritis. In these cases, the most appropriate behavior may be to strengthen adherence to medication therapy.[16]

The monitoring of patients by diabetes specialists with clear guidelines and achievable goals is critical in reducing blood glucose, HbAc1 and smoking, in comparison to those accompanied by health professionals with no specialized training.[28]

The creation of support groups composed of qualified professionals, people with type 2 diabetes *mellitus* (compliant and non-compliant) and their families can be an alternative to share successful experiences and also the barriers faced by patients and

## Conclusion

The results obtained allow the conclusion that there was no association between adherence to treatment of type 2 diabetes *mellitus* and socio-demographic and clinical variables. Regarding metabolic control variables, it was found that total cholesterol and HbA1c showed statistically significant association with adherence to a diet plan and physical exercise, respectively.

The chance of a patient with cholesterol within the recommended level adhering to a diet is almost five times the chance of the patient in poor lipid control. The chance of patients with poor glycemic control adhering to exercise is almost twice the chance of those who keep adequate glycemic control.

### Acknowledgments

### Collaborations

Faria HTG; Rodrigues FFL; Araújo MFM; Damasceno MMC and Zanetti ML declare that contributed to the conception and design, analysis and interpretation of data, drafting the article, revising it critically for important intellectual content and final approval of the version to be published.

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