Research Article
Artigo de Pesquisa
Artículo de Investigación

DOI: http://dx.doi.org/10.12957/reuerj.2020.49109

Association between diabetes mellitus and eye diseases in people with visual impairment

Associação entre diabetes mellitus e doenças oculares em pessoas com deficiência visual

Asociación entre diabetes mellitus y enfermedades oculares en personas con discapacidad visual

Evandro Scarso de Brito[I]; Maria Helena Pinto[II]; Denise Beretta[II]; Lilian Cristina de Castro Rossi[III]; Thiare Júnia de Francisco Brito[IV]; Rildo César Nunes Czorny[III]

[I]Secretaria Municipal de Saúde de São José do Rio Preto, São José do Rio Preto São José do Rio Preto, SP, Brazil; [II]Faculdade de Medicina de São José do Rio Preto, São José do Rio Preto, SP, Brazil; [III]União das Faculdade dos Grandes Lagos, São José do Rio Preto, SP, Brazil; [IV]Associação dos Pais e Amigos dos Excepcionais de São José do Rio Preto, São José do Rio Preto, SP, Brazil

ABSTRACT

Objective: to verify the association between diabetes mellitus and eye diseases in people with visual impairment. **Method**: this cross-sectional study involved 51 people with diabetes and visual impairment at a Visual Rehabilitation Center in São Paulo, who participated in a structured interview in 2018. The tests used were: Kolmogorov Smirnov, Poisson Regression, Binary Logistic Regression, and Spearman Correlation. **Results**: most participants were blind, reported that diabetic retinopathy, glaucoma and cataracts were the causes of their visual impairment, and had been diagnosed with diabetes over 109 months earlier. Cataract returned a low level of correlation with time with diagnosis of diabetes (r = 0.280 and p = 0.047), and diabetic retinopathy, moderate correlation (r = 0.565 and p = 0.000). **Conclusion**: a statistically significant association was found between type of diabetes and retinopathy, and statistically significant correlations between the time diagnosed with diabetes, cataracts and diabetic retinopathy.

Descriptors: Diabetes Mellitus; Cataract, Diabetic Retinopathy, Glaucoma.

RESUMO

Objetivo: verificar associação entre diabetes mellitus e doenças oculares em pessoas com deficiência visual. **Método:** estudo transversal com 51 pessoas com diabetes e deficiência visual, em um centro de reabilitação visual do interior paulista, que participaram de entrevista estruturada, em 2018. Utilizou-se os testes: Kolmogorov Smirnov, Regressão de Poisson, Regressão de Logística Binária, e Correlação de Spearman. **Resultados:** a maioria das pessoas era cega e relatou que a retinopatia diabética, o glaucoma e a catarata foram causa da deficiência visual; com tempo de diagnóstico do diabetes acima de 109 meses. A catarata apresentou um nível de correlação baixa (r=0,280 e p=0,047), e a retinopatia diabética um nível de correlação moderada (r=0,565 e p=0,000), considerando o tempo de diagnóstico do diabetes. **Conclusão:** associação estatisticamente significante entre o tipo de diabetes e a retinopatia, e correlação estatisticamente significante entre o tempo de diagnóstico do diabetes, a catarata e a retinopatia diabética.

Descritores: Diabetes Mellitus; Catarata, Retinopatia Diabética, Glaucoma.

RESUMEN

Objetivo: verificar la asociación entre diabetes mellitus y enfermedades oculares en personas con discapacidad visual. **Método:** este estudio transversal involucró a 51 personas con diabetes y discapacidad visual en un Centro de Rehabilitación Visual en São Paulo, quienes participaron en una entrevista estructurada en 2018.Las pruebas utilizadas fueron: Kolmogorov Smirnov, Regresión de Poisson, Regresión Logística Binaria y Spearman Correlación. **Resultados:** la mayoría de los participantes eran ciegos, informaron que la retinopatía diabética, el glaucoma y las cataratas eran las causas de su discapacidad visual y habían sido diagnosticados con diabetes más de 109 meses antes. La catarata devolvió un bajo nivel de correlación con el tiempo con el diagnóstico de diabetes (r = 0,280 yp = 0,047) y la retinopatía diabética, correlación moderada (r = 0,565 yp = 0,000). **Conclusión:** se encontró asociación estadísticamente significativa entre tipo de diabetes y retinopatía, y correlaciones estadísticamente significativas entre el tiempo de diagnóstico de diabetes, cataratas y retinopatía diabética.

Descriptores: Diabetes Mellitus; Catarata, Retinopatía Diabética, Glaucoma.

INTRODUCTION

Visual Impairment (VI) is defined by partial or total sight loss, being classified as low vision subnormal vision and blindness; and its causes can be congenital or acquired[1].

The main causes of VI in adults and older adults are associated to population aging. In Brazil, as the population presents one of the highest rates of increase in life expectancy among the most populous countries in the world, we also expect an increase in the prevalence of such causes, mainly diabetes mellitus (DM)[2].

Glaucoma and cataracts are frequent and early pathologies in people with diabetes[3]. Diabetic retinopathy (DR) is the main and most prevalent microvascular complication[4], which affects more than one third of the people with diabetes, being considered the main cause of sight loss in adults of working age[5].

Paper extracted from the master's thesis "Diabetes Mellitus as a risk factor for eye diseases in patients with visual impairment" (Nursing *Stricto Sensu* Graduate Program – Faculdade de Medicina de São José do Rio Preto, Brazil, 2019).

Corresponding author: Evandro Scarso de Brito. E-mail: evandroscarsobrito@gmail.com

Responsible Editor: Flavia Giron Camerini

Received: Mar 10th 2020 – Accepted: Dec 7th 2020

DOI: http://dx.doi.org/10.12957/reuerj.2020.49109

Considering the high prevalence, severity and relevance of DM and VI in Brazil and worldwide, as well as the scarcity of articles in the related literature about this association[6], this study aimed to verify the association between DM and eye diseases in people with visual impairment attending a Vision Rehabilitation Center.

LITERATURE REVIEW

DM is considered a growing and important public health problem worldwide, regardless of the development level of the countries[7]. It is characterized by an increased concentration of glucose in the blood and can be a consequence of insufficient insulin secretion, resistance to the action of insulin, or both[8].

It is estimated that, by 2045, the number of people with VI aged 20 years old or over will rise from 448.3 million to 691.6 million. In Brazil, in 2017 VI affected 12.5 million people aged between 20 and 79 years old, with a projection of 21.8 million by 2045. Approximately four million people aged between 20 and 79 years old will die due to VI in 2017 in the world, which equals to one death every eight seconds[5].

People with diabetes are 30 times more likely to become blind than individuals who do not have the disease[2], and if DM is not treated or poorly controlled, they can develop more complications[7].

According to the Guidelines of the Brazilian Diabetes Society (*Sociedade Brasileira de Diabetes*, SBD), in the world there are 93 million people with diabetes who have some degree of DR, while in Brazil approximately four million people have the disease[7].

Glaucoma is considered the second leading cause of blindness in the world, with an estimated incidence of 1% to 2% of the general population, this percentage increasing after 40 years of age[2]. Worldwide, it is estimated that 95 million people are affected by cataracts[9]. In Brazil, in 2015, 350,000 people were blinded by cataracts, with a 20% increase in new cases each year[2].

The last Demographic Census conducted in Brazil in 2010 showed that more than 45 million Brazilians (23.9% of the total population) have at least one disability, with VI being the most prevalent (18.6% of the Brazilian population)[10]. Globally, it is estimated that more than 407 million people have some type of VI, with 188 million presenting mild visual impairment, more than 216 million having moderate to severe VI, and 36 million individuals being blind[3].

METHOD

Cross-sectional, qualitative and descriptive study developed in a vision rehabilitation center of the inland of São Paulo. The institution serves individuals in all stages of the life cycle who have VI (low vision and blindness), referenced by establishments linked to the Unified Health System (*Sistema Único de Saúde*, SUS); it has 241 enrolled patients, 113 are adults or older adults and, of these, 62 are diabetics.

The study population consisted of all the people with diabetes and visual impairment, adults or older adults, registered in the institution. The inclusion criteria were the following: being 18 years old or older and attending the institution. In this way, eleven individuals were excluded: six for not being attending the institution any longer and five for not having accepted to participate in the interview; thus, the sample consisted of 51 individuals.

Data collection was carried out between June and August 2018 by the researcher, who scheduled meeting with the people who accepted the invitation to participate in the research. Each participant, after being presented the objective and outlining the research, signed the Free and Informed Consent Form, which was read through a portable and independent device, which enlarges and reads aloud printed materials for people with VI.

Subsequently, a structured interview was carried out individually and privately, with a mean duration of 40 minutes, followed by a data collection instrument prepared by the researcher contemplating the following variables: gender, age, type of VI, cause of VI, presence of eye diseases (glaucoma, cataracts and DR), time with VI, type of DM, and time of DM diagnosis.

The SPSS Statistics Software, version 23, linked to the features of the Excel® tool, version 2016, was used for data analysis. Initially, a descriptive analysis of the variables was performed, with the quantitative variables being described with mean values and standard deviation and the qualitative variables with simple and percentage frequencies. Normality was tested by means of the Kolmogorov-Smirnov test. Poisson regression was used to analyze the dependence of the dichotomous variables when crossed with dichotomous (2x2) or continuous variables, Binary Logistic regression for multivariate crossing, and Spearman's correlation, were used to verify the correlation between the “time of DM diagnosis” and “eye diseases” variables. The test contemplated a 5% alpha error and 95% reliability; thus, the associations were considered statistically significant when $p<0.05$.

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This study was submitted to and approved by the institution's Research Ethics Committee (*Comitê de Ética e Pesquisa*, CEP), under opinion No. 2,595,328, meeting the legal requirements involving human beings, according to Resolution 466/12 of the National Council on Research Ethics.

RESULTS AND DISCUSSION

A total of 51 individuals with diabetes and visual impairment were interviewed, with predominance of the male gender (58%), aged 60 years old or older (43.1%), mean age of 54 years old, and standard deviation of 16.3 years old. The results of this study were similar to the study conducted in the Federal District with people with diabetes, which also verified predominance of the male gender, aged between 60 and 70 years old, and who presented some visual impairment[11].

However, international studies portray a different reality. In a research study conducted in Hungary, people with diabetes aged 50 years old or older were mostly female, 13.80% had some type of VI, and 0.90% were blind[12]. In the country of Ghana, in a hospital environment, it was identified that, among the people with diabetes who attended the institution, the female gender predominated, 18.40% had some type of VI and 5.80% were blind[13]. In Mexico, a study conducted with people with diabetes, also over 50 years old, showed that the majority were female, that 14.90% had some type of VI, and that 1.50% were blind[14].

In addition, in this study it was observed that most people (72.55%) were blind and that cataracts prevailed both in the blind individuals (59.46%) and in those with low vision (57.14%); glaucoma prevailed in blind people (51.35%); and DR did not prevail in more than half of the blind individuals and those with low vision. Eye diseases (DR, glaucoma and cataracts) were the cause of VI reported by most people (62.75%), with a statistically significant association between the cause and the types of VI (p=0.000) (Table 1). These data are in line with the study carried out in the state of Bahia[15], in which 53.90% of the older adults with diabetes had some visual complication; and with a research study conducted in South India, which followed-up people with diabetes for four years, and identified the incidence of VI (21.70%) as being mild (18.30%) and moderate (3.40%)[16].

TABLE 1: Distribution of eye diseases and the cause of VI, according to the types of VI, mentioned by the people with diabetes São José do Rio Preto, SP, Brazil, 2018.

Variables	Low Vision		Blind		Total		p
	n	%	n	%	n	%	
Cataracts							
No	6	42.86	15	40.54	21	41.18	0.923**
Yes	8	57.14	22	59.46	30	58.82	
Glaucoma							
No	9	64.29	18	48.65	27	52.94	0.266**
Yes	5	35.71	19	51.35	24	47.06	
Diabetic Retinopathy							
No	8	57.14	19	51.35	27	52.94	0.549**
Yes	6	42.86	18	48.65	24	47.06	
Cause of the Visual Impairment							
Eye Diseases*	8	57.14	24	64.86	32	62.75	
Others	6	42.86	13	35.14	19	37.25	0.000**
TOTAL	**14**	**27.45**	**37**	**72.55**	**51**	**100.00**	

*Eye Diseases: RD, Glaucoma and Cataracts
**Poisson Regression test applied at p<0.05

In the present study, glaucoma did not predominate in any type of DM, with 52.17% of people with type 1 diabetes and 53.57% with type 2 not having the disease; nor did it prevail in most of the studied sample (52.94%). Cataracts prevailed in most of the individuals (58.82%), as also in both type of DM (65.11% in type 1 and 53.57% in type 2). DR prevailed in most people with type 1 diabetes (78.26%), with a statistically significant association (Poisson regression test at p<0.05) between the type of DM and the presence of DR (p=0.008).

In addition, a study conducted in Venezuela with people diagnoses with cataracts identified VI as the most prevalent associated disease[17]. The relationship between cataracts and VI was also reported by most of the participants of a study conducted in the state of Paraíba. Type 2 DM causes changes in ocular physiology and lens opacification, making cataracts the main cause of acquired blindness in Brazil[18].

A study carried out in Nepal, whose objective was to verify the association between DM and glaucoma, identified in its sample that 27.40% of the people with type 2 diabetes had the disease[19]. In a retrospective cohort study, with a

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10-year follow-up period and conducted in South Korea, it was shown that the development of glaucoma was significantly higher in people with DM, compared to those who did not have the disease, regardless of age and gender[20]. In the present study, glaucoma prevailed in blind individuals and did not predominate in any type of DM, as well as it did not prevail in most of the studied sample.

Although DR did not prevail in more than half of the blind individuals and in those with low vision, the majority of people with type 1 diabetes had the disease, with a statistically significant association, as in the study carried out in Portugal, which verified that people with type 1 DM had higher prevalence values of DR than those with type 2, with statistically significant differences[21].

People with type 1 DM and longer DM time have an increased risk for DR[22] and, consequently, for blindness[2], corroborating the findings of this study, since the time with VI and the types of DM had a statistically significant association. Most people with type 1 and type 2 diabetes were diagnosed with DM more than 109 months ago; however, of these, only individuals with type 1 diabetes reported that they became visually impaired less than 108 months ago, thus inferring that in these people, DM was one of the determinants for the development of eye diseases and, consequently, for VI.

It is noteworthy that 91.3% of the people with type 1 diabetes and 53.58% of the individuals with type 2 diabetes reported that they were diagnosed with DM more than 109 months ago. However, when analyzing the time with VI, most people with type 1 diabetes (69.56%) reported that they became visually impaired less than 108 months ago; in people with type 2 diabetes, time with VI above 109 months predominated (60.71%). A statistically significant association (p=0.022) is also observed between the time with VI and the typed of DM (Table 2).

Table 2: Distribution of the time of DM diagnosis and time with VI, according to the type of DM. São José do Rio Preto, SP, Brazil, 2018.

Variables	Type 1 DM		Type 2 DM		Total		p
	n	%	n	%	n	%	
Time of DM diagnosis							
Up to 36 months	1	4.35	6	21.43	7	13.73	0.057*
37 to 72 months	1	4.35	3	10.71	4	7.84	
73 to 108 months	-	0.00	4	14.29	4	7.84	
109 to 144 months	4	17.39	4	14.29	8	15.69	
> 144 months	17	73.91	11	39.29	28	54.90	
Time with VI							
Up to 36 months	9	39.13	5	17.86	14	27.45	0.022*
37 to 72 months	3	13.04	5	17.86	8	15.69	
73 to 108 months	4	17.39	1	3.57	5	9.80	
109 to 144 months	2	8.70	3	10.71	5	9.80	
> 144 months	5	21.74	14	50.00	19	37.25	
TOTAL	**23**	**45.10**	**28**	**54.90**	**51**	**100.00**	

*Binary Logistic Regression test applied at p<0.05

The time of DM diagnosis influences people's quality of life, since prolonged time with DM increases the risk of complications[23]. A research study carried out in the state of Bahia showed that the longer the time of DM diagnosis, the lower the perception of people's quality of life[24]. A cross-sectional epidemiological study with 13,473 adult individuals with diabetes conducted in China identified that the prevalence of DR is closely related to the time with DM and to the age at the onset of DM (p<0.001)[25]. In Goiás, a research study identified that 51.4% of the people were diagnosed with DM more than ten years ago[26]. The results of this study also show this reality since, after 109 months of DM diagnosis, the longer the time of diagnosis, the greater the prevalence of all eye diseases (Table 3).

After 15 years of DM, approximately 2% of the people with diabetes become blind and 10% develop severe sight loss; and after 20 years with the disease, more than 75% of the people have some form of DR[2]. In the present study, it was observed that the longer the time of DM diagnosis, the greater the prevalence of cataracts and DR, and these correlated in a statistically significant way. This data is in line with the study carried out in Portugal, which identified a significantly longer DM evolution time in individuals with DR[21].

When analyzing the correlation between the time of DM diagnosis and the presence of eye diseases, through Spearman's Correlation, a statistically significant correlation was identified with cataracts and DR, with cataracts having a low correlation level (r=0.280 and p=0.047), and DR a moderate correlation level (r=0.565 and p=0.000). Glaucoma did not present correlation (r=-0.074 and p=0.608).

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TABLE 3: Distribution of the eye diseases, according to the time of DM diagnosis. São José do Rio Preto, SP, Brazil, 2018.

Variables	Time of DM diagnosis – n (%)					
	Up to 36 months	37 to 72 months	73 to 108 months	109 to 144 months	> 144 months	Total
Glaucoma						
No	4 (57.14)	3 (75.00)	2 (50.00)	3 (37.50)	15 (53.57)	27 (52.94)
Yes	3 (42.86)	1 (25.00)	2 (50.00)	5 (62.50)	13 (46.43)	24 (47.06)
Cataracts						
No	3 (42.86)	3 (75.00)	4 (100.00)	2 (25.00)	9 (32.14)	21 (41.18)
Yes	4 (57.14)	1 (25.00)	0 (0.00)	6 (75.00)	19 (67.86)	30 (58.82)
RD						
No	7 (100.00)	3 (75.00)	4 (100.00)	4 (50.00)	9 (32.14)	27 (52.94)
Yes	0 (0.00)	1 (25.00)	0 (0.00)	4 (50.00)	19 (67.86)	24 (47.06)
TOTAL	**7 (13.73)**	**4 (7.84)**	**4 (7.84)**	**8 (15.69)**	**28 (54.90)**	**51 (100.00)**

A number of authors reported that, in individuals aged between 16 and 64 in the year 2009-2010, DR was no longer the leading cause of blindness in the United Kingdom and Wales, corresponding to 14.40% of blindness records compared to 17.70% in the year 1999-2000[27]. The reasons behind this change include the introduction of national DR screening programs in the UK and Wales and improvements in glycemic control, as well as education for people with diabetes about how to manage their condition, and how to slow the progression and possibly avoid vision-related complications[28].

Study limitations

The study limitations are related to the data collection locus, not being possible or feasible to access the data from medical charts to confirm the diverse information reported. And, for being a cross-sectional study without clinical follow-up over time, it can reflect possible recall biases, since the patient reports past subjective information.

CONCLUSION

In this study, there was a statistically significant association between the type of diabetes and DR, a disease present in most of the people with type 1 diabetes, as well as a statistically significant correlation between the time of DM diagnosis, cataracts and DR, inferring that the longer the time with DM, the greater the risk of developing these eye diseases.

The time with VI and the types of DM were also statistically relevant, with the majority of people with type 1 diabetes becoming visually impaired after DM diagnosis. It is noted, therefore, that DM is one of the main risk factors for the development of eye diseases and for VI, especially in people with type 1 diabetes.

Thus, it is expected that the study will contribute to the performance of health professionals, especially nurses, in the promotion of healthier life habits, with educational actions, whether for the prevention of DM or of complications arising from the disease, as well as enabling reflection criticism and rethinking practices in the care of people with diabetes. For that, it is necessary to periodically monitor these individuals, through consultations, exams and screening for chronic hyperglycemia, in order to prevent and reduce the incidence of eye diseases, severe VI and irreversible blindness.

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