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An Infodemiological Study to Estimate Risk Factors of Urinary Incontinence Using Elastic Net Regression

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***Abstract*— Urinary incontinence is a health problem of having a higher prevalence in the society which is observed widely and affecting the life quality negatively. In this study, it is hereby aimed to determine the risk factors which lead to urinary incontinence and to assess the seasonality of it. This study was a cross-sectional research. In the study, infodemiologic procedures were used. Persons' nationwide, relative search volume for the words relevant with urinary incontinence and risk factors were obtained from the internet search engines during 2016-2021. Relative search volume values were received from Google Trends. Urinary incontinence reasonability was determined through seasonal decomposition. Risk factors' effect on urinary incontinence was evaluated through Elastic.net regression procedure. Search volume of the words relevant to urinary incontinence in internet search engines displays seasonality. Search volume of urinary incontinence in internet search engines between November and February is hereby determined to be higher than other months. Risk factors on urinary incontinence are; prostate, diabetes, kidney pain, constipation and menopause. In the study, infodemiologic procedures were being applied and it was determined that urinary incontinence is showing seasonality. Risk factors of urinary incontinence were estimated successfully. Relative search volumes obtained from Google Trends are able to be used for the estimation of the epidemiologic parameters of urinary incontinence in the society successfully. In researches, enabling to include more countries and more variables to the models may provide a contribution for the generalization of the results.**

***Index Terms*— Google Trends, Infodemiologic analysis, Seasonality, Urinary Incontinence.**

I. Introduction

URINARY INCONTINENCE is one of the disorders which is widely seen in the society. Urinary incontinence means an involuntary evacuation of urinary or excessive loss of urinary. There are different types of urinary incontinence such as; urge urinary incontinence, stress urinary incontinence and mixed urinary incontinence [1-4]. Urinary incontinence is a widely experienced disorder in the society. In Turkey, the prevalence of urinary incontinence between women of 17-80 age is hereby determined as 46, 3% averagely [5]. In terms of both genders, stress sourced urinary incontinence prevalence is found as %11, 1 approximately. Urinary incontinence particularly is observed more frequently in women over 60 [6].

People suffering from urinary incontinence problem tend to conceal the disorder because of feeling of the embarrassment [7]. People suffering from urinary incontinence do not go to the hospital as they are embarrassed and abstain from being treated [8]. This is a problem for finding the accurate prevalence of this disorder. In different researches, it was determined that urinary incontinence prevalence in women is between 8% - 45% [9]. This prevalence gets higher in pregnant women. In various researches, urinary incontinence prevalence in pregnant women seems to have a wider range [10]. As the patients hide their problem the prevalence in various researches gives different results. Patient hides their urinary incontinence disorder, so no homogeneous data can be obtained from the researches.

One of the methods applicable for the estimation of the prevalence of disorders in the society is infodemiologic researches. Infodemiology has introduced a new approach for obtaining health data in line with the advance of internet and computer technologies. Infodemiology was set forth by Eysenbach (2002). Infodemiology means the researches made on the distribution and dissemination of health-information and inaccurate information in the society [11]. Infodemiology may provide significant information about the contagion of epidemics in the society. Besides, infodemiology may provide important findings about the dissemination of inaccurate information in the society. Infodemiology provides a strong alternative with its advantages in terms of field researchs. Infodemiology; besides estimating the contagion of epidemics in the society may be also used for the estimation of the prevalence of seasonal and chronic diseases, estimation of symptoms of the diseases and for the determination of the society's attitudes against diseases.

Infodemiology researches' one of the most important data sources is the internet. Inquiries made for diseases on the internet by the society may provide important information thereof. One of the most popular tools of infodemiology which

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is used for the examination of inquires made in the internet search engines is Google Trends (https://trends.google.com/trends/?geo=TR). Google Trends is a free access portal which gives the users' relative search volume according to a specific region or time period belonging to inquiries made online on the internet search engine [12]. Google Trends has provided an important alternative for the researches in which obtaining data seems to be difficult. With Google Trends, important information can be provided in relation to disease prevalence, the contagion of epidemics and society's attitude towards diseases [13]. Google Trends has been applied for the estimation of the contagion of various epidemics in the society. Mavragani and Gkillas (2020), in their studies, utilized Google Trends data in order to estimate the contagion of Covid-19 in United States [14]. Morsy et al. (2018), in their studies, estimated the number of Zika virus cases that were seen in Brazil and Colombia by using Google Trends data [15]. Samaras et al. (2017), in their studies, utilized Google Trends data to model the syndromic surveillance flue cases in Italy and Greece [16]. With Google Trends, various researches have been made for the determination of society's mental health and society's behaviors. Parker et al. (2017), in their studies, for the estimation of deaths based on suicide used Google Trends data as well [17]. Google Trends data is used for model production for the determination of the seasonality of diseases. The prevalence of some diseases may vary seasonally. Google Trends data may be used for the examination of seasonal movements of diseases. Moccia et al. (2016), in their studies, utilized Google Trends data for the modeling of seasonal change of Multiple-Sclerosis disease [18]. Rossignol et al. (2013) utilized Google Trends data for the modeling of the seasonality of urinary tract infections. [19]. Zhang et al. (2018), used Google Trends data to reveal that the occurrence of cellulite changes seasonally [20].

The literature includes very little information about the seasonality of Urinary Incontinence. This study, to the best of our knowledge, is one of the primary studies in the literature in which the seasonality of urinary incontinence is assessed through infodemiologic procedures. In this study, in order to determine the urinary incontinence seasonality, an infodemiologic study has been planned. Besides, for the determination of factors that affect urinary incontinence, Google Trends data on urinary incontinence and risk factors within the last 5 years in Turkey were assessed.

II. MATERIAL AND METHODS

This study is a cross-sectional study. Infodemiologic research was made in the study. In the study, the relative search volume of the individuals in Turkey regarding urinary incontinence made on internet search engines was obtained for the period 15 February 2016 - 15 February 2021 in Turkey. Such data were obtained from Google Trends [12]. Google Trends assesses the words' rates of search in internet search engines between 0-100 points. The words' rate of search provided from Google Trends is defined as, Relative Search Volume (RSV). RSV values take place between 0-100 points. In the study, in order to find out the relative search volume of urinary incontinence in internet search volume, inquiries were made in Google Trends. These inquiries were made between 15 February 2016- 15 February 2021 and in Turkish and nationwide. For rates of search volume of urinary incontinence; in Google Trends inquiries, various definitions were searched. For the determination of the risk factors of urinary incontinence; words; "Prostate", "Diabetes ", "Renal Pain", "Constipation", "Vaginal infection, "Menopause", "Fistula" and "Cystitis" were searched in Google Trends".

A. ELASTIC.NET REGRESSION

Elastic.net regression is a resistant regression procedure against the higher correlation among independent variables. In fact, Elastic.net uses the techniques which are applied in Lasso regression and Ridge regression procedure together [21]. In higher dimensional data, successful estimations are achievable. In Lasso regression procedure; l_1 penalty coefficient is being applied, but in Ridge regression procedure l_2 penalty coefficient is applied. In Elastic.net regression calculations, l_1 and l_2 coefficients are used together. The basic purpose of Elastic.net regression is; with $l_1$and l_2 coefficients, to obtain the coefficient which minimizes the error sum of squares [22].

B. STATISTICAL ANALYSIS

The conformity of the variables to normal distribution was examined with the Kolmogorov- Smirnov test. In variables which comply with normal distribution, for the comparison of RSV values in terms of months, Anova test was applied. For the determination of differences in terms of months, Tukey HSD test and Tamhane T2 test was applied. For the determination of seasonality, a seasonal decomposition procedure was applied. The relation between quantitative variables was examined by Pearson correlation test. The effect of risk factors over urinary incontinence values was assessed by Elastic.net regression procedure. Statistical parameters were defined with Mean±Standard Deviation. Statistical significance was accepted; $p<0.05$. For the assessment of data, IBM SPSS Statistics version 22 (IBM SPSS for Windows version 22, IBM Corporation, Armonk, New York, United States) and R 3.3.2 statistical software was utilized.

III. RESULTS

In the study, urinary incontinence cases' seasonality was examined. In figure 1, during 2016-2021, a change of RSV values regarding urinary incontinence in internet search engine in Turkey was specified. Urinary incontinence RSV values were observed to increase in winter and decrease in summer. During 5 years period, for every year, in winters, RSV values rose up and declined in summer.

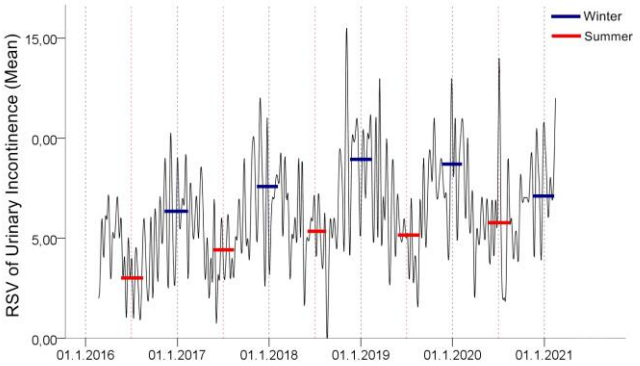

Fig.1. The change of RSV values of urinary incontinence between 2016-2021 in Turkey

For the determination of urinary incontinence seasonality, a seasonal decomposition procedure was applied. Urinary incontinence RSV values' seasonal factors effect was assessed. In winter and autumn, RSV values related to urinary incontinence were observed to increase importantly whereas these values tended to decrease in spring and summer. Findings relevant to urinary incontinence's seasonality are defined in figure 2. Urinary incontinence's RSV values display seasonality.

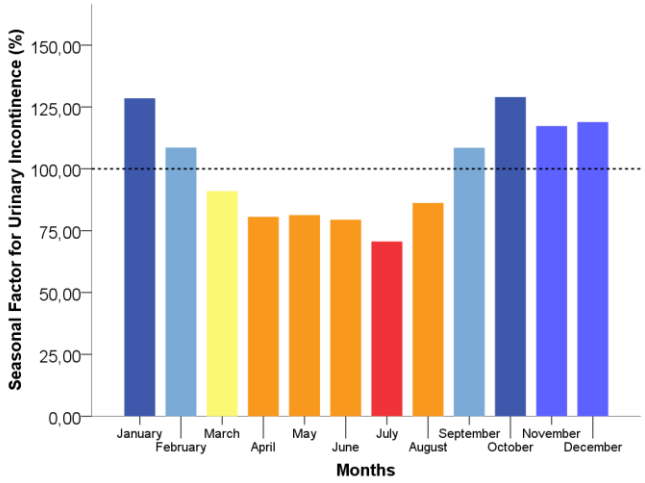

Fig.2. Seasonality of Urinary Incontinence

In the study, risk factors affecting urinary incontinence were evaluated. It is hereby determined that the relation of urinary incontinence RSV values with renal pain, prostates, diabetes, menopause, vaginal infection and fistula RSV values are statistically significance ($p<0.05$). Findings were determined in Table 1. The effect of risk factors on urinary incontinence RSV values was evaluated. The most important variables which explain the change in urinary incontinence was determined respectively as Prostates, Diabetes and renal pain. Prostates, diabetes and renal pain, menopause and constipation affect urinary incontinence significantly. The most important variables which explain the change in urinary incontinence were defined in figure 3. Effects of independent variables on urinary incontinence were assessed by Elastic.net regression.

In Table 2, the effect of independent variables over urinary incontinence was estimated. Prostates, renal pain, diabetes, constipation and menopause were seen to have affected the urinary incontinence substantially.

TABLE I
CORRELATION BETWEEN RISK FACTORS AND URINARY INCONTINENCE

	Urinary Incontinence	
	r	p
Constipation	0,058	0,352
Cystitis	0,062	0,321
Renal Pain	0,257	**p<0,001***
Prostate	0,348	**p<0,001***
Diabetes	0,332	**p<0,001***
Menopause	0,173	**0,005***
Vaginal Infection	0,130	**0,036***
Fistula	0,182	**0,003***

Pearson Correlation Test;α:0.05; *Correlation is statistically significant

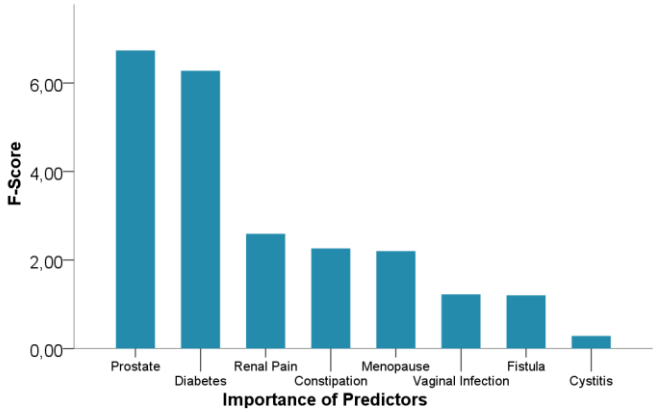

Fig.3. Importance of risk factors in terms of urinary incontinence

TABLE II
EFFECTS OF RİSK FACTORS ON URINARY İNCONTİNENCE

Predictor Variables	Regression Coefficient
Constant	0.062
Constipation	0.001
Renal Pain	0.073
Prostate	0.065
Diabetes	0.051
Menopause	0.026

Elastic net regression:Dependent variables: Urinary Incontinence; MAE:1.823;RMSE:2.316; R^2:0174

The difference between the RSV values of urinary incontinence and risk factors in terms of months are defined in table 3. The difference were determined among urinary incontinence, Prostate, cystitis, constipation, diabetes, renal pain and fistula RSV values in terms of months ($p<0.05$). RSV values of urinary incontinence, renal pain, diabetes and prostate are higher in November compared to other months. The change in RSV values of renal pain, diabetes and prostate in terms of months show similarity with the change in urinary incontinence.

TABLE III
COMPARISON OF RSV VALUES OF RISK FACTORS AND URINARY INCONTINENCE BY MONTHS

	Urinary Incontinence Mean±SD	Constipation Mean±SD	Cystitis Mean±SD	Renal Pain Mean±SD	Prostate Mean±SD	Diabetes Mean±SD	Menapause Mean±SD	Vaginal Infection Mean±SD	Fistula Mean±SD
December	7,39±2,90	49,43±7,58	10,65±2,44	17,04±4,94	44,38±8,74	36,52±6,72[l]	22,04±4,82	2,09±1,35	7,61±2,74
January	7,61±1,64	53,00±4,70	11,22±1,59	16,91±4,32	46,48±6,89	32,13±5,30[l]	**23,00±5,57**	2,17±1,15	7,70±2,12
February	7,58±2,85	51,74±6,12	11,05±3,92	16,11±4,51	47,74±10,81	33,84±6,79[l]	22,89±4,33	2,21±1,40	7,84±2,93
March	6,50±2,50	49,68±7,37	10,32±2,97[i]	16,09±4,00	45,00±14,85	35,32±5,95[l]	21,23±5,65	2,45±1,34	7,23±2,69
April	5,68±1,84	51,82±10,93	10,91±2,99	16,00±4,92	38,27±8,68	33,18±5,40[l]	19,64±3,99	1,91±1,11	7,09±2,31
May	5,32±1,96[k]	**53,14±16,68**	10,82±2,54	14,68±3,12	40,73±7,09	31,73±6,66[l]	20,45±4,91	1,91±1,11	6,18±1,97
June	4,71±1,71[l]	46,14±6,92	12,38±2,96	13,67±3,40[l]	38,24±8,80	26,57±3,92[l]	21,00±4,99	2,05±0,97	7,14±2,31
July	4,61±2,68[l]	44,65±7,28[f]	12,74±2,80	13,61±3,16[l]	40,78±12,95	24,30±5,38[l]	19,30±3,95	1,96±1,36	6,74±2,36
August	4,24±2,05[l]	46,67±6,58	**12,81±3,08**	15,24±3,33	37,24±7,55[l,b]	24,57±4,74[l]	21,19±4,15	2,43±1,21	5,81±2,46[k]
September	5,55±1,97[l]	42,00±4,82[f]	11,91±2,22	15,23±3,32	40,91±6,60	25,23±4,98[l]	22,05±3,67	2,59±1,44	6,14±1,98
October	6,91±2,02	44,91±6,02[f]	12,23±2,93	16,05±3,48	43,00±7,80	30,55±5,49[l]	21,32±5,48	**2,68±1,67**	**8,18±2,67**
November	**7,86±2,87**	43,90±4,39[f]	11,33±2,37	**18,62±4,44**	**47,96±8,51**	**54,43±22,12**	20,00±4,57	2,29±1,27	7,24±3,10
p	p<0.001*	p<0.001*	0.023*	0.002*	p<0.001*	p<0.001*	0.179	0.526	0.042*

Anova ;α:0.05; Post-hoc: Tukey HSD test; Tamhane T2 test;*Statistical significance; [a]Significant difference with December values; [b] Significant difference with January values; [c] Significant difference with February values; [d] Significant difference with March values; [e] Significant difference with April values; [f] Significant difference with May values; [g] Significant difference with June values; [h] Significant difference with July values; [i]Significant difference with August values; [j] Significant difference with September values; [k]Significant difference with October values; [l] Significant difference with November values

IV. Discussions

Urinary incontinence is an important health problem affecting the individuals' life quality negatively [23]. For the treatment of urinary incontinence, the factors causing this situation should be determined correctly. There are various factors causing urinary incontinence. Age, gender, sociologic and psychologic factors, physical factors, comorbid diseases may be listed. People generally do not prefer to go to the hospital due to the sense of embarrassment or being blamed [24]. Alternatively, in order to get information about urinary incontinence, people are getting informed by using internet search engines and try to find the reasons and treatment methods thereof. In this study, the seasonality of urinary incontinence and factors causing it were researched through infodemiologic procedures. In the study, relative search values for urinary incontinence in internet search engine were assessed. RSV values of the terms relevant to urinary incontinence were reached by Google Trends.

Some diseases may show seasonality depending on environmental and physiological properties. Most of the contagious diseases may show seasonality [25]. Rotavirus shows seasonality in tropical climates and more rotavirus cases are seen in cold air [26]. Watad et al.(2017) in their studies, stated that autoimmune diseases may be affected by environmental factors, Type 1 Diabetes Mellitus and Multiple Sclerosis diseases. Autoimmune diseases change seasonally and are observed more in spring. [27]. Rosello et al. (2018), in their studies, stated that urinary tract infections show seasonality. Urinary tract values infection is mostly observed in September-November period [28]. In our study, urinary incontinence's seasonality was evaluated by infodemiologic researches. The research was made nationwide in Turkey. Weather is generally hot in spring (March-April-May) and summer (June-July-August) whereas the weather is cold in autumn (September-October-November) and winter (December-January-February). In our study, it is determined that urinary incontinence reveals seasonality. In the study, November was found to have the highest urinary incontinence values. RSV values relevant to urinary incontinence were observed to reach at the highest level between November-February periods.

Different risk factors lead to urinary incontinence to occur. Urinary incontinence may be observed more by some factors such as; physical disorders, higher age, obesity and gender [29]. Urinary incontinence is observed more in women. Urinary tract infection, intestinal obstruction, vaginal birth, menopause, hormonal disorders are defined as important risk factors for urinary incontinence for women [30-31]. Diabetes, body mass index is the most important risk factor for women; whereas advanced age, prostate, cystitis and urinary tract infection is the most important risk factor for urinary incontinence for men [32]. In this study, for the determination of risk factors relevant with urinary incontinence, an infodemiologic research was made. Besides the 5 years RSV values of urinary incontinence, 5 years- RSV values of the words; prostate, constipation, renal pain, vaginal infection cystitis, menopause, diabetes and fistula were also researched. Prostate, diabetes, menopause, constipation and renal pain were observed to be the factors affecting urinary incontinence. Our findings provided various results which are compliant with the literature.

The study involves some constraints. In the study, Relative Search Volumes of the words relevant to urinary incontinence which are searched by the people in internet search engines were evaluated. Apart from the risk factors specified in the study, despite different risk factors affecting urinary incontinence, these factors were not included into the study as they have not been searched on internet search engines. Urinary incontinence and risk factors are searched under different names in the society. Therefore in Google Trends inquiries, the most used terms thereof have been researched. The study was conducted in Turkey only. As the genders, ages and comorbid diseases of the searchers are not known, the data in the study were not assessed according to age, gender and comorbid diseases. In literature, as there is not a known research made for urinary incontinence's infodemiologic

researches, the findings of the study were not compared with the literature.

V. Conclusion

In this study, an infodemiologic research was made for the determination of the seasonality of urinary incontinence and the risk factors affecting it. In the study, RSV values in Google Trends regarding urinary incontinence and risk factors were evaluated in Turkey for the period 2016 – 2021. According to the findings, urinary incontinence reveals seasonality. The highest rate of urinary incontinence case is observed between November-February. Risk factors affecting this disease were determined. Prostate, diabetes, renal pain, constipation and menopause affect urinary incontinence. With RSV values obtained from Google Trends, successful estimations have been made for the determination of seasonality relevant to urinary incontinence and for the evaluation of risk factors thereof. By including more risk factors in the study, the research's estimation achievement may be increased. Including different countries into the study may provide a contribution to the generality of the findings. For the researches in which various difficulties are encountered for the determination of prevalence, infodemiologic researches may an important alternative to field researches.

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