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Patient-reported assessment of self-management strategies of health in cancer patients: development and validation of the Smart Management Strategy for Health Assessment Tool (SAT)

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Abstract

***Objective*: The objective of this study was to evaluate the psychometric properties of the Smart Management Strategy for Health Assessment Tool (SAT), which we developed to enable cancer patients to assess their self-management (SM) strategies of health by themselves.**

***Patients and methods*: The development of the questionnaire included four phases: item generation, construction, pilot testing, and field testing. To assess the instrument's sensitivity and validity, we recruited 300 cancer patients from three Korean hospitals who were 18 or more years old and accustomed to using the Internet or email. Using the appropriate and priority criteria for pilot and field testing, we tightened the content and constructed the first version of the SAT.**

***Results*: We developed the core strategies with 28 items, preparation strategies with 30 items, and implementation strategies with 33 items. Factor analysis of data from 300 patients resulted in core strategies with four factors, preparation strategies with five factors, and implementation strategies with six factors. All the SAT subscales demonstrated a high reliability with good internal consistency. The total scores of the three SAT sets differentiated participant groups well according to their stage of goal implementation and proportions of action of the 10 Rules for Highly Effective Health Behavior. Each factor of the three SAT sets correlated positively with the scores for additional assessment tool.**

***Conclusion*: The SAT is a three-set, 16-factor, 91-item tool that assesses the SM strategies of health that patients use to overcome a crisis. Patients can use the SAT to assess their SM strategies of health and obtain feedback from clinicians in the practice setting.**

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Introduction

The number of cancer patients has increased in many countries, including the USA [1] and Korea [2], and they face intensive treatments, surveillance for cancer recurrence, health promotion, and management of long-term effects [3–7].

Intervention programs based on the transtheoretical model or cognitive behavioral therapy have improved health outcomes [8,9], and time-limited courses that are focused on empowering cancer patients to manage their own illness have improved disease control [10], but a sustained program with a common set of actions may be more effective in the cancer care continuum [9,10].

Self-management education programs for cancer patients are being adopted, and their effectiveness is being documented [11]. Several intervention studies [12–15] report that such programs reduce symptom severity, depression, anxiety, fatigue, distress, and exercise and diet barriers, and improve confidence and quality of life (QOL).

To overcome the crisis of a cancer diagnosis and grow positively after it, patients need to reframe their objectives

and adapt to the disease or its treatment [15]. In addition, the early crisis period and the treatment period require different actions. Furthermore, strategies are needed to prevent a new crisis of original cancer recur or a secondary cancer appearance [16].

We have developed such a tool to evaluate the strategies. We call it the Smart Management Strategy for Health Assessment Tool (SAT). By using the SAT to evaluate the patient's time-specific strengths and weaknesses involved in overcoming the crisis precipitated by a cancer diagnosis, it should be possible to help patients exercise their strong points and compensate for their weak points, thereby easing them through adversity.

Methods

Study design

Development and validation of the SAT comprised four phases following the modular approach to developing a QOL assessment tool suggested by the European Organization for Research and Treatment of Cancer Quality-of-Life Group [17]: (1) item generation, (2) domain construction, (3) pilot testing, and (4) field testing. This study was approved by the institutional review boards of Seoul National University Hospital, the National Cancer Center, and Samsung Medical Center.

Phase I: item generation

Phase 1 involved organizing a list of relevant proactive issues for overcoming crises and positive growth in the fields of medicine, psychology, educational technology, and business management. We first reviewed more than 100 published sources (here, we cite only the most important source for each topic) in the areas of transtheoretical models [18], cognitive behavior therapy [19], leadership [20], counseling [21], coaching [22], coping strategies [23], resilience [24], positive growth [25], positive psychology [26], self-management [11], social support [27], and risk-management [28], including several QOL questionnaires [25,29]. We then summarized the topics concisely.

We also considered results of the prior study. In the prior study, we investigated the positive association between self-leadership (Seven Habit Profiles), health behaviors (10 Rules of Highly Effective Health Behavior), health-related QOL (HRQOL) (36-Item Short-form Health Survey, Hospital Anxiety and Depression Scale), and post-traumatic positive growth (Post-traumatic Growth Inventory) [25,29,30].

We conducted semi-structured interviews with 21 health and leadership professionals (four surgical oncologists, two medical oncologists, seven oncology nurses, two psychologists, three chief executive officers, and three master coaches). A semi-structured questionnaire explored their experiences and insights; thus, we were able to generate new assessment items for overcoming a health crisis and growing positively after one.

In addition, we invited 50 cancer patients and 10 caregivers, and 10 patients who were just diagnosed, 10 who were being treated, 10 who completed treatment, and 20 health partners who are experienced in health coaching [31]. We derived scales and items from them and deduced strategies for overcoming cancer and for positive growth. We then generated three sets of phase-specific strategies: core strategies (SAT-C), preparation strategies (SAT-P), and implementation strategies (SAT-I). Through phase 1, we could find out the relevance, breadth of coverage, and relative importance of positive growth and overcoming crisis issues for cancer patients.

From our literature review and interviews, we hypothesized that cancer patients with excellent competency in SAT-C, SAT-P, and SAT-I are better at achieving the goals of self-leadership, health behaviors, social support, post-traumatic positive growth, and HRQOL, and have less decisional conflict. Following that, we drew up a conceptual framework incorporating management strategies for overcoming crises and adapted those to overcoming cancer (Figure 1).

To tighten those, we used the Web to identify 23 experts (seven medical oncologists, one psychologist, one business administration professor, seven nurses, two master coaches, one chief executive officer, and four trained health partners [32]). They evaluated the relevance of the items on a four-point Likert scale (*not at all*, *a little*, *quite a bit*, and *very much*) and to evaluate about 30 strategies for each set of questionnaires on a binary scale (yes or no). We then deleted the several items that had a mean score <3.0 or a priority ratio $\geq 30\%$. All the researchers agreed that the priorities setting for item selection should be considered because it had conceptual importance.

Based on that analysis and on comments gathered from the respondents, we deleted about 40 strategies from each set and combined several issues to avoid content overlap and tighten the instrument. Finally, a total of 101 items for the three sets of strategies were compiled: 30 items for SAT-C, 35 for SAT-P, and 36 for SAT-I. These selection rules for decisions were adapted in the questionnaire module guidelines developed by the European Organization for Research and Treatment of Cancer Quality-of-Life Group [33,34].

Phase II: item construction

Using the responses of the 23 experts, we constructed a list of strategy items for the proactive overcoming of crises and positive growth. Items and scale structure can be constructed in this phase with the consultation of healthcare professionals. The list of related issues was converted into specific questionnaires that referred to the

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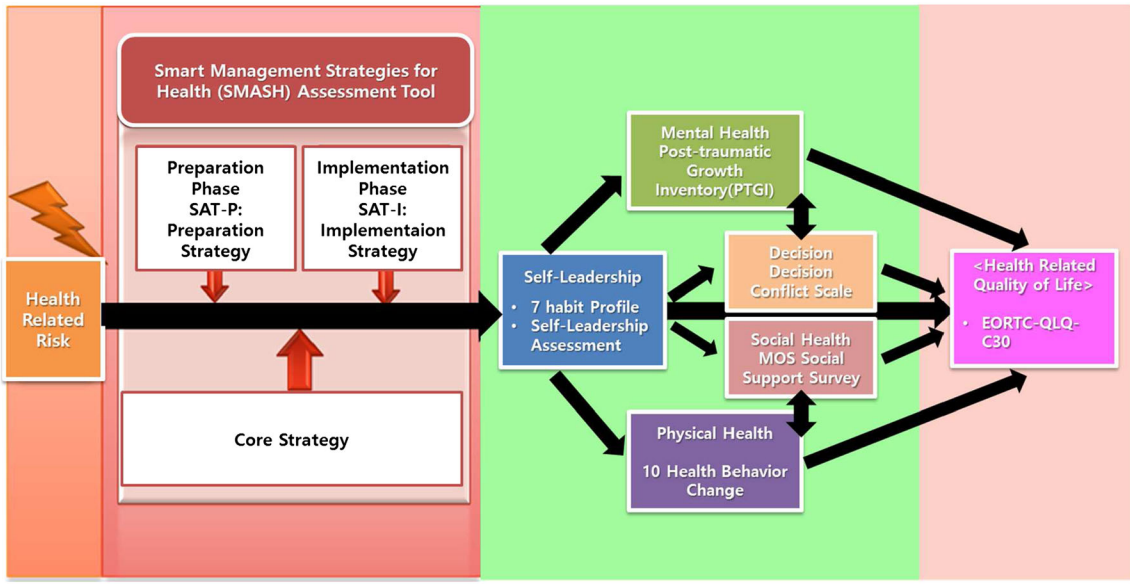

Figure 1. This conceptual framework shows how the Smart Management Strategy for Health Assessment Tool (SAT) is used in a practical setting. Recently, we verified the interrelationships of Self-leadership, PTGI, Health Behavior, and Health-related Quality of Life. By developing the SAT, we should be able to assess the effect of SMASH on patients' individual competence and improvement of their quality of life. MOS, Medical Outcomes Study; EORTC-QLQ, European Organization for Research and Treatment of Cancer Quality-of-Life

patients' experience and experts' experience. To rate the three assessment tools (SAT-C, SAT-P, and SAT-I) for evaluation in phase 3, we chose a four-point Likert scale (*never*, *sometimes*, *quite often*, and *always*).

Phase III: pilot testing

The objective of pilot testing was to identify potential application problems, such as in phrasing, and to determine which questions needed to be altered or eliminated. According to the guidelines for developing a QOL assessment tool [35,36], in phase 3, each cell of the sample matrix should contain at least 15 patients. Considering two stages, 15 patients who were being treated and 19 who had completed treatment participated in the pilot testing.

Patients were able to complete the SAT in less than 15 min. A debriefing session revealed which strategies were confusing, upsetting, or difficult to respond to and yielded helpful comments. We modified the questionnaire accordingly, improving its clarity and making it easier to respond to, and we added three more items: the biggest current crisis, best goal, and current stage of change for attainment of goals.

The result was three sets of questions that included 101 strategy items. Because several participants said that the sentences should be easier to understand, we asked the Ewha Womans University Korean Culture Center to improve them. That process removed some redundancy, and the number of strategies was reduced. The final questionnaire had 93 strategy items: SAT-C and SAT-P each had 30, and SAT-I had 33. As the SAT was in Korean language, for international use, we employed 'forward–backward' translation procedure. The SAT was first translated into English by two professional American translators who have excellent knowledge of Korean and English. The English version was then back-translated by two native speakers of Korean who had excellent knowledge of English, but no knowledge of the Korean version of the questionnaire. The translated questionnaire was subsequently reviewed by our team, and this process was repeated and revised. Its final form was revised and approved by our team.

Phase IV: field testing

To assess the instrument's sensitivity and validity, we recruited patients from three Korean hospitals. Eligibility criteria were as follows: (1) have been diagnosed with cancer, (2) be 18 or more years old, (3) be able to read and understand Korean and to fill out the questionnaire, (4) be accustomed to using the Internet or email, and (5) provide written informed consent. The questionnaire was completed online on the survey's password-protected website. Outpatients from three Korean hospitals were asked to participate in the study. The various stages of treatment were well represented among the recruited participants.

We conducted a factor analysis of the principal components with an orthogonal rotation to examine construct validity, and we did a multi-trait scaling analysis to examine the extent to which the strategy items could be

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integrated into a more restricted multi-item set. These methods can be used to examine the extent to which the module items can be combined in the hypothesized multi-item scales [31]. We evaluated the convergent validity of items by analyzing the correlations between an item and its own scale, considering a correlation of ≥0.4, corrected for overlap, as evidence of validity. To examine the discriminant validity, we compared the extent of the correlation of a strategy item with its own scale contrasted with other scales. We held as scaling errors those cases in which an item correlated significantly less with its own scale than with other scales [31]. To test reliability, we estimated Cronbach's α, a measure of internal consistency of patient responses. We generally regarded an $\alpha \geq 0.70$ as adequate for the aggregation of responses into a single score.

Additional evaluation

We administered additional questionnaires to measure correlation with prior validated scales. By conducting concurrent validity studies based the conceptual framework (Figure 1), we tested the hypothesis that cancer patients showing high competency in SAT-C, SAT-P, and SAT-I are better achievers in self-leadership, health behaviors, social support, post-traumatic positive growth, decisional conflict, and HRQOL. The questionnaires included the following scales: Current Goals, Goal Practice Stage using the transtheoretical model, 10 Rules of Highly Effective Health Behavior [30], the Seven Habit Profiles [29], Self-leadership Assessment, Post-traumatic Growth Inventory, Medical Outcomes Study—Social Support Survey, and Decision Conflict Scale [35].

The 10 Rules of Highly Effective Health Behavior [30] is a 10-item scale using transtheoretical model to measure the stage of the patient's health practices (Cronbach's α, 0.805). Self-leadership Assessment [36] is a nine-item scale that measures self-management skills (Cronbach's α, 0.965). The Seven Habit Profiles [29] is a 27-item scale that measures nine leadership skills (Cronbach's α, 0.980). The Post-traumatic Growth Inventory is a 21-item scale that measures the five domains of personal growth that follows traumatic events (Cronbach's α 0.981) [25]. The Medical Outcomes Study—Social Support Survey is an 18-item scale that measures perceived social support, including tangible, emotional, affective, and positive support (Cronbach's α, 0.989). The Decision Conflict Scale is a 16-item scale that measures personal perceptions of decision uncertainty, feeling unsupported, having reduced value clarity, feeling uninformed, and making ineffective decisions (Cronbach's α, 0.978) [35].

All collected information was kept confidential. All calculated p values were two-sided with the significance level set at $p < 0.05$. We used SAS statistical package, version 9.3 (SAS Institute, Cary, NC, 1990).

Results

During the 1-month data collection period, 624 cancer patients and survivors were contacted and asked to fill out the questionnaires. They were shown how to access the program on the Internet and to participate in the SAT test. Among them, 273 did not access the program at all, and 51 did not respond to several of the items. We telephoned the latter group and asked them to complete the job. Finally, 300 subjects responded to the whole set of questionnaires, which satisfied the ratios of participants to items for each questionnaire for validation of an assessment tool. The validation considers 10 rules, which suggests a ratio of about 5–10 subjects per item [34]. Because each SAT set has 30–33 items, 165–330 subjects would be appropriate for the validation process. Table 1 shows their demographic and clinical characteristics.

Factor analysis

We initially had four significant factors for SAT-C with 30 items, five for SAT-P with 30 items, and six for SAT-I with 33 items, and we discarded two items from SAT-C because they were not relevant. The statistics and distribution of the three sets of the SAT items with the item-to-factor loadings for all the items are shown in Appendixes A–C (Supporting information).

Descriptive statistics and reliability

For ease and clearness of interpretation, all scale and item scores were linearly transformed to a 0 to 100 scale. For all scales, item responses were coded so that a higher score represented a higher strategy level in accordance with the international standard scoring manual [33]. All subscales and the total score of the three SAT sets showed a high reliability with good internal consistency (Cronbach's α range 0.75–0.91 for SAT-C, 0.81–0.93 for SAT-P, and 0.73–0.93 for SAT-I) (Table 2).

Validity

Multi-trait scaling analysis

All correlations between an item and its own scale exceeded the 0.4 criteria for item convergent validity (Table 2). For item–other scale correlations, which signify item discriminating validity, we found scaling errors for SAT-C (1.7%), SAT-P (0.7%), and SAT-I (4.0%). We did not exclude the scaling error items, however, because there were still strong meaningful implications for the model.

Clinical validity

The SAT scores differentiated the two groups well: before action versus action and maintenance groups for achieving goals, and practicing lower than 50% versus practicing more than 50% of the 10 Rules of Highly Effective Health

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Table 1. Demographic characteristics of participating patients

		Cancer patients ($N = 300$)	
		No.	%
Sex	Male	131	43.7
	Female	169	56.3
Age (years)	21–39	33	11.0
	40–49	88	29.3
	50–59	94	31.3
	≥60	61	20.3
Married	Yes	255	85.0
	No	43	14.3
Education	≤Middle school	22	7.3
	High school	101	33.7
	University	175	58.3
Monthly income (\)	<2000	44	14.7
	2000–3000	52	17.3
	3000–4000	60	20.0
	>4000	142	47.3
Residence	Metropolitan area	153	51.0
	Rural	145	48.3
Religion	Christian (non-Catholic)	89	29.7
	Catholic	39	13.0
	None	110	36.7
	Other	5	1.7
Cancer type	Breast	81	27.0
	Lung	96	32.0
	Colorectal	58	19.3
	Gastric	36	12.0
	Others	29	9.7
Treatment stage	Before	3	1.0
	During	106	35.3
	Post (within 5 years)	189	63.0
Cancer stage	I	151	50.3
	II	71	23.7
	III	50	16.7
	IV	11	3.7

Behavior [30] (Table 3). For the latter, more than 50% of patients who reported action and maintenance of health behavior stages showed significantly higher levels of all strategy scores ($p < 0.01$), and patients who reported achieving practicing goals showed significantly greater differences than those who did not achieve those goals ($p < 0.01$).

Comparisons with self-leadership, leadership competency, social support, decision conflict, and post-traumatic growth

As expected, overall self-leadership and leadership competency (Seven Habit Profiles) scores correlated significantly with each of the three sets of the SAT subscales (SAT-C, SAT-P, and SAT-I) (Table 4). Higher strategy scores correlated positively with leadership and self-leadership skills. For self-leadership, the Pearson correlation (r) range was 0.16–0.43 for SAT-C, 0.39–0.51 for SAT-P, and 0.27–0.54 for SAT-I. For leadership, it was 0.26–0.54 for SAT-C, 0.43–0.52 for SAT-P, and 0.30–0.54 for SAT-I. The SAT overall scores correlated significantly with Post-traumatic Growth Inventory and negatively and significantly with Decision Conflict; the SAT scores correlated significantly and positively with Social Support and significantly and negatively with Decision Conflict (Table 4).

Discussion

The SAT contains about 91 items that set the context for individual patient strategies for proactively managing their own care as part of a cancer care continuum [11]. Our findings suggest that patients with high scores in the three SAT tool sets show self-leadership, solve decisional conflicts, and receive social support from caregivers, friends, and medical personnel. Thus, patients with better self-management health strategies seem to be associated with overcoming their cancer-induced crisis, improving their health and QOL, and growing positively. We recognize that there is a serious gap between the expected level of cancer control and its real level [8,11,37–39]. Health coaching [40] is a model for proactive health management for patients.

This study, however, has several limitations. First, this is a Korean study, and its findings may not be generalizable to other cultures. Second, our study relied exclusively on cancer patients, and the results might not be generalizable to patients with other chronic diseases. With some modifications, however, most of the strategies of the SAT measures could be applied to non-cancer patients as well. Third, the classic test theory techniques used in this study could be superseded by other methods in the development of the psychometrics. Item response theory (IRT) might be a useful tool to adapt in deciding whether to include an item. We used IRT twice for factor and Multitrait-Multimethod Matrix (MTMM) analysis. The MTMM is an approach to measuring the construct validity of a set of assessment in a study [41]. First, we deleted some items based on the criteria including category response rate, item fit, and the slope of the linear regression. There were also several scaling errors: SAT-C (2.08%), SAT-P (1.43%), and SAT-I (4.29%). Second, we did a new MTMM analysis after moving the scaling error items to a subscale where they showed higher correlation, but that led to other scaling errors. Therefore, we will reconsider scoring as we develop a short version of the SAT using an IRT method to reduce the time required, to make it simpler, and to make it applicable to non-cancer patients as well. Fourth, as the SAT assesses idealized coping strategies, it might underestimate them because a patient could be coping well because of the effective use of one or two strategies yet appear to be coping poorly based on another strategy. Further study is needed on ways to evaluate the whole picture of a patient's coping. Another limitation was the low response rate (48.1%), which could have been

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Table 2. Descriptive statistics and subscale reliability of SAT ($N = 300$)

Strategy	Subscale[a]	Mean (SD)	Cronbach's α	Item–self scale correlation	Item–other scale correlation	No. (%) of scaling errors
Core	Total (28 items)		.95	0.43–0.77	0.13–0.67	2 (1.7)
	Factor 1: proactive problem-solving strategy (items 11–20)	64.62 (19.72)	.91	0.56–0.75	0.21–0.63	0
	Factor 2: positive-reframing strategy (items 1–4, 6–10)	69.05 (20.46)	.92	0.62–0.75	0.13–0.67	0
	Factor 3: creating empowered relationship strategy (items 5, 22, 26–29)	79.00 (17.50)	.84	0.49–0.77	0.26–0.62	1 (0.8)
	Factor 4: experience sharing strategy (items 23–25)	50.67 (25.75)	.75	0.43–0.66	0.22–0.47	1 (0.8)
Preparation	Total (30 items)		.95	0.46–0.79	0.33–0.67	1 (0.7)
	Factor 1: goal and action setting (preparing) strategy (items 6–10, 17–20) 29)	50.33 (21.64)	.93	0.56–0.79	0.42–0.62	0
	Factor 2: rational decision-making strategy (items 11–16)	66.02 (17.92)	.83	0.55–0.65	0.33–0.54	0
	Factor 3: healthy environment creating (building) strategy (items 25–28, 30)	58.13 (21.43)	.84	0.46–0.75	0.34–0.60	0
	Factor 4: priority-based planning strategy (items 21–24)	53.86 (21.09)	.81	0.58–0.67	0.36–0.59	0
	Factor 5: life value pursuing (seeking) strategy (items 1–5)	62.22 (21.26)	.82	0.53–0.69	0.34–0.67	1 (0.7)
Implementation	Total (33 items)		.96	0.45–0.81	0.27–0.71	8 (4.0)
	Factor 1: self-sustaining strategy (items 1–4, 13–17, 29–31)	55.62 (19.93)	.93	0.62–0.77	0.27–0.70	0
	Factor 2: self-motivating strategy (items 22–28)	58.73 (20.64)	.89	0.56–0.73	0.29–0.64	2 (1.0)
	Factor 3: activity-coping strategy (items 5–9)	59.04 (23.61)	.90	0.70–0.81	0.31–0.66	0
	Factor 4: self-implementing (maintaining) strategy (items 18–21)	55.17 (22.17)	.80	0.50–0.71	0.29–0.71	3 (1.5)
	Factor 5: reflecting strategy (items 32–33)	47.00 (27.84)	.86	0.75–0.75	0.28–0.58	0
	Factor 6: energy-conserving strategy (items 10–12)	61.04 (20.41)	.73	0.45–0.63	0.28–0.51	3 (1.5)

[a]Range of scores 0–100.
SAT, Smart Management Strategy for Health Assessment Tool.

Table 3. SAT strategy differentiation according to goal practice and health behaviors

Variable	Group	*n*	Core strategy (mean ± SD)	Preparation strategy (mean ± SD)	Implementation strategy (mean ± SD)
Goal practice	Before action	101	63.99 ± 17.69	53.37 ± 19.33	51.28 ± 19.31
	Action and maintenance	189	69.39 ± 16.28*	59.65 ± 16.23*	60.00 ± 16.99*
Health behavior[a]	≤50% action	134	63.06 ± 17.52	53.46 ± 18.67	52.22 ± 18.67
	>50% Action	133	73.27 ± 14.34*	61.95 ± 14.83*	61.95 ± 14.83*

[a]10 Rules of Highly Effective Health Behavior.
Before action in goal practice involves the stages of pre-contemplation, contemplation, and preparation.
SAT, Smart Management Strategy for Health Assessment Tool; SD, standard deviation.
*$p < 0.01$ (*t*-test).

Table 4. Pearson correlation between SAT and other validated questionnaires ($N = 300$)

	Core strategy factor				Preparation strategy factor					Implementation strategy factor					
	1	2	3	4	1	2	3	4	5	1	2	3	4	5	6
Self-leadership															
Overall	.425**	.344**	.402**	.256**	.433**	.410**	.517**	.392**	.473**	.542**	.505**	.3.89**	.477**	.271**	.278**
7 Habit Profiles															
Overall	.536**	.498**	.478**	.258**	.490**	.494**	.519**	.431**	.4291**	.541**	.501**	.435**	.501**	.297**	.334**
PTGI															
Overall	.529**	.497**	.565**	.359**	.473**	.444**	.433**	.345**	.536**	.538**	.578**	.410**	.454**	.250**	.344**
Social Support															
Overall	.261**	.344**	.407**	.284**	.255**	.250**	.270**	.179**	.230**	.279**	.289**	.279**	.235**	.189**	.207**
Decision Conflict															
Overall	−.245**	−.166**	−.245**	−.121*	−.215**	−.239**	−.259**	−.248**	−.217**	−.268**	−.180**	−.2.07**	−.180**	−.192	−.171**

SAT, Smart Management Strategy for Health Assessment Tool; PTGI, Post-traumatic Growth Inventory.
**$p < 0.01$.
*$p < 0.05$.

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due to the lengthiness of the questionnaire (93 items) and could negatively impact on the representativeness of the sample and the generalizability of the results. Finally, we did not assess test–retest. No test–retest may limit the psychometric properties of this SAT. As health status and HRQOL among cancer patients can change frequently, test–retest might not be feasible.

When facing a crisis, some patients deal with it proactively. Others, however, are unable to cope with the crisis and need support from a professional, such as a health coach, to help them grow proactively as they continue the long journey through and beyond the disease. With the SAT, clinicians can measure health management strategies, which are especially important for cancer patients who have difficulty in achieving health goals, and they can provide feedback about changes in health management strategies and in health status and behaviors.

For the SAT to be used easily and efficiently, an Internet-based self-management program or a health coaching program based on the SAT needs to be developed. In the survivorship setting, clinicians can recommend the SAT to cancer patients for assessing their self-management health strategies. Patients can use the SAT to assess their self-management health strategies by themselves and obtain feedback from the SAT scoring manual and strategy paper. Moreover, medical teams can monitor patients' change of health status and their competency and provide personalized clinical consulting.

In conclusion, we believe that this self-reported assessment tool of patient strategies for self-management of health embodies appropriate psychometric properties, but additional testing needs to be required for supporting the usefulness and clinical application.

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