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Authors

Erden, Sevilay
Yikar, Seda
Doğan, Sevgi
et al.

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Validation of the tablet-based Turkish-PAIN*Report*It® for lung cancer patients after thoracotomy in Turkey

Sevilay Erden, RN, PhD[a,*], **Seda Karacay Yikar, RN, PhD**[b], **Sevgi Deniz Doğan, RN, PhD**[c], **Robert J. Lucero, PhD, RN, FAAN**[d], **Kardelen Simal Yıldız, BA**[e], **Suat Gezer, MD**[f], **Evsen Nazik, RN, PhD**[b], **Sevban Arslan, RN, PhD**[a], **Yingwei Yao, PhD**[g], **Diana J. Wilkie, PhD, RN, FAAN**[g]

[a]Department of Surgical Nursing, Faculty of Health Sciences, Cukurova University, Adana, Turkey

[b]Department of Obstetrics and Gynecologic Nursing, Faculty of Health Sciences, Cukurova University, Adana, Turkey

[c]Uluborlu Selahattin Karasoy Vocational School, Isparta University of Applied Sciences, Isparta, Turkey

[d]University of California, Los Angeles, School of Nursing, Los Angeles, CA, United States of America

[e]University of Central Florida Orlando, FLORIDA Biomedical Sciences, FL, ABD, United States of America

[f]Chest Surgery, Cukurova University, Adana, Turkey

[g]Department of Biobehavioral Nursing Science, University of Florida, Gainesville, FL, United States of America

Abstract

Background: Digital pain assessment is advantageous and timely for healthcare priorities in Turkey. However, a multi-dimensional, tablet-based pain assessment tool is not available in the Turkish language.

[*]Corresponding author at: Çukurova University, Faculty of Health Science, Nursing Department, Adana, Turkey. sevilaygil@gmail.com (S. Erden).

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CRediT authorship contribution statement

Sevilay Erden: Conceptualization, Funding acquisition, Investigation, Project administration, Resources, Writing – original draft, Writing – review & editing. **Seda Karacay Yikar:** Investigation, Writing – review & editing. **Sevgi Deniz Doğan:** Investigation, Writing – review & editing. **Robert J. Lucero:** Formal analysis, Writing – review & editing. **Kardelen Simal Yıldız:** Formal analysis, Writing – review & editing. **Suat Gezer:** Investigation, Writing – review & editing. **Evsen Nazik:** Writing – review & editing. **Sevban Arslan:** Writing – review & editing. **Yingwei Yao:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Methodology, Writing – original draft, Writing – review & editing. **Diana J. Wilkie:** Conceptualization, Formal analysis, Funding acquisition, Methodology, Project administration, Resources, Software, Supervision, Writing – original draft, Writing – review & editing.

Conflicts of interest:

Dr. Wilkie is co-founder and Chairman of eNursing llc a company without current ownership of PAINReportIt®. The other authors have no funding or conflicts of interest to disclose

Purpose: To validate the Turkish-PAIN*Report*It® as a multi-dimensional measure of post-thoracotomy pain.

Methods: In the first of a two-phased study, 32 Turkish patients (mean age 47.8 ± 15.6 years, 72 % male) participated in individual cognitive interviews as they completed the tablet-based Turkish-PAIN*Report*It® once during the first four days post-thoracotomy, and 8 clinicians participated in a focus group discussion of implementation barriers. In the second phase, 80 Turkish patients (mean age 59.0 ± 12.7 years, 80 % male) completed the Turkish-PAIN*Report*It® preoperatively, on postoperative days 1–4, and at the two-week post-operative follow-up visit.

Results: Patients generally interpreted accurately the Turkish-PAIN*Report*It® instructions and items. We eliminated some items unnecessary for daily assessment based on focus-group suggestions. In the second study phase, pain scores (intensity, quality, pattern) were low pre-thoracotomy for lung cancer and high postoperatively high on day 1, decreasing on days 2, 3 and 4, and back down to pre-surgical levels at 2-weeks. Over time, pain intensity decreased from post-operative day 1 to post-operative day 4 ($p < .001$) and from post-operative day 1 to post-operative week 2 ($p < .001$).

Conclusions: The formative research supported proof of concept and informed the longitudinal study. Findings showed strong validity of the Turkish-PAIN*Report*It® to detect reduced pain over time as healing occurs after thoracotomy.

Keywords

McGill pain questionnaire pain; Tablet-based pain assessment; Thoracotomy pain; Turkish-PAIN*Report*It®

1. Introduction

Persistent pain is a reality for 50 % of patients after thoracotomy for lung cancer (Kelsheimer et al., 2019; Rawal, 2016). Early detection and treatment is needed to reduce the burden of this persistent pain in the Turkish population where lung cancer is common, ranking 1st in males and 4th in females Mnistry of Health, 2021). Understanding the multiple dimensions (location, intensity, quality and pattern) of the post-thoracotomy pain experience is important for reducing its burden. However, a multi-dimensional, tablet-based pain assessment tool is not available in the Turkish language. The purpose of our study was to validate the tablet-based Turkish-PAIN*Report*It® as a multi-dimensional pain measure in a post-thoracotomy model of pain.

Thoracotomy is one of the most common procedures in the treatment of early-stage lung cancer and one with high risk of acute post-operative pain and complications, including persistent pain (Kelsheimer et al., 2019; Rawal, 2016; Wang et al., 2017). Under normal conditions, as healing progresses after surgery, the sensation of pain reduces until there is no pain at all. Severe and persistent pain, however, is an important indicator that the pain may become chronic as secondary mechanisms reduce normal functionality in the nervous system (Glare et al., 2019). In the case of persistent post-thoracotomy pain, the chronic pain is not associated with infection or recurrent tumor and is often unidentified, underreported, and incurable (Hopkins & Rosenzweig, 2012). If chronic pain is not treated, it can adversely

affect the patient's quality of life. Therefore, pain identification and prevention are needed as early as possible post-surgery. For effective pain management, pain assessment tools can help clinicians treat the pain before it becomes chronic and negatively affects the patient's quality of life.

A modern, appropriate, and comprehensive pain assessment tool is essential for effective pain management. Recent technological developments involving tablets and smartphones hold promise to facilitate pain assessment (Scher et al., 2018), and are timely for use in Turkey where there is a focus on improving the healthcare system with the "Digital/Paperless Hospital" project (Ministry of Health, 2021). With the acceleration of technological developments in Turkey, wireless internet connections have been established in hospitals that are suitable for implementation of web-based pain assessment tools, such as PAIN*Report*It.® The PAIN*Report*It® is based on the valid and reliable McGill Pain Questionnaire (Melzack, 1975). The PAIN*Report*It® is a comprehensive measure of pain location, intensity, quality and temporal pattern that has been used extensively in the United States (Chin et al., 2014; Page et al., 2010; Wilkie et al., 2003, 2009; Wilkie et al., 2010). However, it has not been translated to Turkish language or validated for cultural relevance in Turkey.

The specific aims of our study were to (1a) describe the meanings attributed to the Turkish-PAIN*Report*It® items and instructions by Turkish speaking post-thoracotomy patients who were experiencing pain; (1b) identify technical and human factors that could be barriers or facilitators to implementing the Turkish-PAIN*Report*It;® and (2) compare the Turkish-PAIN*Report*It® scores for change over the first four post-thoracotomy days and at two weeks after the surgery. We expected to use the findings from phase 1 to clarify the wording and presentation of the Turkish-PAINReportIt® screens and the protocol for implementation in clinical cancer studies and practice. We also hypothesized that in phase 2 the pain intensity would decrease over time as the patients recovered from the surgery, supporting construct validity of the Turkish-PAINReportIt®.

2. Methods

2.1. Design

The research was a 2-phased study. Phase 1 was a descriptive, cross-sectional design. Phase 2 was a longitudinal, repeated measures comparative design (Fig. 1). The Institutional Review Boards at the Cukurova University and the University of Florida (IRB201701928) approved the study.

2.2. Setting

The study was a collaboration between faculty at Cukurova University, where data collection occurred, and the University of Florida (UF), where the Turkish-PAIN*Report*It® application and database servers were located and analysis of de-identified data occurred. The Institutional Review Boards at the Cukurova University and the University of Florida approved the study.

The study was conducted in Cukurova University Faculty of Medicine Balcalı Hospital Thoracic Surgery Clinic between April 2018 and July 2020. One of Turkey's largest hospitals, Balcalı Hospital is a research hospital that was founded in 1972 and has 1,200 beds and 44 polyclinics serving approximately 20 million patients. Patients, most of whom have *low-medium* education and social class, come to this hospital from South and Southeastern Anatolia for advanced treatments and care. With a team of two or three thoracic surgeons, approximately 100 patients diagnosed with lung cancer undergo thoracotomy each year. There is no standardized approach to clinical pain assessment, therefore, records of pain assessment data are sporadic. Parenteral opioids (e.g., tramadol) and nonopioids (e.g., acetaminophen, diclofenac), intercostal nerve block and thoracic epidural block are the most frequent analgesics.

2.3. Samples

For the phase 1a study procedures, a convenience sample of patients was eligible if they: were age 18 years or older, able to speak and read Turkish language; underwent thoracotomy with the diagnosis of lung cancer in the Balcali Hospital Thoracic Surgery Department; and had moderate to severe pain (>3 on a 0–10 scale) on the first day after surgery. Patients who were legally blind or physically unable to complete study procedures were not eligible for inclusion. For the phase 1b study procedures, physicians and nurses who were not in surgery or on annual leave were eligible for inclusion.

For the phase 2 study procedures, sequential patients were eligible if they were age 18 years or older, able to speak and read Turkish language, and scheduled for thoracotomy with the diagnosis of lung cancer in the Thoracic Surgery Department. Patients who were legally blind or physically unable to use the tablet to complete study procedures were not eligible for inclusion.

2.4. Procedures

The investigators informed the thoracic surgery clinic staff about the purpose of the study, their role in referral of patients to the study research assistants, and the importance of patient participation. In both phase 1 and 2, the research assistants explained the study procedures and obtained signed informed consent. For phase 1a, two research assistants conducted the cognitive interview – one as the interviewer and one as the observer – while the patient completed the Turkish-PAIN-*Report*It® 1 h after the administration of an analgesic. For phase 1b, the first author convened and facilitated a focus group session with the health professionals. For phase 2, a research assistant approached referred patients before surgery, allowed the patient to practice using the Turkish-PAIN*Report*It® and then allowed the patient to complete the Turkish-PAIN*Report*It® screens to self-report pain. At a time convenient for the patient on the first, second, third and fourth postoperative days, a research assistant asked the patient to complete the Turkish-PAIN*Report*It,® Then at the 2-week post-operative clinic visit, a research assistant asked the patient to complete the Turkish-PAIN*Report*It® during the postoperative follow-up visit in the outpatient policlinic.

2.5. Data collection tools

We used four instruments for data collection. The instruments included the Turkish-PAIN*Report*It®, Turkish Think Aloud Interview Form, Turkish Health Professional Interview Guide, and the Personal Information Form.

2.5.1. Turkish-PAINReportIt®

2.5.1.1. Translation process.: The Turkish-PAIN*Report*It® was translated from English to Turkish language by a committee method of translation, which is the accepted, contemporary approach to translation to produce culturally relevant tools or questionnaires (Garyfallos et al., 1991). Three academicians (algologist, biologist, and nurse) who are fluent in the English and Turkish languages comprised the committee and completed independent direct translations from English to Turkish of the PAIN*Report*It® screens. The three translators then met as a committee to reconcile differences and agreed on an integrated version. The open dialogue among the translators during the reconciliation meeting helped to identify biases and conceptual nuances in the meaning of individual items, which is important when conceptual equivalence is essential. Although translation of some words can be straightforward, there is greater complexity with idiomatic expressions. Bilingual translators may interpret the meaning of words differently than monolingual participants because of different and/or disparate educational backgrounds and socioeconomic status between the translators and participants. The committee approach to translation minimizes the differences in meanings to achieve cultural relevance of the translation.

During the translation by committee process, monolingual “consultants” who were representative of potential study participants read the questionnaires and discussed their own interpretations of the measurement items, provided alternative translations, and affirmed translations. Since the consultants performed translation checking, the focus was simply on identifying and creating accurate statements, rather than eliciting opinions or studying group dynamics. These combined approaches for translating the study measures produced measures ready for research using the cognitive interview approach. The translation excluded the demographic questions (e.g., race, religion, language) because of the homogeneous Turkish population. The first author translated the error messages that were part of the application since the committee had disbanded upon completion of the translation.

2.5.1.2. Measure description.: PAIN*Report*It® software was first developed as an electronic McGill Pain Questionnaire (1970 version) (Melzack, 1975) with support from the National Institutes of Health (R43/44 NR04742). Since its creation, investigators have used PAIN*Report*It® in numerous studies in the United States (Chin et al., 2014; Dyal et al., 2020; Ezenwa et al., 2014, 2016a, 2016b, 2019; Huang et al., 2003; Jha et al., 2010; Page et al., 2010; Powell-Roach et al., 2019; Schlaeger et al., 2017, 2018, 2019; Schoppee et al., 2020; Stapleton et al., 2022; Wilkie et al., 2003, 2009, 2010, 2020; Yoon et al., 2021). PAIN*Report*It® is a program designed as an interactive, touch-screen method for pain assessment. It is a tablet-based application that includes the pain assessment information contained in the paper versions of the McGill Pain Questionnaire. Validity and reliability

of a Turkish version of the McGill Pain Questionnaire short form (paper) (Melzack, 1987) was published in 2012 (Bicici & Gunes, 2012). However, validity and reliability of the tablet-based version of the McGill Pain Questionnaire have not been studied in Turkey.

PAIN*Report*It® includes 5 'practice' screens for patients to understand how to use the program. Its 30 pain assessment screens include the following elements: items related to body drawing, items scaled from 0 to 10 to indicate the current, least and worst pain intensity in the past 24 h, intensity of past common pain conditions (worst headache, toothache, stomachache), targets for pain intensity (optimal goal, tolerable goal), number of hours in the past 24 h that the pain intensity was less than the tolerable level, verbal descriptors of the quality (nature) of pain and the temporal course of pain, patient satisfaction with the pain level, expectations about pain, experience with past pain treatments, non-drug treatments used for pain, the tendency to tell others about pain, the onset of the pain, and beliefs about the cause of the pain. Examples of several Turkish-PAIN*Report*It® screens for reporting pain location, intensity, quality and pattern appear in the panels of Fig. 2 (supplementary material).

When each screen is completed, the patient touched an arrow at the bottom of the screen to move to the next screen. Having a single element on each screen reduces the patient's cognitive load and increases attention to the concept being evaluated. When the patient selected the appropriate response on the screen and touched the next button, the data were automatically stored in the database (Structural Query Language, SQL) server at the University of Florida and the next screen populated from the separate application server at the University of Florida. To maintain patient privacy, no data were stored even momentarily on the tablet.

2.5.2. Turkish think-aloud (cognitive interview) guide—We used cognitive interviews to understand what the Turkish-PAIN*Report*It® questions meant to the respondents and if necessary to select more culturally appropriate words (Tourangeau & Rasinski, 1988). The interview guide focused on patients' 1) understanding and interpretation of the elements of Turkish-PAIN*Report*It,® (2) ability to retrieve the information needed to answer questions, (3) formation of their judgment based on questions and recalled information, and (4) framing their responses relative to other individuals' experiences and responses to questions (Warnecke et al., 1996). In previous studies, findings from cognitive interviews of the PAIN*Report*It® with adults speaking English or Spanish supported the construct validity of the tablet-based instrument (Jha et al., 2010; Suarez et al., 2022). To adapt and validate the Turkish-PAIN*Report*It® elements, we used the Turkish Think-Aloud Guide.

Since the primary goal of the phase 1a study was focused not on the pain of the patients, but on understanding how they used the tool, qualitative data were collected using face-to-face interview on a post-operative day, 1 h after an analgesic dose and at a time acceptable to the patient. All cognitive interviews were audio recorded and observations during the patient's use of the Turkish-PAIN*Report*It® were documented in writing. Specifically, one research assistant interviewed the patient and the other managed the audio recorder and documented the observed patient's use of the Turkish-PAIN*Report*It®. The interview typically lasted

1.5–2 h. After the data were collected, the first author checked the data for accuracy and transferred it to the collaborating study team for analysis.

2.5.3. Focus group interview guide—The focus group interview guide included 14 questions focused on identifying technical and human (clinician, patient) factors that could be barriers or facilitators to implementing the Turkish-PAIN*Report*It®. In the focus group meeting, the Turkish-PAIN*Report*It® was introduced to the participants and practical issues were discussed. The focus group session was audio recorded with written notes. The data obtained from the focus group, which lasted about 1.5 h, were examined by the first author and then transmitted to the study team in the United States for analysis.

2.5.4. Personal information form—This form is a 14-item questionnaire consisting of the demographic characteristics of the patient (e.g., age, gender, educational status, etc.), the presence of chronic diseases, and information about the thoracotomy surgery (e.g., type, duration, use of analgesia, etc.).

2.6. Analysis

2.6.1. Qualitative data analysis—The audio recordings were transcribed verbatim and translated by a bilingual team member. Two team members independently read the transcripts and used a content analysis approach focused on identifying issues with use of the Turkish-PAIN*Report*It® in terms of understanding and interpretation, information retrieval, judgment, and item response description. This analysis was focused at the screen level to identify potential changes that would be needed to improve the clarity of the Turkish-PAIN*Report*It® for patient use.

A bilingual team member also transcribed and translated the focus group recording verbatim. One team member independently read the transcript and used a content analysis approach focused on identifying barriers and facilitators of the use of the Turkish-PAIN*Report*It® in clinical research with patients post-thoracotomy for lung cancer.

2.6.2. Quantitative data analysis—We extracted data from the SQL database and imported to R, a statistical program, for analysis (R Core Team, 2018). We performed descriptive analysis to obtain descriptive statistics (mean, standard deviation, frequency, and percentage) of variables of interest. We used paired *t*-tests to compare between day 1 post-op and day 4 post-op and between day 1 post-op and 2 weeks post-op. We used mixed effect regression analysis to examine the change over time from day 1 to day 4 post-op. We used the Benjamini-Hochberg (BH) procedure to account for multiple testing (Benjamini & Hochberg, 1995). In our tables, p values are unadjusted observed significance and q values are BH adjusted values.

3. Results

3.1. Phase 1a: cognitive interviews

Thirty-two patients who were recovering after thoracotomy for lung cancer participated in the cognitive interviews. The sample mean age was 47.8 ± 15.6 years, and 72 % of the participants were male. Qualitative analysis of the cognitive interview data indicated that the

participants generally interpreted the questions and instructions as intended, were retrieving information about their post-operative pain experience, and forming their responses relative to it. These responses supported content validity of the Turkish PAIN*Report*It®. Additionally, the transcripts included information that was general in nature and provided instances when participants asked the research assistants for additional information as the patients progressed through the Turkish-PAIN*Report*It® interface. It is unclear from the transcripts whether the "explanations" participants asked for were a result of functionality or design features of the PAIN*Report*It® system, part of their think-aloud process, or actual need for clarification of content. For the participants with such requests, they requested a minimum of four and a maximum of seventeen explanations with an average of 8.5 requests per participant over the multiple Turkish-PAIN*Report*It® screens.

Specifically, there were 24 items that resulted in at least one participant asking for further explanation. More than three participants requested further explanation of 12 items. These items included in ranked order were: 9 participants asked about three items (quality matched to pain site, optimal goal, and tolerable goal); 7 participants asked about two items (body image and text box for what relieves pain); 6 participants asked about six items (least pain in the past 24 h screen, worst pain in the past 24 h, number of hours pain was less than tolerable level in the last 24 h, pain relief with past pain treatments, text box for non-drug treatments for pain, and text box for when pain was first noticed); and 4 participants asked about the current pain intensity item.

Therefore, the screens with the most frequent request for explanation were those that included the numerical keypad, the body outline drawing, and text boxes. Notable is the finding that the pain quality screens were not among the screens about which the patients asked for additional explanation. The patients' questions did not indicate issues with translation of the items and were similar to the types of questions that patients in previous cognitive interview studies have asked (Jha et al., 2010, Suarez et al., 2022). These questions did not prevent the patients from completing the items to provide their answers about the location, intensity, quality, and pattern of their pain.

Based on these findings, we concluded that there was a need to emphasize the importance of using the practice session to help patients understand the functional aspects of using the tablet to complete the Turkish-PAIN*Report*It® system. The decision was to move forward with the validation study without additional changes to the Turkish-PAIN*Report*It® system.

3.2. Phase 1b: focus group findings

The focus group included two surgeons (1 male, 1 female) and six nurses (1 male, 5 females). Findings indicated that all focus group participants supported and recommended use of the Turkish-PAIN*Report*It® on a tablet given the state of technology availability in Turkey. But they emphasized that adequate training of the patients and clinical staff would be needed before it could be implemented clinically, and there would need to be enough tablets available given the volume of patients. Participants indicated that the training of patients should occur when they were not in much pain and were able to concentrate on the training.

The participants provided advice and suggestions for optimal use of the tablet-based Turkish-PAIN*Report*It®. Generally, there was support for its use on the day of surgery about 6–8 h post-op but not earlier because patients are not sufficiently conscious earlier in the post-op period. One participant suggested using the tablet on the 3rd or 4th day after surgery. There was general concern that literacy could be an important factor and those illiterate would need additional assistance to use the tablet. The older patients were considered more at risk due to literacy issues. The nurse participants had observed patients using the tablet during the cognitive interview phase of the study and judged that the patients were successful in using the tablet. Another factor thought to affect a patient's ability to use the tablet was the severity of the patient's pain. If the pain was too severe, they might not be able to use the tablet. For those with more pain, there was a suggestion to create a separate shorter application for them with different questions. One participant expressed a perception of too much repetition in some of the questions and that some questions were too long. Another participant commented that the instructions were appropriately easy to understand.

The findings from patients and providers indicated that teaching the patient to complete the tablet-based pain assessment during the early post-operative period was not a good strategy. Therefore, the findings indicated the need to instruct the patients in phase two of this study before their surgery so that their post-operative pain would not be a barrier to their use of the tablet-based pain reporting. Approaching the patient in the outpatient clinic rather in the pre-operative holding area would be a preferred process for recruitment and screening for reading ability. The evidence indicated that the current interface requires inclusion of patients who are able to read the directions or someone to read the directions and items. This level of literacy should be tested as part of study screening procedures for future studies. In such screening, the researcher as part of the consent process asked patients to read the practice screens aloud so the researcher could determine whether the patient could read or would require assistance in reading the screens.

The findings also indicated that all the data screens were not needed for daily administration. The items collected once (e.g., worst toothache, headache, stomachache) were collected at the pre-operative recruitment and training session. We provided a short version (location, intensity, quality and pattern screens) for daily data collection, which reduced participant burden. The findings were used to adapt the Turkish-PAIN*Report*It® for optimal delivery in the phase 2 study.

3.3. Phase 2 longitudinal repeated measures findings

The 80 participants in the phase 2 longitudinal repeated measures study were on average 59.0 ± 12.7 years of age, 80 % were male, and all were Turkish (race and ethnicity were not culturally relevant concepts). Table 1 shows the means and standard deviations (±) for the pre- and post-op pain variables (intensity, quality, pattern, and location) measured with the Turkish-PAIN*Report*It®. Mean pain scores were low pre-op and high on post-op day 1, decreasing on post-op days 2, 3 and 4 and back down to the pre-op level by 2 weeks post-thoracotomy for lung cancer. Table 1 shows, in the last two rows, the average pain intensity for patients with versus those without pre-op pain at different time points. There was no clear difference in their mean post-op pain intensity scores or standard deviations.

Comparing day 4 post-op and 2 weeks post-op with day 1 post-op, respectively (Table 2), we observed that pain intensity, quality, pattern, and location scores were all significantly lower at 2 weeks postop, while at day 4, the decreases in pain intensity, quality, and pattern scores were statistically significant in our sample.

Mixed effects regression analyses of the daily pain scores (intensity, quality, pattern, and location) over the first 4 days (Table 3) showed that there were significant longitudinal changes in pain intensity ($q < 0.001$), quality ($q < 0.001$), and pattern ($q = 0.02$).

Some of the pain variables were not expected to change over time, such as optimal goal for pain intensity and tolerable pain intensity (Table 4). Indeed, as expected, these variables varied minimally from pre-op to 2 weeks post-op. Satisfaction with pain level also did not change much and about a third of the sample (29 % at pre-op and 34 % at week 2 post-op) indicated that they were not satisfied with their pain levels (Table 4), which is consistent with the low mean pain scores at these two time points.

3.4. Observations regarding feasibility of the internet-based study

None of the patients refused to use the Turkish-PAIN*Report*It® over the multiple measurement days. Some type of system error interfered with data collection for 9 subjects over the 24-month study and required replacement of 6 participants in the phase 1a cognitive interview study and 3 participants in the phase 2 longitudinal study.

4. Discussion

We conducted a two-phase validation study with patient cognitive interviews, a focus group of health professionals, and a longitudinal, repeated measures study of the Turkish-PAIN*Report*It® with patients recovering from thoracotomy. The qualitative findings showed that patients and health professionals supported use of the Turkish-PAIN*Report*It® in clinical practice for evaluating post-op pain after thoracotomy. Together the qualitative and quantitative findings demonstrated content validity and strong construct validity for the Turkish-PAIN*Report*It®. We did not identify the need for further refinement of any of the questions or instructions. Patients were able to use the technology and self-reported pain scores over time that reflected the expected post-op pain recovery process. The robust pain assessment system is ready for use in future research with individuals whose language is Turkish.

The post-operative thoracotomy model of pain was an excellent experimental model for validating the Turkish-PAIN*Report*It®. It is well known that the pain after thoracotomy is acute and decreases over time as surgically damaged tissues heal (Bendixen et al., 2016; Erden & Çelik, 2015; Khoronenko et al., 2018). This phenomenon of reduction in pain scores has also been observed after other surgical procedures, such as cardiac surgery (Alharbi et al., 2020), in adults but also a variety of surgical procedures in children and adolescents (Savedra et al., 1993). It is not surprising that the mean number of pain locations was low and did not decrease significantly over the first 4 post-op days, but did so by 2 weeks post-op. Researchers have found that the incision area can be the most prominent pain location in the early postoperative period (Alharbi et al., 2020; Sudjud, 2020), the duration

of the pain decreases along with the intensity and quality of the pain as the wound heals after thoracotomy (Erden & Çelik, 2013, 2015). The significant decrease in pain intensity, pain quality, pain pattern, and pain location scores after thoracotomy in our study supports the construct validity of Turkish-PAIN*Report*It®. Therefore, the scores on these and the other pain variables were consistent with studies of other pain populations, supporting the validity of the Turkish-PAIN*Report*It®.

One important finding of this study was the high success rate in conducting Internet-based pain assessment using the tablet-based Turkish-PAIN*Report*It® in Turkey with screens populated from the application server at the University of Florida and the data written to the database server at the University of Florida. Additional system-related coordination work and training are needed to avoid unavailability of the system when patients need to complete the data collection process. This successful proof of concept, however, is important for implementing rigorous, technology-based cancer pain measurement for intervention research conducted on a global scale. Future studies will be needed to determine the proportion of the population that require assistance of an interface that compensates for low literacy with auditory directions and cues to assist the patient to complete the tablet-based pain assessment.

4.1. Limitations

Conceptualized as an initial proof-of-concept trial of the technology, some limitations warrant consideration. Analgesic medications administered to the participant on post = op days 1–4 or taken by the participant at the 2-week post-op visit were not standardized or considered in the analyses. Women were under-represented in the study sample. The study recruited only patients with post-thoracotomy pain. As designed now, the Turkish-PAIN*Report*It® is not appropriate for individuals who lack sufficient written literacy skills. Additional evidence from women, individuals with other pain conditions, and individuals with limited literacy competency would strengthen conclusions about study findings.

5. Conclusions

In conclusion, we showed strong validity of the Turkish-PAIN*Report*It® to detect the expected phenomenon—reduction in the pain as healing occurs from the thoracotomy. The Turkish-PAIN*Report*It® program is reliable and technologically feasible for literate Turkish patients to share how their pain feels. With this application they can report where their pain is located, its intensity, quality, temporal pattern, other cognitive aspects and how it compares to past pain experiences. Such data can guide the pain management team to improve pain control for the individual and for patient populations.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Data availability statement

Data are available from the corresponding author.

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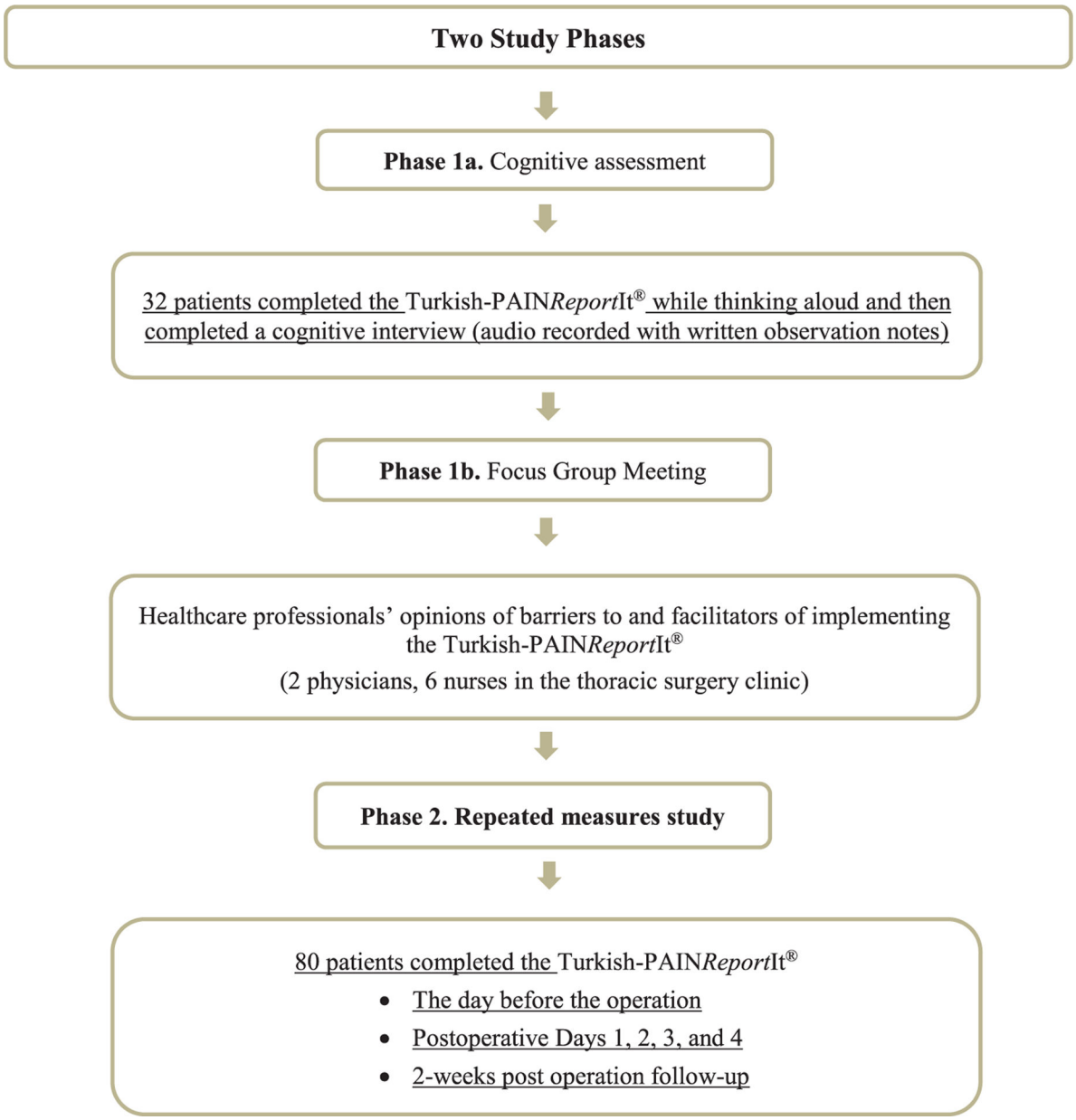

Fig. 1.
Study flow chart for application validation.

Table 1

Mean (±) pain intensity, quality, pattern, location, composite pain index scores and average pain intensity for participants with and without pre-op pain across time ($N = 80$).

Variable	Pre-op mean (±)	Post-op				
		Day 1 mean (±)	Day 2 mean (±)	Day 3 mean (±)	Day 4 mean (±)	Week 2 mean (±)
Current pain intensity	1.8 (2.7)	7.0 (2.2)	5.5 (2.0)	4.0 (2.0)	2.5 (2.2)	1.0 (1.4)
Least pain intensity	0.6 (1.7)	4.8 (2.8)	3.4 (2.1)	2.1 (1.9)	1.2 (2.0)	0.2 (0.7)
Worst pain intensity	2.8 (3.5)	8.8 (1.7)	7.6 (2.1)	5.9 (2.2)	4.6 (2.6)	2.0 (2.1)
Average pain intensity	1.7 (2.4)	6.9 (2.0)	5.5 (1.8)	4.0 (1.8)	2.8 (1.9)	1.0 (1.2)
Pain quality (pain rating index-total)	5.3 (7.8)	19.1 (7.4)	15.4 (6.9)	11.0 (6.3)	8.6 (6.4)	4.3 (4.9)
Total pain pattern score	1.0 (1.3)	2.7 (1.1)	2.7 (0.8)	2.5 (0.9)	2.4 (1.0)	1.4 (1.4)
Pain location: number of pain sites	0.6 (1.1)	1.8 (0.7)	1.8 (0.7)	1.8 (0.9)	1.7 (0.7)	0.7 (0.8)
Composite pain index	10.5 (13.1)	35.9 (9.4)	31.3 (7.7)	25.1 (8.1)	20.8 (9.2)	10.3 (9.9)
Average pain intensity for participants with pre-op pain (n=36)	3.8 (2.2)	6.8 (2.0)	5.5 (1.8)	4.3 (1.8)	3.0 (1.8)	1.0 (1.3)
Average pain intensity for participants without pre-op pain (n = 44)	0.0 (0.0)	6.9 (2.0)	5.5 (1.9)	3.8 (1.9)	2.6 (2.0)	1.0 (1.2)

Note: (±) = standard deviation.

Table 2

Comparisons of pain scores over time (N = 80).

Variable	Day 1 mean (±)	Day 4 mean (±)	Day 4 vs day 1		Week 2 mean (±)	Week 2 vs day 1	
			p	q		p	q
Average pain intensity	6.9 (2.0)	2.8 (1.9)	<0.001	<0.001	1.0 (1.2)	<0.001	<0.001
Pain rating index-total	19.1 (7.4)	8.6 (6.4)	<0.001	<0.001	4.3 (4.9)	<0.001	<0.001
Total pattern score	2.7 (1.1)	2.4 (1.0)	0.034	0.046	1.4 (1.4)	<0.001	<0.001
Number of pain sites	1.8 (0.7)	1.7 (0.7)	0.083	0.083	0.7 (0.8)	<0.001	<0.001

Note: (±) = standard deviation; *p* = unadjusted p value; *q* = Benjamini-Hochberg adjusted values.

Table 3

Mixed effects model regression of change in pain scores over the four post-operative days (N = 80).

Variable	Change/day	SE	t	p	q
Average pain intensity	−1.385	0.082	−16.879	<0.001	<0.001
Pain rating index-total	− 3.580	0.290	−12.364	<0.001	<0.001
Total pattern score	− 0.119	0.048	− 2.495	0.013	0.018
Number of pain sites	− 0.044	0.027	−1.612	0.108	0.108

Note: *p* = unadjusted p value; *q* = Benjamini-Hochberg adjusted values.

Table 4

Change in pain goals and satisfaction with pain levels across time (N = 80).

Variable	Category	Pre-op	Post-op week 2
Optimal pain goal (mean ±)		0.0 ± 0.3	0.0 ± 0.0
Tolerable pain goal (mean ±)		3.0 ± 1.6	2.9 ± 1.6
Satisfaction with pain level (%)	Yes	64 %	62 %
	Not sure	8 %	4 %
	No	29 %	34 %

Note: (±) = standard deviation.