Functional food knowledge and use in individuals with type 2 diabetes and the relevant factors

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Summary. This study aimed to determine the knowledge and use of functional foods in individuals with type 2 diabetes who applied to Dokuz Eylul University Hospital's Endocrinology Polyclinic, were aged 18 years or older, and diagnosed with type 2 diabetes no earlier than six months from before the study began. The study also focused on the associated factors. This is a cross-sectional study. In an infinite population, the smallest sample size to be achieved was 196 with 50% frequency and 7% error margin. The study was conducted with individuals who visited Dokuz Eylul University Hospital's Endocrinology Polyclinic between May and July of 2016. The dependent variable is the knowledge and use of functional foods. The independent variables are the socio-demographic and economic characteristics, health status variables, and information sources for functional foods. The study data were collected using a face-to-face questionnaire as well as chi-square and logistic regression analyses. The mean age of the participants was 57.9±11.5 years (21-77), and of them, 58.7% were female (n=115). The frequency of knowing at least one functional food that is effective for balancing the blood sugar was 95.9% (n=188), and the frequency of using this knowledge was 83.7% (n=164). In this study group, the current use of functional food was not affected by sociodemographic variables, diabetes history in family, health perception, compliance with treatment, presence of a chronic disease other than diabetes, receiving nutritional counseling, following a diabetic diet, receiving functional food counseling and having friends and/or acquaintances as information source. The participants who did exercise regularly (OR=3.370, 95%CI=1.201-9.458, p=0.021), provided information from health professionals (OR=3.921, 95%CI=1.106-13.894, p=0.034), and provided information from the internet (OR=4.152, 95%CI=1.176-14.661, p=0.029) had a significantly higher use of functional food currently. Diabetic individuals should be supported to become more informed about functional food that has a growing popularity, and they should also be taught not to consume it without consulting a physician or dietitian. The study suggests that further studies should be conducted to assess functional food, its effects on health, and individuals' knowledge and frequency of using it, and to make interventions in relation to these subjects.

Key words: diabetes mellitus, functional food, type 2 diabetes

Introduction

According to the World Health Organization (WHO), diabetes mellitus (DM) is a metabolic disorder of multiple etiology, characterized by chronic hyperglycemia with disturbances of carbonhydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action or both (1). DM is becoming more common in Turkey and worldwide. It is reported by WHO to be the most significant health problem that occurs in relation to a chronic disease. DM is included in epidemic diseases group (2).

Many individuals fall victim to ill-advised health recommendations and nutrition advice that leaves us-

ers lacking in necessary nutritional elements which can increase the number of health problems they may face (3). Society has become more conscious of healthy diets, which leads to an overall shift towards attentiveness in food and lifestyle choices. In the first quarter of the twentieth century, individuals started to use natural sources to treat DM which lead to the development of new medicinal molecules. Different plants and foods are used throughout the world for traditional methods of treating DM. Some traditional treatments are embraced by scientific authorities including the WHO, which supports studies in this field (4). The increase in the prevalence of chronic diseases and desire of leading a quality life directs individuals to functional foods (3).

Functional foods are defined as the foods or food elements that meet basic nutritional needs. They provide additional benefits for human physiology and metabolic functions and help reduce the occurrence of disease (5). Today, there is a considerable amount of misinformation and misuse regarding functional foods. It is critical to provide correct information about functional foods for improving personal and social health. To prevent misuse of functional foods, it is mandatory to determine the knowledge level, attitudes, and behaviors of individuals and eradicate any errors (6). Functional foods may bring harm to individuals with DM if they do not follow the daily dosing instructions and/or switch their treatment plan without professional permission.

The aim of this study was to determine the knowledge, usage and related factors of functional foods on patients diagnosed with type 2 diabetes who applied to Dokuz Eylul University Endocrinology Polyclinic.

Methods

Subjects and setting

The population of this cross-sectional study was 196 individuals. 196 individuals who applied to Dokuz Eylul University Hospital Endocrine Polyclinic between May and July of 2016 were included in the study.

Ethics committee approval was obtained on 05.05.2016 and 2016/12-23 numbered decision of Dokuz Eylul University Non-Invasive Clinical Research Ethics Committee.

Conducting data

A total of 196 individuals who older than 18 years and applied to Dokuz Eylul University Hospital Endocrine Polyclinic between May and July of 2016 were included in the study. Informed consent form was at the beginning of the questionnaire and data were collected by researcher with face-to-face interview.

Variables of the study

The independent variables were sociodemographic and economic characteristics (age, gender, education level, marital status, working status, income-expense perception, the longest living place) health status features (presence of a chronic disease other than diabetes, diabetes history in family, blood sugar control status, compliance with treatment, use of insulin status, receiving nutritional counseling, exercising regularly, following a diabetic diet, use herbal products) functional food counseling and information source of functional food. Dependent variables were knowledge of functional foods and use of functional foods.

Knowledge of functional foods: Participants were given lists of functional foods used to balance blood sugar level. Participants were asked the following question for each food in the list: "Did you know that this food is effective for balancing blood sugar level?" Those who stated that they knew at least one of the functional foods were accepted as "they know."

Use of functional foods: The list of functional foods that are used to balance blood sugar level was given to the participants. The questions, "Do you use this food to balance your blood sugar level?" and "Did you know that these foods are effective for balancing blood sugar level?" were asked for the functional foods. Those who state that they currently use these foods were accepted as "they use."

Statistical Analysis

Chi-Square and Logistic Regression Analysis were used in SPSS 15.0. Logistic regression analysis variables were performed for three groups, which are sociodemographic variables, health status variables, and functional food variables.

Results

Of the participants, 34.2% were 65 years old or older, and the mean age was 57.9±11.5 years old. Of them, 58.7% were female. Of the participants, 36.8% received a primary education or lower, 81.1% have lived in a provincial center for the majority of their lives, and 71.9% were married. Additionally, 37.8% were retired and 36.7% were housewives (Table1). The participants' economic status data indicates that the incomes and expenses of 48.0% are equal. Incomes of 39.8% of participants were lower than their expenses while 12.0% earned more than their expenses.

The participants' health status data is presented in Table 2.

The number of those who knew at least one of the functional foods in the list that are effective in balancing the blood sugar level was 188 (95.9%). The most popular foods recognized were cinnamon (89.8%), olive leaves (58.5%) and dietary fiber, respectively. 164 participants (83.7%) stated that they currently use at least one of the functional foods to balance their blood sugar. 139 participants (70.9%) mentioned that they used a functional food "each day" currently or in the past. In addition, 168 participants (85.7%) expressed that they did not consider the amount consumed when using a functional food. The functional foods used were presented in Table 3.

Of the participants, 89.3% stated that they had not ever received counseling regarding functional foods. The three most common information sources for functional foods are acquaintances or friends (71.2%), television (41.4%), health professionals (32.4%), or the internet (32.4%) displayed in Table 4.

Causal analyses could not be performed on the variable of knowing a functional food because of the high number of individuals knowing at least one functional food effective in balancing blood sugar level.

Age group (p= 0.212), gender (p=0.276), educational level (p=0.200), marital status (p=0.194), the longest living place (p=0.051), income-expense perception (p=0.197), and working status (p=0.409) did not significantly affect functional food use.

The presence of a chronic disease other than diabetes, diabetes history in the family, blood sugar control status, thinking about to compliance with treatment, using insulin, receiving nutritional counseling

Table 1. Socioeconomic characteristics of diabetic individuals

Characteristics (n=196)	n	%
Educational level		
Illiterate	7	3.6
Literate	5	2.6
Primary school	60	30.6
Secondary School	18	9.2
High school	56	28.6
University and over	50	25.5
The longest living place		
Province	159	81.1
District	29	14.8
Village	8	4.1
Working status		
Retired	74	37.8
Housewife	72	36.7
Officer	25	12.8
Self-employed	16	8.2
Worker	5	2.6
Employer	2	1.0
Unemployed	1	0.5
Not working	1	0.5

Table 2. Health status characteristics of individuals

Characteristics (n=196)*	n	%
Presence of a chronic disease other than diabetes (Yes)	177	90.3
Diabetes history in family (Yes)	133	67.9
Blood sugar control status(Yes)	57	29.1
Compliance with treatment (Yes)	146	74.5
Use of insulin status (Yes)	69	35.2
Receiving nutrition counseling from dietitian (Yes)	148	75.5
Exercising regularly to regulate blood sugar (Yes)	125	63.8
Following a diabetic diet to regulate blood sugar (Yes)	153	78.1
Use herbal products to regulate blood sugar (Yes)	77	39.3

*More than one option checked

from a dietitian, and following a diabetic diet did not significantly affect functional food use (p>0.05) (Table 5). Those who exercise regularly as a way to regulate blood sugar level used functional foods more frequently when compared to those who did not exercise. This difference was significant (p=0.008) (Table 5).

Receiving counseling on functional foods and receiving information from books, advertisements, ac-

Table 3. Distribution of functional foods currently used by participants

Functional foods (n=196)*	n	%
Cinnamon	105	53.6
Dietary fiber	100	51.0
Walnut	51	26.0
Almond	48	24.5
Apple	45	23.0
Nigella sativa	39	19.9
Pumpkin	11	5.6
Purslane	11	5.6
Olive leaves	11	5.6
Broccoli	10	5.1
Pomegranate	10	5.1
Coffee	10	5.1
Blueberries	9	4.6
Oats	9	4.6
Black mulberry	7	3.6
Persimmon leaf	7	3.6
Turmeric	7	3.6
Green tea	6	3.1
Allium porrum	5	2.6
Dead nettle	5	2.5
Quince	4	2.0
Garlic	3	1.5
Cumin	3	1.5
Onion	2	1.0
Teucrium polium	2	1.0
Sweet basil	1	0.5
Soy beans	1	0.5
Fennel	0	0.0
Fenugreek	0	0.0
Algea	0	0.0
Ginseng	0	0.0

* More than one option checked

Table 4. Counseling on functional food and distribution of information resources

Characteristics	n	%
Received counseling (Yes) (n=196)	21	10.7
Information sources of functional foods which known (n=188)*		
Acquaintances or friends	134	71.2
Television	78	41.4
Health professionals	61	32.4
Internet	61	32.4
Health or diet-related journals and books	23	12.2
Newspaper	13	6.9
Books	11	5.8
Food producers	5	2.6
Advertisement	3	1.5
Radio	2	1.0
Herbalist	2	1.0

* More than one option checked

Table 5. Functional food use according to health status

Characteristics (n=196)	Using functional foods				p*
	Yes		No		
	n	%	n	%	
Presence of a chronic disease other than diabetes					
No	17	89.5	2	10.5	0.744**
Yes	147	83.1	30	16.9	
Diabetes history in family					
Yes	114	85.7	19	14.3	0.261
No	50	79.4	13	20.6	
Thinking about the ability to control the blood sugar level					
Yes	49	86.0	8	14.0	0.578
No	115	82.7	24	17.3	
Thinking about the compliance with treatment					
Yes	122	83.6	24	16.4	0.942
No	42	84.0	8	16.0	
Using insulin					
Yes	58	84.1	11	15.9	0.915
No	106	83.5	21	16.5	
Receiving nutritional counseling from a dietitian					
Yes	124	83.8	24	16.2	0.942
No	40	83.3	8	16.7	
Exercise regularly to regulate blood sugar					
Yes	66	93.0	5	7.0	0.008
No	98	78.4	27	21.6	
Following a diabetic diet to regulate blood sugar					
Yes	40	93.0	3	7.0	0.060
No	124	81.0	29	19.0	

* Chi-Square Analysis; **Fisher's p

quaintances-friends, food producers and newspapers or radio did not significantly affect functional food use (p>0.05). Functional foods were significantly used more frequently by those whose information sources were internet (p=0.004), health professionals (p=0.004) and health or diet-related journals and books (p=0.017).

Logistic regression analyses were performed by separating the variables into three groups. First group

variables were the sociodemographic variables (Table 6). Age group, gender, educational level, marital status, the longest living place and income-expense perception did not significantly affect functional food use (Table 6).

The logistic regression analysis performed by the health status variables indicates that health perception, presence of a chronic disease other than diabetes, diabetes history in the family, compliance with treatment, receiving nutritional counseling, and following a diabetic diet did not significantly affect functional food use. Those who performed regular exercises used the functional foods three or four times more frequently (OR=3.370, 95%CI=1.201-9.458 p=0.021) (Table 7).

Receiving functional food counseling and friends or acquaintances as an information source did not significantly affect the use of functional foods. Functional foods were used 4.2 times higher by those whose information source is the internet (OR=4.152, 95%CI=1.176-14.661 p=0.027) and 3.9 times higher by those whose information source is health professionals (OR=3.921, 95%CI=1.106-13.894 p=0.034) (Table 8).

Discussion

Participants stating that they knew at least one of the functional foods were accepted as "they know." The number of those who knew at least one of the functional foods in the list was 188, or 95.9% of patients. This rate indicates that participants' awareness about balancing blood sugar levels using certain foods is high. Of the participants, 86.2% knew cinnamon is effective for balancing blood sugar levels, while 56.1% mentioned olive leaves, 55.6% mentioned dietary fiber, 52.0% mentioned black cumin, and more than 30% mentioned almond, walnut, and cranberry.

It is believed that cinnamon balances blood sugar levels by boosting insulin resistance. In a study 109 individuals with type 2 DM were administered one gram

Table 6. Logistic regression analysis data: the effect of sociodemographic variables on functional food use

Characteristics (Reference group)	Using functional foods		
	p	OR	95% CI
Age group (65 years old or older)	0.428	1.409	0.603-3.295
Gender (Male)	0.090	2.116	0.889-5.040
Education (Lower than high school)	0.395	1.469	0.606-3.562
Marital Status (Single)	0.173	0.545	0.228-1.305
The longest living place(District- village)	0.107	2.123	0.851-5.300
Status of income and expense (Income lower than the expense)	0.351	1.482	0.649-3.383

*Age group (reference group; 65 years or older), gender (reference group; male), education (reference group; lower than high school), marital status (reference group; single), the longest living place (reference group; district- village), status of income and expense (reference group; income lower than the expense.)

Table 7. Logistic regression analysis data: Health status effects on functional food use

Characteristics (Reference group)	Using functional foods		
	p	OR	95% CI
Health perception (Poor)	0.490	0.726	0.292-1.803
Presence of a chronic disease other than diabetes (Not Present)	0.483	0.562	0.112-2.818
Diabetes history in family (Not Present)	0.166	1.791	0.785-4.086
Compliance with treatment (Yes)	0.986	1.008	0.397-2.560
Receiving nutritional counseling (No)	0.219	3.732	0.457-30.504
Exercising regularly (No)	0.021	3.370	1.201-9.458
Following a diabetic diet (No)	0.146	2.600	0.718-9.416

*Health perception (reference group: poor), presence of a chronic disease other than diabetes (reference group: not present), diabetic family history (reference group: not present), compliance with treatment (reference group; yes), receiving nutritional counseling (reference group; no), exercising regularly (reference group=no), following a diabetic diet (reference group=no.)

Table 8. Logistic regression analysis data: variables related to the effects of functional food information counseling on the use of functional foods.

Characteristics (Reference group)	Using functional foods		
	p	OR	95% CI
Receiving functional food counseling (No)	0.274	3.226	0.395-26.340
Internet as information source (No)	0.027	4.152	1.176-14.661
Health professionals as information source (Yes)	0.034	3.921	1.106-13.894
Friends or acquaintances as information source (No)	0.283	1.598	0.679-3.763

*Receiving functional food counseling (reference group: no), internet as information source (reference group: no), health professionals as information source (reference group: yes), friends-acquaintances as information source (reference group: no)

of cinnamon daily for 90 days, and their HbA1c values decreased significantly (14). In a recent study conducted on 60 volunteers with type 2 DM, participants were administered 1, 3, and 6 grams of cinnamon right after a meal for the first 40 days. In the last 20 days, they were administered a placebo. Blood sugar levels of the participants who were administered cinnamon decreased by 18-29% in the first 40 days. At the end of the last 20 days, no significant decrease was present in blood sugar levels (15). Thirty individuals with type 2 DM were administered 1, 3, and 6 grams of cinnamon daily for 40 days, and a daily intake of 1-3 grams of cinnamon significantly decreased blood glucose levels (4).

Of the participants, 58.5% stated that they know olive leaves are effective for balancing blood sugar levels. A study conducted by Gonzalez et al. to examine the glycemic responses to cooked rice indicates that olive leaf extract significantly decreases blood sugar levels, and oleuropein in oil leaves boosts the rate of glucose intake to the cells. Diabetic rabbits were administered 20 mg/kg oleuropein for 16 weeks and their glucose levels were found to decrease after the eighth week (16).

Dietary fiber, which was mentioned by 57.9% of participants, delays glucose absorption in diabetic individuals and reduces insulin levels. Thus, diabetic individuals are recommended to consume 30-50 grams of dietary fiber (17). In a randomized controlled study, individuals with type 2 DM consumed two types of diets with the same macro and micro food elements for six weeks. One of these diets was recommended by American Diabetes Association (ADA). The other diet contained high amounts of fiber. Pre and postprandial glucose levels, insulin concentrations, total cholesterol level and TG and LDL cholesterol levels significantly decreased after dietary fiber was consumed when comparing the two diets. Consumption of dietary fiber by individuals with type 2 DM upon the recommendation of ADA ensured that glycemic control was maintained, hyperinsulinemia rate decreased, and blood lipid concentrations were reduced (18).

In the current study, 54.2% of the participants stated that they knew black cumin is effective for balancing blood sugar levels. Thymoquinone, dithymoquinone, thymohydroquinone, and thymol components increase insulin secretion in beta cells. Thus,

black cumin increases insulin levels. A study conducted with volunteers indicated that consuming 1 gram of black cumin twice daily for two weeks reduces blood glucose levels (4). Another study suggests that black cumin seeds traditionally used to treat type 2 DM in North Africa and the Middle East display insulin-related effects. Ethanol extract of black cumin seeds displays antihyperglycemic effects on beta, skeletal, muscle, and fat cells (19). In a study where diabetic rabbits were orally administered black cumin seeds for two months, high blood glucose levels were found to decrease (4). In a six-week study conducted to compare the effects of 2g/kg black cumin to those of metformin (300mg/kg/day), used to treat DM, black cumin was found to improve glucose tolerance as effectively as metformin. Using black cumin as a supplement for individuals with DM reduces the glucose absorption rate and glucose tolerance. In addition, metformin and black cumin helps weight loss without causing any toxic effects (20).

More than 30.0% of the participants stated that they knew almond, walnut, and blueberries are effective for balancing blood sugar. A relevant study was conducted on individuals with type 2 DM in China, where 20% of the diet calorie of the experimental group had almond derivatives (60 grams/day). At the end of the two-week study, adding almond to a healthy diet reduced lipoidosis, insulin resistance, and the cholesterol of participants with type 2 DM, while also increasing glycemic control (21). A similar study was conducted to examine the metabolic effects of polyunsaturated fatty acids during walnut consumption. Fifty overweight individuals with type 2 DM who did not use insulin consumed a low-fat diet (2000 kcal, 30% fat) for one year. The intervention group consumed approximately 30 grams of walnut derivatives in their diet. The preprandial insulin levels of those who consumed walnut sources significantly decreased in the first three months (22). A study conducted on nurses showed that the prevelance of type 2 DM among women who consumed a fatty seed (almond, walnut, peanut, hazelnut, etc.) for five times or more in a week was 27% lower than the rate for those who did not consume fatty seeds at all (23). Almond and walnut consumption ensures glycemic control for those with type 2 DM and reduces the risk of cardiovascular

disease (24). In a study conducted on individuals with type 2 DM, daily consumption of 200 ml blueberry juice for three months reduced fasting blood glucose, HbA1c and blood lipid levels (25).

Of the participants, 89.3% stated that they had not received counseling regarding functional foods before. The three most common information sources for functional foods were acquaintances or friends (71.2%), television (41.4%), health professionals (32.4%), or internet sources (32.4%). In a study conducted to determine individuals' attitudes towards functional foods, it was found that even scholars with the highest academic degrees did not have sufficient knowledge of functional foods. The most common reference source for functional foods used by participants was "acquaintances and friends," which is similar to the our study. Health professionals, (doctor/dietitian), advertisements, and company personnel, respectively, follow acquaintances and friends (6).

The current study analyzes whether participants consumed functional foods. Findings indicate that 53.6% used cinnamon, 51.0% consumed dietary fiber, 26.0% ate walnut, 24.5% consumed almond, 23.0% ate apples, and 19.9% used black cumin to balance their blood sugar levels. A study conducted in İzmir on academic staff awareness, acceptance, and attitudes towards functional foods indicated that the three most common functional foods participants consumed were mineral water, cereals that contained whole grain, and wholegrain dietary biscuits. Foods that contain plenty of grains were regarded as dietary fiber and the second most common food in our study (26). Dietary fiber, walnut, almond, and apple, which were all commonly consumed by participants, are among the foods recommended by the dietitians within the medicinal dietary treatments for diabetic individuals. The most commonly consumed functional foods can be attributed to counseling advice, with 75.5% of the participants receiving DM-related counseling from a dietitian before and 78.1% following a diabetic diet to balance blood sugar levels.

Age group, gender, educational level, marital status, the longest living place, and income-expense status were not found to have a significant effect on functional food consumption. Two studies conducted in Turkey indicate that educated young individuals are more inclined to consume functional foods (26). Studies conducted in USA suggest that functional foods are consumed more frequently by the middle-aged, highly-educated, female population (27). European women who are older than middle-aged and from high socioeconomic status use functional foods the most (28). The consumption of functional foods is more frequent among individuals with high educational and socioeconomic status. This can be attributed to the increase of health consciousness in popular culture. In addition, perceiving functional foods to be more expensive than other food products may prevent individuals with low socioeconomic status from buying and consuming these foods (6).

The presence of another chronic disease was not related to the consumption of functional foods. When a person with a chronic disease other than DM uses functional foods to balance their blood sugar level, care should be taken to make sure that the functional food(s) will not negatively affect the progression of the chronic disease. Functional foods are consumed more frequently by diabetic individuals that did not have cardiovascular disease than those who did. The reason why individuals that had both DM and cardiovascular diseases consumed less functional foods to balance their blood sugar levels may be attributed to the assumption that the functional food to be consumed may negatively affect the cardiovascular disease or interact with a medicine.

The effects of DM-related characteristics on the use of functional foods indicate that DM history in the family, thinking about the ability to control the blood sugar level, thinking about the compliance with treatment, using insulin, receiving nutritional counseling from a dietitian, and following a diabetic diet did not significantly affect the use of functional foods. Those who exercised regularly to regulate blood sugar levels used functional foods more frequently when compared to those who did not exercise, and the difference was significant. A study conducted to determine consumers' attitudes towards functional foods indicates that individuals who regularly exercise have more positive attitudes towards functional foods compared to those who do not exercise (6). This trend may be attributed to the assumption that individuals who exercised regularly seek non-medicinal solutions to lower their blood sugar level.

Receiving counseling on functional foods and acquaintances or friends being a source of information on functional foods did not significantly affect the use of functional foods. The internet and health professionals as information resources increase the rate of using functional foods. This may be attributed to general trust in health professionals and the internet.

Limitations

The greatest limitation of the current study is that it was conducted with the individuals who applied to the relevant polyclinic for DM and received healthcare. Educational and awareness levels of the individuals who live in the area around the endocrine polyclinic where the study was conducted were high, and the study was conducted with the individuals who already received healthcare, which prevent the generalization of the outcomes. In addition, data related to the balancing of blood sugar levels, exercising regularly, and following a diabetic diet were spontaneously collected in the first and only interviews with each person. This may be regarded as another limitation. Finally, only a few studies on diabetic individuals' awareness and consumption of functional foods have been conducted, which makes it challenging to compare results.

Strengths

Our study is the first study that examines diabetic individuals' awareness and consumption of functional foods in Turkey. All data were collected by the researcher. Findings from this study may guide diabetic individuals to pursue a better understanding of the specific features of functional foods. In addition, this study may show which subjects diabetic individuals need to educate about functional foods.

Conclusion

Diabetic individuals should be informed about functional foods that are becoming more popular and educated on the necessity of consulting a doctor or dietitian before consuming them. In addition, when diabetic individuals use functional foods, they may be harmed if they don't attention amount of usage. This should be the responsibility of doctors, dietitians, and all health professionals who meet with diabetic individuals.

The development of functional food science research and proper media coverage of consequent findings could lead to potential progress in the treatment of DM. Raising awareness of the society and increasing the number of studies measuring the frequency of knowledge levels and consumption frequencies are important. Although scientific studies indicate that foods affect our quality of life, it should be remembered that no food can create miracles and foods cannot be used as medicines for the treatment of diseases.

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