

EFFECT OF HEALTH LITERACY ON TREATMENT RESULTS OF TYPE-2 DIABETES MELLITUS PATIENTS ADMITTED FOR INSULIN PEN USE EDUCATION

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ABSTRACT

Aim: In this study we aimed to evaluate the cognitive status of diabetes mellitus patients referred to an educator nurse for subcutaneous injection treatment education and to measure their health literacy level and compare the findings with treatment results.

Methods: The study population consisted of 200 volunteer Type2 diabetes mellitus patients over age 18 receiving subcutaneous injection (insulin or exenatide) treatment who were admitted to the SBU Bursa Yuksek Ihtisas Training and Research Hospital diabetes education outpatient clinic between January 2018 and February 2018. The Standardized Mini-Mental State Examination and the European Health Literacy Scale Questionnaire were used. A face-to face interview method was used for data collection. HbA1c values of patients were recorded at the time of admission for insulin pen use education, and HbA1c values of the patients coming for diabetes outpatient control 3 months after the training were also recorded.

Results: From the results of the study, the total rate of participants with insufficient/limited general health literacy was 83%. The incidence of dementia was 24% in the same population. There was a linear relationship between general health literacy status and mini-mental test scores. The decrease in HbA1c levels of patients receiving insulin pen education was greater in the group with sufficient health literacy and normal cognitive functions.

Conclusions: Impairment of cognitive functions and low health literacy levels were assessed as obstacles to management of the disease in diabetes mellitus cases receiving injection education. Consideration of these circumstances in patient education could positively affect treatment outcomes.

Keywords: Health literacy, diabetes mellitus, dementia, insulin pen education, HbA1c

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Introduction

Diabetic patient education is necessary to make the individual feel better, keep the disease under control, protect him/her against possible side effects, reduce treatment mistakes and treatment expenses, and to increase the knowledge and experience of the patient to make him/her capable of using new technologies (1).

Health literacy (HL) can basically be defined as the patient's understanding and interpretation of medical information and behaving accordingly. HL is a holistic concept that requires the ability to define the individual's health, to know about his/her illness, to make appropriate decisions about his/her health, and to know how to use the health system and how to benefit from it, rather than just reading and understanding information (2).

Baker et al. found that insufficient health literacy skills are independently associated with increased mortality risk among senior adults in the society (3). It is well known that unnecessary hospital charges increase, time of stay in the hospital is prolonged and the rate of unnecessary examinations increase in individuals with insufficient and limited health literacy levels compared to those with sufficient health literacy levels (4). Similarly, hospitalization rates were found to be higher for individuals who were admitted late to the health system due to insufficient and limited health literacy levels (5). As a conclusion, insufficient functional health literacy was found to be a serious obstacle to the education of patients on chronic diseases.

In the study performed by Mark V. Williams et al. with diabetes patients, the aim was to assess the relationship between HL level of patients, their chronic diseases and their awareness about treatments. Patient consciousness levels concerning their diseases

were tested by asking them 10 diabetes questions considering the main elements in the education materials on these diseases. 94% of the individuals with high health literacy level knew the hypoglycemic symptoms, whereas this rate was reported as 55% for individuals with low or insufficient HL (6). In another study evaluating the relationship between HL level and hemoglobinA1c, it was found that glycemic control was worse and hemoglobin A1c values were two times greater in individuals with low or limited HL levels (7).

Low health literacy is also associated with increased dementia risk (8). In a previous study it was shown that a decrease in cognitive function in the elderly is associated with a decrease in health literacy, impairment of physical health and a higher rate of depression (9). When it is considered that the elderly population and chronic disease incidence are increasing in the society, there is a need for further research on low health literacy and the resulting high mortality.

In this study we aimed to evaluate the cognitive status of diabetes mellitus patients referred to an educator nurse for subcutaneous injection treatment education and to measure their health literacy level and compare the findings with treatment results.

METHODS

Research Type and Population

The study population consisted of Type2 diabetes mellitus patients over age 18 who was admitted to the SBU Bursa Yuksek Ihtisas Training and Research Hospital diabetes education outpatient clinic for insulin pen education between January 2018 and February 2018.

The Ministry of Health Istanbul Kartal Dr. Lutfi Kirdar Training and Research Hospital Clinical Research Ethics

Committee approved the dissertation "Effect of Health Literacy on Treatment Results of Type-2 Diabetes Mellitus Patients Admitted for Insulin Pen Use Education" with its resolution and authorization no. 2017/ 514/ 118/ 15, 28.11.2017.

Participants

This study was conducted with 200 volunteer Type2 DM patients over age 18 receiving subcutaneous injection (insulin or exenatide) treatment who were admitted to the SBU Bursa Yuksek Ihtisas Training and Research Hospital diabetes education outpatient clinic between January 2018 – February 2018. Consent was obtained from these 200 individuals and the research was performed using a survey method.

Research Inclusion Criteria

Research inclusion criteria were: admission to the Diabetes Education Outpatient Clinic for insulin pen education, being a Type 2 DM patient, receiving insulin or exenatide treatment and accepting to participate in the study.

Questionnaires

A questionnaire interrogating socio-demographic characteristics of the patients, Standardized Mini-Mental State Examination to assess cognitive function and to distinguish dementia, and the Turkish version of the European Health Literacy Scale Questionnaire (HLS-EU-Q) were used in this research.

Anthropometric measurements, height and weight, were measured with standard measurement tools. The individuals were asked to take off their shoes during height measurement. It was ensured that patients were wearing light clothing during weight measurement. BMI: Body mass index value was calculated by dividing the patient's weight by the square of his/her height (kg/m^2). Waist circumference was measured in standing position with an inelastic

tape measure and the narrowest diameter between arcus costarum and processus spina iliaca anterior superior was accepted as the waist circumference.

The Mini Mental State Examination test form is comprised of eleven items under five main topics: orientation, registration, attention and calculation, recall and language, and is evaluated with a total score of 30. Any score of 24 or more (out of 30) indicates normal cognition. Below this, scores can indicate severe (≤ 9 points), moderate (10–18 points) or mild (19–23 points) cognitive impairment. In order to provide standardization in our study, we determined the limit for dementia as 23/24 (≤ 23 ; there is dementia).

The European Health Literacy Scale Questionnaire (HLS-EU-Q) form consists of 47 questions. Each of the 47 items is rated on a 4-point scale (1= very difficult, 2= difficult, 3= easy, 4= very easy). This scale is based on the principle of evaluating how "easy" or "difficult" the behavior specified in each item is, according to one's own perception.

Index scores were standardized on a scale between 0 and 50; "0" is the lowest health literacy, "50" is the highest health literacy, as shown in the formula below:

Formula: $\text{Index} = (\text{mean} - 1) \times (50/3)$

Index: Index specific to the calculated person

Mean: Mean of each item answered

HL was divided into four categories according to the index values obtained:

(0-25) insufficient,

(>25-33) problematic – limited HL

(>33-42) sufficient HL

(>42-50) perfect HL

Statistical Analysis

Conformity of the variables to normal distribution was analyzed with Shapiro Wilk test. Continuous variables are presented with median (minimum: maximum) and mean \pm standard deviation values. Categorical variables are presented as n (%). In case of conformity of the variables to normal distribution according to the normality test results, independent paired-samples t test was used in comparison of two groups and in case of non-conformity of variables to normal distribution Mann Whitney U test was used. Pearson chi-square test and Fisher's exact chi-square test were used in comparisons of categorical variables between groups. Internal consistency of the health literacy scale was analyzed with Cronbach alpha coefficient. The relationship between general health

literacy score of the variables and mini-mental scores was analyzed with Spearman correlation coefficient. SPSS (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.) program was used for statistical analysis and $p < 0.05$ was accepted as statistically significant.

RESULTS

There were 127 female and 73 male participants. Mean age was calculated as 58.17 ± 11.04 . Health literacy distribution of the participants is given in Table1. Total rate of the participants with insufficient/problematic general health literacy was calculated as 83%. Dementia was detected in 23.80% of the participants ($n=47$) (Figure1).

Table1. Health literacy distribution

	InsufficientHL (%)	ProblematicHL (%)	Sufficient HL (%)	Perfect HL(%)
General HL	34.50%	48.50%	17%	0%
Health Care Service HL	21.50%	36%	38.50%	4%
Disease Prevention HL	55%	33%	12%	0%
Health Improvement HL	42%	47.50%	10%	0.50%

HL: Health literacy

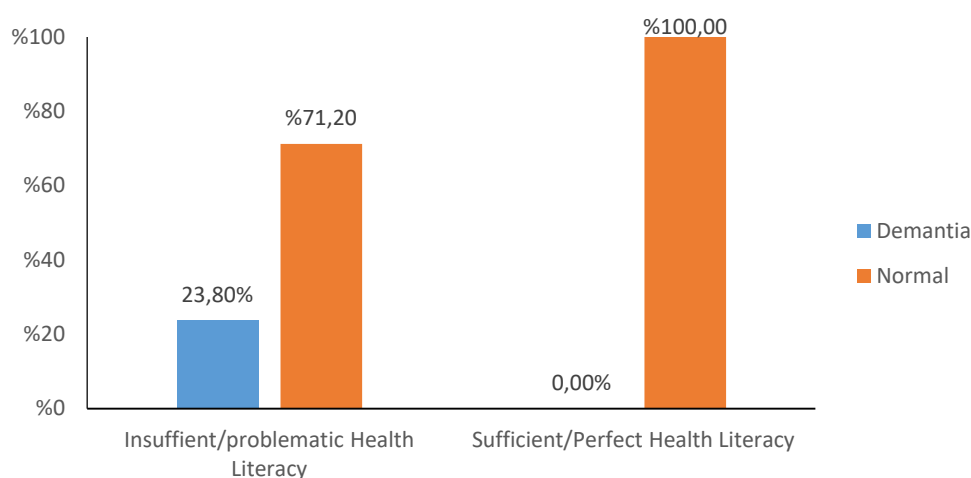


Figure1. Health literacy and mini-mental test score relationship

No difference was detected between HL groups in the comparison of HbA1c levels ($p=0.277$) (Table2).

The percentage change was calculated to analyze the change in baseline measurements during control measurements. When related percentage change values were analyzed, it was seen that HbA1c levels of those with limited health literacy decreased to

a rate of 9.94% while this decreased rate was 17.26% in those with sufficient health literacy. It was determined that the decrease in HbA1c values in the group with adequate health literacy following insulin pen education was greater than inadequate health literacy group ($p=0.025$) (Table2 and Figure2).

Table2. Hba1c and health literacy relationship before and after insulin pen education

	Inadequate Health Literacy (n=166)	Adequate Health Literacy (n=34)	
HbA1c	10.58±2.44	11.10±2.74	0.277 ^a
Control HbA1c	9.19±2.13	8.96±2.01	-
HbA1c (Control→First measurement)	-9.94% (-55.41:53.33)	-17.26% (-42.65:14.10)	0.025^b

Data presented as mean ±standard deviation or median (minimum: maximum).

a: Independent paired sample t test, b: Mann Whitney U test

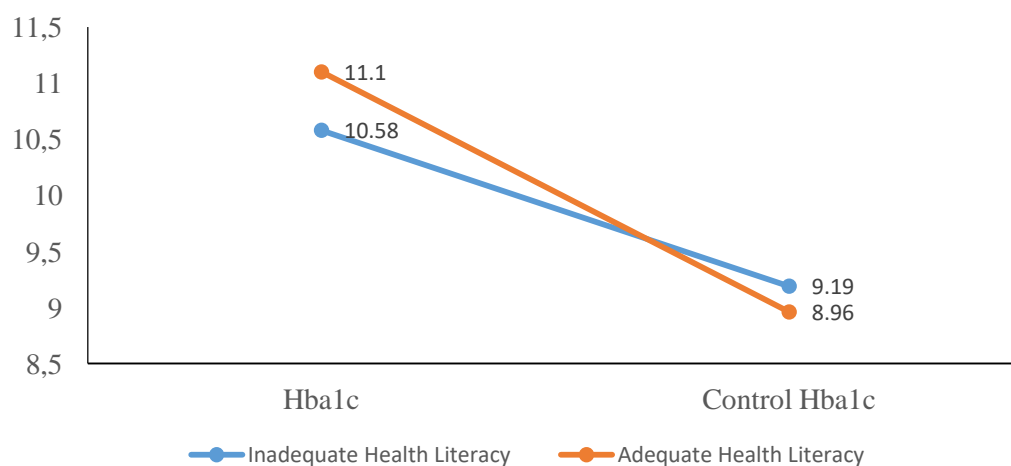


Figure2. HbA1c change and health literacy relationship

The percentage change was calculated to analyze the change in baseline measurements versus control measurements. When related percentage change values were analyzed, it was observed that HbA1c

levels decreased 5.58% in the dementia group, whereas the decrease in the normal group was 13.04%. The decrease in HbA1c level in the normal group following insulin pen education was greater than

the patients with dementia ($p=0.006$) (Table3 and Figure3).

Table3. HbA1c and dementia relationship before and after insulin pen education

	DEMENTIA (n=47)	NORMAL (n=153)	p-value
HbA1c	10(5.50:15.80)	11(5.40:18.60)	0.084 ^b
Control HbA1c	9.10(4.70:15.80)	8.60(5.70:15.20)	-
HbA1c (Control→First measurement)	-5.88% (-40.16:24.41)	-13.04% (-55.41:53.33)	0.006^b

Data presented as median (minimum: maximum).

b: Mann Whitney U test

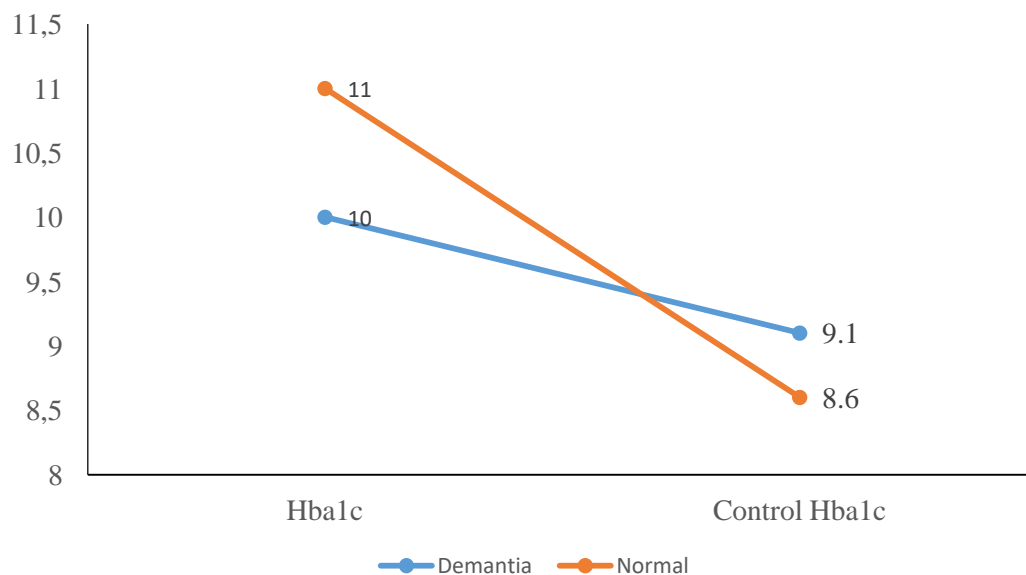


Figure3. HbA1c change and dementia relationship

A reverse relationship was detected between the increase in general health literacy score and number of

hospitalizations. Increase in health literacy score corresponded to a decrease in the number of hospitalizations (Table4).

Table4. Relationship between health literacy and hospitalization, hypoglycemic attack and admission to emergency service before and after education

n=200	GENERAL HEALTH LITERACY SCORE	
	r_s	p-value
Number of hospitalizations	-0.21	0.002
Number of hypoglycemic attacks	0.02	0.754
Number of admissions to emergency	-0.10	0.155
Number of admissions to emergency after education	-0.04	0.584

r_s : Spearman correlation coefficient

There was also a reverse relationship between the increase in mini-mental score and number of days in the hospital. Increase of mini-mental score corresponded to a decrease in the number of days in

the hospital (Table5). A reverse relationship was detected between the increase in mini-mental score and the number of admissions to the emergency. The increase in mini-mental score corresponded to a decrease in the number of admissions to the emergency service (Table5).

Table5. Relationship between mini-mental test score and hospitalization, hypoglycemic attack and admission to emergency service before and after education

n=200	MINI-MENTAL SCORE	
	r_s	p-value
Number of hospitalizations	-0.15	0.030
Number of hypoglycemic attacks	-0.04	0.533
Number of admissions to emergency	-0.14	0.048
Number of admissions to emergency after education	-0.03	0.724

r_s : Spearman correlation coefficient

DISCUSSION

The total rate of participants with insufficient/limited health literacy was 83% at the end of the study. In the same population, the dementia incidence was 24% and there was a direct relationship between general health literacy status and mini-mental test scores. The decrease in HbA1c levels for the patients receiving

insulin pen education was greater in the group with sufficient health literacy and without dementia.

In a study conducted in Turkey with the participation of 4924 individuals randomly selected from 23 Turkish provinces, based on the European Health Literacy Scale (HLS-EU), it was found that 64.6% of the

Turkish society was in the category of “insufficient” (24.5%) or “problematic” (40.1%) health literacy (10). In the study performed by Ozdemir et al., the rate of insufficient or problematic health literacy in adults was 41.3% according to REALM and 71.9% according to the NVS scale (11). In a study compiling research based on different scales, insufficient health literacy was between 22-29% (12). In another systematic compilation, the prevalence of insufficient health literacy was reported to be between 34-59% (10). Values we obtained in our study are higher than the previous studies. The reason for this may be the higher mean age of the patients.

It was shown that limited health literacy was common in individuals with a chronic disease diagnosis (13,14). In studies performed in America including hypertensive and diabetes patients, health literacy levels of the patients were assessed using a final vital signs scale and their mean scores were, respectively, 3.00 ± 1.90 and 2.87 ± 1.80 (15,16). It was found that 45.1% of the hypertension patients evaluated in a study conducted in Singapore had a sufficient level of HL and 69.0% of the patients assessed in another study in America had a sufficient HL level (17,18). In another study with diabetes patients in the Netherlands, 28% of the patients were reported to have a sufficient HL level (19). In our study, HL levels of the diabetes patients were assessed with HLS-EU-Q and a sufficient HL level was detected in only 17% of the patients.

In a study analyzing reasons for hospitalization of DM patients, the top three items were cardiovascular disease, pulmonary system disease and diabetic circumstances (20). According to a study conducted in Turkey by Akin et al., the hospitalization rate of patients admitted to the emergency service was 23.8% (21). When acute complications except comorbid conditions among hospitalization reasons were analyzed, insulin usage and age were found as

significant risk factors in the literature. It was found in particular that 64.5% of the hypoglycemia patients did not take any measurements, only a small number were admitted to the emergency service after taking measurements and only 16% of the patients were hospitalized (22). We found in our study that an increase in the HL level corresponded to a decrease in hospitalization frequency. Besides this, we observed that there was no significant difference between the number of hypoglycemic attacks and number of admissions to the emergency service before and after the education and general HL score level.

In a study evaluating self-administration of insulin, it was found that all diabetic patients made mistakes in insulin administration. For example, hyperglycemia can occur in case of long acting insulin injections instead of short acting insulin, or hypoglycemia can occur in case of short acting insulin injections instead of long acting insulin (23). These results can be caused by the patients' lack of information about their insulin types and characteristics. In a study performed in our country it was found that none of the patients knew the insulin type they used (24). Another study showed that failure to adjust the insulin dose was related to individual insufficiency (25). It has been demonstrated that the injection method used in diabetes treatment affects the patient's ability to accept the insulin treatment, his/her quality of life, barriers in insulin treatment and his/her compliance with medication (26). Besides this, it was shown in many clinical studies that amelioration in metabolic control and decrease in HbA1c level occurs with the increase in compliance to the treatment (27-30). In the study of Rhee MK et al. analyzing the relationship between the number of controls and compliance with the treatment and HbA1c, a decrease of 0.35% in HbA1c was observed with an increase of 25% in compliance with treatment within one year, and a decrease of 0.12% in HbA1c was seen with each additional control (28).

Similarly, in the studies of Schectman et al. (29) and Kravitz et al. (30), it was indicated that there was a greater decrease in HbA1c levels of patients with high compliance rates. Kravitz et al. observed in this study that there was a decrease of 0.4% in HbA1c with each 25% increase in compliance with the medication in 20 months follow-up. In a study on type 1 diabetics, it was seen that skipping two meals with insulin per week was associated with an increase of 0.5% in HbA1c (31). We aimed to increase patient compliance with medication by giving them insulin pen education. Thus, a decrease was detected in HbA1c levels in both groups following 3 months of follow-up, whereas the decrease was statistically more significant in the patient group with sufficient health literacy. Similar to our study, the higher the level of knowledge of patients on diabetes and on medical treatment they receive, the greater the compliance with the treatment and better HbA1c values are achieved (27).

In a thesis study conducted in Turkey on Alzheimer type dementia patients, it was found that the group of patients with Alzheimer type dementia was more unsuccessful in systematic and accurate thinking, mental skills and reasoning, and had slower response rates and psychomotor speed processes compared to the control group. The discrepancies detected in this study, similar to our study, were from lower health literacy in dementia patients compared to non-dementia patients (32).

The presence of more than one chronic disease in elderly individuals with dementia has been reported in the literature, whereas it has also been mentioned that this patient group with impaired cognition and functionality experienced additional problems due to their inability to manage their chronic diseases accurately (33-35). In the study conducted by Rudolph et al. (2010), Alzheimer patients and other elderly groups were compared and it was reported that falls,

wrong medication usage, dehydration and malnutrition were quite frequent problems that Alzheimer patients faced and which may reach to a life-threatening extent. It was also mentioned that early diagnosis is vital in order to prevent such negative circumstances (34). For these reasons, we observed in our study as well that dementia patient admission to the emergency service and the number of hospitalizations was higher. We predicted that this insufficiency in the follow-up of chronic diseases would lead to impairment in glycemic values, a decrease in the awareness of complications that may develop in diabetes follow-up of dementia patients and an increase in diabetic complications due to skipping screening programs. In our study, in which we compared the relationship between dementia and retinopathy, neuropathy, nephropathy and CAD among diabetic complications, the incidence of retinopathy, nephropathy and neuropathy was greater in the group with dementia, but the difference was not statistically significant.

No difference was detected between the HbA1c levels of patients with and without dementia, whereas it was observed that patients without dementia had a better understanding of insulin pen education and a more significant low level of HbA1c. We assume that episodic memory impairment, registration problems and the corresponding inability to learn new and repeated trials with dementia caused this discrepancy (36,37). Moreover, according to some studies, the decrease in arithmetic skills of dementia patients could lead to a failure in measuring their blood glucose levels and adjustment of insulin doses, and thus to a smaller decrease in their HbA1c levels (38,39).

LIMITATIONS OF THE STUDY

This was a mono-centered study. It was performed in the diabetes education outpatient clinic of Bursa Yuksek Ihtisas Training and Research Hospital and

reflects the results of this province only and these results cannot be generalized.

We conducted this research with diabetes patients who were admitted to the diabetes education outpatient clinic for insulin pen education. In case injections were performed by relatives of patients when the patients were unable to perform it themselves, the health literacy levels of the patient helpers may have affected the treatment results.

CONCLUSION

As a conclusion from the study, the total rate of participants with insufficient/problematic general health literacy was 83% according to HL-EU-Q. This rate was assessed to be very high compared to previous studies. The degree of decrease in HbA1c levels of the patients who received insulin pen education was better in the group with sufficient health literacy and without dementia. Health literacy levels and sufficient cognitive function in diabetes mellitus cases would increase the efficiency of patient education.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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