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Why people fail to participate in annual skin cancer screening: creation of the perceptions of annual skin cancer screening scale (PASCSS)

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Abstract

Objectives: Many studies show that most people, even at-risk individuals, do not undergo routine clinical skin cancer screening, and many questions remain unanswered regarding the participation (or lack thereof) in annual skin cancer screening. Perhaps the largest unanswered question is the most essential: *why do people fail to undergo annual skin cancer screening?* We provide an avenue to answer this question by creating the Perceptions of Annual Skin Cancer Screening Scale (PASCSS).
Methods: In Study 1, we conduct a qualitative investigation to identify potential scale dimensions and items (n=233). In Study 2, we test the validity and psychometric properties of our initial item list via exploratory factor analysis (n=406). In Study 3, we further test the psychometric properties of our item list via confirmatory factor analysis (n=587).
Results: These three studies provide strong support for the validity and psychometric properties of our item list, resulting in the PASCSS. The PASCSS includes 48 items and 12 dimensions that each represent unique perceptions regarding annual skin cancer screening.
Conclusions: We encourage future authors to utilize the PASCSS to identify those most at risk for failing to participate in annual skin cancer screening as well as develop adaptive interventions that can target these participants.

Keywords: cancer; dermatology; patient perceptions; preventive behaviors; scale development; skin cancer; skin cancer screening.

Introduction

The critical importance of early detection in treating skin cancers is well-known, and prior studies have supported that individuals who undergo annual clinical screenings with a primary care provider or dermatologist are more likely to detect the early occurrence of skin cancers [1, 2]. While present evidence is not conclusive or strong enough for most public health organizations to recommend that all individuals should undergo annual skin cancer screenings, many organizations, including American Cancer Society, recommend regular self-screening for everyone and annual clinical skin cancer screening for at-risk individuals [3, 4]. Unfortunately, many studies show that most people, including at-risk individuals, do not undergo annual skin cancer screening [5, 6], such as Coups et al. [7] demonstrating that only 16% of men and 13% of women (U.S., age >50) had a clinical skin examination in the past year.

Due to the importance of early detection but low prevalence of annual screening, significant efforts have been allocated toward widening access to clinical skin cancer screening. The American Academy of Dermatology has provided free skin cancer screening programs since 1985 [8], and Germany introduced biannual nationwide skin cancer screening in 2008 [9, 10]. Despite extensive efforts, many questions remain unanswered regarding the participation (or lack thereof) in annual skin cancer screening. Perhaps the largest unanswered question is the most essential: *why do people fail to undergo annual skin cancer screening?* Prior interventions have largely assumed that access is the largest barrier to participation; however, authors have also recognized that access explains only a portion of variance in participation, and they have called for future researchers to assess broader barriers [8–10]. Thus, the primary goals of the current article are to (1) identify barriers to participation via a perceptions-based approach and (2) promote the patient-focused study of participation in annual skin cancer screening.

To achieve these goals, the current article undergoes a three-study process to develop the Perceptions of Annual Skin Cancer Screening Scale (PASCSS). PASCSS is a multidimensional measure that assesses the most common negative perceptions that patients may have of annual skin cancer screening, which represent cognitive barriers to engaging in the preventive health behavior. By creating this multidimensional measure, we demonstrate that negative perceptions surrounding annual skin cancer screening are

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complex. People may have several different – possibly even conflicting – perceptions regarding annual skin cancer screening, which include perceptions involving cost, access, risk factors, and many other aspects. We also identify correlates of these perceptions in providing validity evidence, and we assess whether the PASCSS predicts variance in whether people undergo annual skin cancer screening beyond popular existing measures of skin cancer perceptions [11].

By achieving these goals, the current article poses several implications for research and practice. Regarding research, few studies have investigated the cognitive processes of peoples' decision to undergo annual skin cancer screening, indicating that avenues to increase adherence could be identified via a patient-focused approach [12, 13]. PASCSS provides an additional avenue to integrate modern theories of behavioral decision making into the study of participation in annual skin cancer screening, such as protection motivation theory [14] and the health belief model [15], which could be used to develop comprehensive models of the entire annual skin cancer screening decision process. Regarding practice, PASCSS can identify perceptions that are most pertinent to deciding whether to undergo annual skin cancer screening, and subsequent interventions could be developed to target these specific perceptions. PASCSS can also be used to develop adaptive interventions [16, 17], wherein participants could be provided intervention components matched to their perceptions. Prior studies have supported that such adaptive interventions can produce greater outcomes with fewer resources [18, 19]. Therefore, the current article and provide directions for future research as well as implications for immediate practice.

The PASCSS should also be compared against current measures to further understand its potential impact. First, no prior article created an annual skin cancer screening perceptions measure by undergoing the traditional scale development process, including item generation, exploratory factor analysis (EFA), confirmatory factor analysis (CFA), and validity assessment. Without psychometric or validity evidence, it cannot be assured that extant measures provide accurate inferences regarding perceptions of annual skin cancer screening. Second, some authors have administered general measures to measure perceptions of annual skin cancer screening as a global construct [20, 21]. As discussed below, these measures may produce ambiguous empirical results, as differences among specific perceptions of annual skin cancer screening may be obfuscated in these measures. Third, some authors have alternatively administered measures for specific perceptions regarding annual skin cancer screening, such as accessibility and expense [22, 23]. It is unclear, however, whether specific perceptions still relate to relevant outcomes when accounting for other specific perceptions, and firm evidence has yet to be provided for the predominant importance of any one specific perception. The current article addresses these issues by undergoing the scale development process to create a psychometrically sound and valid multidimensional measure to assesses the multiple different perceptions of annual skin cancer screening. By doing so, differences among specific perceptions can be observed in empirical research and predominant perceptions can be differentiated from minor perceptions.

In the following, we perform three studies to create the PASCSS using best practices in scale development as recommended by prior authors [24–30]. Study 1 qualitatively identifies preliminary dimensions and scale items; Study 2 investigates the scale's validity, utility, and psychometric properties via EFA; and Study 3 confirms its psychometric properties via CFA.

Study 1

Study 1 has two primary goals: to qualitatively (a) identify preliminary skin cancer screening dimensions and (b) obtain statements that can be adapted to develop our measure.

Study 1 method

Study 1 participants

Sample 1: Participants (n=233; 78% from Western English-Speaking Countries) were recruited from MTurk and provided five U.S. cents in monetary compensation. MTurk is an online platform that connects those needing tasks completed, such as taking a survey, with those willing to complete the tasks. Many authors have used MTurk to study health perceptions and behaviors, as it can provide diverse and representative samples [31–33]. MTurk samples have also been shown to provide reliable and valid results when precautions are taken, which we followed in the current article [34–36]. We restricted participation to those who completed at least 50 MTurk tasks with a 95% or higher lifetime approval rate. Our measure was also only administered in English, and participants had to indicate that they were proficient in the English language to participate. We also removed those that provided nonsensical qualitative responses, and the reported sample sizes reflect the samples after removing these participants.

Sample 2: Participants (n=252; 87% from Western English-speaking countries) were recruited from MTurk using the same procedures as Sample 1.

Study 1 procedure

For both samples, participants enrolled via the MTurk platform. They provided their informed consent and immediately completed the survey. For all studies in the current article, the procedures were in accordance with the ethical standards of the institutional research committee of the primary author (Educational and Behavioral Research IRB) and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Study 1 measures

Participants were provided two open-ended qualitative questions in both samples. The questions for the first sample asked about reasons for not receiving yearly skin cancer screening, whereas the questions for the second sample asked about reasons for not receiving yearly dermatologist checkups. For both samples, the first question asked about participants' reasons, whereas the second question asked about perceived reasons of others. All items are provided in Supplementary Material A. By asking participants to provide their own as well as others' reasons, we obtain insights into personal and public perceptions regarding annual screening. Doing so improves the scope and generalizability of our qualitative findings, and it also aids the content validity of our created scale. Many participants provided more than three responses to their two questions, and location was the only other recorded information to ensure maximum anonymity.

Study 1 results

To conduct our qualitative analyses, we followed item generation and scale pretesting guidelines [29, 30, 37]. The primary author qualitatively analyzed and thematically categorized participant qualitative responses using an inductive content categorization approach. Categories were considered substantive if they included responses from 10% or more participants, as recommended by prior guidelines [29, 30, 37]. After the coding process was completed, the "Other" category represented responses from less than 10% of participants, indicating that a new construct category was not needed. Therefore, we created a comprehensive set of representative categories as indicated by the final distribution of qualitative responses, suggesting that prior guidelines are effective in conducting inductive content categorization approaches [29, 30, 37].

Table 1 provides our coding results, which includes category descriptions. 15 categories were identified. 10 categories included qualitative responses from 10% or more participants for personal perceptions regarding either skin cancer or dermatologist screening, indicating that they should be represented in the initial item list. One category approached the 10% cutoff, Uncomfortable. Because initial item lists should be over-representative [28, 29], we included this category in the initial item list. Four categories were represented by few participant responses: Effort, COVID-19, Referral, and Other. We chose not to include these four categories in our initial item list, but it is recognized that they may be important perceptions for specific subsets of the population. Therefore, 11 of the 15 categories are included in our initial item list, which are viable dimensions that may be included in our final measure.

Table 1: Qualitative coding results of study 1.

Dimension	Description each begins with: "perception that yearly (skin cancer/dermatologist) screening …"	Personal perceptions of skin cancer screening	Others' perceptions of skin cancer screening	Personal perceptions of dermatologist screening	Others' perceptions of dermatologist screening
Cost	Cost too much money.	**53%**	**67%**	**58%**	**76%**
Not at risk	Are not needed because I am not at risk	**40%**	**19%**	**41%**	**25%**
Time	Are difficult to fit into my schedule.	**30%**	**36%**	**42%**	**40%**
Not needed	Are not needed in general.	**29%**	**40%**	**25%**	**39%**
Undesirable	Can produce undesirable outcomes.	**23%**	**30%**	**21%**	**30%**
Unknowledgeable	Are not a practice that I am aware of.	**22%**	**38%**	**11%**	**25%**
Access	Are difficult to get.	**17%**	**15%**	**19%**	**17%**
Recommended	Are not recommended by my doctor.	**11%**	6%	2%	1%
Uncomfortable	Invade my privacy or embarrass me.	9%	6%	2%	4%
Forget	Are easy to forget.	8%	6%	**10%**	9%
Inconvenient	Are inconvenient to get.	6%	6%	**11%**	9%
Effort	Require too much effort to get.	5%	9%	7%	7%
COVID-19	Put people at risk of getting COVID-19.	5%	3%	6%	4%
Referral	Are difficult to get without a referral.	3%	1%	6%	4%
Other	All other responses	3%	4%	3%	6%

Listed figures indicate the percent of participants with a qualitative response coded within the respective category. Bolded values indicated that at least 10 percent of participants mentioned the respective dimension.

Study 1 brief discussion

Study 1 identified 11 possible dimensions for our measure. These dimensions are believed to be fully representative of perceptions regarding annual skin cancer screening, and no prior study has discussed all 11 dimensions together. Many prior articles, however, have discussed many of these dimensions individually [8, 38, 39]. For instance, Oliveria et al. [38] identified time constraints as a barrier to patients receiving annual skin cancer screening, whereas the American Academy of Dermatology has long recognized cost and access as being primary barriers [8]. These dimensions are also seen in discussions of similar preventative behaviors, such as the inclusion of convenience in vaccine hesitancy measures [39]. Thus, the intermittent discussion of these individual dimensions supports their inclusion as representative perceptions regarding annual skin cancer screening, but the novelty of studying each of them together emphasizes the potential for our measure to substantially advance current research.

We intend to create a relatively concise scale that can be widely applied. For this reason, we initially created five to eight items per category (68 total) with the intent of reducing the number of items for each dimension to four. To aid content relevance, we modified participants' qualitative responses to generate our initial items. For example, the qualitative participant response of, "I do not want other people to touch me", was adapted to create the item, "I am uncomfortable with doctors touching me." Supplementary Material B includes the initial item list.

Study 2

Study 2 has four primary goals. First, we reduce our over-representative item list into a concise set of items. By doing so, the scale can retain its beneficial measurement qualities while being more applicable in broader contexts. Second, we identify its factor structure via EFA, which provides initial support for its psychometric properties. EFA identifies the underlying dimensions of a set of indicators, and it identifies the relations of each indicator with the emergent dimensions [28]. No model is specified *a priori*, and EFA identifies the factor structure in an exploratory manner. EFA can thereby provide substantial support for the existence of dimensions and the indicators' capability to represent these dimensions. Third, we assess the relation of our developed measure with associated constructs to investigate its validity. Fourth, we test the extent that our measure predicts substantial variance in whether people receive an annual skin cancer screening beyond popular existing measures of skin cancer perceptions [11]. Achieving these four goals provides significant support for the suitability of our measure.

Study 2 method

Study 2 participants

Participants (66% from Western English-speaking countries; 42% female; age_{mean}=35.71; age_{SD}=10.85) were recruited from MTurk using the same criteria as Study 1, and our resultant demographic characteristics are similar to prior wide-scale studies using MTurk [40, 41]. We provided US$1.35 in compensation. Our measure was also only administered in English, and participants had to indicate that they were proficient in the English language to participate. We removed those that failed any of seven attention checks, and the sample sizes below reflect the sample after removing these participants. Thus, it is believed that those who passed the attention checks were sufficiently motivated and proficient in the English language.

Study 2 procedure

Participants enrolled via the MTurk platform. They provided their informed consent and immediately completed the first survey (T1, n=846). One week later, they were emailed and completed the second survey (T2, n=477). One week after the second survey, they were emailed and completed the third survey (T3, n=406). The over-representative item list was given at T2 and all other measures were given at T3 to address common-method bias [42].

Study 2 measures

Information regarding our measures can be found in Supplementary Material C.

Study 2 results

For all EFAs reported below, we utilized a principal axis factoring method with oblimin rotation. We first reduced our over-representative item list via EFA, for which we performed an iterative process. We performed separate EFAs on the items that represented each intended factor. We retained only the four items that loaded strongest onto that factor, as these would be the four items that were most representative of the underlying factor (e.g., perception). The Kaiser criterion and visual scree plot analyses indicated a clear one-factor solution for each EFA, with the exception

of the Undesirable factor. The EFA for this dimension indicated a two-factor solution, such that items regarding undesirable results and items regarding undesirable doctor interactions loaded onto two separate factors. We retained both factors because they could be theoretically justified, resulting in a set of 12 factors and 48 items to be analyzed together.

The 48 items produced a 12-factor solution via the Kaiser criterion, a 12-or 13-factor solution via a visual scree plot analysis, and a 13-factor solution via parallel analysis. Lim & Jahng [43] recently determined that researchers should also interpret parallel analysis solutions that include one more and one less factor than the posited solution, as they could also be statistically plausible solutions. Therefore, we interpreted the 12-, 13-, and 14-factor solutions.

In the 12-factor solution, each set of items largely loaded onto its posited factor, and each factor was represented by three or more items with strong loadings (>0.40). In the 13-factor solution, the Not Needed items were split across two separate factors, such that each factor was represented by two items. In the 14-factor solution, the additional factor was not adequately represented by any items. Because emergent factors should be represented by a sufficient number of items (e.g., ≥3), we chose to interpret the 12-factor solution.

In this solution, only one item loaded more strongly onto an alternative factor than its posited factor. We removed this item. No previously removed item from its respective dimension (Inconvenience) produced adequate factor loadings when inserted into the omnibus EFA, and this factor continued to be represented by three items. Only one other item had a cross-loading greater than 0.20, which was the second Not Needed item (0.30). Because its primary loading (0.39) was significantly smaller than the other items' primary loadings, we removed this item. A previously removed Not Needed item produced satisfactory item loadings when inserted into the omnibus EFA, and therefore this item was included such that the Not Needed factor could be represented by four items. The 47 items produced a satisfactory factor solution with all primary loadings greater than 0.45 and cross-loadings less than 0.19. These final item loadings are provided in Supplementary Material D, and the dimension intercorrelations are presented in Supplementary Material E.

With the item list refined, we assessed the concurrent validity of the dimensions. Table 2 includes correlations of the dimensions with the other measures. The Not at Risk dimension had strong relations with the perceptions of health status ($r=0.35$, $p<0.01$) and likelihood of skin cancer ($r=-0.35$, $p<0.01$) scales; Not Needed had a moderate relation with the likelihood of skin cancer scale ($r=-0.23$, $p<0.01$); Undesirable Results had moderate to strong relations with health worry ($r=0.23$, $p<0.01$) and likelihood of skin cancer ($r=0.29$, $p<0.01$) scales; Undesirable doctor interactions had a very large relation with attitudes towards doctors ($r=0.43$, $p<0.01$); Access had a strong relation with the health worry scale ($r=0.32$, $p<0.01$); Uncomfortable had moderate to strong relations with the health worry ($r=0.26$, $p<0.01$) and attitudes towards doctors ($r=0.34$, $p<0.01$) scales; and Forget had a moderate relation with the likelihood of skin cancer scale ($r=-0.21$, $p<0.01$). These theoretically justified and statistically significant results collectively support the concurrent validity of the scale.

We tested the predictive validity of the dimensions regarding the primary outcome of receiving a skin cancer screening in the past year (Table 3). When assessed individually, Cost ($r=-0.11$, $p<0.05$), Not at Risk ($r=-0.14$, $p<0.01$), Unknowledgeable ($r=-0.27$, $p<0.01$), Recommended ($r=-0.25$, $p<0.01$), and Forget ($r=-0.24$, $p<0.01$) each significantly related to whether participants received a yearly skin cancer screening. When assessed together, Cost ($\beta=-0.12$, $p<0.05$), Unknowledgeable ($\beta=-0.15$, $p<0.05$), and Forget ($\beta=-0.13$, $p<0.05$) each significant predicted the primary outcome. When assessed in conjunction with perceived likelihood and severity of skin cancer, the dimensions collectively explained an additional 10 percent of the outcome's variance, wherein Unknowledgeable was statistically significant ($\beta=-0.15$, $p<0.05$) and Cost ($\beta=-0.09$, $p<0.10$), Forget ($\beta=-0.12$, $p<0.10$), and Inconvenience ($\beta=-0.11$, $p<0.10$) were marginally significant. These results provide strong support that the developed items can predict meaningful variance in whether people receive a yearly skin cancer screening – satisfying the intent of their creation.

Study 2 brief discussion

Study 2 provided strong support for our developed measure. We reduced its length, demonstrated initial support for its factor structure, provided validity evidence, and showed that the measure predicts variance in whether people receive a yearly skin cancer screening beyond a popular measure of skin cancer perceptions. These results collectively indicate the further research on the developed measure is appropriate.

Study 3

Study 2 provided initial psychometric support, but scale development guides indicate that factor structures should be confirmed via CFA [24–27]. When performing CFA, the

Table 2: Correlations between skin cancer screening perceptions and other measured variables.

	Cost	Not at risk	Time	Not needed	Undesirable results	Undesirable doctor interactions	Unknowledgeable	Access	Recommended	Uncomfortable	Forget	Inconvenient
1.) Age	−0.18[b]	−0.03	−0.17[b]	−0.03	−0.09[a]	0.03	−0.01	−0.15[b]	0.01	−0.07	−0.01	−0.10[a]
2.) Gender	0.09	−0.08	0.07	0.04	0.05	0.12[b]	0.07	0.11[a]	0.11[a]	0.15[b]	0.03	0.08
3.) Health status	−0.07	0.35[b]	−0.03	−0.00	−0.12[a]	−0.12[a]	−0.01	−0.05	−0.05	−0.15[b]	−0.08	−0.09
4.) Health worry	0.15[b]	−0.15[b]	−0.01	−0.09	0.18[b]	0.12[a]	−0.08	0.04	0.02	0.06	−0.04	0.04
5.) Attitude towards doctors	0.15[b]	−0.00	−0.00	0.08	0.18[b]	0.43[b]	0.06	0.19[b]	0.05	0.34[b]	0.06	0.17[b]
6.) Likelihood of skin cancer	−0.04	−0.35[b]	0.07	−0.23[b]	0.17[b]	0.08	−0.16[b]	0.06	−0.12[a]	0.00	−0.21[b]	0.03
7.) Severity of skin cancer	0.23[b]	0.03	0.03	0.06	0.29[b]	0.13[a]	0.05	0.11[a]	0.14[b]	0.17[b]	−0.00	0.05
8.) Preventive behaviors	0.01	0.04	0.13[a]	−0.01	0.08	0.06	−0.04	0.10	−0.13[a]	0.02	−0.18[b]	−0.05
9.) Knowledge of skin cancer risk	−0.06	−0.05	0.01	−0.10[a]	0.07	0.01	−0.03	0.11[a]	−0.08	0.10[a]	−0.06	0.07
10.) Health insurance	−0.16[b]	−0.05	0.05	−0.05	0.01	−0.07	−0.05	−0.03	−0.00	−0.02	−0.01	0.02
11.) Yearly doctor checkup	0.02	−0.01	0.04	0.03	−0.05	−0.12[a]	−0.06	0.01	−0.04	−0.06	−0.09	−0.15[b]
12.) Yearly cancer screening	−0.11[a]	−0.14[b]	0.05	−0.03	0.01	0.00	−0.27[b]	0.02	−0.25[b]	0.01	−0.24[b]	−0.09

[a]p<0.05, [b]p<0.01.

Table 3: Regression results predicting received skin cancer screening in past year.

	Regression 1		Regression 2		Regression 3	
	β	t	β	t	β	t
1.) Likelihood of skin cancer	0.21	4.34[c]			0.17	3.13[c]
2.) Severity of skin cancer	−0.11	−2.32[b]			−0.10	−2.03[b]
3.) Cost			−0.12	−2.29[b]	−0.09	−1.70[a]
4.) Not at risk			−0.01	−0.14	0.04	0.64
5.) Time			0.06	1.15	0.05	0.94
6.) Not needed			0.04	0.69	0.07	1.24
7.) Undesirable results			0.04	0.69	0.04	0.73
8.) Undesirable doctor interactions			0.01	0.14	−0.02	−0.29
9.) Unknowledgeable			−0.15	−2.32[b]	−0.15	−2.28[b]
10.) access			0.06	0.99	0.05	0.81
11.) Recommended			−0.09	−1.49	−0.09	−1.45
12.) Uncomfortable			0.07	1.36	0.09	1.45
13.) Forget			−0.13	−2.11[b]	−0.12	−1.96[a]
14.) Inconvenient			−0.10	−1.67	−0.11	−1.94[a]
R^2		0.06[c]		0.12[c]		0.16[c]

[a]p<0.10, [b]p<0.05, [c]p<0.01.

researcher must specify a model to be tested, including the number of latent factors and relation of indicators to the latent factors. The analysis assesses the specified model's fit with the data, and it also estimates the strength of indicators' relations with the latent factors. Substantial support can be provided for the existence of dimensions and the indicators' capability to represent these dimensions if the model fit is satisfactory and the indicators sufficiently relate to the latent factors. We perform a CFA in Study 3 using a different sampling source than Studies 1 and 2.

Study 3 method

Study 3 participants

Participants (n=587; 39% female; age_{mean}=26.25; age_{SD}=8.29; 25% Portuguese, 18% Polish, 15% English, 9% Mexican, 7% Italian, 26% other nationalities) were recruited from Prolific and provided US$0.75 in compensation. Prolific is a platform similar to MTurk, but it includes differing participant populations. Using Prolific and MTurk for separate studies can help ensure that obtained inferences are more generalizable. Our measure was administered only in English, and participants had to indicate that they were proficient in the English language to participate. We removed those that failed more than one of four attention checks, and the sample size above reflects the sample after removing these participants. Thus, those who passed the attention checks are believed to be sufficiently motivated and proficient in the English language.

Study 3 procedure

Participants enrolled via the Prolific platform. They provided their informed consent and immediately completed the survey.

Study 3 measures

Reduced item list: We administered our item list reduced in Study 2. As the Inconvenience dimension was represented by only three items at the end of Study 2, we added one item to match the other dimensions. This resulted in a 48-item scale.

Study 3 results

To construct our CFA, we modeled 12 latent factors, and each set of four items loaded onto their respective latent factor. Then, we covaried the latent factors. The initial model fit indices (CFI=0.96, IFI=0.95, RMSEA=0.05, SRMR=0.05, χ^2/df=2.21) met or closely approached cutoffs for satisfactory fit (CFI≥0.95, IFI≥0.95, RMSEA≤0.05, SRMR≤0.05, χ^2/df≤2). Each item had satisfactory standardized factor loadings of 0.48 and above.

Prior authors have recommended that covariances should be added between error terms when the additional shared variance can be conceptually justified [24–27]. We analyzed the modification indices to identify such instances that may significantly improve model fit, and we observed five modification indices larger than 20. Each of these item pairs represented items that were closely synonymous, and therefore the additional shared variance could be reasonably explained. These item pairs were: Not Needed 1 and 2, Undesirable Results 3 and 4, Undesirable Doctor Interactions 1 and 2, Access 1 and 3, as well as Recommended 1 and 2. Once these covariances were added, model fit improved such that all model fit indices (CFI=0.96, IFI=0.96, RMSEA=0.04, SRMR=0.05, χ^2/df=1.94) met cutoffs for satisfactory fit, and each item again had a satisfactory item loading of 0.45 and above. These results confirm the psychometric properties of our measure, and support that it should be used to assess perceptions of annual skin cancer screening. Henceforth, we label these collective items the Perceptions of Annual Skin Cancer Screening Scale (PASCSS), and the scale is presented in Appendix A.

Study 3 brief discussion

The results of Study 3 confirmed the psychometric properties of the PASCSS, providing significant support for its continued usage.

Overall discussion

The goals of the current article were to identify why people fail to receive annual skin cancer screening as well as promote the patient-focused study of participation in annual skin cancer screening. To achieve these goals, we created the 48-item PASCSS that assesses 12 different negative perceptions regarding skin cancer screening, and we demonstrated that these dimensions predict significant variance in whether people receive annual skin cancer screening beyond existing measures of similar constructs. Therefore, this tool can indeed be used to identify and address cognitive barriers to participating in this preventive health behavior.

These results provide many avenues for future research and practice. Regarding research, participation in annual skin cancer screening should be recognized as a preventive behavior and integrated into relevant models. Bish & Michie [44] developed a model to identify the primary predictors of preventive behaviors, and perceptions were identified as both a key predictor and mediator of other antecedent effects. Future research should utilize the PASCSS to investigate the role of perceptions in these models. Likewise, perceptions are key in many theories used to understand protective behaviors, such as protection motivation theory [14] and the health belief model [15]. While these two theoretical perspectives have their nuances, both suggest that personal dangers are primarily evaluated by their severity (i.e., threat) and controllability (i.e., coping). The PASCSS includes dimensions associated with both the severity (e.g., Not Needed, Not Risk) and controllability (e.g., Cost, Access) of forgoing annual skin cancer screenings, and the PASCSS can now be used to integrate these theories into the study of annual skin cancer screening. For instance, the PASCSS's dimensions can grouped together based on their associations with severity and controllability, and researchers can make broad hypotheses about the relation of these groupings with screening behaviors. Even yet, dimensions associated with severity may interact with dimensions associated with controllability, and future research can develop hypotheses regarding moderating effects among the dimensions. By doing so, this avenue of research can identify further barriers to participation and avenues for improvement.

We also showed, however, that the perceptions produced differing relations, and some perceptions did not significantly relate to whether the participant received yearly skin cancer screenings. The capability to observe these differing relations is a significant benefit of the PASCSS. Many prior measures for perceptions of annual skin cancer screening only provide global assessments [20, 21].

Two people could score the same on these measures because they may both hold negative perceptions, but one person may have negative perceptions due to being unknowledgeable of annual skin cancer screenings and the other may have negative perceptions due to being uncomfortable with annual skin cancer screenings. With prior measures, researchers would be unable to disentangle these different perceptions, and the global measure of annual skin cancer screening perceptions may produce ambiguous results. The PASCSS, however, can show that perceptions due to being unknowledgeable negatively relate to receiving a yearly skin cancer screening, whereas perceptions due to being uncomfortable do not significantly relate to receiving a yearly skin cancer screening. The PASCSS can therefore provide more certainty to the current literature, and future researchers should strive to identify other instances and outcomes in which our scale's dimensions produce differing outcomes.

Additionally, a common axiom in research is that the scale development process is never complete [45]. Future researchers should reinvestigate the PASCSS across different populations. Notably, we only developed an English-language version of the PASCSS. To administer a scale in an alternative language than its original creation, researchers should undergo back-translation procedures and obtain psychometric and validity evidence for the translated measure [24–27]. If done for the PASCSS, researchers could determine whether the same dimensions emerge across cultures, and they could also assess whether these dimensions produce similar relations. Doing so could not only provide strong support for the PASCSS, but it could also uncover any cultural differences in perceptions of annual skin cancer screening. Similarly, researchers have shown that MTurk and Prolific produce samples that are similar to the general population, but the two sources do produce some differences in their samples. For this reason, we wanted to support the PASCSS's psychometric properties with each sampling source, once with EFA and once with CFA. By doing so, we ensured that our observed results were not solely due to idiosyncrasies of a particular sampling source and our scale provides sufficient psychometric information with multiple sampling sources. Future research should nevertheless investigate the PASCSS with additional sampling sources beyond MTurk and Prolific.

Future researchers should also reinvestigate the validity of the PASCSS with additional constructs. While we assessed the PASCSS's validity with its more proximal relations, other constructs should relate to annual skin cancer screening perceptions. For instance, those with fairer skin tones are more at risk for skin cancer, and annual skin cancer screening perceptions may have notable relations with skin tone. Several constructs are also similar to those measured in the current article, and they should therefore relate to annual skin cancer screening perceptions, such as education, family history, and immunosuppression. Supporting a relation of the PASCSS with these constructs would provide important validity evidence, and they could also be meaningful observations to guide future research and practice.

Regarding practice, while annual skin cancer screening is not presently recommended for everyone [3, 4], even at-risk individuals who are recommended to receive annual skin cancer screening often fail to engage in the practice [5–7]. The PASCSS can be used to identify those most likely to not receive an annual skin cancer screening, and practitioners could target those who score the highest on the PASCSS for interventions to encourage their adherence. Also, the PASCSS can be used to develop adaptive interventions. Adaptive interventions present specific intervention components to particular individuals, such that participants are only presented components that are believed to be effective based on their characteristics [16, 17]. For instance, a person who scores highly in Not Needed may be presented a video on the importance of early skin cancer detection, whereas a person who scores highly in Uncomfortable may be provided information on how to manage anxiety during a skin cancer screening. By doing so, participants are less fatigued by their interventions while still receiving effective components, which has been shown to significantly improve intervention outcomes in prior research [16, 17]. Specific methods to create these interventions, such as the sequential multiple assignment randomized trial [16, 17], could be utilized in conjunction with the PASCSS to easily develop effective interventions.

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Informed consent: No written consent was obtained to ensure maximum anonymity. Due to the very low risk of the study, an information sheet was instead provided to participants.

Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the primary author's institution and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. All procedures were approved by the IRB of the primary author's institution (IRB#: 1663301).

Appendix A Perceptions of annual skin cancer screening scale

Please indicate your extent of disagreement to agreement for each of the following statements using the scale below.

1 = Strongly Disagree
2 = Disagree
3 = Slightly Disagree
4 = Neither Disagree or Agree
5 = Slightly Agree
6 = Agree
7 = Strongly Agree

Answer each item as if it began with,"If I do not get a yearly full-body skin cancer screening with either a primary care provider or dermatologist, it is because…"

Cost
(1) I do not have the money to do so.
(2) It is too expensive.
(3) My insurance (or lack thereof) may not cover it.
(4) The price is too high.

Time
(1) There are not any times that I could go.
(2) I am unable to miss or be late for work and/or other obligations.
(3) I cannot spare the time right now.
(4) My schedule is too busy.

Not needed
(1) It is pointless.
(2) You can just handle any skin problems yourself.
(3) It is only necessary to go when you have a skin problems.
(4) It is only necessary to go when something is wrong.

Not risk
(1) I do not have any skin problems, such as signs of skin cancer.
(2) I think that I am healthy.
(3) I do not have any conditions that warrant a visit.
(4) I take enough precautions.

Inconvenient
(1) It is too inconvenient.
(2) It is a hassle.
(3) I cannot be bothered to go.
(4) It is too irritating to go.

Forget
(1) I never think about it.
(2) I do not think about skin problems, such as skin cancer.
(3) It does not often come to my mind.
(4) I do not really consider it.

Undesirable
(1) I am scared of being diagnosed with cancer.
(2) I am scared that something will be wrong with me.
(3) I am afraid that they might find an issue.
(4) I am afraid of bad news.

Undesirable doctor interactions
(1) I do not trust doctors.
(2) I fear doctors.
(3) I do not like going to a doctor's office or hospital.
(4) I prefer to just avoid doctors.

Access
(1) There are not any available doctors near me.
(2) I do not know where to find an available doctor.
(3) I am not sure who to go to.
(4) I do not have any available providers.

Unknowledgeable
(1) I did not know it was recommended to go for yearly appointments.
(2) I did not realize that yearly dermatologist visits are recommended.
(3) I did not know that this was something that I should be doing.
(4) I did not recognize the importance of a yearly checkup.

Recommended
(1) My primary care provider has never recommended it to me.
(2) My doctor has never brought it up.
(3) My doctor has never offered to perform one.
(4) My doctor has never suggested that I should get one.

Uncomfortable
(1) It would be embarrassing.
(2) The procedure would invade my privacy.
(3) I would feel ashamed.
(4) I do not want to feel judged.

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