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Validity and reliability of the Turkish version of the health belief model scale for colorectal cancer screening

Ferdane Koçoğlu[1*], Mesut Teleş[2] and Semra Kocaöz[3]

Abstract

Background Colorectal cancer ranks second among the most prevalent and deadly cancer types for both sexes. Despite having a high mortality rate, colorectal cancer is simultaneously identifiable and preventable through early diagnosis. This study was intended to assess the validity and reliability of the Turkish version of the Health Belief Model Scale for Colorectal Cancer Screening.

Methods This methodological study evaluated the 45-item five-point Likert-type Health Belief Model Scale for Colorectal Cancer Screening. Data collection forms were administered via convenience sampling to 649 participants selected from individuals seeking health services at primary healthcare institutions. The scale's reliability and validity were evaluated via item analyses, content and construct validities, exploratory and confirmatory factor analyses, Cronbach's alpha, McDonald's omega, the Spearman-Brown formula, and test-retest reliability coefficients. The data set was randomly divided into two subsamples. EFA, reliability analyses (Cronbach's alpha, McDonald's omega, Spearman-Brown Coefficient) and item-total statistics were conducted in sample 1 ($n=324$). CFA was conducted in sample 2 ($n=325$). Item and scale means and, discriminant validity were calculated and tested using the total sample ($N=649$).

Results According to the resulting four-dimensional structure, the factor loads of the subscale items were 0.48–0.89, and subscales explained 49% of the total variance. The Cronbach's alpha coefficients of the subscales were 0.804–0.923. The confirmatory factor analysis revealed good fit indices ($\chi^2/df=2.05$; RMSEA = 0.06; CFI = 0.95; IFI = 0.95; GFI = 0.80; RMR = 0.08; NFI = 0.91). The subscale means ranged from 2.23 ± 0.72 to 3.60 ± 0.70 while the item means ranged from 1.95 ± 0.81 to 3.80 ± 0.91.

Conclusion The Turkish version of the Health Belief Model Scale for Colorectal Cancer Screening is a valid and reliable measuring tool for Turkish people. Except for barrier scale items, those with low means suggest opportunities for improvement. This scale can be applied in Turkey when measuring individuals' health belief perceptions regarding colorectal cancer screening.

Keywords Colorectal cancer screening, Health belief model scale, Reliability, Turkish version, Validity

*Correspondence:
Ferdane Koçoğlu
ferdanetas@ohu.edu.tr
[1]Zübeyde Hanım Faculty of Health Sciences, Nursing Department, Department of Public Health Nursing, Niğde Ömer Halisdemir University, Derbent Campus, Niğde 51200, Türkiye
[2]Zübeyde Hanım Faculty of Health Sciences, Department of Health Management, Niğde Ömer Halisdemir University, Niğde, Türkiye
[3]Zübeyde Hanım Faculty of Health Sciences, Nursing Department, Department of Obstetrics and Gynecology Nursing, Niğde Ömer Halisdemir University, Niğde, Türkiye

Introduction

Colorectal cancer (CRC) is one of the most common types of fatal cancer, ranking second among the most lethal cancers for both sexes. Globally, there are 19.3 million new cancer cases annually, with CRC accounting for 10% [1]. In Turkey, CRC is the third most common cancer in both women (8.0%) and men (9.6%) [2].

While CRC has a high mortality rate when detected at advanced stages, it is also highly preventable [3]. Polyps in the colon can be detected early through screening tests and removed before progressing to CRC [4]. Screening tests are reported to reduce CRC mortality rates by 9–20% [3, 5]. CRC screenings not only ensure early detection of cancer but also contribute to the reduction of disease-related burden [6], leading to a decrease in hospitalizations [7] and lower treatment costs [8]. Despite being an effective method for reducing the incidence and mortality rates of CRC [3, 4, 6], the participation rate of individuals in CRC screenings in Turkey is not at the desired level [9]. While the rate for CRC screenings is 68.3% in the United States [10], it ranges only between 20% and 30% in Turkey [11]. Despite these services being provided free of charge in Turkey, the targeted participation rate of 70% has not yet been achieved [9]. It is emphasized that health behaviors should be examined to increase the participation of individuals in screening behaviors [12].

Health behaviors are influenced by individuals' beliefs, attitudes, and values. When beliefs and attitudes hindering positive health behaviors are identified, proper education and treatment methods can be tailored to meet individual needs. In this context, the Health Belief Model (HBM) was developed to understand the factors influencing individuals' health and medical behaviors, and symptom management [12]. The HBM utilizes components such as seriousness, susceptibility, benefits, barriers, and self-efficacy to understand the motivation sources for individuals to engage in protective behaviors, participate in health screenings for early diagnosis, and exhibit behaviors to control these issues [13]. In line with the subcomponents of the HBM, identifying the underlying perceptions of individuals' attitudes and behaviors and correcting existing deficiencies or misconceptions can facilitate actions to achieve a healthy life [12]. Determining individuals' perceptions regarding CRC screening is crucial for planning behavior change interventions to increase participation rates in relevant screening programs [14].

In Turkey, there were three scales for CRC based on the HBM with established Turkish validity and reliability [15–17]. Dönmez et al. [15] examined the perceptions of benefits and barriers regarding individuals' adherence to fecal occult blood tests (FOBT) and colonoscopy procedures for CRC screenings. Özsoy et al. [16] adapted the Champion HBM scale to CRC in their study, assessing its Turkish validity and reliability and examining individuals' perceptions of confidence, benefits, health motivation, susceptibility, barriers, and seriousness regarding CRC prevention. Koç [17] conducted a doctoral dissertation where the scale, developed within the framework of the Preventive Health Model based on the HBM, the Theory of Reasoned Action, and the Social Cognitive Theory, was validated and assessed for reliability in Turkish. In this study, which has not yet been published as an article, both perceptions and barriers related to CRC screening were evaluated under the subheadings of importance and consistency, susceptibility perception, response efficacy, cancer anxiety, and social impact [17]. However, the aforementioned scales [15–17] have not thoroughly examined the perceptions and barriers to performing the FOBT. This test is free for CRC screenings in Turkey, is recommended for all citizens in community-based screenings, and is self-administered by individuals at home and in clinical settings [5]. The Health Belief Model Scale for CRC Screening (HBMS for CRC Screening), which was developed by Lee and Lee [20], revised by Lee et al. [18], and adapted to Turkish in the present study, assesses individuals' perceptions of barriers, benefits, and self-efficacy related explicitly to the implementation of FOBT, which is widely used in CRC screening programs in addition to severity and susceptibility perceptions associated with CRC. There is a need to assess the appropriateness of using the scale developed by Lee et al. [18] in diverse cultural contexts. With this perspective in mind, the present study aimed to introduce a Turkish version of the HBMS for CRC Screening revised by Lee et al. [18] and conduct a validity and reliability study in the Turkish context.

Methods

Population and sample

The target population for this community-based study consisted of individuals seeking health services from primary healthcare institutions in the central district of Niğde, including community health centers, family medicine units, healthy life centers, and the Cancer Early Diagnosis, Screening, and Education Center (KETEM). Inclusion criteria for participation in the study were: (1) being in the age range of 50–70 years, (2) absence of psychiatric and communication problems (no mental or physical disability), (3) literacy (individuals who are physically and cognitively able to read, understand and answer the survey questions), and (4) willingness to participate in the research. Since CRC screening is provided free of charge to individuals aged 50–70 years in Turkey [9], this age group was included in the study.

The generally recommended minimum number of observations for factor analysis is at least five

observations per variable. Having 300 observations is considered good, 500 is very good, and 1000 is excellent [19]. The HBMS for CRC Screening used in this study was comprised of 45 items; therefore, the minimum required sample size was 225 ($45 \times 5 = 225$). For this study, a sample of 649 individuals was reached through convenience sampling, which can be considered excellent. Surveys were administered by researchers visiting primary healthcare facilities on weekdays from February 1, 2023 to March 30, 2023. During these two months, 700 individuals meeting the inclusion criteria were reached, and 649 (92.7%) agreed to participate in the study. The aim of the study was explained to the participants, they were asked to voluntarily participate in the study and written informed consent was obtained from those who agreed.

Data collection tool

The initial version of the HBMS for CRC Screening was derived by Lee and Lee [20] based on original HBM scales (susceptibility, severity, benefits, barriers, and self-efficacy). Then, the HBMS for CRC Screening was created and revised by Lee et al. [18]. The revised version of the HBMS for CRC Screening [18] was utilized in this study.

According to the original study by Lee et al. [18], the HBMS for CRC Screening consisted of 45 items and four subscales, namely: (1) barriers (22 items), (2) susceptibility (4 items) and severity (8 items), (3) self-efficacy (6 items), and (4) benefits (5 items) scored on a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). Subscales are evaluated separately and there is no total score. The scale scores are standardized between 1 and 5; first, the responses to the items from each scale are summed and then divided by the number of items on each scale. Except for the barrier scale, a higher score indicates greater perceived benefits of stool blood testing (or FOBT). The scores on this self-reporting scale indicate individuals' health belief perceptions regarding CRC screening and FOBT use.

Translation and back-translation process of the scales

Lee and colleagues granted permission to use the HBMS for CRC Screening in the current study through email. The translation-back-translation process was conducted by four experts proficient in Turkish and English (two experts conducted translation from English to Turkish, and the other two performed translation from Turkish to English). Subsequently, Lee and colleagues were contacted via email to inquire about any discrepancies in meaning between the English back translation and the original English version of the scale. Following a review by Lee and colleagues, which indicated that the translation was consistent with the original scale, a pilot application was conducted with more than 20 individuals to ensure that the Turkish population understood the questions. All questions were determined to be clearly understood by the participants, and the survey was subsequently administered.

Data analysis

The data were evaluated using SPSS 20.0 and LISREL-LisWin32 software programs. The validity of the HBMS for CRC Screening was examined with content validity and construct validity methods. Expert opinions were sought to determine content validity, and exploratory and confirmatory factor analyses and, discriminant validity were employed to assess construct validity. The Lawshe technique was applied and a total of 10 experts were consulted to determine the content validity. While testing discriminant validity, the mean scores based on participant characteristics were compared using the independent-samples t test, Welch's analysis of variance (ANOVA), and one-way ANOVA. The Bartlett's Test of Sphericity, the determinant of the correlation coefficient matrix and the Keiser-Meyer-Olkin Sampling Adequacy Measure (KMO) were used to determine factorability. The EFA used the principal component method of factor extraction with promax rotation. Cronbach's alpha coefficient, McDonald's omega, split-half reliability, and test-retest methods were used to assess the reliability of the scales. In the test-retest method, there were 15 days between the first and second tests. After the exploratory factor analysis, item analyses were conducted to examine the contribution of individual items to the scale. At the end of the study, the appropriateness of the structure revealed by the exploratory factor analysis was evaluated by confirmatory factor analysis using the LISREL-LisWin32 statistical software program. Explanatory factor analysis (EFA) and confirmatory factor analysis (CFA) can be used coordinately to compare the results and decide the factor design with an eclectic perspective [21]. It is recommended that EFA and CFA be conducted on different samples [22]. Therefore, the data set was randomly divided into two subsamples. EFA, reliability analyses (Cronbach's alpha, McDonald's omega, Spearman-Brown Coefficient) and item-total statistics were conducted in sample 1 ($n = 324$). CFA was conducted in sample 2 ($n = 325$). Item and scale means and, discriminant validity were calculated and tested using the total sample ($N = 649$).

Results

Approximately two-thirds of the participants were females, and the majority (83.1%) were married. The mean age of the participants was 57.1 ± 5.7 years, with half falling in the 50–55 age range and two-fifths (39.9%) having completed primary school. While only 7.7% of the participants were diagnosed with cancer, about one-third

had close relatives with a cancer diagnosis. Despite most participants (83.1%) not having undergone CRC screening, almost half expressed a willingness to undergo testing. Participants were most knowledgeable about colonoscopy (23.1%) and FOBT (19%) among the CRC screening tests, but almost none (99.5%) had information about sigmoidoscopy (Table 1).

Table 1 Demographic and CRC screening characteristics of the participants ($N = 649$)

	n	%
Sex		
Female	380	58.6
Male	269	41.4
Marital status		
Married	539	83.1
Single[a]	110	16.9
Age (years)[b]		
50–55	320	49.3
56–60	168	25.9
60–65	84	12.9
66–70	77	11.9
Education level		
Literate	113	17.4
Primary school	259	39.9
Middle school	83	12.8
High school	94	14.5
University	100	15.4
Diagnosed with cancer (breast, lung, prostate, cervix, bowel, etc.)		
Yes[c]	50	7.7
No	599	92.3
Have a family member diagnosed with cancer (breast, lung, prostate, cervix, bowel, etc.)		
Yes[d]	202	31.1
No	447	68.9
Had CRC screening		
Yes	110	16.9
No	539	83.1
Have knowledge of FOBT		
Yes	123	19.0
No	526	81.0
Have knowledge of colonoscopy		
Yes	150	23.1
No	499	76.9
Have knowledge of sigmoidoscopy		
Yes	3	0.5
No	645	99.5
Willingness to CRC screening		
Yes	323	49.8
No	326	50.2

[a] 31 single, 66 widowed, 13 separated/divorced

[b] mean 57.1 ± 5.7

[c] 17 breast cancer, 7 cervical cancer, 11 prostate cancer, 2 lung cancer, 1 skin cancer, 3 marrow/lymphoma/blood cancer, 3 pituitary cancer, 1 thyroid cancer, 1 ovarian cancer, 3 colon cancer

[d] 74 1st-degree relatives (mother, father, and children), 48 2nd-degree relatives (grandfather, grandmother, grandchild, sibling), 55 3rd-degree relatives (nephew, uncle, aunt), 25 others (wife, sister-in-law)

The appropriateness of the scale items to the culture, language, and system of the adapted country should be checked after the translation–back-translation process. Samuelsson et al. [23], have stated that the process of translation, cultural adaptation, and psychometric evaluation consists of five stages. The third stage of this process involves content validity analysis, including the use of content validity indexes [23]. In our study, the Lawshe technique was applied and a total of 10 experts were consulted to determine the content validity of the HBMS for CRC Screening. During this process, each expert was asked to evaluate whether each item in the scale tested the intended characteristic by choosing one of three options: "necessary," "useful but insufficient," or "unnecessary." When the majority of experts marked an item as "necessary," it was recommended to keep that item in the scale. Additionally, the decision could be made based on the content validity ratio and the content validity index. When employing 10 experts, the minimum content validity index for items at the significance level of $\alpha = 0.05$ is 0.62 according to Lawshe's criteria. The desired content validity index for the scale was > 0.67 [19]. In the evaluation, out of 45 items, 3 were deemed necessary by eight experts, 13 were deemed necessary by nine experts, and the remaining 29 were considered necessary by all ten experts. In the current study, the content validity ratios of the items ranged from 0.6 to 1, and the content validity index was 0.92, allowing us to decide to retain all items in the scale.

In the next step, an exploratory factor analysis was conducted. Bartlett's Test of Sphericity was significant (chi-square = 15597.20; $p \leq 0.001$), the KMO was 0.879, and the determinant of the correlation matrix was ≤ 0.001. The determinant value being close to zero indicates that the correlated structure in the data has increased. This means that the data is suitable for factorability. In terms of EFA, the KMO value is expected to be more than 0.80 [19]. These values in our study are considered sufficient for factorability. In this study, iterated principal factor extraction method and a Promax rotation were used in the EFA. To determine the number of factors, a scree plot (Fig. 1) was used, and the Kaiser criterion (number of eigenvalues > 1) and explained total variance rate were considered. Although it is desired that the explained variance be above 65% [19], according to some authors [21, 24] the explained variance rates ranging between 40% and 60% are accepted to be adequate in social sciences. There can sometimes be differences between the scree plot and the Kaiser criterion in determining the appropriate number of factors. Typically, where the drop (or slope) levels off or starts to change indicates the appropriate number of factors in the scree plot [19]. The scree

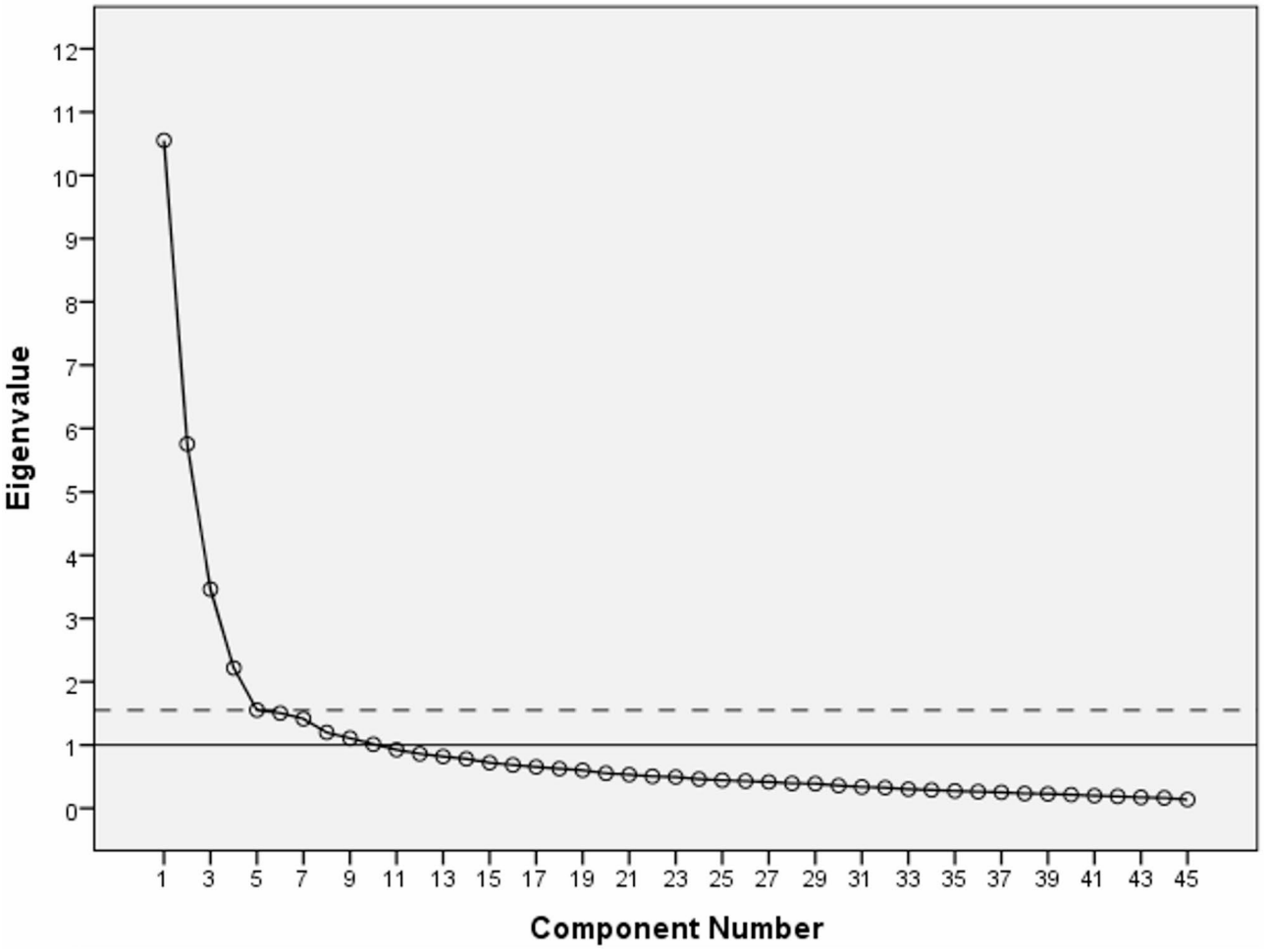

Fig. 1 Factor analysis of the Turkish version of the HBMS for CRC screening —scree plot

plot in Fig. 1 shows that after the fourth factor, the slope levels off, indicating stability or a minimal change in values. In this study, the eigenvalues of the first four factors are >1(10.97–2.14), explaining 48.86% of the total variance (Table 2). Based on these results, the number of factors in the scale was determined to be four in this study.

If the results of factor analysis are found to be insufficient, factor rotation methods can be used. Factor rotation methods are classified into two categories: orthogonal rotation and oblique rotation [25]. Factors are assumed to be uncorrelated in orthogonal rotation methods; however, when necessary, oblique rotation methods are also used based on the fact that factors cannot be uncorrelated with each other. As a general practice in the factor rotation process, oblique rotation is performed first, considering the desired number of factors. If the correlation coefficients between the factor scores exceed 0.32, it is recommended to use oblique rotation methods but orthogonal rotation methods if they do not exceed 0.32 [19]. When the Promax method, an oblique rotation method, was applied in this study, one of correlation coefficients between the factor scores was higher than threshold value. Oblique rotations may be a more appropriate assumption for most social and behavioral research phenomena [26]. The oblique rotation rotation method is recommended when the main goal is to make the factor loadings stronger and to reach the solution that provides the lowest correlation between the factors. Direct oblimin and Promax are the oblique rotation methods commonly used in practice [19]. Based on this reasons, Promax rotation method was preferred in this study. Table 2 presents the Promax rotated factor loadings, reliability coefficients for the scale, the emerged subscales, and descriptive statistics of the subscales items. Accordingly, the scale has structural validity because out of the 45 items, 22 loads highly on the first factor (barriers; factor loadings 0.46–0.75), 11 loads on the second factor (self-efficacy and benefits; factor loadings 0.59–0.81), 8 load on the third factor (severity; factor loadings 0.48–0.78), and 4 loads on the fourth factor (susceptibility; factor loadings 0.50–0.89). The Cronbach's alpha coefficients for the subscales range between

Table 2 Descriptive statistics, reliability coefficients and exploratory factor analysis results of the Turkish version of the HBMS for CRC screening

Four Factors/Subscales and Survey Items	Mean ± SD	Factor Loadings			
		1	2	3	4
Factor 1 / Barriers (22 items)	**2.49 ± 0.67**				
BAR1	2.55 ± 1.17	0.62			
BAR2	2.35 ± 1.09	0.46			
BAR3	2.39 ± 1.10	0.62			
BAR4	2.65 ± 1.16	0.66			
BAR5	2.27 ± 1.02	0.64			
BAR6	2.38 ± 1.04	0.75			
BAR7	3.00 ± 1.21	0.69			
BAR8	2.31 ± 1.03	0.66			
BAR9	2.51 ± 1.11	0.54			
BAR10	3.15 ± 1.17	0.66			
BAR11	2.49 ± 0.97	0.72			
BAR12	2.27 ± 0.96	0.62			
BAR13	2.26 ± 0.92	0.56			
BAR14	2.68 ± 1.12	0.69			
BAR15	2.43 ± 1.03	0.65			
BAR16	2.24 ± 0.93	0.53			
BAR17	2.36 ± 1.05	0.61			
BAR18	2.53 ± 1.05	0.65			
BAR19	2.51 ± 0.95	0.53			
BAR20	2.43 ± 1.01	0.54			
BAR21	2.52 ± 1.09	0.58			
BAR22	2.63 ± 1.014	0.59			
Factor 2 / Self-efficacy and Benefits (11 items)	**3.60 ± 0.70**				
SE1	3.47 ± 1.03		0.74		
SE2	3.49 ± 0.99		0.71		
SE3	3.63 ± 0.95		0.79		
SE4	3.45 ± 1.01		0.81		
SE5	3.79 ± 0.90		0.71		
SE6	3.70 ± 0.95		0.77		
BEN1	3.80 ± 0.91		0.72		
BEN2	3.53 ± 0.91		0.59		
BEN3	3.64 ± 0.91		0.64		
BEN4	3.58 ± 0.95		0.68		
BEN5	3.55 ± 0.93		0.69		
Factor 3 / Severity (8 items)	**3.01 ± 0.81**				
SEV1	3.35 ± 1.20			0.76	
SEV2	2.88 ± 1.15			0.78	
SEV3	2.99 ± 1.13			0.77	
SEV4	3.29 ± 1.05			0.71	
SEV5	2.59 ± 1.10			0.62	
SEV6	3.06 ± 1.14			0.74	
SEV7	3.33 ± 1.07			0.67	
SEV8	2.61 ± 1.07			0.48	
Factor 4 / Susceptibility (4 items)	**2.23 ± 0.72**				
SUS1	2.06 ± 0.83				0.86
SUS2	1.95 ± 0.81				0.89
SUS3	2.08 ± 0.88				0.83
SUS4	2.82 ± 1.07				0.50
Eigenvalues		10.55	5.75	3.46	2.22
Variance (%)		23.45	12.79	7.69	4.93

Table 2 (continued)

Four Factors/Subscales and Survey Items	Mean ± SD	Factor Loadings			
		1	2	3	4
Cumulative variance (%)		24.45	36.24	43.93	48.86
Cronbach's α		0.923	0.907	0.854	0.804
McDonald's omega		0.924	0.907	0.855	0.832
Spearman-Brown Coefficient (Overall = 0.94)		0.86	0.76	0.73	0.78
Test-retest (Overall = 0.85)		0.87	0.64	0.61	0.80
Determinant	≤ 0.001				
Kaiser–Meyer–Olkin Measure of Sampling Adequacy	0.879				

BAR = barrier; SE = self-efficacy; BEN = benefit; SEV = severity; SUS = susceptibility

0.80 and 0.92. McDonald's omega values for the subscales range between 0.83 and 0.92. The Spearman-Brown reliability coefficient is 0.94 for the overall scale and ranges between 0.73 and 0.86 for the subscales. The test-retest reliability is 0.85 for the overall scale and ranges between 0.61 and 0.87 for the subscales. The reliability coefficients for the scale and subscales are high across all four methods.

In this study, the mean scores of the subscales of the HBMS for CRC Screening range from 2.23 ± 0.72 to 3.60 ± 0.70. The lowest mean score belongs to the severity subscale, and the highest mean score belongs to the self-efficacy and benefits subscale. For the barriers subscale, the items with the highest mean score are "BAR10. Not having a doctor's recommendation would keep me from having a stool blood test (3.15 ± 1.17)" and "BAR7. Not having symptoms would keep me from having a stool blood test (3.00 ± 1.21)". For the self-efficacy and benefits subscales, the items with the highest mean score are "BEN1. Having a stool blood test will help me detect colon cancer early (3.80 ± 0.91)" and "SE5. I can complete a stool blood test if I really want to (3.79 ± 0.90)". For the severity subscale, the item with the highest mean score is "SEV1. The thought of colon cancer scares me (3.35 ± 1.20)". For the susceptibility subscale, the item with the highest mean score is "SUS4. As I get older, my chances of getting colon cancer increase (2.82 ± 1.07)".

Item analyses are required to examine the contribution of items to the scale. It is desirable for the correlations between items not to be too high and to be less than 0.90 [19]. In the current study, all correlations are < 0.74. The results of item-total statistics analyses are provided in Table 3. As seen in the item-total statistics, when a respective item is deleted, there is no significant change in the means and variances of the remaining items. For the barriers subscale, when an item is deleted, alpha coefficients (0.917–0.923) are less than the alpha coefficient obtained for the entire subscale (≤ 0.923); for the self-efficacy and benefits subscale, when an item is deleted, alpha coefficients (0.892–0.905) are less than the alpha coefficient obtained for the entire subscale (< 0.907); for the severity subscale, when an item is deleted, alpha coefficients (0.826–0.854) are less than the alpha coefficient obtained for the entire subscale (≤ 0.854); and for the susceptibility subscale (except the fourth item), when an item is deleted, alpha coefficients (0.708–0.722) are less than the alpha coefficient obtained for the entire subscale (< 0.804). Therefore, it can be said that all items work appropriately. The alpha coefficient of the susceptibility subscale increased from 0.804 to 0.861 when the item "SUS4. As I get older, my chances of getting colon cancer increase" was deleted, so this item seems a bit problematic. However, to explain the structure, it is sufficient for factor loadings to be > 0.30 and item-total correlation coefficients to be > 0.25 [19]. Another method used to determine the validity of an item is comparing the mean item scores of the lower and upper 27% of the groups. If a difference exists, it is believed that the relevant item can distinguish this difference and hence is retained in the scale [19]. In this study, a statistically significant difference was observed between the mean scores of the lower 27% of the groups (2.20 ± 0.94) and the upper 27% of the groups (3.38 ± 1.05) for the SUS4 item ($p \leq 0.001$). Considering that the item-total correlation coefficient and factor loading of the item SUS4 are > 0.40 and, found a statistically significant difference ($p \leq 0.001$) between item SUS4 mean scores of the lower and upper 27% of the groups, it was decided optimistically to keep this item in the scale. Thus, all items continued to be included in the scale.

CFA can test the conformity of the structures determined by exploratory factor analysis to the theoretical or assumed factor structures [27]. In the current study, the four-dimensional structure of the HBMS for CRC Screening obtained through exploratory factor analysis was tested using CFA. The data used in the model showed a multivariate normal distribution; therefore, the Maximum Likelihood Estimation method was employed. The resulting model is presented in Fig. 2. After the model was created, t-values were examined, and it was observed that all values were statistically significant (t-values ranged from 6.85 to 17.57; $p < 0.05$). The numbers on the arrows in Fig. 2 indicate the direct effects from the latent variables to the observed variables

Table 3 Item-Total statistics of items on subscales

		Item-Total Statistics for Subscales				
Subscales[a]	**Items**	**Scale Mean if İtem Deleted**	**Scale Variance if İtem Deleted**	**Corrected Item-Total Correlation**	**Squared Multiple Correlation**	**Cronbach's Alpha if İtem Deleted**
Barriers	BAR1	53.91	190.30	0.59	0.50	0.920
	BAR2	54.11	196.87	0.41	0.45	0.923
	BAR3	54.13	192.69	0.57	0.54	0.920
	BAR4	53.77	189.28	0.62	0.51	0.919
	BAR5	54.15	192.45	0.60	0.53	0.919
	BAR6	54.04	189.42	0.71	0.63	0.917
	BAR7	53.40	188.90	0.63	0.57	0.919
	BAR8	54.12	192.39	0.61	0.58	0.919
	BAR9	53.93	195.16	0.49	0.37	0.922
	BAR10	53.25	190.48	0.60	0.53	0.920
	BAR11	53.93	191.27	0.67	0.53	0.918
	BAR12	54.20	194.49	0.56	0.57	0.920
	BAR13	54.20	197.20	0.51	0.49	0.921
	BAR14	53.75	190.88	0.62	0.55	0.919
	BAR15	54.02	192.65	0.60	0.46	0.919
	BAR16	54.21	197.40	0.48	0.33	0.922
	BAR17	54.09	192.64	0.57	0.48	0.920
	BAR18	53.87	191.67	0.61	0.46	0.919
	BAR19	53.88	197.34	0.49	0.33	0.921
	BAR20	53.99	195.39	0.51	0.46	0.921
	BAR21	53.87	193.36	0.56	0.48	0.920
	BAR22	53.82	192.68	0.56	0.47	0.920
Self-efficacy and Benefits	SE1	36.23	44.51	0.68	0.59	0.896
	SE2	36.24	44.79	0.66	0.61	0.898
	SE3	36.09	44.12	0.75	0.69	0.893
	SE4	36.29	43.85	0.75	0.63	0.892
	SE5	35.90	46.20	0.64	0.55	0.898
	SE6	35.97	45.13	0.70	0.60	0.895
	BEN1	35.87	45.87	0.66	0.51	0.898
	BEN2	36.17	47.61	0.52	0.40	0.905
	BEN3	36.03	47.51	0.55	0.45	0.903
	BEN4	36.06	46.51	0.60	0.48	0.900
	BEN5	36.12	46.11	0.62	0.48	0.899
Severity	SEV1	21.36	29.09	0.64	0.47	0.831
	SEV2	21.87	28.91	0.66	0.57	0.828
	SEV3	21.77	29.18	0.65	0.56	0.829
	SEV4	21.48	30.50	0.60	0.42	0.836
	SEV5	22.10	30.32	0.55	0.36	0.841
	SEV6	21.73	28.88	0.67	0.58	0.826
	SEV7	21.41	30.53	0.58	0.46	0.838
	SEV8	22.16	32.24	0.41	0.23	0.854
Susceptibility	SUS1	7.07	5.22	0.69	0.56	0.726
	SUS2	7.17	5.14	0.73	0.64	0.708
	SUS3	7.02	4.96	0.69	0.53	0.722
	SUS4	6.25	5.29	0.43	0.20	0.861

[a]The correlation coefficients between items range from 0.04 to 0.67 for the barriers subscale, from 0.28 to 0.74 for the self-efficacy and benefits subscale, from 0.19 to 0.70 for the severity subscale, and from 0.36 to 0.73 for the susceptibility subscale. All correlations are significant at the $p \leq 0.001$ level

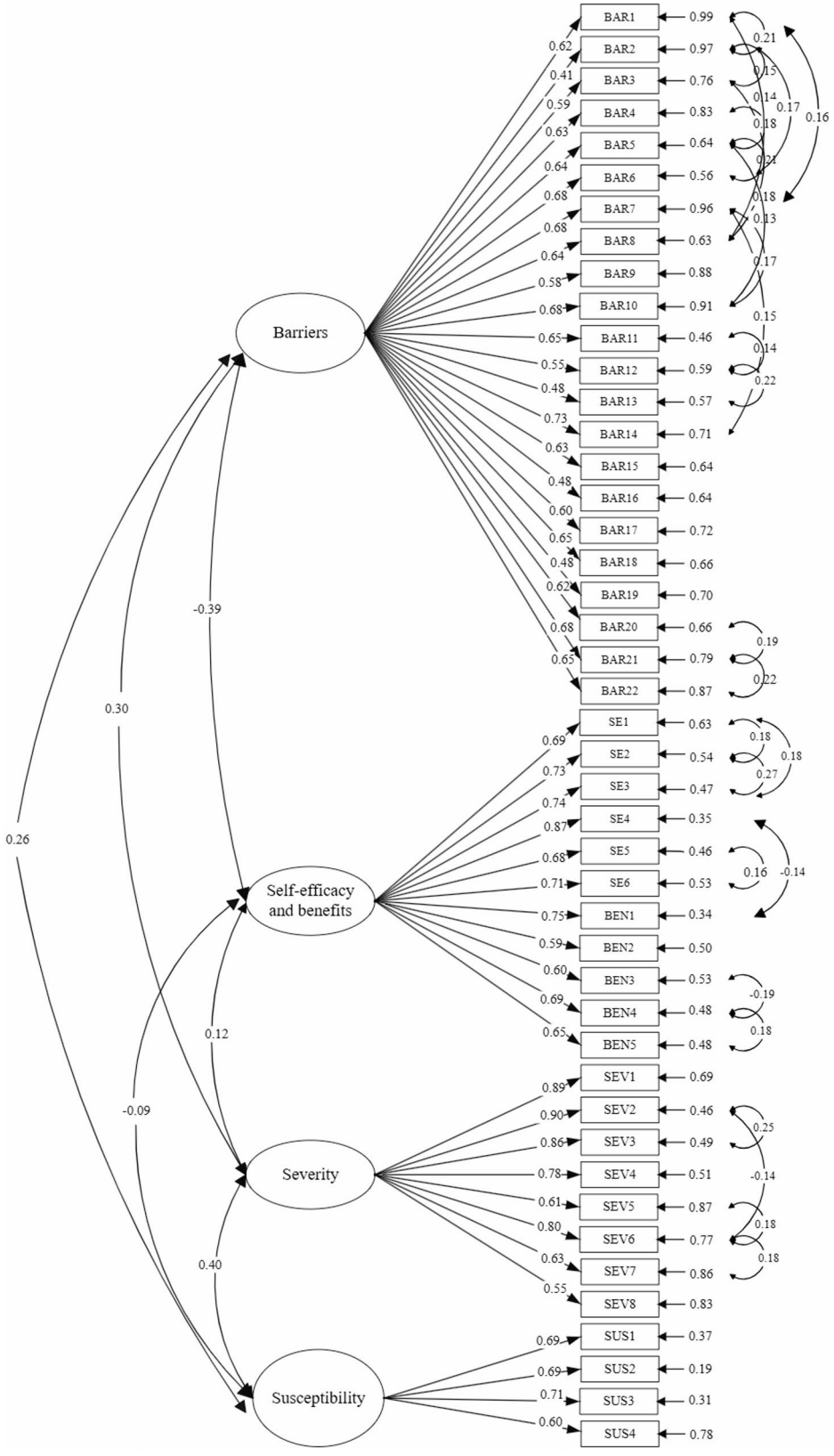

Fig. 2 Confirmatory factor analysis results for the Turkish version of the HBMS for CRC screening

and correspond to the factor loading values in exploratory factor analysis [21]. Loadings of 0.50 and above refer to those that can explain the structure and have practical significance [19]. Since the values here range from 0.48 to 0.90 in Fig. 2, it is considered that these factor loadings generally explain the structure well. In evaluating CFA results, a p-value > 0.05 is desirable. In this study, the probability value was $p \leq 0.001$. However, the p-value is influenced by the sample size [21], and in cases where $p < 0.05$, various model fit indices can be used to evaluate the model. The most commonly used guides are χ^2/df, RMSEA, CFI, IFI, GFI, RMR, and NFI. Typically, $\chi^2/df \leq 5$; RMSEA and RMR ≤ 0.08; CFI, IFI, GFI, and NFI ≥ 0.90 suggest that the model fits well [21, 28–30]. In the current study, except GFI (0.72), the CFA revealed good fit indices ($\chi^2/df = 3.02$; RMSEA = 0.079; CFI = 0.92; IFI = 0.92; RMR = 0.07; NFI = 0.88). To improve the model fit, researchers should first modify the error covariances between the items within the same dimension based on theoretical justification [27]. This study examined suggested model modifications, revealing that all recommendations pertained to items within the same dimension. Improvements were observed in the model fit indices after making the modifications suggested by the model. In the current study, after modifications, since $\chi^2/df = 2.05$, RMSEA = 0.06, RMR = 0.08, CFI = 0.95, IFI = 0.95, GFI = 0.80, and NFI = 0.91, it can be concluded that the model generally fits well confirming the suitability of the Turkish version of the HBMS for CRC Screening with its four-factor structure consisting of 45 items.

Finally, the construct validity of the scale was tested using another method—the discriminant validity method. The scale averages were compared based on the characteristics of the participants and are listed in Table 4.

Discussion

This study tested the validity and reliability of the Turkish version of the HBMS for CRC Screening developed by Lee and Lee [20] to be applied to Korean Americans and then revised by Lee et al. [18] for Koreans living in Korea. To achieve this goal, the study involved content validity, followed by exploratory factor analysis, reliability and item analyses, and finally, CFA. To our knowledge, there is no validity-reliability study of the HBMS for CRC Screening in languages other than Korean and English. A total of 649 individuals (response rate:92.7%) participated in this study, marking the first examination of the psychometric robustness of the Turkish version of the HBMS for CRC Screening.

The scale's validity was assessed using content and construct validity methods. For content validity, the number of experts who deemed the items necessary was ≥ 8. The Item-level Content Validity Index (I-CVI) values ranged from 0.60 to 1.00, and the Scale-level Content Validity Index (S-CVI) was 0.92. With 10 experts, the smallest I-CVI value should be 0.62 at $\alpha = 0.05$ significance level, and the S-CVI should be > 0.67 [19]. Lee and Lee [20] reported I-CVI values ≥ 0.67 and S-CVI values ≥ 0.84. Lee et al. [18] found both the index values for scale items and subscales to be 1. The present study found the I-CVI values to be ≥ 0.60 and the S-CVI value to be 0.92, consistent with the literature. Therefore, the researchers decided all items should be retained in the scale, indicating content validity.

EFA and CFA were conducted on different samples to examine the factor structure of the Turkish version of the HBMS for CRC Screening. As a result of the factor analysis, a four-factor structure emerged for the scale, and the items loaded highly onto their respective factors. These factors were: (1) barriers (factor loadings range 0.46–0.75), (2) self-efficacy and benefits (factor loadings range 0.59–0.81), (3) severity (factor loadings range 0.48–0.78), and (4) susceptibility (factor loadings range 0.50–0.89) subscales. Consistent with this study, the factor analysis results in the studies by Lee and Lee [20] and Lee et al. [18] showed that the HBMS for CRC Screening resulted in four factors: (1) barriers, (2) susceptibility and severity, (3) self-efficacy, and (4) benefits. The barriers subscale in the present study is similar to that in their studies. While the susceptibility and severity dimensions were combined into a single subscale in their studies, they were separated into two subscales in this study. Additionally, the self-efficacy and benefits dimensions were combined into a single subscale in this study, while in the studies by Lee and Lee [20] and Lee et al. [18], they were separated into two subscales. HBMS for CRC Screening was developed by Lee and Lee [20] and Lee et al. [18] based on the subscales of HBM (1: susceptibility, 2: seriousness, 3: benefits, 4: barriers, and 5: health motivation). Therefore, various combinations of the dimensions of HBMS for CRC Screening are expected. These differences are considered to arise from the distinct cultural structures of the study populations.

In this study, while the barriers subscale alone explained approximately one-fourth of the total variance (23.45%), the total variance explained by all factors was 48.86%. Lee and Lee [20] reported that the barriers subscale explained 15.07% of the total variance, and the four factors explained 41.8%. Lee et al. [18] reported these values as 28.87% and 55.5%, respectively. Thus, the variance explained by the factors in the present study is similar to those in the literature. The highest contribution of the barriers subscale to the explained variance may be attributed to its larger number of items (22) compared with the other subscales. The advantage of this high variance explanation is that the people most affected by barriers to CRC screening in the Turkish population can be more

Table 4 Comparison of scale means by demographic and CRC screening characteristics of participants (*N* = 649)

	HBM Scales for CRC Screening			
Characteristics	**Barrier Mean ± SD**	**Self-efficacy and benefits Mean ± SD**	**Severity Mean ± SD**	**Susceptibility Mean ± SD**
Sex				
Female	2.47 ± 0.71	3.67 ± 0.65	2.91 ± 0.81	2.20 ± 0.73
Male	2.51 ± 0.64	3.55 ± 0.73	3.09 ± 0.80	2.25 ± 0.72
	t=-0.69; *p* = 0.494	**t = 2.19; p = 0.029**	**t=-2.79; p = 0.005**	t=-0.76; *p* = 0.448
Marital status				
Married	2.47 ± 0.67	3.62 ± 0.70	2.99 ± 0.82	2.21 ± 0.72
Single	2.59 ± 0.66	3.53 ± 0.69	3.13 ± 0.73	2.31 ± 0.73
	t=-1.68; *p* = 0.094	t = 1.18; *p* = 0.237	t=-0.70; *p* = 0.090	t=-1.38; *p* = 0.169
Age (years)				
50–55	2.46 ± 0.64	3.60 ± 0.71	2.99 ± 0.78	2.19 ± 0.70
56–60	2.49 ± 0.72	3.61 ± 0.72	2.95 ± 0.90	2.20 ± 0.77
60–65	2.52 ± 0.68	3.69 ± 0.66	3.13 ± 0.75	2.40 ± 0.76
66–70	2.64 ± 0.67	3.48 ± 0.67	3.11 ± 0.78	2.27 ± 0.67
Post hoc (Tukey)	F = 1.62; *p* = 0.184	F = 1.20; *p* = 0.310	F = 1.40; *p* = 0.241	F = 2.17; *p* = 0.091
Education level				
1.Literate	2.75 ± 0.59	3.32 ± 0.66	3.22 ± 0.77	2.51 ± 0.72
2.Primary school	2.52 ± 0.67	3.66 ± 0.63	3.05 ± 0.79	2.20 ± 0.68
3.Middle school	2.61 ± 0.67	3.60 ± 0.82	2.98 ± 0.81	2.18 ± 0.69
4.High school	2.28 ± 0.69	3.63 ± 0.83	2.77 ± 0.91	2.11 ± 0.84
5.University	2.24 ± 0.59	3.75 ± 0.61	2.95 ± 0.75	2.12 ± 0.66
	F = 11.60;p ≤ 0.001	**F = 7.06; p ≤ 0.001***	**F = 4.34; p ≤ 0.001**	**F = 5.56; p ≤ 0.001***
Post hoc (Tukey or Tamhane)	1.2.3 > 4.5 and 1 > 2 ($p < 0.05$)	2.4.5 > 1 ($p < 0.05$)	1.2 > 4 ($p < 0.05$)	1 > 2.3.4.5 ($p < 0.05$)
Diagnosed with cancer				
Yes	2.33 ± 0.66	3.72 ± 0.69	3.11 ± 0.72	2.45 ± 0.80
No	2.51 ± 0.67	3.59 ± 0.70	3.01 ± 0.82	2.21 ± 0.71
	t=-1.86; *p* = 0.063	t = 1.24; *p* = 0.216	t=-0.83; *p* = 0.406	**t = 2.22; p = 0.027**
Have a family member diagnosed with cancer				
Yes	2.44 ± 0.69	3.74 ± 0.66	3.14 ± 0.79	2.22 ± 0.71
No	2.52 ± 0.67	3.54 ± 0.71	2.95 ± 0.81	2.23 ± 0.73
	t=-1.37; *p* = 0.171	**t = 3.48; p = 0.001**	**t = 2.75; p = 0.006**	t=-0.14; p = 0.892
Had CRC screening				
Yes	2.18 ± 0.66	3.90 ± 0.61	3.12 ± 0.75	2.38 ± 0.83
No	2.56 ± 0.66	3.54 ± 0.71	2.99 ± 0.82	2.20 ± 0.70
	t=-5.45; p ≤ 0.001	**t = 5.51; p ≤ 0.001**	t = 1.52; *p* = 0.129	**t = 2.36; p = 0.019**
Have knowledge of FOBT				
Yes	2.11 ± 0.63	4.02 ± 0.58	3.06 ± 0.84	2.26 ± 0.84
No	2.58 ± 0.65	3.50 ± 0.69	3.00 ± 0.80	2.22 ± 0.69
	t=-7.26; p ≤ 0.001	**t = 8.51; p ≤ 0.001**	t=-0.69; *p* = 0.490	t = 0.53; p = 0.597
Have knowledge of colonoscopy				
Yes	2.27 ± 0.60	3.89 ± 0.58	3.06 ± 0.79	2.30 ± 0.74
No	2.56 ± 0.68	3.52 ± 0.71	3.00 ± 0.82	2.21 ± 0.72
	t=-4.71; p ≤ 0.001	**t = 6.53; p ≤ 0.001**	t = 0.85; *p* = 0.398	t=-0.34; *p* = 0.180
Willingness to CRC screening				
Yes	2.39 ± 0.65	3.77 ± 0.66	3.08 ± 0.78	2.27 ± 0.79
No	2.60 ± 0.67	3.43 ± 0.71	2.95 ± 0.83	2.19 ± 0.65
	t=-4.14; p < 0.001	**t = 6.42; p < 0.001**	**t = 1.96; p = 0.051**	t = 1.48; *p* = 0.140

*The Welch ANOVA test was used for F statistics here, and the one-way ANOVA test was used for other F statistics

easily identified. This is because the observations (or participants) can be ranked in order using the factor scores (e.g., factor scores of the barriers subscale) [25].

An item analysis was conducted following the exploratory factor analysis. When the fourth item of the susceptibility subscale, "SUS.4 As I get older, my chances of getting colon cancer increase," was removed, the Cronbach's alpha coefficient of the scale increased from 0.804 to 0.861; therefore, keeping this particular item in the scale reduces the reliability of the scale. However, when a large number of item analyses are performed, a decision should be made about the item by making an overall assessment [19]. The researchers of this study decided to retain this item in the scale due to the factor loading and item-total correlation coefficient being >0.40 and, there was a statistically significant difference ($p \leq 0.001$) between item SUS4 mean scores of the lower and upper 27% of the groups. Lee et al. [18] reported the factor loading of the SUS.4 item as 0.66 and the item-total correlation coefficient as 0.60. Despite these relatively low values, at 0.16 and 0.14, respectively, Lee and Lee [20] retained this item in the scale. In conclusion, all items from the original scale were included in the Turkish version of the scale.

More than one fit index is obtained in the structural equation model, and hence decisions are made by evaluating all indices together rather than relying on a single fit index [31]. In this study, based on the fit indices obtained from CFA ($\chi^2/df = 2.05$, RMSEA = 0.06, RMR = 0.08, CFI = 0.95, IFI = 0.95, GFI = 0.80, and NFI = 0.91), it was confirmed that the HBMS for CRC Screening consists of a four-dimensional (factorial) structure. Only the GFI value (0.80) in this study was slightly below the desired level (≥0.90) among the fit indices. Although some researchers interpret GFI values between 0.80 and 0.89 as indicating a reasonable fit, values of 0.90 or higher are considered as evidence of a good fit [32, 33]. In the original study by Lee et al. [18], the GFI value (0.83) was also <0.90, and other fit indices ($\chi^2/df = 1.99$, RMSEA = 0.05, SRMR = 0.06, CFI = 0.92, GFI = 0.83, and NFI = 0.85) were similar to those in the current study.

Another method for determining construct validity is through the discriminant validity method. This approach assesses groups expected to differ based on the test whose validity is being measured [19]. Studies suggest that individuals with a family history of CRC, who undergo regular annual check-ups, follow physicians' screening recommendations, are informed about screening tests, and perceive themselves at risk for CRC are more likely to undergo screening [13, 34–38]. Low literacy level, monthly household income, and fatalism, especially among men, are reported as factors inversely related to screening intention and behavior [39]. In this study, as expected, the mean scores on the barriers subscale were higher among individuals in the groups with lower education levels, those who had never undergone screening tests, those unaware of screening tests, and those unwilling to undergo screening tests. Also, the mean scores on the self-efficacy and benefits or severity or susceptibility subscales were higher among individuals with higher education levels, those with a family history of cancer, those who had previously undergone screening tests, those knowledgeable about screening tests, and those willing to undergo screening tests. These findings support the construct validity of the HBMS for CRC Screening, as demonstrated through the discriminant validity method.

In the present study, four different methods (Cronbach's alpha, McDonald's omega, Spearman-Brown, and test-retest) were employed to determine the reliability coefficients of the HBMS for CRC Screening. According to the test-retest method, only the reliability coefficients of the subscales self-efficacy and benefits at 0.64 and severity at 0.61 were slightly low. However, according to the test-retest method, the reliability of the other two subscales, namely, the barriers and susceptibility subscales, were high (≥0.80). Additionally, according to the Cronbach's alpha, McDonald's omega, and Spearman-Brown tests, the reliability coefficients of all subscales were high (0.73–0.92). Therefore, the Turkish version of the HBMS for CRC Screening is highly reliable. Lee et al. [18] reported Cronbach's alpha coefficients as 0.88 and above for subscales. Lee and Lee [20] also reported Cronbach's alpha coefficients as 0.72 and above for subscales. In the present study, the Cronbach's alpha coefficients for the subscales range from 0.80 to 0.92. Based on the results of the study, the Turkish version and four-dimensional structure of the HBMS for CRC Screening constitute a valid and reliable tool for measuring individuals' health belief perceptions regarding CRC screening in Turkey. The Questionnaire guide was developed for this study by the authors. Both the Turkish version of the HBMS for CRC Screening and the Questionnaire guide are included in the supplementary file (Appendix I).

Limitations

All data obtained in the study are based on the participants' subjective evaluations. The results presented here represent findings from individuals receiving health services at primary healthcare facilities in one province in Turkey and may not necessarily reflect other provinces. For the generalizability of the results, similar studies should be conducted with individuals in other provinces.

Conclusion

The Turkish version of the HBMS for CRC Screening is a valid and reliable tool to measure the perception of health beliefs towards CRC screening among individuals

in Turkey. Participants stated they were less likely to undergo FOBT primarily due to a lack of symptoms or a doctor's recommendation. These findings highlight areas that may benefit from improvements. This study specifically measured the applicability of the HBMS to evaluate individuals' health belief perceptions regarding CRC screening in Turkey. Based on the findings, using the HBMS for CRC Screening in further studies may explore the relationship between individuals' health belief perceptions about CRC screening and participation in screening test programs. Additional studies aimed at increasing participation in screening programs may be planned in this context.

The Turkish version of the HBMS for CRC Screening can be utilized to measure individuals' perceptions of and attitudes toward CRC screening in Turkey and assess their positive or negative health beliefs about CRC screening. This scale may help researchers understand people's health beliefs, which influence their CRC screening behaviors, and develop appropriate educational programs. If necessary, interventions can be made to address individuals' negative health beliefs regarding CRC screening. Such interventions can save lives through early diagnosis and improve the community's overall health. This study was conducted in a single province in Turkey. It is recommended that future studies include participants from multiple regions.

Abbreviations

ANOVA	Analysis of variance
BAR	Barriers
BEN	Benefits
CRC	Colorectal cancer
FOBT	Fecal Occult Blood Tests
HBM	Health Belief Model
HBMS for CRC Screening	Health Belief Model Scale for Colorectal Cancer Screening
I-CVI	Item-level Content Validity Index
KETEM	Cancer Early Diagnosis, Screening, and Education Center
KMO	Keiser-Meyer-Olkin Sampling Adequacy Measure
S-CVI	Scale-level Content Validity Index
SE	Self-efficacy
SEV	Severity
SUS	Susceptibility

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12889-025-23127-y.

Supplementary Material 1

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Data availability
The datasets generated and/or analysed during the current study are not publicly available but are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
Approval was obtained from the Niğde Ömer Halisdemir University Ethics Committee (Date: December 27, 2022, No: 2022/15–17), and permission was received from the Provincial Health Directorate of Niğde, Turkey. In accordance with the Declaration of Helsinki, the purpose of the study was explained to the participants, their consent was obtained and their voluntary participation was ensured.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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References

1. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, et al. Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2021;71(3):209–49. https://doi.org/10.3322/caac.21660
2. Republic of Turkey Ministry of Health, Sağlık istatistikleri yıllığı. (Health statistics yearbook), Available from https://www.saglik.gov.tr/TR,95109/saglik-istatistikleri-yilligi-2021 yayinlanmistir.html. (2021). (in Turkish) Accessed March 10, 2023.
3. Ladabaum U, Dominitz JA, Kahi C, Schoen RE. Strategies for colorectal cancer screening. Gastroenterology. 2020;158(2):418–32. https://doi.org/10.1053/j.gastro.2019.06.043
4. Centers for Disease Control and Prevention. What should I know about screening? 2023. Available from https://www.cdc.gov/cancer/colorectal/basic_info/screening/index.htm.Accessed March 10, 2023.
5. Hultcrantz R. Aspects of colorectal cancer screening, methods, age and gender. J Intern Med. 2021;289(4):493–507. https://doi.org/10.1111/joim.13171
6. Maida M, Macaluso FS, Ianiro G, Mangiola F, Sinagra E, Hold G, et al. Screening of colorectal cancer: present and future. Expert Rev Anticancer Ther. 2017;17(12):1131–46. https://doi.org/10.1080/14737140.2017.1392243
7. Altobelli E, D'Aloisio F, Angeletti PM. Colorectal cancer screening in countries of European Council outside of the EU-28. World J Gastroenterol. 2016;22(20):4946–57. https://doi.org/10.3748/wjg.v22.i20.4946
8. Ran T, Cheng CY, Misselwitz B, Brenner H, Ubels J, Schlander M. Cost-effectiveness of colorectal cancer screening strategies—a systematic review. Clin Gastroenterol Hepatol. 2019;17(10):1969–81. https://doi.org/10.1016/j.cgh.2019.01.014
9. Republic of Turkey Ministry of Health, Turkey Public Health Institution Cancer Control Department, Turkey cancer control programme. (2016) Available from https://www.iccp-portal.org/system/files/plans/Turkiye_Kanser_Kontrol_Program_English.pdf. Accessed April 5, 2023.
10. Sabatino SA, Thompson TD, White MC, Shapiro JA, Clarke TC, Croswell JM, et al. Cancer screen test use——U S 2019. Am J Prev Med. 2022;63(3):431–9. https://doi.org/10.1016/j.amepre.2022.02.018
11. Tekiner S, Peker GC, Doğan MC. Colorectal cancer screening behaviors. PeerJ. 2021;e10951. https://doi.org/10.7717/peerj.10951
12. Gözüm S, Çapık C. Sağlık Davranışlarının Geliştirilmesinde Bir Rehber: Sağlık İnanç modeli. (A guide in the development of health behaviours: health belief model (HBM)) (in Turkish). DEUHYO ED. 2014;7(3):230–7. https://dergipark.org.tr/tr/download/article-file/753364

13. Champion VL, Skinner CS, Glanz K, Rimer BK, Viswanath K. San Francisco: Jossey-Bass; 2008.
14. Rawl SM, Menon U, Champion VL, May FE, Loehrer PSr, Hunter C, et al. Do benefits and barriers differ by stage of adoption for colorectal cancer screening? Health Educ Res. 2005;20(2):137–48. https://doi.org/10.1093/her/cyg110
15. Dönmez E, Nahcivan NO, Rawl SM. Validity and reliability of the instruments to measure colorectal cancer screening benefits and barriers—Turkish version. Cancer Nurs. 2022;45(2):364–73. https://doi.org/10.1097/NCC.0000000000000921
16. Ozsoy SA, Ardahan M, Ozmen D. Reliability and validity of the colorectal cancer screening belief scale in Turkey. Cancer Nurs. 2007;30(2):139–45. https://doi.org/10.1097/01.NCC.0000265012.25430.30
17. Koç Ş. Kolorektal kanser risk danışmanlığının riskli bireylerin birincil ve ikincil koruma davranışlarını geliştirmeye etkisi. (The effect of colorectal cancer risk counseling on the promoting of primary and secondary preventive behaviors of the individuals at risk) Unpublished Doctoral Thesis, İstanbul Üniversity Health Sciences Institute; İstanbul. (in Turkish). 2014.
18. Lee SY, Lee EE, Rhee YS, Yang EY, Shin JH, Lee S. Adaptation and validation of the health belief model scale for colorectal cancer screening. Nurs Health Sci. 2019;22(2):355–63. https://doi.org/10.1111/nhs.12656
19. Alpar R. Uygulamalı Istatistik ve geçerlik-güvenirlik (Applied statistics and validity-reliability). Ankara: Detay Publishing; 2022. (in Turkish).
20. Lee SY, Lee EE. Cross-cultural validation of instruments measuring health beliefs about colorectal cancer screening among Korean Americans. J Korean Acad Nurs. 2015;45(1):129–38. https://doi.org/10.4040/jkan.2015.45.1.129
21. Çokluk O, Şekercioğlu G, Büyüköztürk Ş. Multivariate statistics for social sciences SPSS and LISREL applications. 7th ed. Pegem Publishing (in Turkish); 2023.
22. Henson RK, Roberts JK. Use of exploratory factor analysis in published research: common errors and some comment on improved practice. Educ Psychol Meas. 2006;66(3):393–416. https://doi.org/10.1177/0013164405282485
23. Samuelsson M, Wennick A, Bengtsson M, Lydrup ML, Jakobsson J. Translation, cultural adaptation, and psychometric testing of the supportive care needs survey for partners and caregivers for Swedish family members of persons diagnosed with colorectal cancer. J Patient Rep Outcomes. 2023;7(1):100. https://doi.org/10.1186/s41687-023-00636-1
24. Mankan T, Erci B, Turan GB, Aktürk Ü. Turkish validity and reliability of the diabetes self-efficacy scale. Int J Nurs Sci. 2017;4(3):239–43. https://doi.org/10.1016/j.ijnss.2017.05.001
25. Alpar R. Uygulamalı Çok değişkenli Istatistiksel Yöntemler (Applied multivariate statistical methods). Ankara: Detay Publishing; 2020. (in Turkish).
26. Sellbom M, Goretzko D. Introduction to exploratory factor analysis: an applied approach. In: Edlund J, Nichols AL, editors. The Cambridge handbook of research methods and statistics for the social and behavioral sciences: volume 1: building a program of research. Cambridge University Press; 2023.
27. Harrington D. Confirmatory factor analysis. Oxford University Press; 2009.
28. Hu LT, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. Struct Equation Modeling: Multidisciplinary J. 1999;6(1):1–55. https://doi.org/10.1080/10705519909540118
29. Tabachnick BG, Fidell LS. Using multivariate statistics. 6th ed. Pearson Education; 2013.
30. Thompson B. Exploratory and confirmatory factor analysis: understanding concepts and applications. 1st ed. American Psychological Association; 2004.
31. Jöreskog KG, Sörbom D. LISREL 8: structural equation modeling with the SIMPLIS command language. Scientific software international; 1993.
32. Doll WJ, Xia W, Torkzadeh G. A confirmatory factor analysis of the end-user computing satisfaction instrument. MIS Q. 1994;18(4):357–69. https://doi.org/10.2307/249524
33. Cheng SI. Comparisons of competing models between attitudinal loyalty and behavioral loyalty. Int J Bus Social Sci. 2011;2(10):149–66. http://ijbssnet.com/journals/Vol._2_No._14;_July_2011/18.pdf
34. Oh KM, Park B, Jacobsen KH. A qualitative analysis of barriers to colorectal cancer screening among Korean Americans. J Cancer Educ. 2021;36(2):261–70. https://doi.org/10.1007/s13187-019-01621-3
35. Chand BR, Phillipson L, Ha T. Factors influencing organised faecal occult blood test screening participation in culturally and linguistically diverse populations: a scoping review. Public Health. 2023;219:67–72. https://doi.org/10.1016/j.puhe.2023.03.022
36. Taş F, Kocaöz S, Çirpan R. The effect of knowledge and health beliefs about colorectal cancer on screening behaviour. J Clin Nurs. 2019;28(23–24):4471–7. https://doi.org/10.1111/jocn.15032
37. Dressler J, Johnsen AT, Madsen LJ, Rasmussen M, Jorgensen LN. Factors affecting patient adherence to publicly funded colorectal cancer screening programmes: a systematic review. Public Health. 2021;190:67–74. https://doi.org/10.1016/j.puhe.2020.10.025
38. Mack LA, Cook LS, Temple WJ, Carlson LE, Hilsden RJ, Paolucci EO. Colorectal cancer screening among first-degree relatives of colorectal cancer patients: benefits and barriers. Ann Surg Oncol. 2009;16(8):2092–100. https://doi.org/10.1245/s10434-009-0528-z
39. Lau J, Lim TZ, Jianlin Wong G, Tan KK. The health belief model and colorectal cancer screening in the general population: a systematic review. Prev Med Rep. 2020;20:101223. https://doi.org/10.1016/j.pmedr.2020.101223

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