Visual acuity in the management of diabetes *mellitus*: preparation of the insulin dose

Acuidade visual no manejo do diabetes *mellitus*: preparo da dose de insulina

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Abstract

Objective: To assess the near visual acuity of people who prepare insulin doses.

Methods: Cross-sectional study developed at 20 Primary Health Care services between April 2013 and January 2015. The convenience sample consisted of 65 diabetes *mellitus* patients and 35 caregivers responsible for preparing the insulin dose. A form was used with sociodemographic and clinical variables and the Jaeger eye chart.

Results: The near visual acuity in the preparation of insulin doses was 40% lower in the patients and 20% in the caregivers. A statistically significant association was found between reduced near visual acuity and economic class (p=0.032) and age range (p=0.024) for patients, and reduced near visual acuity and age (p=0.024) for caregivers.

Conclusion: The near visual acuity was compromised and specific protocols need to be constructed for use in Primary Health Care.

Resumo

Objetivo: Avaliar a acuidade visual para perto das pessoas que preparam doses de insulina.

Método: Estudo transversal, realizado em 20 Unidades Básicas de Saúde, no período de abril de 2013 a janeiro de 2015. A amostra por conveniência foi constituída por 65 pacientes com diabetes *mellitus* e 35 cuidadores responsáveis pelo preparo da dose de insulina. Utilizou-se um formulário contendo variáveis sociodemográficas e clínicas, e o cartão de Jaeger.

Resultados: A acuidade visual para perto no preparo de doses de insulina estava diminuída em 40% nos pacientes e 20% nos cuidadores. Houve associação estatisticamente significante entre acuidade visual para perto diminuída e classe econômica (p=0,032) e faixa etária (p=0,024) para pacientes, e acuidade visual para perto diminuída e idade (p=0,024) para os cuidadores.

Conclusão: A acuidade visual para perto esteve comprometida e há necessidade de construção de protocolos específicos que possam ser utilizados na Atenção Primária.

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Introduction

Diabetes *mellitus* patients' compliance with the medication treatment has represented a problem in clinical practice and a challenge for health professionals.[1] In daily life, depending on the type of diabetes, the medication treatment can be oral or subcutaneous.

One of the factors that negatively affect the compliance is the error of patients or responsible caregivers when preparing the insulin dose. In that context, errors related to the medication, dose, time, administration route, action time and expiry are frequent.

What the use of insulin is concerned, additional errors are related to the dose preparation technique, administration and storage, ranging from the verification of the ideal temperature to apply the doses, the homogenization of the insulin without shaking it, the needle angle, waiting five seconds to withdraw the needle after applying the dose, among others.[2]

Particularly concerning the insulin preparation, among other errors, a mismatch is noticed between the prescribed and prepared doses, compromising the achievement of the desired glucose control.[3,4]

The lack of knowledge on the disease and of skills required to prepare insulin doses and the deficient near visual acuity can lead to the application of insufficient or excessive doses.

In clinical practice, the assessment of near visual acuity hardly ever precedes the teaching-learning process the nurse, patient or caregiver should participate in. The lack of this essential element compromises the nurse's clinical judgment and, consequently, decision making on the best conduct to respond to this therapeutic need.

In accordance with the safe preparation and application practices of insulin doses, this drug was included on the list of the five drugs that most provoke damage to adult and child patients, due to usage errors. In addition, being a narrow therapeutic index drug, excessive or insufficient doses can cause hyperglycemia or hypoglycemia, respectively.[5] These considerations highlight the importance of assessing the near visual acuity before the start of the teaching-learning process, with a view to guiding the actions involving insulin treatment and minimizing the risks of applying an incorrect dose.

In the literature, the various errors committed in the preparation of insulin doses are appointed but, as far as the probable causes are concerned, the decrease in near visual acuity is hardly mentioned.[3,6,7] Also regarding the theme, there is a lack of studies on the assessment of near visual acuity in Primary Health Care, evidencing knowledge gaps. Particularly the people who prepare the daily insulin dose need normal visual acuity to guarantee the accuracy of the prescribed dose. Based on the above, the objective in this study was to assess the near visual acuity in the preparation of insulin doses.

Methods

Cross-sectional study developed at 20 Primary Health Care services reoriented and operated by the Family Health Strategy in the urban region of Picos (PI), in the State of Piauí, between April 2013 and January 2015.

The population consisted of diabetes mellitus patients. The inclusion criteria were: being registered at the referred services; under monitoring in the Registration and Monitoring System of Hypertensive and Diabetic Patients (HIPERDIA); being ≥20 years; using insulin as continuing drug treatment; and preparing insulin doses.

The cut-off point in terms of age is justified when considering that the main cause of reduced visual acuity are refraction errors.[8] Patients using insulin pens and infusion pumps; patients whose dose was prepared and applied by a health professional at the services; and patients who were not at home during the data collection period were excluded from the sample.

The convenience sample consisted of 100 diabetes *mellitus* patients. When considering the final inclusion criterion, however, we verified that, for 35 patients, a caregiver prepared the dose. Thus, the study sample consisted of 65 patients and 35 caregivers. For the purpose of the study, the sociodemographic were selected (age, sex, education, professional activity, socioeconomic classification and

marital situation) and clinical variables (length of disease and glycated hemoglobin - A1c); variables related to the insulin therapy (type of syringe used, reuse of syringe and type of insulin used); and to the visual acuity (ophthalmological monitoring and level on the Jaeger card) were chosen for the diabetes mellitus patients who prepared the insulin doses; and socioeconomic (age and sex) and visual acuity (ophthalmological monitoring and level on the Jaeger card) variables for the caregivers responsible for preparing the insulin doses.

The data were collected at home after the signing of the Free and Informed Consent Form. Initially, the form was applied to collect the sociodemographic and clinical variables of the diabetes mellitus patients and sociodemographic variables of the caregivers who prepared the insulin doses; next, a venous blood sample was collected for the A1c dosage. Previously hired specialized laboratory technicians collected the blood samples, complying with the sample preservation and patient safety standards.

To assess the near visual acuity of the 65 diabetes mellitus patients and 35 caregivers, the Jaeger eye chart was used. It consists of optotypes: numbers 1 to 9 in increasing order of size, and the letter E in increasing order of size and in different directions (upwards, downwards, right, left). Each number (1 to 9) and letter (E) size corresponds to the letter J, scored as follows: J1, J2, J3, J4, J5 and J6, according to the increasing order of the optotypes and the equivalent distance of 0.37m, 0.50m, 0.67m, 0.75m, 1.00m and 1.25m, respectively.[9]

The card was placed at eye height at a distance of 35cm. First, the right eye was investigated, followed by the left and both eyes simultaneously. Depending on the education level, the numbers 1 to 9 were appointed for reading, or the letter E in order to reproduce the position with the fingers.

As far as the interpretation of the results is concerned, for each letter J, there is an equivalent distance, using 20/40 (0.50m) as a parameter, which corresponds to J2. Thus, people classified as level J1 or J2 were assessed with normal near visual acuity, while people with levels J3 to J6 or who could not see were considered as reduced near visual acuity.

The data were exported to the statistical software Statistical Package for Social Science, version 20.0 for treatment to produce the results. For the inferential analyses of comparison of means, the Kruskal-Wallis test was used, and the qualitative variables were measured by means of the likelihood ratio, in order to associate the visual acuity with the age range and economic class. For all statistical tests, a first-rank error of 5% was adopted (p<0.05).

Approval for the study was obtained from the Ethics Committee for Research involving Human Beings at Universidade Estadual do Piauí, under opinion 901.145.

Results

What the preparation of the insulin dose is concerned, 35% indicated that it was prepared by a caregiver, 80% of the caregivers being women, with a mean age of 45 years and finished secondary education (31.4%). To prepare the insulin doses, the diabetes mellitus patients and caregivers used U-100 syringes with the needles attached and 72% reuse the syringe. Eighty percent used NPH insulin, 3% regular insulin and 15% both types of insulin.

Ophthalmological monitoring was found in 72.3% and 57.1% of the diabetes mellitus patients and caregivers, respectively. The test using the Jaeger card evidenced reduced near visual acuity in 40% of the patients and 20% of the caregivers (Table 1).

Table 1. Visual acuity of patients (n=65) and caregivers (n=35) responsible for preparing the insulin doses

Visual acuity		Patients n(%)	Caregivers n(%)
Both eyes	J1	10(15.4)	17(48.6)
	J2	29(44.6)	11(31.4)
	J3	11(16.9)	5(14.2)
	J4	6(9.2)	1(2.9)
	J5	2(3.1)	-
	J6	3(4.6)	-
	Could not see	4(6.2)	1(2.9)
	Total	65(100.0)	35(100.0)

Table 2. Association of near visual acuity with economic class and age of patients who prepare insulin doses (n= 65)

Variables		J1 n(%)	Both eyes J2 n(%)	J3 n(%)	J4+ n(%)	p-value*
Economic class	A	-	2(33.3)	2(33.3)	2(33.3)	
	B	3(18.8)	10(62.5)	2(12.5)	1(6.3)	0.032
	C	7(23.3)	8(26.7)	7(23.3)	8(26.7)	
	D or E	-	9(69.2)	-	4(30.8)	
Age	22 - 32	3(100.0)	-	-	-	
	33 - 43	4(44.4)	2(22.2)	1(11.1)	2(22.2)	
	44 - 54	1(7.1)	8(57.1)	1(7.1)	4(28.6)	0.024
	55 - 65	2(9.5)	11(52.4)	4(19.0)	4(19.0)	
	66 - 76	-	7(43.8)	4(25.0)	5(31.2)	
	>77	-	1(50.0)	1(50.0)	-	

*p-value related to likelihood ratio

Table 3. Association between visual acuity and age range of caregivers who prepare insulin doses (n= 35)

Sociodemographic characteristics		J1 n(%)	Jaeger - both eyes J2 n(%)	J3 n(%)	J4+ n(%)	p-value*
Age	21 - 31	5(62.5)	2(25.0)	1(12.5)	-	
	32 - 42	7(77.8)	2(22.2)	-	-	
	43 - 53	4(50.0)	3(37.5)	1(12.5)	-	0.024
	54 - 64	1(14.3)	3(42.9)	3(42.9)	-	
	>65	-	1(33.3)	-	2(66.7)	

*p-value related to likelihood ratio

As regards the patients, a statistically significant association was found between reduced near visual acuity and economic class (p=0.032) and age range (p=0.024) (Table 2). Hence, the higher the percentage of reduced near visual acuity, the lower the economic class and the higher the age.

With regard to the caregivers, a statistically significant association was found between reduced near visual acuity and age (p=0.024) (Table 3), showing a higher percentage of reduced visual acuity in older caregivers.

Discussion

The lack of literature limited the discussion of the study results. Therefore, further research on the theme is recommended to arouse the nurses' need to question the near visual acuity of people who prepare insulin doses.

This study of diabetes *mellitus* patients assessed the near visual acuity in the preparation of insulin doses, considering that an appropriate sight for this distance is one of the conditions needed to guarantee the accuracy of the dose that needs to be prepared. Nevertheless, the results have shown that, in 35% of the patients, caregivers prepared the dose, being mostly relatives. In daily care, it is common for a caregiver to prepare and apply the insulin doses.[10] This dependence, which is frequently observed in clinical practices, means a lack of competence for self-care, represented by factors like reduced visual acuity, commitment of motor function, lack of compliance with medication treatment and particularities of the insulin syringe.[1,10-12]

The percentage of patients and caregivers who prepared insulin doses and revealed reduced near visual acuity in this study was similar to the findings in a study involving a population of elderly diabetes *mellitus* patients.[7,13] A study has shown that patients on insulin aspire a dose different from the prescription due to difficulties to see the quantity of the drug in the syringe.[3,13]

The types of syringes and needles in the market to prepare insulin doses are made of plastic. Although indicated for single use, the reuse is recommended in clinical practice.[14] The total capacity ranges between U-30, U-50 and U-100, and the needles can be fixed or not, besides presenting marks along the body of the syringe. According to the capacity of the syringe, each mark represents one unit (syringes of U-30 and U-50) and two units (U-100).[15] Part of these particularities, in combination with the reduced near visual acuity, can favor errors related to the preparation of the insulin dose, mainly in case of uneven doses in U-100 syringes. In addition, for

people who prepare regular and NPH insulin in the same syringe, the possibility of these errors increases. The reuse of syringes also facilitates the disappearance of the marks printed on the body of the syringe and favors differences between the prescribed and the aspired doses.

Appropriate technologies exist nowadays to help people with reduced near visual acuity, such as magnifiers which, when placed on the body of the syringe, serve as magnifying lenses, making it easier to see the marks.[3]

The visual acuity tests are examples of tools that should be part of problem prevention actions, permitting the early identification of visual problems. In this study, the Jaeger test was used, which the nurse can apply, who should read it to support the diagnosis.[15] Any abnormalities identified define the Family Health team's priorities to forward the person to the ophthalmologist.

Particularly concerning the eye health of people who prepared insulin doses, the Primary Health Care professionals should also monitor compliance with ophthalmological monitoring in accordance with established protocols.[16] In this study, considerable amounts of patients are caregivers were registered who were being monitored by an ophthalmologist, in accordance with the relevant literature.[17] On the other hand, the patients forwarded do not always attend the ophthalmological appointments, representing yet another case of lack of treatment compliance and self-neglect.[16]

The reduced near visual acuity of people who wore glasses underlines the importance of ophthalmological monitoring, as the prescription of corrective lenses reduced the prevalence of decreased visual acuity.[8]

The statistically significant association found between reduced near visual acuity, age and economic class for patients is supported by other studies. The speed of the visual problems is directly related with the age, and the easy access to ophthalmological services depends on the socioeconomic conditions.[16,18,19]

As the entry door to Primary Health Care, the Family Health Strategy is a health care model based on longitudinality and care integrality, favoring the autonomy of individuals, families and groups to practice care and self-care in accordance with the potentials and limitations of each.[20,21] The identification of people who prepare insulin doses despite their reduced near visual acuity reveals the extent of a problem that can contribute to increase the prevalence of diabetes *mellitus* complications, comorbidities, mortality rates and costs for the Unified Health System.

The Jaeger eye chart is a tool that can be used in Primary Health Care to assess the near visual acuity, due to its easy use and low cost. The nurses working in the Family Health Strategy are also responsible for channeling efforts to offer dose magnifiers to people diagnosed with deficient near visual acuity, as well as to monitor the attendance to ophthalmological appointments.

Conclusion

The near visual acuity was reduced in a considerable number of patients with diabetes *mellitus* and in the caregivers who prepared insulin doses. A statistically significant association was found between reduced near visual acuity and economic class and age range for the patients, and reduced near visual acuity and age for the caregivers. These results are relevant for nursing practice, as they show the need to construct specific protocols to assess near visual acuity that can be used in Primary Health Care. Thus, nurses can start the teaching-learning process on the preparation of insulin doses based on clinical judgment for decision making, with a view to empowering the patient or caregiver.

Collaborations

critical review of the intellectual content and final approval of the version for publication.

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