

ORIGINAL ARTICLE

Development and psychometric evaluation of the Aversion to Bowel Cancer Screening Scale

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Abstract

Objective: Avoidance of colorectal cancer (CRC) screening is well documented with emotional barriers deterring screening intention and uptake. However, the assessment of such aversion is limited by the available instruments focusing on siloed emotions or screening procedures, limiting relevance to the complete process of decision-making in the CRC context.

Methods: To address this gap, psychometric properties of the newly developed Aversion to Bowel Cancer Screening Scale (ABCSS) were assessed using data from 640 CRC screening eligible asymptomatic community members. Item review and piloting reduced 179 items to the initial 29-item scale. Using a holdout sample technique, exploratory and confirmatory factor analysis, reliability and validity checks were conducted.

Results: A three-factor model (Fecal Occult Blood Test [FOBT] Aversion, Colonoscopy Aversion and Health Conscientiousness) with 21 items was identified. Analyses of the 21-item ABCSS indicated excellent reliabilities for the scale and subscales ($\alpha = .91$ to $.95$). Correlations with relevant existing measures, intention and behaviour indicated good construct validity.

Conclusion: The ABCSS is a valid measure of aversion to CRC screening for asymptomatic community members facing the decision to undertake CRC screening. This instrument may provide a more comprehensive understanding of the decision-making process for CRC screening.

KEYWORDS

bowel cancer, cancer, emotions, information, prevention

1 | INTRODUCTION

Globally, colorectal cancer (CRC) is the third most commonly diagnosed cancer and second leading cause of cancer death (Sung et al., 2021). Early detection, diagnosis and treatment are key to prevent CRC mortality. To this end, population screening for CRC is recommended (Young, 2009). However, participation in screening is suboptimal. For example, although a minimum target of 60% uptake

for population screening has been reported (Worthington et al., 2020), participation varies across countries, with some countries indicating participation as low as 33% (Klabunde et al., 2015). As a result, it is important to understand the decision-making process underlying non-participation.

Low public awareness, low perceived risk and lack of general practitioner endorsement are commonly identified as prominent barriers to screening participation (Benito et al., 2018; Brown

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et al., 2020; Honein-AbouHaidar et al., 2016). More recently, the emotions involved in CRC screening decision-making have been identified, including fear, embarrassment and disgust. Although the literature has progressed since Consedine and Moskowitz's (2007) review on emotions in health, the psychometric assessment of emotions in CRC screening has been limited to methodological restraints of siloed assessment (e.g., investigating discrete emotion in isolation due to shared variance concerns), generalised or dispositional measures (e.g., disgust sensitivity) or limited psychometric capacity to assess multiple emotions. Although there are measures currently available (e.g., Colorectal Cancer Fear Scale [CRCFS], Leung et al., 2014; Colonoscopy Embarrassment Scale [CES-13], Mitchell et al., 2012; and modified ICK factor, O'Carroll et al., 2015), these measures are limited by investigating siloed emotions or targeting isolated or generalised screening modalities (e.g., colonoscopy or Fecal Occult Blood Test [FOBT] specifically, or CRC screening generally). The Emotional Barriers to Bowel Screening Scale (EBBS; Reynolds et al., 2018) has recently been used to measure multiple emotions (i.e., fear, embarrassment and disgust) in the CRC screening context. Validation with an Australian sample (Davis et al., 2017) failed to support the measure as a multidimensional instrument, with psychometric evaluation suggesting a single factor measuring fecal disgust. The suggested unidimensional nature of the EBBS has recently been contested by researchers using the measure to assess emotions (i.e., fecal disgust, embarrassment and fear) limited to the fecal test (Scaglioni & Cavazza, 2021). However, to predict screening behaviour and delayed medical care, these researchers only used 10 items from the EBBS with 5 items, regarding insertion disgust, removed, following confirmatory factor analysis (CFA) that had supported the multidimensional structure. As it currently stands, there are no measures that take into account the likely multidimensional nature of emotions experienced in the CRC screening context.

A measure to assess CRC screening deterrence needs to take a broader view than just one method of testing. Although fecal tests are the prominent screening modality for population-based programmes worldwide, limiting investigation of screening decision-making to only this test constrains the process to the immediate testing modality and suggests that individuals are only influenced by emotions involved with their immediate action. However, this is unlikely to be the case with individuals influenced by emotions along the decision-making process, including anticipated emotions to the necessary diagnostic test and subsequent first line of treatment, colonoscopy (Hall et al., 2015; Xu & Guo, 2019). Accordingly, for a measure to assess CRC screening deterrence accurately, it needs to address both CRC screening modalities.

Further, motives involved in CRC screening are most likely multifactorial, with multiple elicitors of emotions relevant for both screening modalities and anticipated outcomes. As such, a measure addressing multiple emotions in relation to the complete process of screening (i.e., stool testing and subsequent colonoscopy) is needed. This will provide a more applicable measure for use with most population screening programmes. Thus, the current study aims to explore the development and psychometric evaluation of a new measure to

assess aversion to CRC screening within the population-based screening programme context.

2 | METHODS

2.1 | Design

A cross-sectional psychometric study was used to validate the Aversion to Bowel Cancer Screening Scale (ABCSS), following item creation, selection and refinement of items. Ethical clearance from the Griffith University Human Research Ethics Committee was obtained (GU Ref No. 2015/701). Written consent was obtained from all participants prior to study completion.

2.2 | Participants

Participants were recruited using online advertising across community newsletters, social media pages, and paid advertising (e.g., Facebook). These methods were used to reach a broader community of individuals relevant to screening eligibility, aged between 40 and 75 years and available in Australia. Specifically, this age criteria was used to include current screening guidelines for people who are aged between 50 and 75 years (Australian Institute of Health and Welfare [AIHW], 2021) and to address the rise in early-onset CRC (Feletto et al., 2019). Initially, 894 individuals provided responses to the online study, of whom 75 failed to complete more than 50% of the study, 166 failed to complete the scale items and 13 were removed due to not meeting the study inclusion criteria (i.e., participants reported being aged between 17 and 35 years). This resulted in a sample of 640 individuals (562 females, $M_{age} = 57.27$, $SD = 9.07$ years) who provided data for the current analysis. The majority reported being Caucasian (87.8%) and born in Australia (73.6%). Participants reported locality across all eight states and territories of Australia, in both metropolitan and rural areas. Previous invitation to the National Bowel Cancer Screening Program (NBCSP) was reported by 68% of participants, of whom 66% indicated previous completion, and 43.1% and 48.6% indicated previous completion of the FOBT and colonoscopy, respectively. Refer to Table 1 for further demographic details. Intention to undertake screening was reported by 75.2% of the sample.

2.3 | Measures

2.3.1 | Sociodemographic characteristics

Participants self-reported their age, sex, ethnicity, relationship status, education, employment status, income, health status including chronic health condition and cancer history for self and family.

TABLE 1 Participant demographics for population sampled and analyses samples

	Sample (N = 640) (n [%])	EFA subsample (n = 340) (n [%])	CFA subsample (n = 300) (n [%])
Age (years), M (SD) ^a	57.27 (9.07)	57.04 (9.32)	57.53 (8.79)
Sex ^a			
Female	562 (87.9)	306 (90.0)	256 (85.3)
Male	75 (11.7)	32 (9.4)	43 (14.3)
Other	2 (0.3)	1 (0.3)	1 (0.3)
Ethnicity			
Caucasian	562 (87.8)	299 (87.9)	263 (87.7)
Indigenous Australian	8 (1.3)	6 (1.8)	2 (0.7)
European	58 (9.1)	29 (8.5)	29 (9.7)
Asian	7 (1.1)	4 (1.2)	3 (1.0)
Indian	1 (0.2)	-	1 (0.3)
Middle Eastern	3 (0.5)	2 (0.6)	1 (0.3)
Maori	1 (0.2)	-	1 (0.3)
Education ^a			
Primary	6 (0.9)	5 (1.5)	1 (0.3)
Secondary	127 (19.9)	63 (18.5)	64 (21.3)
Tertiary	263 (41.1)	143 (42.1)	120 (40.0)
Postgraduate	204 (31.9)	109 (32.1)	95 (31.7)
Trade	39 (6.1)	20 (5.9)	19 (6.3)
Relationship status			
Single	115 (18.0)	55 (16.2)	60 (20.0)
Married or de facto	346 (54.1)	180 (52.9)	166 (55.3)
Divorced or separated	134 (20.9)	82 (24.1)	52 (17.3)
Widowed	45 (7.0)	23 (6.8)	22 (7.3)
Current employment ^b			
Unemployed	32 (5.0)	18 (5.0)	14 (4.6)
Self-employed or full time	169 (26.4)	91 (26.8)	78 (26.0)
Part time	141 (22.0)	79 (23.2)	62 (20.7)
Retired	202 (31.6)	103 (30.3)	99 (33.0)
Student	18 (2.8)	8 (2.4)	10 (3.3)
Carer/parent	43 (6.7)	22 (6.5)	21 (7.0)
Pensioner	26 (4.1)	14 (4.1)	12 (4.0)
Income protection	7 (1.1)	4 (1.2)	3 (1.0)
Healthcare professional ^c			
Yes	206 (32.2)	116 (34.1)	90 (30.0)
No	431 (67.3)	223 (65.6)	208 (69.3)
Annual personal income (AUD)			
Nil/prefer not to say	54 (8.4)	28 (8.2)	26 (8.7)
<\$20,799	127 (19.8)	57 (16.8)	70 (23.3)
\$20,800–\$51,999	247 (38.6)	141 (41.5)	106 (35.3)
\$52,000–\$130,999	174 (27.2)	95 (27.9)	79 (26.3)
>\$104,000	38 (5.9)	19 (5.6)	19 (6.3)
Chronic health condition ^d			
Yes	319 (50.2)	172 (50.6)	147 (49.0)
No	316 (49.8)	166 (48.8)	150 (50.0)
CRC diagnosis			

(Continues)

TABLE 1 (Continued)

	Sample (N = 640) (n [%])	EFA subsample (n = 340) (n [%])	CFA subsample (n = 300) (n [%])
Self	1 (0.2)	1 (0.3)	-
First-degree relative	29 (4.5)	17 (5.0)	12 (4.0)
Extended family	17 (2.7)	9 (2.6)	8 (2.7)
Other cancer diagnosis			
Self	18 (2.8)	9 (2.6)	9 (3.0)
First-degree relative	99 (15.5)	49 (14.4)	50 (16.6)
Extended family	20 (3.1)	10 (2.9)	10 (3.3)
NBCSP invitation			
Yes	435 (68.0)	223 (65.6)	212 (70.7)
No	166 (25.9)	95 (27.9)	71 (23.7)
Unsure	39 (6.1)	22 (6.5)	17 (5.7)
NBCSP completion			
Yes	287 (44.7)	143 (42.1)	144 (48.0)
No	148 (23.1)	80 (23.5)	68 (22.7)
Prior FOBT			
Yes	276 (43.1)	137 (40.3)	139 (46.3)
No	297 (46.4)	166 (48.8)	131 (43.7)
Unsure	67 (10.5)	37 (10.9)	30 (10.0)
Prior colonoscopy			
Yes	311 (48.6)	167 (49.1)	144 (48.0)
No	328 (51.2)	173 (50.9)	155 (51.7)
Unsure	1 (0.2)	-	1 (0.3)

Note: Colorectal cancer (CRC) diagnosis and other cancer diagnosis derived from participants indicating diagnosis for self or immediate family members ($n = 447$); National Bowel Cancer Screening Program (NBCSP) completion was only completed by participants indicating affirmatively for NBCSP invitation.

^aOne participant did not respond.

^bTwo participants did not respond.

^cThree participants did not respond.

^dFive participants did not respond.

2.3.2 | Item development, selection and refinement for ABCSS

The ABCSS was developed by the authors. The initial items for the measure were generated from qualitative data (described in detail in a manuscript under review) obtained from 39 community members, aged between 40 and 75 years, of various screening status (i.e., screeners, non-screeners, intenders and non-intenders) discussing anticipated and experienced emotions towards the FOBT and colonoscopy. Briefly, the interviews discussed prior screening and intention in conjunction with emotions elicited along the screening process for both procedures (e.g., from kit receipt or referral, procedure completion and post-completion), and emotional barriers and facilitators of screening. Thematic analysis identified four emotional barriers (embarrassment, e.g., *I would be humiliated if somebody saw the FOBT kit arrive in the mail*; diagnosis apprehension, e.g., *I do not want to know if I have bowel cancer*; procedural apprehension, e.g., *I would be scared*

to have a camera inserted into my rectum; and disgust, e.g., *I think sending a poo sample through the mail is gross*) and one cognitive facilitator (health conscientiousness, e.g., *I would complete bowel cancer screening for reassurance that I do not have bowel cancer*). Items were developed using a blueprint to ensure each domain (i.e., emotional barriers and cognitive facilitator), key eliciting stimuli (e.g., postage, storage, feces, rectal and exposure) and component (i.e., cognitive, affective and behavioural) were reflected for both the FOBT and colonoscopy.

A two-stage expert review process, undertaken by the second and fourth authors (MO and SO) assessing item redundancy, clarity and face validity, reduced the initial item pool from 179 items to 47 items, with initial piloting of the items with a community sample resulting in a further reduction of the scale to 29 items. Participants indicate their level of agreement with each statement on a 7-point scale (1 = *strongly disagree* to 7 = *strongly agree*).

To evaluate the ABCSS's construct validity, additional self-report measures were included in the study instrument.

2.3.3 | Three Domains of Disgust Scale (TDDS; Tybur et al., 2009)

The TDDS is a 21-item self-report measure of disgust in three domains: pathogen, sexual and moral disgust. Participants indicate how disgusting they find concepts on a 7-point scale (1 = *not at all disgusting* to 7 = *very disgusting*). The total scale and subscales demonstrated good internal reliability in the current sample ($\alpha = .88$), pathogen ($\alpha = .81$), sexual ($\alpha = .84$) and moral ($\alpha = .87$).

2.3.4 | Emotional Barriers to Bowel Screening (EBBS; Reynolds et al., 2018)

The EBBS was used to assess CRC context-specific disgust—fecal disgust (refer to Davis et al., 2017, for a previous psychometric evaluation with an Australian sample). The measure asks participants to indicate their agreement with 15 items on a 5-point scale (1 = *strongly disagree* to 5 = *strongly agree*). A summed total EBBS score was calculated for each participant, with higher scores representing greater fecal disgust. The EBBS demonstrated excellent internal consistency ($\alpha = .95$).

2.3.5 | Colonoscopy Embarrassment Scale (CES-13; Mitchell et al., 2012)

CES-13 is a 13-item scale with a 4-point agreement scale (1 = *strongly disagree* to 4 = *strongly agree*) used to assess colonoscopy-related embarrassment. Scores are summed, with higher scores indicating greater colonoscopy-related embarrassment. The CES-13 demonstrated excellent internal reliability in the current sample ($\alpha = .96$).

2.3.6 | Colorectal Cancer Fear Scale (CRCFS; Leung et al., 2014)

CRCFS was adapted by Leung et al. from the eight-item Breast Cancer Fear Scale (Champion et al., 2004). The measure assesses CRC-related fear with eight items on a 5-point agreement scale (1 = *strongly disagree* to 5 = *strongly agree*). Greater scores indicate greater fear of CRC. The CRCFS demonstrated excellent internal consistency ($\alpha = .92$).

2.3.7 | Screening intention and prior completion

Participants indicated their current plans to be tested for CRC (i.e., screening intention) by selecting from two statements: (1) I do not intend to get screened for CRC and (2) I intend to get screened for CRC. Self-reported screening intention was coded as (0 = *no* and 1 = *yes*). Prior NBCSP, FOBT and colonoscopy completion were self-reported by participations (yes, no and unsure) and recoded as a

binary variable (0 = *no* and 1 = *yes*). Participants who were uncertain of their previous CRC screening behaviours were removed from relevant analyses.

2.4 | Procedure

The study was advertised on social media as ‘exploring health beliefs held by community members’ and included the age criteria for participation (i.e., aged between 40 and 75 years), prize draw entry for one of five AUD50.00 online gift vouchers and the link to the online questionnaire via Qualtrics. The study first asked participants to indicate their intention to get screened for CRC, followed by random presentation of the measures and subsequent collection of sociodemographic characteristics.

2.5 | Statistical analysis

The structure of the ABCSS was examined using a two-part strategy: (1) exploratory factor analysis (EFA) and (2) CFA with two approximately equal subsamples generated using the random procedure in SPSS Version 26 ($n = 340$ and 300 , i.e., tested and modified on one subsample and validated on the holdout sample). Factorability of the scale was investigated using item correlations, Kaiser–Meyer–Olkin measure of sampling adequacy, Bartlett's test of sphericity and communalities. The EFA used principal component analysis with oblimin rotation to explore scale structure, identify factors and reduce items. The potential number of factors was derived from scree plots and eigenvalues. CFA was used to test the fit of the refined structure using SPSS AMOS Version 26, using maximum likelihood estimation. Conventional model fit indices and model validity measure cut-offs were used for examination of models, specifically $CMIN/DF < 3$, $RMSEA < .06$, CFI and $TLI > .95$ (Hu & Bentler, 1999) and $CR > .7$, $AVE > .5$ and $MSV < AVE$ (Hair et al., 2014). Model validity was examined using a formula provided by Gaskin et al. (2019), automatically calculating construct reliability (CR), average variance extracted (AVE) and maximum shared variance (MSV). Following model fit assessment, the model was further examined using the second subsample and CFA. A final EFA was conducted with the entire sample to ascertain variance explained. Internal reliability of the scale and subscales was investigated using Cronbach's alpha. Discriminate validity was assessed using Pearson correlations.

3 | RESULTS

3.1 | Exploratory factor analysis

Inspection of the scree plot and eigenvalues suggested three factors, accounting for 42.39%, 14.30% and 12.30% of the variance, respectively. Factor 1 (F1) was labelled FOBT Aversion due to the 13 items referring purely to the FOBT process with disgust and contamination,

TABLE 2 Factor loadings for final exploratory factor analysis (EFA) solution ($n = 340$)

Item	M (SD)	F1	F2	F3	Communalities
I think posting my poo sample in the mail is unhygienic. (25)	2.68 (1.81)	.90			.75
I think having to put my poo in a storage container is disgusting. (16)	2.74 (1.80)	.87			.73
I think sending a poo sample through the mail is gross. (5)	2.78 (1.87)	.86			.73
I would be concerned about germs when collecting my poo sample. (2)	2.34 (1.66)	.85			.70
I would be concerned that my poo sample might leak in the mail. (17)	2.79 (1.84)	.84			.65
I would be concerned that storing my poo sample in the fridge might contaminate my food. (28)	2.72 (1.91)	.82			.65
I would feel ashamed posting the FOBT kit in the mail. (22)	2.10 (1.44)	.79			.73
I would be afraid to post my poo in the mail. (1)	2.23 (1.64)	.78			.61
I think storing my poo sample in the fridge is revolting. (14)	3.41 (2.06)	.77			.63
I would be worried about having to collect my poo. (20)	2.30 (1.66)	.76			.63
I would be concerned that I could get sick from collecting my poo sample. (19)	1.86 (1.34)	.72			.56
I would be humiliated if somebody saw the FOBT kit arrive in my mail. (13)	1.92 (1.31)	.70			.65
I think I would vomit if I had to complete the FOBT kit. (12)	2.09 (1.50)	.64			.55
I would be scared to undergo a colonoscopy. (27)	3.05 (1.97)		.92		.80
I would be scared to have a camera inserted into my rectum. (29)	2.97 (1.95)		.90		.81
I would be scared that I could feel the colonoscopy procedure. (18)	3.32 (2.04)		.89		.75
I would be scared of how invasive the colonoscopy is. (23)	3.14 (2.03)		.88		.79
I would be afraid that the colonoscopy would be painful. (3)	3.11 (1.94)		.86		.75
I would be embarrassed having a colonoscopy. (8)	3.03 (2.04)		.86		.72
I feel repulsed at the thought of having a camera inserted into my rectum. (9)	2.88 (1.85)		.81		.70
I would be afraid I would find the colonoscopy preparation painful. (11)	3.29 (1.98)		.79		.63
I would be humiliated having a camera inserted into my bottom. (4)	2.83 (1.90)		.76		.69
I would be scared of the preparation for the colonoscopy. (24)	3.34 (1.93)		.70		.54
I would complete bowel cancer screening for reassurance that I do not have bowel cancer. (7; r)	2.03 (1.53)			.89	.82
I would complete bowel cancer screening because I want to know if I have cancer. (15; r)	2.17 (1.61)			.87	.76
I would complete bowel cancer screening to prevent myself from dying of bowel cancer. (21; r)	1.95 (1.47)			.87	.75
I would complete bowel cancer screening to be able to catch cancer early. (10; r)	2.02 (1.59)			.85	.71
I think bowel cancer screening is important to ensure I am healthy. (6; r)	1.77 (1.29)			.81	.64
I do not want to know if I have bowel cancer. (26)	1.90 (1.58)			.73	.60
Cronbach's alpha total = .95		.95	.96	.92	
Average factor loading to factor		.79	.83	.73	

Abbreviations: F1, FOBT Aversion; F2, Colonoscopy Aversion; F3, Health Conscientiousness; r, reversed item.

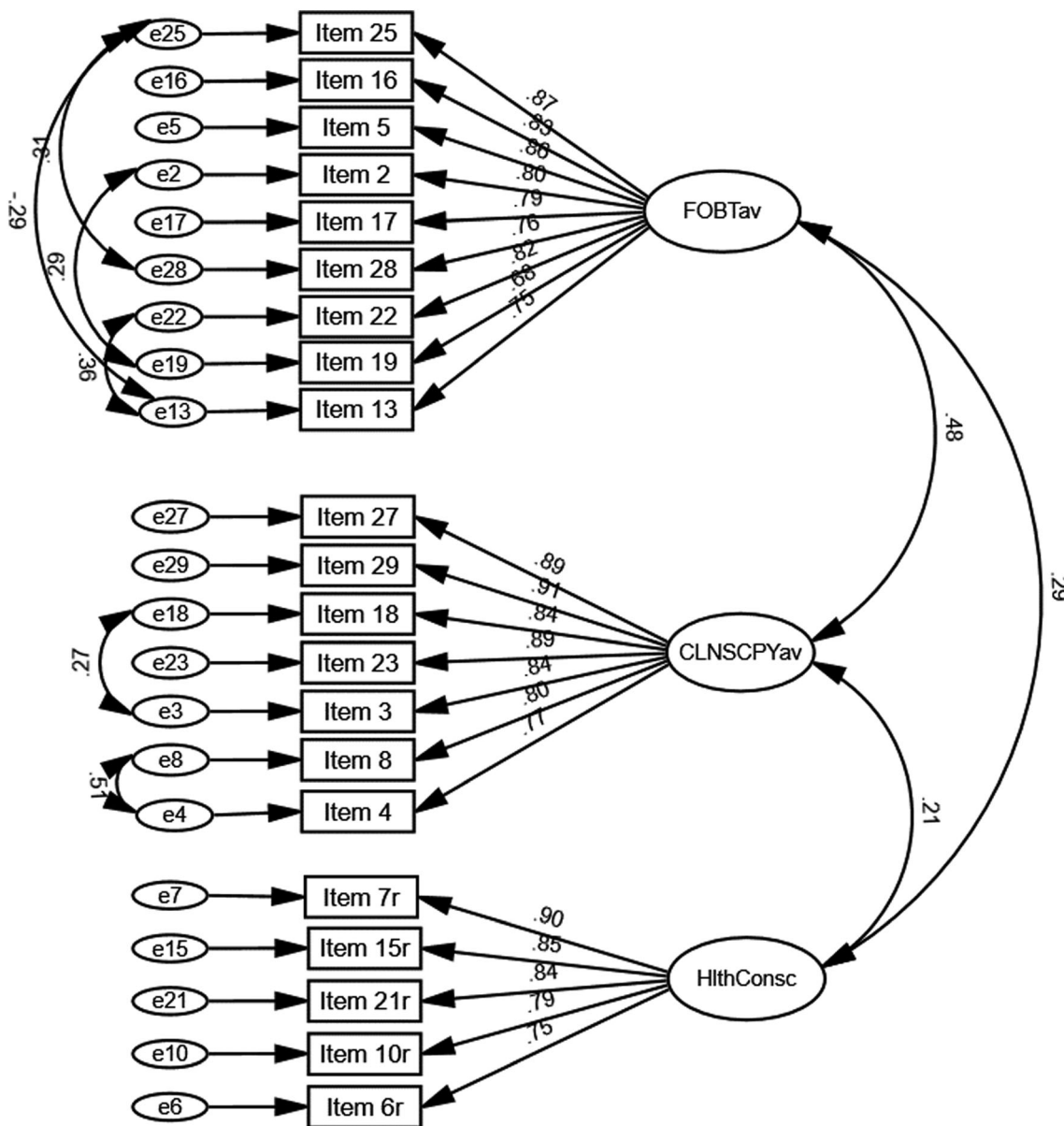


FIGURE 1 Confirmatory factor analysis, Subsample 1, 21-item ABCSS. CLNSCPYav, Colonoscopy Aversion; FOBTav, FOBT Aversion; HlthConsc, Health Conscientiousness; r, reversed item

fear and embarrassment represented in the items. Factor 2 (F2) was labelled Colonoscopy Aversion with all 10 items referring to the colonoscopy procedure eliciting a range of emotions: fear, embarrassment and disgust. Factor 3 (F3) was labelled Health Conscientiousness as all six items related to completing screening due to reassurance, health and prevention of CRC. Five items in F3 were reversed scored. Factor loadings ranged from .92 to .64 (refer to Table 2), and factors were correlated but not strongly ($r = .48$, $p < .001$ F1 and F2; $r = .26$, $p < .001$ F1 and F3; and $r = .17$, $p < .001$ F2 and F3). As such, good divergent validity and low shared variance of factors further supported three distinct factors. Internal consistency for each of the subscales was examined using Cronbach's alpha. Internal reliability of the total scale and factors were excellent (see Table 2).

3.2 | Confirmatory factor analysis

The 29-item three-factor model was submitted to a CFA. The model demonstrated poor fit, $\chi^2(374) = 1372.49$, $CMIN/DF = 3.67$; $CFI = .89$; $TLI = .87$; $SRMR = .06$; and $RMSEA = .09$. Further inspection of factor loadings and standardised residuals identified eight items for removal (Items 1, 9, 11, 12, 14, 30, 24 and 26). Examination of modification indices identified large residual covariances with re-specification of covariances for error terms due to high degree of overlap in item content (e.g., Item 4: *I would be humiliated having a camera inserted into my bottom* and Item 8: *I would be embarrassed having a colonoscopy*). The decision to include covariances between errors was made due to the specificity of the developed scale, insofar as, the scale items refer to a very specific situation (i.e., FOBT or

TABLE 3 Factor loadings for final confirmatory factor analysis (CFA) 21-item solution

Item	Sample 1 (n = 340)			Sample 2 (n = 300)		
	F1	F2	F3	F1	F2	F3
I think posting my poo sample in the mail is unhygienic. (25)	.87			.91		
I think having to put my poo in a storage container is disgusting. (16)	.83			.81		
I think sending a poo sample through the mail is gross. (5)	.86			.82		
I would be concerned about germs when collecting my poo sample. (2)	.80			.78		
I would be concerned that my poo sample might leak in the mail. (17)	.79			.83		
I would be concerned that storing my poo sample in the fridge might contaminate my food. (28)	.76			.83		
I would feel ashamed posting the FOBT kit in the mail. (22)	.82			.91		
I would be concerned that I could get sick from collecting my poo sample. (19)	.68			.78		
I would be humiliated if somebody saw the FOBT kit arrive in my mail. (13)	.75			.81		
I would be scared to undergo a colonoscopy. (27)		.89			.85	
I would be scared to have a camera inserted into my rectum. (29)		.91			.93	
I would be scared that I could feel the colonoscopy procedure. (18)		.84			.85	
I would be scared of how invasive the colonoscopy is. (23)		.89			.87	
I would be afraid that the colonoscopy would be painful. (3)		.84			.79	
I would be embarrassed having a colonoscopy. (8)		.80			.76	
I would be humiliated having a camera inserted into my bottom. (4)		.77			.81	
I would complete bowel cancer screening for reassurance that I do not have bowel cancer. (7; r)			.90			.93
I would complete bowel cancer screening because I want to know if I have cancer. (15; r)			.85			.82
I would complete bowel cancer screening to prevent myself from dying of bowel cancer. (21; r)			.84			.77
I would complete bowel cancer screening to be able to catch cancer early. (10; r)			.79			.83
I think bowel cancer screening is important to ensure I am healthy. (6; r)			.75			.76
Cronbach's alpha—ABCSS total		.93			.93	
Cronbach's alpha	.94	.95	.92	.95	.95	.91
Average factor loading to factor	.80	.85	.83	.83	.84	.82
Composite reliability (CR)	.94	.95	.92	.95	.94	.92
Average variance extracted (AVE)	.64	.72	.69	.69	.71	.68
Maximum shared variance (MSV)	.23	.23	.08	.28	.28	.04
Maximum reliability (MaxR [H])	.95	.95	.93	.96	.95	.93

Abbreviations: F1, FOBT Aversion; F2, Colonoscopy Aversion; F3, Health Conscientiousness; r, reversed item.

colonoscopy procedure). The re-specified model (refer to Figure 1) demonstrated significantly improved model fit in the $\chi^2(180) = 483.29$, $p < .001$, $CMIN/DF = 2.68$; $CFI = .95$; $SRMR = .06$; and $RMSEA = .07$ ($LO90 = .063$; $HI90 = .078$). The model fit was suggested to be adequate, given the violation of normality in both

univariate and multivariate of the sample and sample size. All items demonstrated distinctive loadings ranging from .68 to .91 (refer to Table 3). Reliability for the three subscales was excellent with CR measures above .9. Model fit analyses indicated excellent validity. Examination of the shared variance (AVE) supported convergent

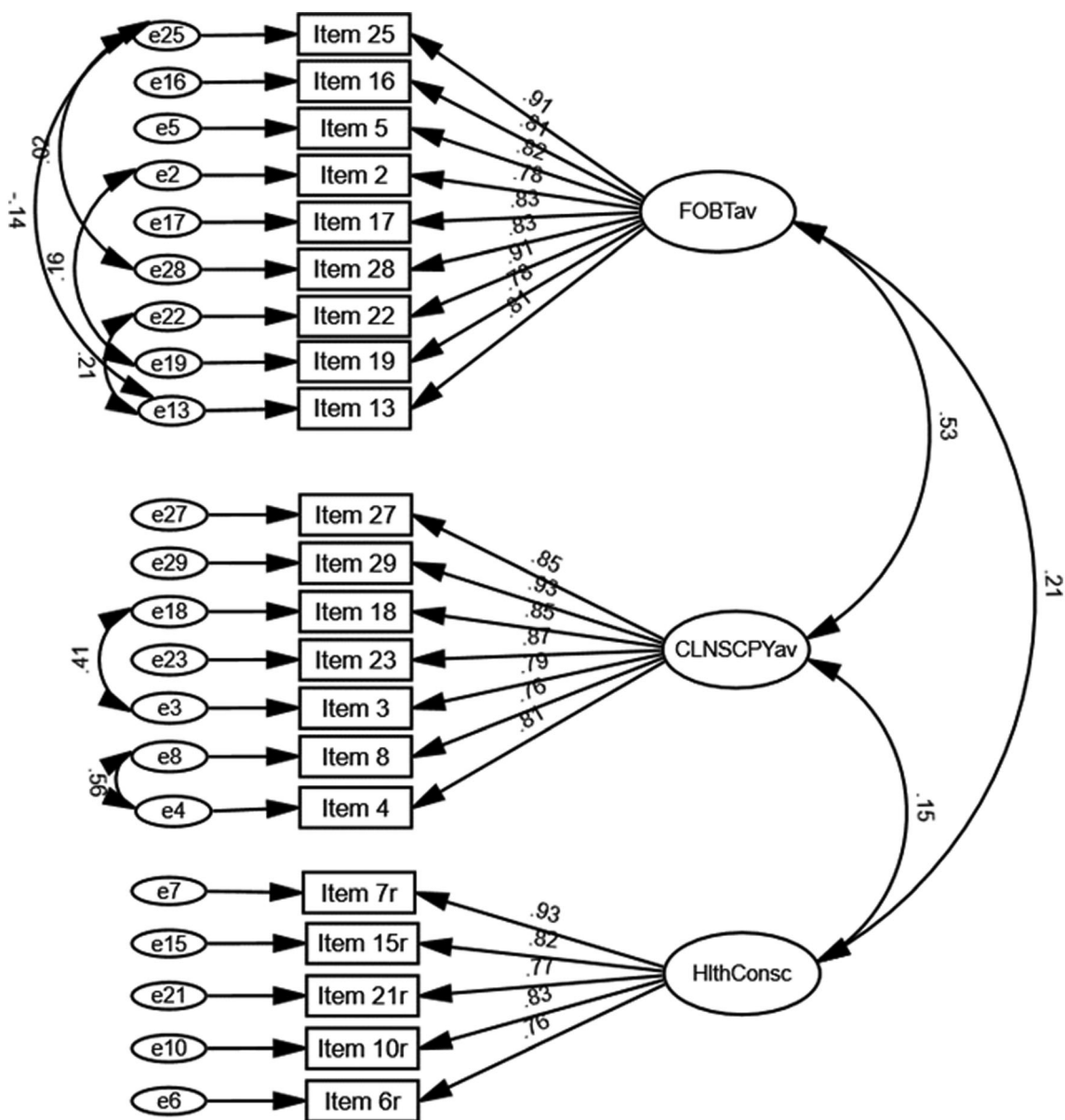


FIGURE 2 Confirmatory factor analysis, Subsample 2, 21-item ABCSS. CLNSCPYav, Colonoscopy Aversion; FOBTav, FOBT Aversion; HlthConsc, Health Conscientiousness; r, reversed item

validity of the factors with all values above .65. Discriminant validity was supported ($MSV < AVE$) for all three factors.

The re-specified model (refer to Figure 2) demonstrated excellent model fit in the holdout subsample ($n = 300$), $\chi^2(180) = 395.11$, $p < .001$, $CMIN/DF = 2.20$; $CFI = .96$; $SRMR = .04$; and $RMSEA = .06$ ($LO90 = .055$; $HI90 = .072$). Comparison of a single-factor, two-factor and the proposed three-factor model provided additional support for the proposed three-factor model solution (refer to Table S1). All items demonstrated distinctive loadings ranging from .76 to .93. No model validity concerns were identified. Refer to Table 3.

3.3 | Variance explained

The 21-item ABCSS was examined using EFA and the entire sample. Three factors with eigenvalues greater than one (9.10, 3.48 and 2.88, respectively) were identified, accounting for 73.66% of the variance. The factor loadings supported the previous structure identified with high factor loadings ($>.77$), communalities ranging from .62 to .85 and excellent internal reliability for the total scale and domains (ranging from .91 to .95). Further detail is available in Table S2.

TABLE 4 Correlations for study variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. ABCSS total														
2. FOBT Aversion	.85***													
3. Colonoscopy Aversion	.86***	.59***												
4. Health Conscientiousness (r)	.48***	.22***	.17***											
5. EBBS	.81***	.76***	.71***	.23***										
6. TDDS total	.18***	.23***	.14**	-.01	.24***									
7. TDDS pathogen	.28***	.32***	.25***	-.02	.31***	.78***								
8. TDDS sexual	.15***	.18***	.08	.06	.19***	.82***	.48***							
9. TDDS moral	-.03	.02	-.02	-.09*	.02	.68***	.32***	.32***						
10. CES-13	.69***	.51***	.77***	.14***	.68***	.19***	.26***	.14**	.04					
11. CRCFS	.17***	.21***	.22***	-.18***	.29***	.22***	.27***	.16***	.05	.25***				
12. CRC screening intention	-.41***	-.30***	-.24***	-.50***	-.50***	-.01	-.01	-.02	.01	-.17***	.14***			
13. NBCSP completion	-.45***	-.41***	-.25***	-.40***	-.40***	-.03	-.05	-.03	.01	-.19***	.03	.40***		
14. Prior FOBT completion	-.47***	-.41***	-.39***	-.22***	-.22***	-.03	-.11*	.00	.04	-.35***	-.08	.33***	.56***	
15. Prior colonoscopy	-.27***	-.02	-.40***	-.16***	-.16***	.07	-.01	.10*	.05	-.29***	.02	.13**	.06	.24***

* $p < .05$. ** $p < .01$. *** $p < .001$.

3.4 | Validity analyses

Correlations between the ABCSS and relevant scales were examined using the entire sample ($N = 640$). As shown in Table 4, correlations between the measures and the developed scale were as expected, with the EBBS, CES-13, TDDS and CRCFS all demonstrating significant positive correlations with the total scale (ranging from .17 to .81). Similarly, FOBT Aversion and Colonoscopy Aversion were positively correlated with all measures as expected and most substantially with EBBS and CES-13, respectively. Health Conscientiousness demonstrated significant positive correlations with EBBS and CES-13 and a negative correlation with CRCFS.

Correlations between the ABCSS and CRC relevant behaviours (i.e., self-reported screening behaviours and intention) were examined (see Table 4). The ABCSS total and subscales (FOBT Aversion, Colonoscopy Aversion and Health Conscientiousness) were positively correlated. Scale and subscales were negatively correlated with intention and prior completion of the NBCSP, FOBT and colonoscopy. Examination of the ABCSS correlations revealed that Health Conscientiousness was most substantially correlated with intention. The total scale and subsequent FOBT Aversion were most substantially correlated with prior NBCSP and FOBT completion. Colonoscopy Aversion was most substantially correlated with prior colonoscopy completion.

4 | DISCUSSION

Examination of the ABCSS indicates the instrument to be an acceptable, valid and reliable measure of aversion to CRC screening for use with average risk community members eligible for CRC screening. The structure of the instrument was validated using a holdout sample. Validity analyses support the three domains of aversion identified, FOBT Aversion, Colonoscopy Aversion and Health Conscientiousness. These domains represent facets of the entire decision-making process undertaken by community members when receiving invitation to participate in population screening using a fecal sample, followed by potential diagnosis and polyp removal during a colonoscopy procedure. Excellent internal reliability was obtained for the ABCSS total and subscales. Convergent validity was supported with significant correlations between the ABCSS total and subscales as expected with the EBBS, CES-13, TDDS and CRCFS. The ABCSS FOBT Aversion subscale was strongly associated with the EBBS, a measure from previous analyses indicated as a measure of fecal disgust (Davis et al., 2017). Further, ABCSS Colonoscopy Aversion was strongly associated with the CES-13, a measure of colonoscopy embarrassment. These strong correlations indicate the measures to be conceptually related. Discriminant validity of the ABCSS and subscales was supported with negative correlations with self-reported intention and screening behaviours. Screening intention was most substantially correlated with the ABCSS Health Conscientiousness subscale, while FOBT completion and colonoscopy completion were most substantially correlated with the relevant ABCSS subscales of FOBT and Colonoscopy Aversion, respectively. These findings support the

instrument as a context-specific measure that comprehensively considers CRC screening in its entirety.

Examination of the subscales in the 21-item measure demonstrated a range of emotions relevant to screening aversion. More specifically, FOBT Aversion included seven items relevant to disgust with the procedure, including collection, storage, postage and contamination, and two items relevant to embarrassment. By comparison, in the Colonoscopy Aversion subscale, five items refer to fear and two items to embarrassment elicited by the procedure. Interestingly, the FOBT Aversion subscale did not include items referring to fear, and Colonoscopy Aversion items were void of disgust based on item face validity. This contrasts Scaglioni and Cavazza's (2021) findings that found only fear predicted FOBT avoidance, using the EBBS. However, the multidimensionality of the measure has been contested with some findings indicating that the items are more consistent with fecal disgust (Davis et al., 2017). Given the ABCSS's associations with various emotions and screening behaviours, we suggest the measure to be a more comprehensive instrument to assess aversion to CRC screening, including both screening modalities and key emotional barriers. It may be that the screening modalities elicit different emotions or that certain emotions are more prominently elicited. The Health Conscientiousness items referred to the health benefits of screening, including reassurance, perceived prevention of death and early detection. Although more cognitive, these items may relate to a fear of cancer diagnosis, with the association to CRC fear (CRCFS) potential support for this suggestion. The moderate correlations of the Colonoscopy Aversion subscale with CRC screening intention, NBCSP and FOBT completion provide support for the need to consider aversion to both modalities relevant to CRC screening decision-making.

Study limitations include the cross-sectional design resulting in potential retrospective recall bias and convenience sampling of participants who may not reflect the wider population of community members eligible for CRC screening. Individuals identifying as female and of Caucasian background were overrepresented in our sample. This may represent a potential caveat to the interpretation of the current findings with females exhibiting better screening participation rates (Brown et al., 2020), reporting different emotional barriers to screening (Clarke et al., 2016; Friedemann-Sanchez et al., 2007) and generally reporting higher disgust (Druschel & Sherman, 1999; Rohrman et al., 2008). Similarly, research has also indicated that ethnic groups experience different barriers to CRC screening and poorer uptake (e.g., Christou & Thompson, 2012) and, for example, variation in CRC screening embarrassment (Consedine et al., 2011); embarrassment deterring discussion of bowel symptoms (Keighley et al., 2004); fear of results, complications and procedures (Brenner et al., 2015); and disgust deterring fecal collection (Dharni et al., 2017). As such, it is recommended that the ABCSS be further validated with a more diverse sample and cross-culturally validated in other jurisdictions with national CRC screening programmes. The differentiation of anticipated versus experienced aversion is also necessary and limited in the current study. However, the ABCSS provides a useful tool for future longitudinal research to investigate responding changes before and after procedure completion. Contrasting these limitations and

future research suggestions, the current study's large sample size and use of validated measures are identified as research strengths, with the current study an important and necessary step in the development of an instrument for future research.

The current findings support the use of the ABCSS total score and three subscales to provide a more comprehensive understanding of decision-making among asymptomatic community members faced with the choice to participate in CRC screening. This study establishes the ABCSS as a valid instrument to identify aversion to CRC screening. The availability of a validated tool will enable future research to examine decision-making in this context and the development of subsequent interventions. Understanding decision-making may aid in identifying individuals who may require further intervention to increase population-based screening uptake for CRC and to target the area of concern held by these individuals. This is critical given the importance of CRC screening uptake and the lower than desirable participation rates in population-based screening programmes.

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CONFLICT OF INTEREST

We have no conflict of interest to report.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on reasonable request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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SUPPORTING INFORMATION

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