



## Original Article

# Acceptability to making a self-assessment using a tablet computer and health-related quality of life in ambulatory breast cancer patients



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## ABSTRACT

**Objective:** The purpose of this study was to examine patient acceptability to making self-assessments of their health conditions using a tablet computer-based questionnaire and identify associations between acceptability and health-related quality of life (HR-QOL).

**Methods:** This study used a convenience sample of 54 patients with breast cancer being treated in an outpatient setting. Participants made self-assessments using a tablet computer-based questionnaire and upon completion they received a report of their results. The HR-QOL self-assessment questionnaire comprised three standardized instruments. Participants gave interviews and completed a survey at home. A follow-up, paper-based HR-QOL self-assessment was completed one month later.

**Results:** Making a self-assessment with a tablet computer was acceptable to most participants, and several factors were identified to be associated with self-assessment making and patient HR-QOL. Participants' who were experiencing symptoms, interference, deteriorating physical function, and unsatisfactory levels of well-being were more favorably disposed toward making a self-assessment. At the one-month follow-up survey, however, participants' subjective well-being and physical function had decreased on average.

**Conclusions:** Patients found the HR-QOL self-assessments easy to complete in the clinical setting, and those with symptoms were particularly interested in completing the assessment. However, simply providing HR-QOL information to patients only (and not to staff) was insufficient to improve HR-QOL long-term, which decreased for participants over the month following the initial HR-QOL self-assessment. Thus, the findings of this study encourage the integration of HR-QOL self-assessments into clinical care at the time of the clinic visit, so they can be used in real time to improve HR-QOL.

## Introduction

Breast cancer can impact all aspects of their health-related quality of life (HR-QOL) both during and after treatment. To manage such difficulties and sustain their HR-QOL, it is important that women attend to, and assess, their own health condition and activities of daily life. Recently, the use of information and communication technology (ICT)-based devices, such as tablet computers and smartphone applications (apps), has gained increasing attention as a means of providing cancer patients with a way to assess and manage their health. A 2008 study

demonstrated that tablet computers can collect data of comparable validity to data collected by well-recognized paper-based HR-QOL surveys.<sup>1</sup> In a systematic review that used 20 studies on mobile interventions for patients with cancer,<sup>2</sup> primary aims of interventions were to improve the monitoring and management of treatment-related symptoms (17/20, 85%), and overall acceptability and feasibility of the interventions was reported as being good. While, most of these studies have been conducted in the United Kingdom or the United States, there are very few studies from Japan that address cancer patients' amenability to using ICT-based devices at outpatient units to assess and manage their own health.

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According to the Information and Communications Statistics Database,<sup>3</sup> in 2019, more than 90% in each demographic of people aged 13 through 69 used the internet, and the rates of use in people over 60 were strongly increased compared with previous years. However, despite the increased internet use and ubiquity of ICT-based devices in Japan, there is not sufficient evidence to demonstrate the advantages of such devices for monitoring and management of cancer patients' health. Thus, in the current study, we aimed to identify whether patients with breast cancer were amenable to using a tablet computer-based questionnaire for making health-related self-assessments.

A randomized controlled trial carried out in Taiwan, evaluated the HR-QOL of women who used a breast cancer self-management support app after receiving their diagnosis.<sup>4</sup> The findings of this trial provided evidence for the usefulness of the app to promote HR-QOL.<sup>4</sup> Although a patient's specific needs regarding the use of ICT-based devices for medical/health purposes will vary from person to person, such technology can certainly be useful for patients trying to manage their own health. A Korean study of cancer survivors revealed that the factors significantly associated with the need for an ICT-based personalized health management program were higher income, information provision experience, problematic HR-QOL, and decisional conflicts.<sup>5</sup> Breast cancer patients are thought to be among those who would likely have interest in utilizing ICT-based self-assessment to understand their condition. According to the Foundation for Promotion of Cancer Research's 2019 survey,<sup>6</sup> in Japanese women, the leading site of cancer in terms of mortality for was colon/rectum (15.4%), while the breast (9.5%) ranked fifth; however, breast cancer ranks highest for incidence/morbidity. Indeed, its estimated incidence in 2020 was approximately 92,300, which accounts for 21% of cancers in women (429,900). In developed nations, including Japan, the number of survivors with breast cancer is on the rise. With regards to age distribution, breast cancer accounted for approximately half of cancer incidences among women aged 40–49 years were cancers of the breast. Thus, many patients with breast cancer are diagnosed at a comparatively young age when a cancer diagnosis and treatment can likely cause profound physical and emotional distress that would affect their daily life and decrease their HR-QOL.

In this study we made a tablet computer-based questionnaire that leverages the strength of ICT to enable patients to conveniently make health-related self-assessments, immediately receive their scores, and allow for comparison/interpretation of those scores. In a systematic review of studies that examined the effects of web-based interventions, the self-assessment/monitoring of both illness and treatment was recognized as one of the major approaches of symptom management for cancer patients.<sup>7</sup> In the current study, three standardized instruments of HR-QOL were included in the questionnaire to measure the patients' symptoms, interference, physical function, mental function, and subjective well-being. HR-QOL was defined by the Centers for Disease Control and Prevention as "an individual's or group's perceived physical and mental health over time,"<sup>8</sup> and, in accordance with this definition, our study involved indicators expressing physical and mental health perceptions and their correlates as HR-QOL. HR-QOL measurements are recognized as being representative of patient-reported outcomes (PROs). PROs exemplify a patient's perspective regarding how a cancer diagnosis and its treatment impact a patient's general well-being and how communication with healthcare providers and how patient satisfaction can be improved.<sup>9,10</sup> Several studies have reported the incorporation of PROs into electronic data collection for self-management interventions and experimentation with various data collection devices.<sup>11–13</sup> The findings of these studies prompted us to consider the association between PROs and breast cancer patients' acceptability to using a tablet computer-based questionnaire.

### Objectives

The aim of the study was to assess breast cancer patients' acceptability to making self-assessments using a questionnaire administered via

a tablet computer at an outpatient setting and to explore the relationship between acceptability and patient HR-QOL.

## Methods

### Study design and participants

This is a descriptive study in which interviews were incorporated alongside questionnaire surveys. The study participants consisted of a convenience sample of 54 Japanese patients with breast cancer who assented to making their self-assessment using a tablet computer at an outpatient setting. The study participants consisted of a convenience sample of 54 Japanese patients with breast cancer. Inclusion criteria were: (1) age  $\geq 20$  and  $< 75$  years, (2) diagnosed with cancer of the breast, (3) awareness of cancer diagnosis, (4) absence of psychiatric disorders, and (5) completed inpatient treatment. Given that the rate of internet utilization of people in their 70s was 46.7% in 2017,<sup>3</sup> we chose to limit the study population to those aged  $< 75$  years.

### Procedures/sample and setting

Participants were recruited at an outpatient unit of a general hospital in Tokyo, Japan, over a period of five months beginning November, 2017. Informed consent was obtained from each participant after careful explanation on the study. Before seeing their physician, the participants were given a tablet computer with which they made a self-assessment of their health condition and life situation. They then gave an interview to the investigator to get feedback about their experience making a self-assessment using our tablet computer-based questionnaire. Subsequently, at home, the participants completed a post-assessment survey about their health and experience of using the tablet computer-based questionnaire and seeing their physician. A follow-up questionnaire—a paper version of the first assessment—was conducted at home one month later. The tablet computer-based questionnaire was made for use only at the outpatient setting; thus, both the post-assessment survey and the follow-up survey were paper-based and returned by mail within one week and one month after visiting the hospital, respectively.

Before the start of the study, approval was obtained from the institutional review board (IRB) of the university with which the principal investigator is affiliated and from the IRB of the hospital in which the recruiting was conducted. This study was strictly conducted to protecting the participants' rights in terms of privacy and confidentiality.

### Computer-administered questionnaire

The questionnaire was administered via a tablet computer (iPad) app, which offers great ease of use due to the device's touch-panel function and allows for instant processing of scores and delivery of feedback. FileMaker Pro 16 (Clarif International Inc, Cupertino, USA) was used to design and build the questionnaire into the iPad app. The questionnaire consisted of seven questions addressing the patients' health conditions including their purposes of visit to the hospital and activities of daily living, in addition to three standardized instruments of HR-QOL to measure symptoms, interference, physical function, mental function, and subjective well-being. On completion of the questionnaire, they received a report of their personal HR-QOL, which takes the form of average scores for symptoms, interference, physical function, mental function, and subjective well-being, and to which are annexed the numerical data for the purpose of comparing and interpreting the scores. Those numerical data were originally generated from a survey involving a heterogeneous population of 179 Japanese cancer patients at their first follow-up appointment after hospital discharge.<sup>14</sup>

### Instruments

HR-QOL was measured using three standardized instruments that

cover the aspects of symptoms, interference, physical function, mental function, and subjective well-being.

**Symptom and interference:** The M. D. Anderson Symptom Inventory (MDASI) consists of a 6-item symptom scale (MDASI-S), which assesses the extent of symptoms experienced during the last 24 h, and a 13-item interference scale (MDASI-I), which assesses how much those symptoms interfere with various aspects of the patient's life (National Cancer Center, Japan, n.d.). The possible range for both scales is from 0 to 10, with higher scores indicating more severe symptoms and interference. The reliability and validities of the Japanese version of the MDASI were previously verified.<sup>15</sup>

**Physical function and mental function:** The Japanese version of the SF-8 health survey short form (SF-8) consists of eight items with ordinal response format for profiling of functional health (iHope International, n.d.). It produces a physical functional health summary score (PCS) and mental functional health summary score (MCS) by calculation using norm-based scoring derived from a Japanese general population, in which a higher score indicates a better physical function and mental function.<sup>16</sup> The license agreement for use of the Japanese version of the SF-8 in this study was approved by iHope International.

**Subjective well-being:** The Ferrans and Powers Quality of Life Index Cancer Version III (QLI) consists of 33 paired items (matched across parallel satisfaction and importance sections) covering various aspects of daily life and the final score represents how satisfied a cancer patient is with the things in life that they value most.<sup>17</sup> The QLI assess overall QOL which consists of four QOL domains: health and functioning, psychological/spiritual, social and economic, and family. The possible range for a score is from 0 to 30, with a higher score indicating higher levels of subjective wellbeing. The cultural adaptation of the QLI for Japanese cancer patients and the reliability/validity of the Japanese version of QLI were evaluated through cognitive interviewing<sup>18</sup> and psychometric assessment.<sup>19</sup>

### Interview

Semi-structured interviews with open questions were conducted to obtain the participants' feedback of making their self-assessment using a tablet computer. Questions were asked regarding the user interface, health assessment function, involvement with healthcare, and influence on self-management. Interviews were audio-recorded and transcribed verbatim.

### Post-assessment survey

In the post-assessment survey, which was carried out at home, participants were again asked about the tablet computer app's user interface, health assessment function, involvement with healthcare, and influence on self-management. The questionnaire was comprised of 11 items that were formatted with 5-value Likert response options. In this questionnaire the participants' background and disease information were also gathered.

### Follow-up survey

The follow-up survey, which was a print version of the same three HR-QOL instruments delivered by tablet computer, was carried out a month after that initial questionnaire.

### Analytic strategies

**Interview data:** Content analysis techniques were used to examine the transcribed interviews. Each unit of analysis that was coded was heuristic and the smallest piece of information that could stand by itself.<sup>20</sup> Every code was categorized based on similarity among terms and trends within the interviews. The taxonomic classification was built in parallel with the level of abstraction. Decisions about the taxonomy and

the components of the meaning were based on consensus between two of the study members. The NVIVO 12 (QSR International Inc, Burlington, MA, USA), which is a qualitative data analysis software, was used to manage and calculate units of analysis.

**Data analysis:** Difference and correlation between variables of background and disease information and each HR-QOL score measured in the tablet computer-device were determined using the Mann–Whitney U test and Spearman's rank correlation coefficient, respectively. After statistics of the paper-based questionnaire had been calculated, to test the association of documented questionnaire with each HR-QOL score measured in the tablet computer-device, the five-value Likert scale was reassigned from five levels into three levels of agree (strongly agree and agree), neutral, and disagree (disagree, and strongly disagree). The differences of each HR-QOL score among those three levels were determined using Kruskal–Wallis test. Subsequently, step-down multiple comparison procedures in a stepwise fashion for were carried out to check for differences between each level. Difference and correlation between the paired variables by a combination of measurements in the tablet computer-based questionnaire and at the paper-based follow-up survey in each HR-QOL scale were assessed by calculating the Wilcoxon rank-sum test and the Spearman's rank correlation coefficient, respectively. SPSS Statistics 25 (IBM, New York, NY, USA) was used for the statistical analysis procedures. For all analyses, two-sided probability (*P*) values below 0.05 were considered to indicate significance.

## Results

Initially, 88 patients were invited to participate in this study of which 81 consented to be interviewed after making their self-assessment using the tablet computer (interview rate, 92.0%). At the post-assessment survey, 81 questionnaires were distributed and 65 were returned. Five patients declined participation in the one-month follow-up survey, thus, 60 questionnaires were distributed, of which 57 were returned. After three uncompleted questionnaires were excluded, 54 patient questionnaires were used for the final analysis (effective participant rate, 61.4%). A flow chart of participation is shown in [Figure 1](#).

### Sample characteristics

Participant information is summarized in [Table 1](#). The mean age of the 54 participants was 55.6 years (SD, 8.6) and 74.1% had a spouse. The mean time since diagnosis was 73.7 months (SD, 72.3), and 59.3% were undergoing chemotherapy or hormonotherapy treatment. On the day of interview, 13.0% of the participants were visiting the hospital to undergo treatment. Between the participants' background and disease information and each HR-QOL scale score no significant difference or correlation was found.

### Feedback at interview

Categories were created from 306 codes that were elicited from the interview data. Taxonomy of the categories and the number of codes is summarized in [Table 2](#).

Many participants commented that the tablet computer-based questionnaire was “easy to use.” Some individual questions, especially those about religion and sexuality, were evaluated as being “difficult to answer.”

Codes related to usefulness of the tablet computer-based questionnaire were categorized as “able to get the result immediately” and “able to objectively assess the current situation using data,” which supported the usefulness of the functions to automatically calculate scores and give numerical data for comparison/interpretation. Meanwhile codes that indicated negative aspects where the usefulness of the tablet computer-based questionnaire was lacking were categorized as: “not accustomed to dealing with numerical information and making comparison” and “want other reference data for comparison/interpretation.” Regarding

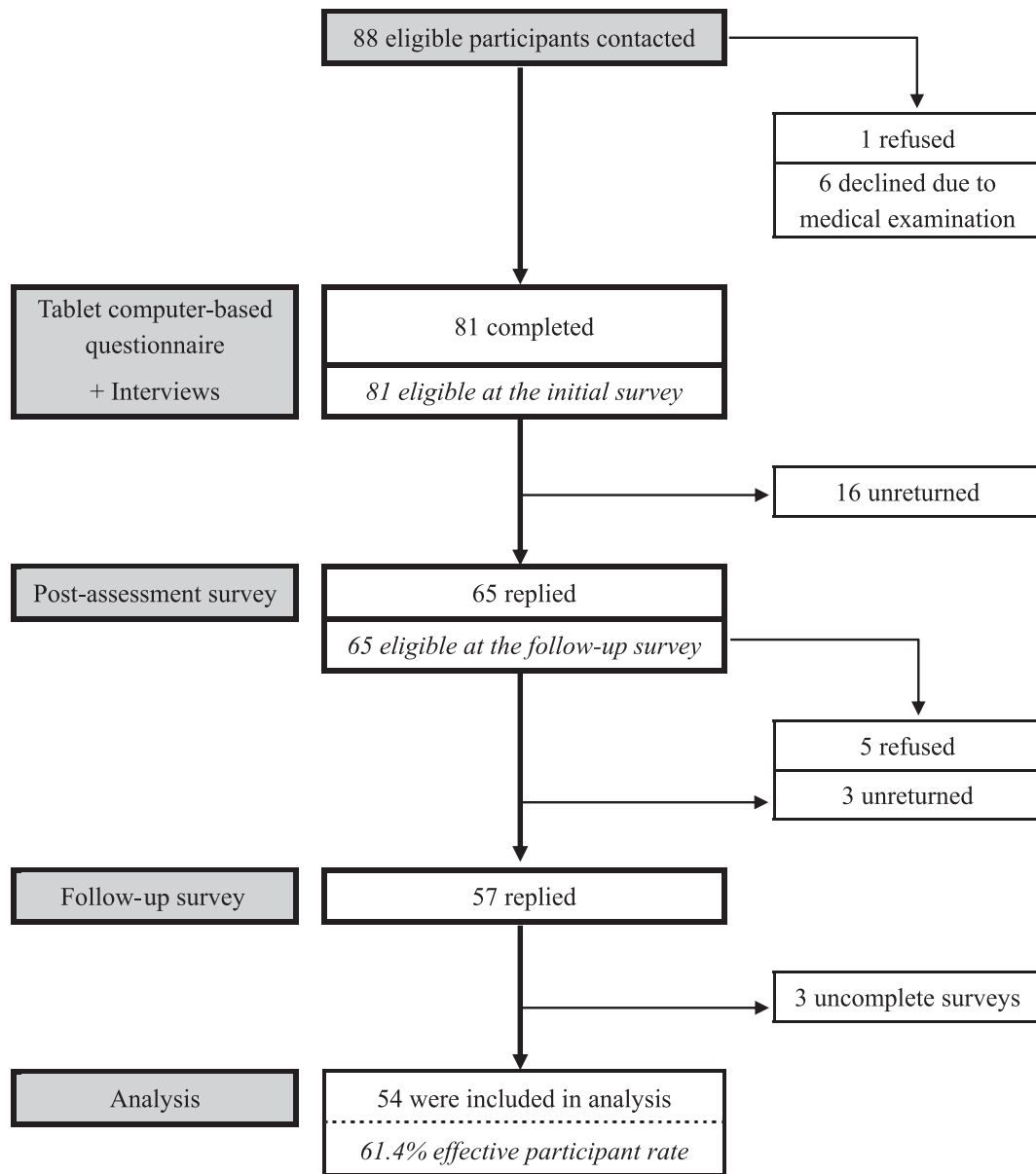


Figure 1. Participant numbers and sampling procedure.

the reference data, participants described their preference for having a more visual form of the information or example data from either the general population, people who are in a similar situation to themselves, or values of their self from previous assessments.

Codes representing the benefits associated with making a self-assessment were large in number and were assigned to three categories; participants described that they could reflect on themselves by answering the questions and understand themselves better. Additionally, their statements indicated that they could objectively evaluate and confront themselves.

Codes pertaining to the usefulness of the scores derived from making a self-assessment were put into five categories. Many of these codes included constructive notions representing the patient's will to use the scores for their own health, for example the score became a resource for communicating their conditions to health professionals and for managing their health condition with doctors and significant others. Meanwhile one category, which reflected the patient's desire for the doctors to know the patient's situation through the results, also included a passive connotation regarding their own health behavior.

In the interviews, several reasons were suggested by those who felt that

answering the questionnaires did not affect them. One of the major reasons was that they were confident about their condition before answering the questionnaire. For example, one patient said, "I always know my health condition without having to answer the questions." Another patient said, "My daily routine and life will not change by answering the questions." There were also those who felt that their situation was better or worse than implied by the questions. In other words, they felt that the questionnaire did not adequately address them or fit their situation because of reasons related to their well-being or circumstances. In fact, there were those who expressed that the questionnaire may have been more relevant for them if they had some symptoms/issues.

*HR-QOL measured in tablet computer and feedback from the post-assessment survey*

In the 11-item post-assessment-survey, in which items were scored on a 5-point scale (range: 1–5) the item 'I felt burdened by answering questions' had a 50th percentile score of 2. The following five items had a 50th percentile score of 4: "The results with scores were useful to understand my health condition"; 'I was able to reflect on my health

**Table 1**  
Participant demographics and disease information in the study sample.

Variable	n	%	Mean	SD
Age (years)			55.6	8.6
Marital status				
Married	40	74.1		
Single	14	25.9		
Cohabitation				
Cohabitation	45	83.3		
Single	9	16.7		
Years of education			14.4	2.2
Work Style				
Employed	29	53.7		
Housework	25	46.3		
Months after diagnosis			73.7	72.3
Existing of comorbidity				
Yes	14	25.9		
No	39	72.2		
Missing data	1	1.9		
Therapeutic status				
Follow up	22	40.7		
In treatment <sup>a</sup>	32	59.3		
Purpose of visiting the hospital (with multiple answer)				
Consultation	44	81.5		
Examination/Test	15	27.8		
Treatment	7	13.0		
Do you have any questions to ask your doctor?				
Yes	42	77.8		
No	10	18.5		
Missing data	2	3.7		
Do you have any questions to ask a nurse?				
Yes	15	27.8		
No	38	70.4		
Missing data	1	1.9		

<sup>a</sup> Treatment included chemotherapy and hormonotherapy.

condition”; “I was able to reflect on my daily activity and life”; “I was able to think about connections between health, illness, and life”; and “I was able to reconfirm my purpose of visiting the hospital.”

The remaining five items had a 50th percentile of 3 and interquartile ranges from 0 to 1.25; therefore, the relationship of these items with each respective HR-QOL scale was determined using non-parametric test (Table 3). The statements of “I was able to explain the health condition to my doctor” and “I was able to consult my doctor about the health condition” had no significant relationship with HR-QOL. The statement “I may try to improve my way of health care” had significant relationship with symptoms, interference, physical function, and subjective well-being ( $H = 11.08, P = 0.004$ ;  $H = 12.77, P = 0.002$ ;  $H = 11.51, P = 0.003$ ; and  $H = 6.22, P = 0.045$ , respectively). The statement of “I may reveal my health condition at home and workplace” had significant relationship with symptoms, interference, and physical function ( $H = 7.73, P = 0.02$ ;  $H = 11.85, P = 0.003$ ; and  $H = 6.85, P = 0.03$ , respectively). The statement “I may change how I act at home and workplace” had significant relationship with interference ( $H = 8.16, P = 0.02$ ). On post hoc tests, participants who agreed with these three statements showed worse indicators of HR-QOL (strong symptoms, high interference, poor physical function, and low subjective well-being) compared with those who responded as “neutral” or as “disagree.” However, all five statements showed no significant relationship with mental function.

*Effects on HR-QOL*

The contrast of HR-QOL between measurements made using the tablet computer-based questionnaire and paper-based follow-up survey is shown in Table 4. Strong or moderate correlations between the two time points were found pertaining to subjective well-being and symptoms ( $r_s = 0.71, P < 0.001$  and  $r_s = 0.67, P < 0.001$ , respectively). However, the correlation coefficients between the two time points with regards the other variables were weak (from 0.38 to 0.54). A significant decrease in

**Table 2**  
Taxonomy of categories and number of cords.

Categories	Cords (n)
<b>Usability of tablet computer-device with questionnaires</b>	[55]
Positive aspects	[36]
Easy to use	19
Easy to answer	10
Available to make effective use of the waiting time	7
Negative aspects	[19]
Difficult to use	4
Have too many questions	4
Have a question that is difficult to answer	11
<b>Usefulness of tablet computer-device with questionnaires</b>	[79]
Positive aspects	[14]
Able to get the results immediately	8
Able to objectively assess the current situation using data	6
Demanding aspects	[65]
Want the other's reference-values for comparison/interpretation	38
Not accustomed to dealing with data and making comparison	17
Wish to know how to act in response to the results	5
Don't want to know the bad results	5
<b>Benefit associated with making a self-assessment</b>	[73]
Able to reflect and understand about myself better	34
Able to objectively adjust and evaluate myself	21
Able to confront myself	18
<b>Usefulness of the results derived by making a self-assessment</b>	[49]
A resource for communicating my condition to health professionals	16
A resource for checking my own performance level against illness	9
A resource for rebuilding my daily activities and life	8
A resource for managing my health condition with doctors/significant others	7
Wish for doctors to know my situation through the results	9
<b>Reasons why answering the questionnaires does not affect me</b>	[50]
It could have been relevant to me if I had some symptoms/issues	17
I was confident about my condition before answering the questions	12
My situation is better or worse than implied by the questions	11
My daily routine/life is not affected by anything.	10
<b>Total</b>	<b>306</b>

HR-QOL measures at the follow-up survey was observed only in subjective well-being ( $Z = -2.90, P = 0.004$ ). The mean level of physical function at the follow-up survey, while only approaching significance, also showed a decreasing trend.

**Discussion**

Many participants recognized the tablet computer-based questionnaire as being easy to use. Although there were participants who were not accustomed to interpretation and comparison of data, many of them were able to cite concrete examples of better or preferred reference data for comparison/interpretation. Additionally, findings from interviews and the post-assessment questionnaire suggested that many of participants recognized that the opportunity to make a self-assessment provided an occasion to reflect on themselves and understand their own health condition. These results matched the findings from a systematic review that described the acceptability and feasibility of mobile interventions to help patients, in non-inpatient settings, to meet their information needs as it relates to cancer.<sup>2</sup> However, there were substantial differences among participants' feedback on the self-assessment regarding their involvement with healthcare and self-management. Participants exhibiting symptoms, interference, deterioration of physical function, and unsatisfactory levels of well-being were favorably disposed toward making a self-assessment. One study suggested that the need for an ICT-based health management program were significantly associated with higher problematic HR-QOL.<sup>5</sup> Likewise, the findings of our study



**Table 3**  
Relationship of post-assessment questionnaire with HR-QOL.

Questions	Level	n	Symptoms (MDASI-S)			Interference (MDASI-I)			Physical function (PCS)			Mental function (MCS)			Subjective well-being (QLU)		
			Med (IQR)	H	P	Med (IQR)	H	P	Med (IQR)	H	P	Med (IQR)	H	P	Med (IQR)	H	P
I was able to explain the health condition to my doctor.	Agree	13	1.85 (1.65)	0.31	0.86	1.50 (3.17)	2.06	0.36	46.91 (13.86)	3.24	0.20	52.50 (6.03)	2.95	0.23	19.85 (5.91)	0.86	0.65
	Neutral	28	1.35 (1.42)			0.92 (2.17)			49.02 (6.98)			49.25 (7.16)			19.56 (3.94)		
I was able to consult my doctor about the health condition.	Agree	12	1.15 (2.06)			0.25 (2.17)			50.66 (6.25)			50.32 (10.55)			18.99 (6.31)		
	Neutral	10	1.88 (1.62)	1.10	0.58	2.58 (2.71)	5.11	0.08	46.91 (15.19)	2.29	0.32	51.95 (6.65)	2.90	0.24	19.85 (4.59)	2.40	0.30
I may try to improve my way of health care.	Agree	27	1.35 (1.48)			0.67 (2.17)			49.53 (7.82)			50.07 (6.71)			18.89 (4.48)		
	Neutral	16	1.15 (2.13)			0.25 (2.25)			50.27 (6.25)			50.63 (11.58)			20.21 (4.63)		
I may reveal my health conditions at home and workplace.	Agree	11	2.00 (.25)	11.08	0.004	2.42 (1.67)	12.77	0.002	42.29 (10.20)	11.51	0.003	48.83 (13.52)	0.45	0.80	18.33 (2.68)	6.22	0.045
	Neutral	31	1.15 (1.85)			0.67 (2.17)			51.00 (7.40)			50.79 (7.47)			20.22 (4.08)		
I may change how I act at home and workplace.	Agree	12	1.12 (.90)			0.08 (.58)			49.02 (8.09)			48.47 (8.37)			20.21 (5.04)		
	Neutral	20	2.00 (.81)	7.73	0.02	0.33 (1.83)	11.85	0.003	47.38 (13.03)	6.85	0.03	51.10 (10.67)	0.82	0.67	19.16 (4.87)	3.29	0.19
I may change how I act at home and workplace.	Agree	13	1.08 (1.46)			0.78 (9.13)			47.88 (9.13)			50.79 (6.82)			20.66 (5.80)		
	Neutral	21	1.15 (1.31)			0.33 (1.67)			51.11 (7.31)			49.63 (8.00)			19.47 (3.96)		
I may change how I act at home and workplace.	Agree	10	1.88 (.73)	3.28	0.19	2.42 (1.83)	8.16	0.02	13.97 (12.35)	5.34	0.07	50.13 (13.64)	0.94	0.63	18.96 (3.32)	3.04	0.22
	Neutral	24	1.15 (1.38)			0.33 (2.17)			49.61 (7.48)			50.79 (7.71)			20.92 (4.52)		
	Disagree	20	1.35 (1.54)			0.67 (1.79)			50.10 (8.90)			50.07 (8.12)			19.74 (3.89)		

MDASI-S:symptom scale in M.D. Anderson Symptom Inventory; MDASI-I : interference scale in M.D. Anderson Symptom Inventory; PCS : physical functional health summary scores in SF-8; MCS : mental functional health summary scores in SF-8; QLI: Ferrans and Powers Quality of Life Index.

show that breast cancer patients' attitudes to making a self-assessment using the tablet computer-based questionnaire at an outpatient setting had a close relationship with their level of HR-QOL.

As mentioned earlier, on completion of the tablet computer-based self-assessment questionnaire, participants immediately received a report of their results/scores and to these reports, the numerical data previously gathered from a survey involving a heterogeneous sample of Japanese cancer patients at their first follow-up appointment after hospital discharge were annexed. From the mean scores of the HR-QOL indicators found in the current study, it can be inferred that many of the participants received better report scores than the numerical data that were annexed from the previous survey. Additionally, the mean score of subjective well-being measured through the tablet computer-based questionnaire was higher than another study that included patients with digestive system cancer who were out of treatment.<sup>19</sup> Thus, this study sample had an overall tendency toward having better HR-QOL. However, the mean score for subjective well-being significantly decreased at the one-month follow-up survey. And the mean level of physical function, while only approaching significance, showed the same trend. A number of possibilities, pertaining to the results and perhaps in the study methodology, might account for this HR-QOL decrease. First, the HR-QOL indicators that were measured at the one-month follow-up survey using a paper version of the initial assessment may not be equivalent to results measured by the tablet computer-based self-assessment questionnaire. The authors of the study that confirmed the statistically equivalence of data collected from tablet computer-based and paper-based PRO surveys also cautioned that data yielded by paper and electronic formats of certain subscales were not statistically equivalent.<sup>1</sup> Additionally, there was the possibility of "response shift" accruing over time. Response shift refers to changes in a person's internal values or standards of measurement (pertaining to PROs in our study), which might reflect better outcomes over time.<sup>21</sup> When using a longitudinal approach to measuring HR-QOL, especially general QOL, we should be aware of "response shifts" in patients' QOL criterion; however, it was difficult to estimate whether response shift was observable in the current study sample, because several indicators decreased at the one-month follow-up survey. Our intervention, which involved providing an occasion to make a self-assessment and immediately afterward indicating the scores and numerical data for comparison/interpretation, might not have greatly affected the participants' criterion of value for well-being. Finally, the decreases may be explained by the probable negative impact on QOL that resulted from the medical treatment that 59.3% of this sample were undergoing; however, no statistical difference of HR-QOL scores between patients under treatment and those out of treatment was found.

*Implications for nursing*

Participants' attitudes towards making a self-assessment using our tablet computer-based questionnaire were generally favorable; however, the HR-QOL of ambulatory breast cancer patients did not improve at the one-month follow-up survey. Studies have shown that the effectiveness of making a self-assessment using an ICT-based device was enhanced by sharing/reviewing the data results with a physician/healthcare provider.<sup>2,11,22</sup> Purposefully providing an occasion to share the health assessment results with a healthcare provider might be necessary to intervene in the HR-QOL of ambulatory cancer patients who independently make a self-assessment using an ICT-based device. Several statements were picked up in the interviews that represented participants' desire to know how to act in response to the results of self-assessments. Additionally, participants who had impaired HR-QOL were favorably inclined towards making a self-assessment using the tablet computer-based questionnaire. Thus, when an ICT-based device, such as the one used in this study, is introduced into clinical practice, we should consider the target users and how the functionality and productivity of the ICT device might be best leveraged to meet the needs of the users. In the current study patients who were experiencing deteriorated HR-QOL seemed to be able/willing to use the device as a vehicle for facilitating sharing their self-assessment results with healthcare

**Table 4**  
Contrast of HR-QOL between computer-device and follow-up survey.

Variables (Instrument, score range)	Computer-device		Follow-up survey		Z	p	$r_s$	p
	Med (IQR)	$\alpha$	Med (IQR)	$\alpha$				
Symptoms (MDASI-S, 0–10)	1.35 (1.54)	0.82	1.08 (1.42)	0.91	–.13	0.90	0.67	< 0.001
Interference (MDASI-I, 0–10)	0.67 (2.25)	0.90	0.50 (1.67)	0.92	–1.04	0.30	0.54	< 0.001
Physical function (PCS, 19.69–56.31)	49.02 (8.27)	–	51.69 (6.98)	–	–1.83	0.07	0.38	0.005
Mental function (MCS, 29.74–54.92)	50.52 (7.70)	–	49.32 (10.28)	–	–1.29	0.20	0.51	< 0.001
Subjective well-being (QLI, 0–30)	19.56 (4.17)	0.92	18.27 (4.14)	0.95	–2.90	0.004	0.71	< 0.001

$\alpha$  : Cronbach alpha. MDASI-S :symptom scale in M.D. Anderson Symptom Inventory; MDASI-I : interference scale in M.D. Anderson Symptom Inventory; PCS : physical functional health summary scores in SF-8; MCS : mental functional health summary scores in SF-8; QLI : Ferrans and Powers Quality of Life Index.

providers. Culturally speaking, Japanese people are more reluctant to share details of their personal lives and health,<sup>23</sup> than those of other, particularly Western cultures. This study is important because it shows that these Japanese patients were comfortable revealing details about themselves, using a tablet computer-based administration. This method of communication may be more comfortable for Japanese people, because it allows them to reveal personal details quietly via the ICT device, without having to say them directly to another person. We need to plan a future study to examine a way to make best use of the self-assessment scores to help patients and health care providers understand, interpret, and act on the scores in meaningful ways to benefit patient HR-QOL.

#### Limitations

There are some limitations to this study. First, the study sample consisted solely of Japanese ambulatory breast cancer patients gathered by convenience sampling at an outpatient unit of an urban general hospital in Japan. Therefore, the applicability of the findings to different clinical settings and patients background should be examined in future research. Secondly, this study aimed to examine ambulatory breast cancer patients' acceptability to making a self-assessment using a tablet computer, but not the effect that making the self-assessment has on the patients. We must fine-tune how we use the instruments to measure the HR-QOL of study outcomes. Therefore, in order to examine the effect of making a self-assessment using our tablet computer-based questionnaire on patient HR-QOL a new experimental study should be planned.

#### Conclusions

In the current study, patients found the HR-QOL self-assessment process using a tablet computer device easy to complete in the clinical setting, and those with symptoms, interference, deteriorating physical function, and unsatisfactory levels of well-being were particularly interested in completing the assessment. Nevertheless, simply providing HR-QOL information to patients only (and not to medical staff) was insufficient to improve HR-QOL (especially the patients' subjective well-being and physical function), which decreased for participants in the month following the initial HR-QOL self-assessment. Thus, the findings encourage the integration of HR-QOL self-assessments into clinical care at the time of the clinic visit, so they can be used in real time to accumulate the assessment data, share detailed HR-QOL information between a patient and a healthcare professional, and ultimately improve the patient's HR-QOL.

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#### Declaration of competing interest

None declared.

#### References

- Abernethy AP, Herndon 2nd JE, Wheeler JL, et al. Improving health care efficiency and quality using tablet personal computers to collect research-quality, patient-reported data. *Health Serv Res.* 2008;43(6):1975–1991. <https://doi.org/10.1111/j.1475-6773.2008.00887.x>. Epub 2008/09/03; PubMed PMID: 18761678; PubMed Central PMCID: PMC2613994.
- Richards R, Kinnersley P, Brain K, McCutchan G, Staffurth J, Wood F. Use of mobile devices to help cancer patients meet their information needs in non-inpatient settings: systematic review. *JMIR Mhealth Uhealth.* 2018;6(12), e10026. <https://doi.org/10.2196/10026>. Epub 2018/12/16; PubMed PMID: 30552082; PubMed Central PMCID: PMC6315262.
- Ministry of Internal Affairs and Communications. Information and Communications Statistics Database. Available from: <https://www.soumu.go.jp/johotsusintokei/statistics/statistics05.html>.
- Hou IC, Lin HY, Shen SH, et al. Quality of life of women after a first diagnosis of breast cancer using a self-management support mHealth app in Taiwan: randomized controlled trial. *JMIR Mhealth Uhealth.* 2020;8(3), e17084. <https://doi.org/10.2196/17084>. Epub 2020/03/05; PubMed PMID: 32130181; PubMed Central PMCID: PMC67081131.
- Sim JA, Chang YJ, Shin A, Noh DY, et al. Perceived needs for the information communication technology (ICT)-based personalized health management program, and its association with information provision, health-related quality of life (HRQOL), and decisional conflict in cancer patients. *Psycho Oncol.* 2017;26(11):1810–1817. <https://doi.org/10.1002/pon.4367>. Epub 2017/01/06; PubMed PMID: 28054737.
- Foundation for Promotion of Cancer Research. *Cancer statistics in Japan*; 2021. Available from: [https://ganjoho.jp/public/qa\\_links/report/statistics/pdf/cancer\\_statistics\\_2021.pdf](https://ganjoho.jp/public/qa_links/report/statistics/pdf/cancer_statistics_2021.pdf).
- Fridriksdottir N, Gunnarsdottir S, Zoega S, Ingadottir B, Hafsteinsdottir EJG. Effects of web-based interventions on cancer patients' symptoms: review of randomized trials. *Support Care Cancer.* 2018;26(2):337–351. <https://doi.org/10.1007/s00520-017-3882-6>. Epub 2017/09/19; PubMed PMID: 28921391.
- Centers for Disease Control and Prevention. *Measuring healthy days.* Atlanta, Georgia: CDC; November 2000:8.
- Broderick JE, DeWitt EM, Rothrock N, Crane PK, Forrest CB. Advances in patient-reported outcomes: the NIH PROMIS(R) measures. *EGEMS (Wash DC).* 2013;1(1):1015. <https://doi.org/10.13063/2327-9214.1015>. Epub 2013/01/01; PubMed PMID: 25848562; PubMed Central PMCID: PMC371419.
- Chen J, Ou L, Hollis SJ. A systematic review of the impact of routine collection of patient reported outcome measures on patients, providers and health organisations in an oncologic setting. *BMC Health Serv Res.* 2013;13:211. <https://doi.org/10.1186/1472-6963-13-211>. Epub 2013/06/14; PubMed PMID: 23758898; PubMed Central PMCID: PMC3700832.
- Girgis A, Durcinoska I, Levesque JV, et al. eHealth system for collecting and utilizing patient reported outcome measures for personalized treatment and care (PROMPT-Care) among cancer patients: mixed methods approach to evaluate feasibility and acceptability. *J Med Internet Res.* 2017;19(10), e330. <https://doi.org/10.2196/jmir.8360>. Epub 2017/10/04; PubMed PMID: 28970188; PubMed Central PMCID: PMC5667931.

12. Tang FWK, Chan CWH, Choy YP, Loong HHF, Chow KM, So WKW. A feasibility study on using tablet personal computers for self-reported symptom assessment in newly diagnosed lung cancer patients. *Int J Nurs Pract*. 2018;24(4), e12658. <https://doi.org/10.1111/ijn.12658>. Epub 2018/04/12; PubMed PMID: 29642280.
13. Wintner LM, Giesinger JM, Zabernigg A, et al. Evaluation of electronic patient-reported outcome assessment with cancer patients in the hospital and at home. *BMC Med Inf Decis Making*. 2015;15:110. <https://doi.org/10.1186/s12911-015-0230-y>. Epub 2015/12/25; PubMed PMID: 26699708; PubMed Central PMCID: PMC4690412.
14. Author (reference blinded for review), Mizuno M. *The effectiveness for cancer survivors to gain understanding of their own living and health conditions using a self-assessment tool (KAKENH No. 15K1582)*; 2018. Available from: <https://kaken.nii.ac.jp/ja/grant/KAKENHI-PROJECT-15K1582/>.
15. Okuyama T, Wang XS, Akechi T, et al. Japanese version of the M.D. Anderson Symptom Inventory: a validation study. *J Pain Symptom Manag*. 2003;26(6): 1093–1104. <https://doi.org/10.1016/j.jpainsymman.2003.05.003>.
16. Tokuda Y, Okubo T, Ohde S, et al. Assessing items on the SF-8 Japanese version for health-related quality of life: a psychometric analysis based on the nominal categories model of item response theory. *Value Health*. 2009;12(4):568–573. <https://doi.org/10.1111/j.1524-4733.2008.00449.x>. Epub 2008/09/12; PubMed PMID: 18783391.
17. Ferrans CE, Powers MJ. Quality of life index: development and psychometric properties. *ANS Advances in nursing science*. 1985;8(1):15–24. Epub 1985/10/01. PubMed PMID: 3933411.
18. Mizuno M, Sugimoto K, Mayers T, Ferrans CE. Ensuring cultural and cognitive integrity in instrument translation: quality of life index for Japanese cancer patients. *Asia Pac J Oncol Nurs*. 2019;6(1):64–71. [https://doi.org/10.4103/apjon.apjon\\_57\\_18](https://doi.org/10.4103/apjon.apjon_57_18). Epub 2019/01/02; PubMed PMID: 30599018; PubMed Central PMCID: PMC6287387.
19. Mizuno M, Munezawa N, Yamashita M, et al. Reliability and validity of the Japanese version of the Quality of Life Index for patients with cancer. *Res Nurs Health*. 2020; 43(2):176–185. <https://doi.org/10.1002/nur.22011>. Epub 2020/01/28; PubMed PMID: 31985085.
20. Lincoln YS, Guba EG. *Naturalistic inquiry*. Sage Publications; 1985:416.
21. Ilie G, Bradfield J, Moodie L, et al. The role of response-shift in studies assessing quality of life outcomes among cancer patients: a systematic review. *Front Oncol*. 2019;9:783. <https://doi.org/10.3389/fonc.2019.00783>. Epub 2019/09/05; PubMed PMID: 31482068; PubMed Central PMCID: PMC6710367.
22. Egbring M, Far E, Roos M, et al. A mobile app to stabilize daily functional activity of breast cancer patients in collaboration with the physician: a randomized controlled clinical trial. *J Med Internet Res*. 2016;18(9):e238. <https://doi.org/10.2196/jmir.6414>. Epub 2016/09/08; PubMed PMID: 27601354; PubMed Central PMCID: PMC45030453.
23. Okuyama T, Endo C, Seto T, et al. Cancer patients' reluctance to disclose their emotional distress to their physicians: a study of Japanese patients with lung cancer. *Psycho Oncol*. 2008;17(5):460–465. <https://doi.org/10.1002/pon.1255>. Epub 2007/09/11; PubMed PMID: 17828705.