Original Article

The Development of an Assessment Model for the Risk of Breast Cancer: Comparison with Gail and Ibis Models

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Abstract

Background: The high incidence of breast cancer in women and the increasing incidence are of vital importance.

Objective: The research was conducted in methodological design with the aim of developing a valid and reliable model f or assessing the risk of breast cancer among women.

Methods: The research was conducted in methodological design with the aim of developing a valid and reliable model for assessing the risk of breast cancer among women. The sample of the study consisted of 800 individuals, 271 of whom had breast cancer, 270 of them was at risk of breast cancer, and 259 of them were healthy, who applied to. A chi-square analysis was performed to investigate the relationship between categorical variables and breast cancer. Logistic regression with LASSO editing with 10-fold cross-validation was used in the built models.

Results: Socio-demographic characteristics, hormonal characteristics, and family cancer history were found to be significant in the breast cancer group compared to the other groups ($p<0.05$). The total mean score of the Healthy Lifestyle Behavior Scale was found to be significantly lower in the breast cancer group compared to the other groups ($p<0.05$).

Conclusion: The calculation score of the risk of breast cancer of the Gail and IBIS models was found to be low. The model developed was found to be more powerful in determining the risk of breast cancer compared to the Gail and IBIS models.

Keywords: Breast Cancer, Nursing, Risk Assessment, Model Development, Gail, IBIS

Introduction

Breast cancer is an important public health problem due to the increasing incidence of morbidity and mortality worldwide (Aker et al., 2015). It is the most common type of cancer among women and is the first cause of death. The incidence of breast cancer in the world is 38.9 per hundred thousand, and the incidence in Turkey is 40.7 per hundred thousand (Demirel & Golbasi, 2015). Considering these rates, the fact that it is common, its incidence is increasing day by day, its detection in the early stages increases the chance of treatment, and its easy diagnosis in today's technology increases the importance of breast cancer and its treatment.

Many risk factors are defined because of the heterogeneity of breast cancer in its etiology (Eroglu et al., 2010). These risk factors are divided into genetic and non-genetic factors. A family history of breast cancer is important, even if there is no genetic mutation, 10-20% of patients diagnosed with breast cancer have a family history (Demirkazik , 2014). The majority of hereditary breast cancers are associated with BRCA1 and BRCA2 mutations, and the majority of breast cancers are known as "hereditary breast and ovarian cancer syndrome", which is due to BRCA1 and BRCA2 mutations (Bolton et al; 2012). The risk of BRCA1 mutation is 5-10% higher than the risk of BRCA2 mutation (Shiovitz & Korde, 2015). Non-genetic factors are age, gender, race, age at menarche, number of births, age of menopause, number of breast biopsies, history of atypical hyperplasia, and dense breast structure (Kocak et al., 2011). In recent years, lifestyle behaviors such as nutrition, obesity, and physical activity have been accepted as important risk factors in breast cancer as well as in all types of cancer (Yilmaz & Atak, 2015). Although important steps have been taken regarding awareness in recent years, breast cancer threatens society materially and morally every day. The most important step to be taken in reducing this threat is for all societies to create their own risk assessment models (Aslan & Gurkan, 2007). There are several assessment tools for the risk of breast cancer in use today. The earliest models are the Gail, Claus, and Tyrer-Cuzick models. While the Gail model considers factors such as the current age of the woman, age at menarche, age of the first birth, number of breast biopsies, atypical hyperplasia, and the number of relatives with breast cancer, the Gail model does not predict risk in those with BRCA1/2 mutations (Engel & Fishcer, 2015). The Claus model, on the other hand, does not include non-hereditary factors when considering age, diagnosis of the first and second-degree relatives, and the age of relatives (Advani & Moreno, 2014). In Tyrer-Cuzick, besides BRCA1/2 genes, body mass index, menopausal age, benign breast diseases are also questioned. It is a more comprehensive model than Gail and Clausa. However, in this model, lifestyle behaviors such as nutrition and exercise, which play an important role in the etiology of cancer, are not questioned (Advani & Moreno, 2014). However, healthy lifestyle behaviors are strongly associated with breast cancer. A prospective study by Mckenzie et al. (2015) evaluated the relationship between a healthy lifestyle index (including a healthy diet, moderate and vigorous physical activity, avoidance of smoking and alcohol consumption, and low BMI) and the risk of breast cancer among women, and the patients were followed for 10 years, it was found that those diagnosed with cancer have more unhealthy lifestyle behaviors (Mckenzie et al., 2015). This situation reveals the necessity of lifestyle behaviors of the individual in the assessment models for the risk of breast cancer.

Although there are some assessment models for the risk of breast cancer, no current calculator for the risk of breast cancer is available. In the present study, it was aimed to build a model that can distinguish healthy individuals and breast cancer patients by examining many factors that may cause breast cancer.

Methods

The study was carried out in a methodological design. The research was carried out between the dates of December 1, 2018, and September 30, 2019 at Adana City Training and Research Hospital and Cukurova University, Medical Faculty, Balcali Hospital. All of the patients (271 patients with breast cancer, 270 patients with the risk of breast cancer, 259 healthy patients, and a total of 800 patients) who underwent surgery for breast cancer in the general surgery clinics of these hospitals, applied to the general surgery polyclinics for a breast mass, to the interventional radiology units for biopsy and to the radiology units for breast control were included.

- The sample of **patients with breast cancer** consisted of patients who applied to the general surgery outpatient clinics and clinics of the mentioned hospitals for breast cancer, were diagnosed with breast cancer as a result of biopsy in interventional radiology, and accepted to participate in the study.
- The sample of the breast cancer risk group consisted of patients with benign biopsy results in the interventional radiology units of the mentioned hospitals. Fifteen patients with cysts as a result of the biopsy were excluded from the study.
- The sample of the healthy group consisted of patients who applied to the radiology units of the mentioned hospitals for breast control and who did not have cancer or a mass in the breast as a result of the control. In the healthy group, mammography was used for patients aged 40 years and older, and ultrasonography

was used as diagnostic criteria for patients under 40 years of age.

Establishing the Item Pool of the Assessment Model for the Risk of Breast Cancer: The model was created as a result of three-stage studies and analyzes:

-In the first stage, literature information (Aslan & Gurkan, 2007; Erdem et al., 217; Acikgoz & Yildiz, 2017; Ozcelik, 2018; Ozmen, 2012) related to the factors playing a role in the etiology of breast cancer was collected and grouped to form a draft of the questionnaire. At this stage, 30 questions were created in line with the literature, including breast cancer risk factors (breast-related characteristics, past cancer history, family history, genetic tests, hormonal factors, smoking and alcohol use, and healthy lifestyle). (Table 1 and Table 2).

- In the second stage, the strengths and weaknesses of the assessment tools for the risk of breast cancer such as Gail, Claus, IBIS or Tyrer–Cuzick Model, BOADICEA, BRCAPRO, and Jonker Models were analyzed and added to the draft model (Nickson et al., 2018; Himes et al., 2016; Antoniou et al., 2004). At this stage, the risks of the healthy, at-risk, and breast cancer groups were calculated from the online risk calculation pages of the Gail and IBIS models compared in the study. (Table 4 and Table 6).

- In the third stage, the "Healthy Lifestyle Behavior Scale" (Walker et al., 1996), which evaluates the healthy lifestyle that includes many causes of breast cancer, and whose validity and reliability have been proven internationally and nationally, was also included among the components of the model. At the end of these stages; The scoring of the factors that distinguish the healthy group from the patient group was performed with the β coefficient (Mass in the breast, Breast and armpit mass, Not knowing atypical hyperplasia, The total score of the subscale of Health responsibility) and The β coefficient was used to score the factors that distinguish the risk group from the patient group (Primary school, High school, University, Living in district, Age, BMI, Low income, Quitting smoking, Smoking, Mass in the breast and armpit, Leakage in the breast, Changes in the image of the breast, Prior history of breast cancer, Presence of atypical hyperplasia, Not knowing atypical hyperplasia, The presence of benign biopsy, Genetic test availability, OKS usage, Receiving in vitro fertilization treatment, The score of the subscale of Interpersonal relationship, The score of the subscale of nutrition, The score of the subscale of health responsibility, The score of the subscale of physical activity, The score of the subscale of spiritual development) (Table 3 and Table 5).

The Healthy Lifestyle Behavior Scale: Health behaviors of individuals were collected with the "Healthy Lifestyle Behavior Scale". The scale was developed by Walker et al. (1987) and revised again in 1996 (Walker et al., 1996). Turkish validity and reliability of the scale were performed by Bahar et al. (2008). The scale measures health-promoting behaviors associated with an individual's healthy lifestyle. The scale consists of 52 items in total and has 6 subscales. Those are spiritual development, health responsibility, physical activity, nutrition, interpersonal relationships, and stress management.

Statistical Analysis - Exploratory analysis and Supervised analysis: To visualize the data from a multivariate point of view, we performed a Principal Component Analysis (PCA). The normality of the numerical variables was tested by Shaphiro Wilk test. To compare 3 groups for numerical data Kruskal Wallis and Dunn multiple comparison tests (for non-normal data) were used as univariate analysis. Furthermore, a Chi-square analysis was performed to investigate the relationship between categorical variables and study groups. Bonferroni correction was used for subgroup analysis of the significant Chi-square test. Ideally, significance was determined by a p-value below 0.05.

Predictive modeling: For modeling, overall data was randomly split into 2 parts; 2/3 of it was used for building the model (train data), 1/3 was used for validation (test data). Logistic regression with LASSO regularization with 10-fold cross-validation was used to build models. LASSO models were performed by using the glmnet package in R and Medcalc package version 18.10.2 respectively. All univariate analysis was performed in SPSS for windows, version 22.0.

Results

A total of 800 individuals were included in the study. Of these, 271 individuals (33.9%) were diagnosed with breast cancer, 270 individuals (33.8%) were in the risk group, and 259 individuals (32.4%) were completely healthy. The mean age of the group of breast cancer was 53.32 ± 12.57 (min-max: 18-87). When the groups were compared in terms of age, the breast cancer group (p=0.001) was statistically significantly older than both the risk group (p=0.001) and the healthy group (p=0.037). It was determined that the group of breast cancer had a higher BMI than the other groups (29.26±5.80, p:0.001), the percentage of the lifetime risk of the Gail model (11.17 ± 20.77, p:0.001) and the lifetime risk of the IBIS model (12.33 ± 10.01, p:0.001) were high. It was discovered that the Healthy Lifestyle Behavior Scale's (HLBS) total score was (82.21±12.24, p: 0.001), the number of illiterate patients (145 patients (53.5%), p:0.001), the patients with a low level of income (215 patients (%) 79.3), p: 0.001), smoking patients (218 patients (80.4%), p: 0.011) was high, and the percentage of patients who were using alcohol (1 patient (0.4%), p: 0.020) were found to be low (Table 1).

Compared with other groups, in the group of breast cancer, the percentages of breast and axillary mass (147 patients (54.2%), p: 0.001), breast discharge (88 patients (32.5%), p: 0.001), changes in the appearance of the breast (142 patients (52.4%), p: 0.001), removal of ovaries (51 patients (18.8%), p:0.001), not knowing the presence of atypical hyperplasia (202 patients (74.5%), p:0.001), having breast cancer in first degree relatives (35 patients (12.9%), p: 0.001), those who gave birth over the age of thirty (38 patients (14%), p:0.016), breastfeeding of three children or more (139 patients (51.3%), p:0.001), menarche between the ages of 9-11 (28 patients (10.3%), p: 0.001), the percentage of menopausal in the 45-54 age range (108 patients (39.9%), p: 0.001) were high (Table 2).

After applying univariate analysis for potential risk factors for breast cancer, LASSO (Least Absolute Shrinkage and Selection Operator) regression was applied to estimate regression coefficients for significant factors. After applying Lasso regression only four variables remained significant for health and breast cancer patient classification. Lasso regression coefficients for significant variables were given in Table 3. The sensitivity of the model was 93%, specificity of the model was 95.8% and the accuracy of the model was 94.3%. (Mass in the breast, β=14.24), breast and armpit mass was β=14.25, not knowing atypical hyperplasia was β=0.32, the total score of the subscale of Health responsibility was β=-0.034(Table 3).

Our model's results were also compared to available risk models for breast cancer prediction. The results were given in Table 4.

Several variables remained significant based on the Lasso regression results to distinguish breast cancer patients and patients with a high risk of breast cancer. Lasso regression analysis results were given in Table 5. (University graduate (β=1,647), Breast and axillary mass (β=2.144), Changes in the image of the Breast (β=1,971), Previous breast cancer history (β=1,404), Presence of atypical hyperplasia (β=2.241)).

The sensitivity of the model was 75.3%, the specificity of the model was 61.9%, and the accuracy of the model was 68.6%.(Table 5).

Our model's results were also compared to available risk models for the prediction of the risk of breast cancer. The results were given in Table 6.

Table1.Socio-demographic characteristics of the groups

Socio-demographic characteristics	Groups			Statistical analysis	
	Breast Cancer (n=271)	Patients with high breast cancer risk (n=270)	Healthy (n=259)		
	Mean±SD	Mean±SD	Mean±SD	KW	P

Age(Min:18, Max:87)	53.32±12.56	43.49±11.72^A	46.51±13.83^AB	78.14	0.001*
BMI	29.26±5.80	27.49±5.34 ^A	26.93±5.04 ^A	26.58	0.001*
Risk model scores					
Gail 5-years risk	1.69 ± 2.74	1.07 ± 0.7 ^A	0.96 ± 0.48 ^A	55.53	0.001*
Lifetime risks	11.17 ± 20.77	10.34 ± 3.73 ^A	8.25 ± 2.88 ^AB	30.74	0.001*
IBIS 10-years risk	3.82 ± 5.54	2.19 ± 1.87 ^A	1.85 ± 1.14 ^A	91.75	0.001*
IBIS Lifetime risks	12.33 ± 10.01	12.84 ± 6.46 ^A	10.11 ± 3.88 ^A	25.34	0.001*
Healthy Lifestyle Behavior Scale (HLBS)					
Total score	82.21±12.24	93.30±15.99^A	99.53±11.88^AB	197.71	0.001*
Interpersonal Relationship	17.56±3.27	20.92±3.99^A	21.38±2.74^A	172.29	0.001*
Spiritual Development	16.66±3.11	19.31±3.38^A	20.24±2.78^AB	159.50	0.001*
Health Responsibility	12.69±2.62	14.73±3.16^A	17.16±3.06^AB	246.31	0.001*
Nutrition	14.34±2.61	15.18±3.38^A	15.38±2.43^A	23.18	0.001*
Physical Activity	8.43±0.98	9.03±1.74^A	9.70±2.06^AB	86.94	0.001*
Stress Management	11.23±1.97	12.45±2.45^A	13.87±2.34^AB	170.04	0.001*
	n(%)	**n(%)**	**n(%)**		
Marital status				26.14	0.001*
Married	194 (71.6)	210 (77.8)	195 (75.3)		
Single	22 (8.1)	40 (14.8)^A	26 (10)		
Divorced	20 (7.4)	13 (4.8)	14 (5.4)		
Widow	35 (12.9)	7 (2.6)^A	24 (9.3)^B		
Educational level				36.47	0.001*
Illiterate	56 (20.7)	35 (13) ^A	29 (11.2)^A		
Primary school	145 (53.5)	140 (51.9)	104 (40.2)^AB		
High school	35 (12.9)	59 (21.9)^A	67 (25.9)^A		
University or postgraduate	35 (12.9)	36 (13.3)	59 (22.8) ^AB		
Place of residence				41.57	0.001*
Province	160 (59)	184 (68.1)	212 (81.9)^AB		
District	48 (17.7)	41(15.2)	34 (13.1)		
Village	36 (23.2)	45 (16.7)	13 (5)^AB		
Employment Status				20.59	0.002*
Unemployed	233 (86)	234 (86.7)	192 (74.1)^AB		
8 hours or less	21 (7.7)	22 (8.1)	35 (13.5)		
Over 8 hours	17 (6.3)	14 (5.2)	32 (12.4)^AB		
Occupation				19.27	0.003*

Housewife	233 (86)	234 (86.7)	192 (74.1)^AB		
In shift	11 (4.1)	13 (4.8)	17 (6.6)		
No shift	27 (10)	23 (8.5)	50 (19.3)^AB		
Household Income				81.36	0.001*
Less than income	215 (79.3)	184 (68.1)^A	110 (42.5)^AB		
Smoking Status				13.15	0.011*
Yes	40 (14.8)	68 (25.2)^A	63 (24.3)^A		
No	218 (80.4)	193 (71.5)^A	180 (69.5)^A		
Quitted	13 (4.8)	9 (3.3)	16 (6.2)		
Alcohol Use				7.783	0.020*
Yes	1 (0.4)	6 (2.2)	10 (3.9)^A		

*Significant at 0.05 level; Kruskal Wallis and Dunn test for numerical data, Chi-square and Bonferroni test for categorical data. A: Significantly different from the breast cancer group. B: Significantly different from the group of patients with high risk of breast cancer

Table 2. Univariate analysis results for the determination of risk factors for breast cancer and high-risk groups.

Variables (n(%))	Breast Cancer (n=271)	Patients with high breast cancer risk (n=270)	Healthy (n=259)	X^2	P
Mass in the breast				1034.6	0.001*
Only on breast	124 (45.8)	257 (95.2)^A	0 (0)		
Breast and lymph	147 (54.2)	13 (4.8)^A	0 (0)		
Leakage in the breast	88 (32.5)	29 (10.7)^A	0 (0)	116,74	0.001*
Changes in the image of the breast	142 (52.4)	21 (7.8)^A	0 (0)	263.9	0.001*
A previous history of breast cancer	45 (16.6)	11 (4.1)^A	0 (0)	61.45	0.001*
Taking ovaries	51 (18.8)	30 (11.1)^A	21 (8.1)^A	14.64	0.001*
Atypical hyperplasia				258.76	0.001
Yes	4 (1.5)	1 (0.4)	0 (0)		
No	65 (24)	132 (48.9)^A	240 (92.7)^AB		
I don't Know	202 (74.5)	137 (50.7)^A	19 (7.3)^AB		
Bening biopsy	77 (28.4)	84 (31.1)	0 (0)	97.11	0.001*
Over cancer	2 (0.7)	2 (0.7)	0 (0)	1.91	0.490
Radiotherapy in childhood	4 (1.5)	0 (0)	0 (0)	7.84	0.020*
Having previous BRCA gene test	33 (12.2)	3 (1.1)^A	0 (0)	56.58	0.001*
Breast cancer in the family				29.63	0.001*
No	187 (69)	211 (78.1)^A	219 (84.6)^A		
Third degree relative	18 (6.6)	18 (6.7)	21 (8.1)		

Second degree relative		31 (11.4)	20 (7.4)	11 (4.2)A		
First degree relative		35 (12.9)	21 (7.8)	8 (3.1)A		
Ovarian cancer in the family		12 (4.4)	8 (3)	1 (0.4)A	8.647	0.013*
Genetic testing in the family					17.55	0.002*
No		258 (95.2)	267 (98.9)A	257 (99.2)A		
The result is negative		6 (2.2)	3 (1.1)	2 (0.8)		
The result is positive		7 (2.6)	0 (0)	0 (0)		
Family history of other cancer	No	131 (48.3)	131 (48.5)	144 (55.6)		
Third degree relative		15 (5.5)	15 (5.6)	32 (12.4)AB		
Second degree relative		47 (17.3)	65 (24.1)	45 (17.4)		
First degree relative		78 (28.8)	59 (21.9)	38 (14.7)A		
Age of the first birth						
Under 30		205 (75.6)	217 (80.4)	210 (81.1)	12.22	0.016*
30 years and older		38 (14)	18 (6.7)A	17 (6.6)A		
No children		28 (10.3)	35 (13)	32 (12.4)		
Breast-feeding						
>3 children		139 (51.3)	92 (34.1)A	85 (32.8)A	34.74	0.001*
2 child		52 (19.2)	90 (33.3)A	93 (35.9)A		
1 child		30 (11.1)	32 (11.9)	42 (16.2)		
No breastfeeding		50 (18.5)	56 (20.7)	39 (15.1)		
Age at Menarche (years)					48.53	0.001*
≥15		36 (13.3)	40 (14.8)	85 (32.8)AB		
12-14		207 (76.4)	208 (77)	169 (65.3)AB		
9-11		28 (10.3)	22 (8.1)	5 (1.9)AB		
Hormonal contraception		86 (31.7)	99 (36.7)	90 (34.7)	1.482	0.47
IVF treatment		12 (4.4)	3 (1.1)	3 (1.2)	8.84	0.012*
Menopausal					46.54	0.001*
No menopause		119 (43.9)	184 (68.1)A	165 (63.7)A		
35-44		28 (10.3)	27 (10)	17 (6.6)		
45-54		108 (39.9)	57 (21.1)A	70 (27)A		
≥55		16 (5.9)	2 (0.7)A	7 (2.7)		
HRT therapy					6.816	0.033*
≥5		14 (5.2)	6 (2.2)	4 (1.5)		
No		257 (94.8)	264 (97.8)	255 (98.5)		

*Significant at 0.05 level; Kruskal Wallis and Dunn test for numerical data, Chi-square and Bonferroni test for categorical data. A: Significantly different from Breast Cancer group. B: Significantly different from the patients with high risk of Breast Cancer

Table 3. Lasso regression coefficients and Principal component analysis scores for the variables used to separate the Patient/Healthy group and found to be significant

Variable	(Invariant)	Breast mass	Mass in the breast and armpit	Not knowing the atypical hyperplasia	The total score of the subscale of health responsibility
β for Lasso	-6.69	14.24	14.25	0.32	-0.034

β: Regression coefficient

Table 4. The Comparison of Classification Performances of Gail and Tyrer Cuizck (IBIS) Models with the Model Created in the Patient/Healthy Groups

	Groups			Predicted
	Observed	**Breast Cancer**	**Healthy**	
Gail 5 years	**Patient**	185	71	Sensitivity =72,3
	Healthy	82	121	Specificity =59,6
	Accuracy			66,7
	Patient	186	70	Sensitivity =72,7
	Healthy	152	51	Specificity =25,1
	Accuracy			51,6
IBIS 10 years	**Patient**	176	89	Sensitivity =66,4
	Healthy	84	173	Specificity =67,3
	Accuracy			66,9
	Patient	131	135	Sensitivity =49,2
	Healthy	122	137	Specificity =52,9
	Accuracy			51,0

Table 5. Lasso regression coefficients to distinguish breast cancer patients and Patients with a high risk of breast cancer

Primary school	High school	University	Living in district
β=0.663	β=0.926	β=1.647	β=0.678
Age	**BMI**	**Low income**	**Quitting smoking**
β=0.042	β=0.003	β=-0.054	β=-0.107
Smoking	**Mass in the breast and armpit**	**Leakage in the breast**	**Changes in the image of the breast**
β=-0.866	β=2.144	β=0.882	β=1.971

Prior history of breast cancer	Presence of atypical hyperplasia	Not knowing atypical hyperplasia	The presence of bening biopsy
β=1.404	β=2.241	β=0.459	β=-0.674
Genetic test availability	**OKS usage**	**Receiving in vitro fertilization treatment**	**The score of the subscale of Interpersonal relationship**
β=1.163	β=-0.598	β=0.779	β=-0.156
The score of the subscale of nutrition	**The score of the subscale of health responsibility**	**The score of the subscale of physical activity**	**The score of the subscale of spiritual development**
β=0.102	β=-0.058	β=-0.069	β=-0.074

β=Lasso regression coefficients.

Table 6. The Comparison of the Classification Performances of Gail and Tyrer Cuizck (IBIS) Models in the Patient/At-Risk Groups with the model created

		Estimated		
		Groups		
	Observed	Patient	Risk	%
Gail 5 years	**Patient**	185	71	Sensitivity=72.3
	Risk	101	113	Specificity =52.8
	Accuracy			63.4
Gail lifetime		**Patient**	**Risk**	**Percentage**
	Patient	256	0	Sensitivity=100
	Risk	214	0	Specificity =0
	Accuracy			54.5
IBIS 10 years	**Patient**	134	131	Sensitivity=50.6
	Risk	69	189	Specificity =73.3
	Accuracy			61.8
IBIS lifetime		**Patient**	**Risk**	**Percentage**
	Patient	225	41	Sensitivity=84.6
	Risk	219	39	Specificity =15.1
	Accuracy			50.4

Discussion

Calculating the risk of breast cancer means identifying women at high risk of developing this disease in the future (Ozmen, 2012). There are many models for calculating individual risk for breast cancer. However, due to the complexity of the etiology of breast cancer and the unknowingness of all the variables leading to breast cancer, today's risk calculation models are insufficient to calculate the risk of breast cancer (Demirkazik , 2014). The model developed in this study was compared with the Gail and IBIS models since Gail and IBIS models have the ability to be calculated online and are more comprehensive than the other models.

This study was more successful in predicting the patient/at-risk groups than the Gail and IBIS risk assessment models. The IBIS model is also more successful than the Gail model. Many studies using risk calculation models have reported conflicting results in estimating the patient/at-risk groups. In a meta-analysis and systematic review study by Wang et al. (2018), it was stated that the Gail model was better in European and American women than in Asian women, but it was insufficient in assessing individual risk (Wang et al., 2018). When Challa et al. (2013) applied the Gail risk calculation model to women with breast cancer, benign breast disease, and completely healthy women in India, they found that the 5-year and lifetime risk percentages of the Gail model were very insufficient and the percentages between groups were not different and indiscriminate from each other. (Challa et al., 2013). In the study of Sa-Nguanraksa et al. (2019) in Thailand with 514 cancer patients who applied to surgical outpatient clinics, it was stated that the Gail model was insufficient in calculating the risk of breast cancer (Sa-Nguanraksa et al., 2019). In the study of Stevanato et al. (2019) in which IBIS, BRCAPRO, and Gail models were compared, it was stated that the IBIS model predicted better risk than BRCAPRO and Gail (Stevanato et al., 2019). In the study of Tery et al. in which (BOADICEA), (BRCAPRO), (BCRAT) and (IBIS) models were compared, it was stated that BOADICEA and IBIS had the ability to better predict the risk of breast cancer (Tery et al., 2019). The risk assessment model developed in this study was compared with the Gail and IBIS risk assessment tools. This model was found to be successful in terms of 4 parameters compared to the Gail and IBIS models in separating the patient and healthy groups. The 4 parameters that make up the differences are the presence of a mass in the breast and armpit, not knowing the atypical hyperplasia, and the health responsibility, which is the subscale of the healthy lifestyle behavior scale. Since these variables reflect the socio-cultural and economic status of women, they suggest that lifestyle plays a role in breast cancer.

This model is more successful than the Gail and IBIS models in estimating the patient/at-risk groups and has significant differences compared to these models. Unlike Gail and IBIS models, in this model, educational level and the place of residence, OKS usage, IVF treatment, breast and armpit mass, leakage from the breast, changes in the image of the breast, and healthy lifestyle behaviors (nutrition, physical activity, health responsibility, spirituality) are included. The increases in the factors such as age, educational level, and economic level, which are the components of socio-demographic factors, affect the behaviors of accessing health services, protecting and improving the health of the individual (Ersin & Bahar, 2012).In this study, socio-economic and cultural characteristics have an important place both in separating the patient/healthy groups and in separating the patient/at-risk groups. The low socioeconomic and cultural characteristics of the breast cancer group suggest that they lack health protection and promotion behaviors. However, some studies in the literature have stated that a high socio-economic level increases the risk of breast cancer twofold (Ozmen, 2012; Gunay, 2014; Cakir et al., 2016). This may be due to the fact that people with high socioeconomic status have a higher risk of developing breast cancer due to giving birth in old age, alcohol usage, and unhealthy lifestyle behaviors (Aslan & Gurkan, 2007).

The fact that the variables in the etiology of breast cancer (hormone use, smoking, alcohol usage, number of children, night shifts) yielded conflicting results in some studies (Borges & Torresan, 2018; Cho, 2018; Scoccianti et al., 2014; Passarelli et al., 2016) suggest that environmental factors may be effective in breast cancer. Studies conducted in recent years frequently have focused on environmental factors (Passarelli et al., 2016; Zengin & Etiler, 2015; Hansen & Stevens, 2012; Catsburg et al., 2015; Romieu et al., 2015; Shiels et al., 2016; Song et al., 2018). Therefore, in this study, environmental factors were tried to be evaluated with the Healthy Lifestyle Behavior Scale. The scale includes nutrition, physical activity, and stress factors that are thought to increase breast cancer (Bahar et al., 2008). In the study, healthy lifestyle behaviors were found to be insufficient in the breast cancer group compared to the at-risk and healthy groups. In the study of Gulcivan and Topcu (2017), it was stated that the healthy lifestyle behaviors of patients with breast cancer were moderate (Gulcivan & Topcu, 2017). In the study of Pervaiz et al. (2018), low physical activity, margarine usage, and sugar usage were found to be significantly higher in the breast cancer group (Pervaiz et al., 2018).In the study conducted by Aydogan et al. (2013) with a case-control group, it was stated that the consumption of animal foods was higher in the breast cancer group, the consumption of vegetables and fruits was lower than the healthy group, and the stress level of the breast cancer group was higher (Aydogan et al., 2013). A healthy diet, physical activity, obesity, and stress are modifiable risk factors and are important in reducing the risk of breast cancer.

Limitations : This study has some limitations. We did not have the lobular carcinoma in-situ data in the latest version of the IBIS risk assessment tool. Although we explained the medical words to the extent that they could understand the majority of the participants due to their low socio-cultural level, some data may have been underestimated. Our sample size is sufficient for this study, and not large enough to generalize to all races.

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