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Screening of physical distress in breast cancer survivors: Concurrent validity of the Distress Thermometer & Problem List

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Conflict of Interest

The authors declare that they have no conflict of interest.

Abstract

Several studies support the validity and psychometric properties of the DT&PL for measuring psychosocial distress in breast cancer survivors (BCSs). However, next to psychosocial problems, it is equally important to identify distress caused by limitations in physical functioning. Validity of the DT&PL for the identification of physical problems in BCSs has not yet been investigated. Therefore, the purpose of the present study is to investigate the concurrent validity and psychometric properties of the Dutch DT&PL in BCSs for the identification of physical problems. Ninety BCSs completed the DT&PL, ShortForm-36 (SF-36) and the Dutch Disability of the Arm, Shoulder and Hand questionnaire (DASH). Forty-seven % of BCSs reported a high level of distress on the DT&PL (score ≥ 5). Distressed BCS showed increased physical and emotional problems and problems at the upper limb region. The scores obtained with the DT&PL correlated weakly to strongly with subscales for physical functioning of the SF-36 ($r = -0.224$ to $r = -0.676$; $p < 0.05$) and with limitations in physical functioning at the upper limb region (DASH; $r = 0.380$ to $r = 0.619$; $p < 0.01$). In conclusion, the Dutch DT&PL is a multidimensional instrument showing good concurrent validity for the screening of physical problems.

Keywords: Distress Thermometer and Problem List, breast cancer, physical problems.

Introduction

Breast cancer is the most common cancer in women with 464.000 new cases diagnosed in Europe in 2012, representing 29% of the overall cancer burden.(Torre et al., 2015) With the advances in early detection and treatment, the 5-year survival rate has improved to 89%, and the 10-year survival rate has increased to 83% across all stages of breast cancer.(Torre et al., 2015) Breast cancer treatment has specific temporary, persistent or late-onset treatment-related side effects, that may negatively affect the quality of life (QoL).(Bruce et al., 2014, Ploos van Amstel et al., 2013) For a significant percentage of breast cancer survivors (BCSs) physical and emotional distress is extreme and persistent.(Bruce et al., 2014, Carlson et al., 2013, Andersen et al., 2009) Proposed surveillance models call for the prevention, early detection and treatment of the side effects that may be detrimental to the survivor's psychosocial and physical well-being.(Hayes et al., 2012, Ploos van Amstel et al., 2013, Campbell et al., 2012)

The Distress Thermometer & Problem List (DT&PL) is recommend by the National Comprehensive Cancer Network to screen for practical, family, emotional, spiritual, and physical problems in oncology and to identify the need for health care interventions. (Donovan et al., 2014, Head et al., 2012, Hegel et al., 2008) The DT&PL is an easy-to-use comprehensive screening tool and consists of three parts, first a thermometer which measures a global level of distress as a Visual Analogue Scale, second an itemized problem list, and third a question about referral for additional care.(Ploos van Amstel et al., 2013, Tuinman et al., 2008) Distress, among other things, contributes to a patient's quality of life after breast cancer treatment. Previous studies already showed an inverse association between DT&PL and QoL in BCS.(Head et al., 2012, Hayes et al., 2010, Iskandarsyah et al., 2013) More specific, several studies supported the validity and psychometric properties of the scores

obtained with the DT&PL for measuring psychosocial distress in patients with breast cancer.(Ploos van Amstel et al., 2013, Hegel et al., 2008, Tuinman et al., 2008) However, next to psychosocial problems, it is equally important to identify distress caused by limitations in physical functioning.(Hollingworth et al., 2013, Nesvold et al., 2011, Yeh et al., 2014, Ploos van Amstel et al., 2013) In the Netherlands, the DT&PL is widely used and recommended as screening tool for distress and the need for health care interventions in breast cancer patients and survivors. However, validity of the DT&PL as a screening tool for physical problems in BCSs has not been investigated yet.

Therefore, the present study aimed at investigating concurrent validity of the DT&PL for screening for physical problems and limitations in physical functioning in BCSs. Additionally, psychometric properties such as sensitivity and specificity were investigated.

Methods

Ethical approval for this study was not needed since administering the questionnaires was part of the standard care program in which the participants were enrolled.

Participants

A cross-sectional study was performed between December 2013 and February 2014. Female BCSs who had completed active treatment for breast cancer were approached via multiple physical therapy clinics in the Netherlands and via two different local hospitals in Roosendaal and Gorinchem (the Netherlands). Inclusion criteria were: 1) curative treatment (surgery, chemotherapy and/or radiation therapy) were finished but adjuvant hormonal therapy or targeted therapy was permitted; 2) free of signs of active cancer e.g. local recurrence or distant metastases at the time of participation; 3) able to read and write in the Dutch language. Participants were excluded when 1) suffering from non-cancer-related severe general disease (based on the list of comorbidities for the Charlson Comorbidity Index)(Charlson et al., 1987); 2) cognitive limitations that precluded providing self-reported data. The participants were personally contacted by the investigators to verify in- and exclusion criteria and to invite them to participate. A convenience sample of 90 BCSs in total was recruited.

Procedure

Before study participation, participants were given an information leaflet which described the purpose of the study. A questionnaire was used to collect personal characteristics, tumour- and treatment-related information. Afterwards, participants were asked to fill out questionnaires in standardized order concerning health-related experienced problems: the DT&PL, the SF-36, and the DASH.

The Dutch Distress Thermometer & Problem List (DT&PL)

First, the DT requires the participants to identify the level of distress they experienced in the past week. Participants indicate on a visual analogue 11-point scale ranging from 0 (no distress) to 10 (extreme distress) how they feel. A cut-off point of 5 and above yields the best sensitivity and specificity for identifying distress. (Tuinman et al., 2008, Hollingworth et al., 2013)

Second, the PL investigates whether the indicated level of distress is related to physical problems (25 items), social problems (3 items), emotional problems (10 items), practical problems (7 items) or spiritual issues and religion (2 items).(Roerink et al., 2013, Ploos van Amstel et al., 2013) Participants were instructed to indicate whether the items listed had been a problem in the past week by selecting from a fixed “yes/no” response. The Dutch version of the PL was used.(Tuinman et al., 2008) The Dutch PL contains 47 problems.(Tuinman et al., 2008) The problem areas in the PL were not designed to function as a scale; however, the five problem areas may represent a multidimensional scale of overall distress.(Tuinman et al., 2008) Finally, participants were asked to indicate whether they would like to be referred to a professional for additional support.

The DT has been validated in cancer patients for detecting psychosocial distress; the total PL has a good internal consistency and reliability ($\alpha = 0.90$). (Tuinman et al., 2008)

ShortForm-36 (SF-36)

SF-36 is a generic, coherent, and easily administered self-reported health-related quality-of-life (HRQoL) measure. It consists of a total of 36 items divided into eight domains: physical functioning, role limitations due to physical problems, role limitations due to emotional problems, social functioning, emotional well-being, energy/fatigue, bodily pain, and general

health perceptions. The Dutch version of the SF-36 has been validated and has good reproducibility in the Dutch population (Cronbach's $\alpha = 0.80 - 0.94$). (Aronson et al., 1998) Higher scores represent a better HRQoL. (Ware et al., 1994)

Disabilities of the arm, shoulder and hand (DASH) Outcome Measure

Numerous studies have shown acceptable levels of its internal consistency, test-retest reliability, and validity of the DASH in varied populations and translations, including BCSs. (Angst et al., 2011, Bot et al., 2004, Ware et al., 1994, Harrington et al., 2013, Campbell et al., 2012) The review of Harrington et al recommends the DASH as patient-reported upper extremity function measurement because the good construct validity and responsiveness. (Harrington et al., 2014) Additionally, the DASH has been used in previous studies as reference measurement to establish validity of wide range of assessment tools of physical functioning in BCS and seemed therefore appropriate to use in the present study as well. (Andersen et al., 2014, Bulley et al., 2014)

The DASH Outcome Measure is a standardized 30-item, self-report questionnaire designed to evaluate impairments and activity limitations of the upper limb, in addition to participation restrictions in both leisure, activities, and work. (Angst et al., 2011) The Dutch version scores 6 items on symptoms (3 about pain, 1 for tingling/numbness, 1 for weakness, 1 for stiffness) and 24 items on activities (21 about physical function, 3 about social/role function). (Angst et al., 2011, Palmen CM, 2004) At least 27 of the 30 items must be completed for a score to be calculated. A higher score indicates greater disability.

For this study sub scores of the 21 physical questions, the six symptoms, and three social questions are calculated to a percentage score, although determination of the sub scores symptoms and function is not originally described. (Angst et al., 2011, Beaton et al., 2001)

Statistical analysis

Data were analysed using SPSS version 22.0 (SPSS, Inc., Chicago, IL, USA). Descriptive statistics were used for demographic and treatment variables collected by questionnaires.

Mean and standard deviation scores were calculated for the DT and PL domain scores. Five domain summary scores were calculated by taking the total score of the items in each domain on the PL.

The participants were divided in two groups; subgroup “non-distressed” (scoring 0-4) and subgroup “distressed” (scoring 5-10) on the DT, using the cut-off score of 5 which renders the optimal sensitivity and specificity and predictive value.(Tuinman et al., 2008) First, an independent sample t-test was performed to measure differences between these two groups for the variables age, Body Mass Index (BMI), time since surgery, DT, PL, SF-36 and DASH. The Chi-square test was used to study differences between distressed and non-distressed BCSs in relation to treatment variables; type of surgery, surgery dominant side, chemotherapy, radiotherapy, and pain medication.

Second, concurrent validity was explored. Spearman’s correlations were used to evaluate the degree of associations between the DT&PL on the one hand and SF-36 and DASH on the other hand. The degree of correlations was explored 1) between the DT and the physical health subscales of the SF-36 and DASH; 2) between total PL score and the physical health subscales of the SF-36 and DASH 3) between physical and practical domains of the PL and physical health subscales of the SF-36 and DASH. All p-values were set at 0.05 to indicate statistical significance.

Third, receiver operating characteristics (ROC) analysis was performed to examine the ability of the DT&PL to identify distressed BCSs. As golden standard for decreased physical functioning a score of > 15 on the DASH was taken.(Angst et al., 2011) The area under the curve, sensitivity and specificity were calculated.

Results

A total of ninety participating BCSs were enrolled in the study. One participant omitted to fill out the SF-36 and two omitted to fill out the DASH without reason. The questionnaires that were completed were used in the statistical analysis.

Descriptive statistics

Demographic and clinical characteristics are depicted in Table 1 in total and for the classification in distressed and non-distressed groups.

The 90 participants rated their distress level on the DT and showed a mean score of 4.1 ± 2.4 with a 0 – 8 range. Within the total group, 42 participants (47%) rated their distress score ≥ 5 .

The groups distressed participants and non-distressed participants did not differ with respect to BMI, treatment characteristics, and time elapsed since primary surgery. Distressed and non-distressed differed for age ($p = 0.003$); the mean age for the distressed participants was six years younger.

→ insert Table 1

Prevalence of distress and problems in breast cancer survivors.

Ninety participants completed the DT&PL, eighty-nine participants completed the SF-36 and eighty-eight completed the DASH.

On the PL, the physical problems domain was the most frequently reported with 92.2 % of the participants reporting at least one item. Emotional problems were reported by 74.4%, practical problems by 48.8 %, problems regarding spiritual issues or religion by 22.2% and social problems by 18.8% of the participants.

Means and standard deviations for the DT, PL domains sub scores, SF-36 subscales, DASH, and DASH sub scores are shown in Table 2.

The non-distressed and distressed groups differed for the practical, emotional and physical domains on the PL, all subscales of SF-36 and DASH, with worse scores for those with distress. Group differences for the PL were most distinct for the physical and emotional domains. Lowest scores for the SF-36, meaning lowest QoL, were scored by the distressed group for “role limitations physical problems”.

→ Insert table 2

Concurrent validity

SF-36: Mainly negative correlations between the *DT* and SF-36 were found because a lower score on the *DT* indicates a better QoL. Data are summarized in Table 3. *Distress (DT)* was strongly correlated to the SF-36 “role limitations due to physical problems” and “social functioning” subscales; and moderately correlated to “bodily pain”, “general health”, “vitality”, “role limitations due to emotional problems” and “mental health”. A weak but significant correlation was revealed with “physical functioning”.

Correlations coefficients for the total score of the *PL* and practical and physical domains of the *PL* were overall moderate; only the total score of the *PL* and physical domain of the *PL* correlated strongly with SF-36 “role limitations due to physical problems”.

DASH: The correlation of the *distress (DT)* to the *DASH* was moderate. The total of the *PL* correlated strongly to the physical items of the *DASH*. The *PL*’s practical and physical domains demonstrated moderate to strong correlations with the *DASH*.

→ Insert Table 3

ROC-analysis

An area under the curve of 0.657 (Standard error: 0.062; 95% Confidence Interval 0.535-0.779; $p=0.018$) was found for the ROC curve predicting increased distress according to the *DASH* (figure 1). A cut-off score of 4.5 on the *DT* corresponds with a sensitivity of 53% and specificity of 68%. Decreasing the cut-off scores would decrease specificity while increasing the cut-off scores would lower sensitivity.

→ Insert Table 4 and Figure 1

Discussion

This is the first study exploring the validity of the DT&PL for the screening of physical problems in BCSs. In this cross-sectional study, BCSs completed the DT&PL, the SF-36, and the DASH. Nearly half of the participating BCSs (47%) reported a high level of distress on the DT (DT-score ≥ 5). Distressed participants dominantly endorsed problems in the physical and emotional domain of the PL. The DT and PL correlated significantly with all domains of SF-36 and DASH, with correlations varying from weak to strong. Highest correlations were found between the DT and PL on the one hand and ‘role limitations due to physical problems’ and ‘social functioning’ on the other hand and between the PL and total score and physical function sub score of the DASH. These correlations support good concurrent validity of the DT&PL for the screening of physical problems. However, one weak correlation between the DT and ‘physical functioning’ subscale of the SF-36 was found as well. The ROC analysis revealed only moderate sensitivity and specificity of the DT&PL as predictor for increased distress when compared to the DASH.

Prevalence of distress and problems in BCSs.

The relationship between reported distress and demographic, treatment and participant variables was explored. The mean age of the distressed subgroup was 6 years younger in comparison to the non-distressed subgroup. This result corresponded with the results of previous studies who also claimed that younger breast cancer patients experience a greater functional decline and they are more affected by fatigue and pain.(Kroenke et al., 2004, Bruce et al., 2014, Fleishman, 2004, Schreiber et al., 2013) This finding is also supported by the study of Head et al in which the *DT* score was higher compared to the present study ($DT = 4.1 \pm 2.4$ versus 4.87 ± 3.2) and the mean age of participants in their study was lower (59.8 vs. 52.7 years), indicating more distress in younger patients.(Head et al., 2012) Additionally, in

comparison to the study of Ploos van Amstel et al, the present study yielded higher levels of distress.(Ploos van Amstel et al., 2013) This may be due to the higher percentage BCSs in the present study who were treated with chemotherapy (69% vs. 41%) or radiotherapy (64% vs. 21%).(Ploos van Amstel et al., 2013) Although, no significant differences in cancer treatments between the subgroup non-distressed and subgroup distressed were found. In line with previous findings, the results of the present study also demonstrated that physical problems were more frequently reported as sources of distress than emotional problems.(Lester et al., 2015, Roerink et al., 2013, Hollingworth et al., 2013, Tuinman et al., 2008) Additionally, although the DT&PL is promoted as psychosocial screening tool, the scores for the social domain did not differ significantly for the non-distressed and distressed participants.(Roerink et al., 2013, Tuinman et al., 2008, Donovan et al., 2014)

SF-36 scores for our study sample were better in comparison to the results of Andersen et al (Andersen et al., 2009) and Matthews et al (Matthews et al., 2002), even though the BCS sample in the study of Andersen et al was comparable. The study sample in the Matthews et al was older which may lead to less QoL because of ageing and age-related comorbidity.(Matthews et al., 2002) In comparison to Bulley et al, the distressed participants of the current study sample reported more upper limb problems.(Bulley et al., 2014) Median score on the *DASH* in the study of Bulley et al was 18.1 compared to a median score of 35.0 in the present study. Bulley et al claimed participants < 12 months post treatment had a higher impact score on the Morbidity Screening Tool, which was congruent to the shorter period since surgery for the distressed participants of the present study.(Bulley et al., 2014)

Concurrent validity

The major aim of the present study was to evaluate the concurrent validity of the DT&PL in BCSs for the screening of physical problems. Especially the strong correlation between the total DT, the practical and physical domain of the PL on the one hand and the subscale “role limitations physical problem” of the SF-36 on the other hand indicate good concurrent validity of the DT&PL for physical distress. The observed association between the DT&PL and the SF-36 domain “role limitations physical problems” can be explained by the resemblance in questions of the DT&PL since for items such as housekeeping, transportation or work, good physical functioning is required.(Ploos van Amstel et al., 2013) The moderate correlation between the emotional domain of the PL and the SF-36 subscale “role limitations physical problem” may indicate an impact of limitations in physical functioning on emotional wellbeing in BCSs. This is also in line with previous findings in BCSs.(Lester et al., 2015) Other correlations between the *DT* and bodily pain and physical functioning were rather moderate to weak correlations but still significant. In addition to these new results, the findings of the present study also confirm previous results on the correlation between the DT&PL and general QoL and psychosocial functioning in BCSs.(Head et al., 2012, Iskandarsyah et al., 2013, Hayes et al., 2010)

Higher distress scores, assessed using the DT&PL, were associated with higher DASH-percentage score, indicating again good concurrent validity of the DT&PL for distress caused by physical problems. Previous studies already found a moderate correlation between psychological distress and DASH scores for patients with chronic shoulder pain.(Roh et al., 2012) In BCSs, pain and limitations in upper extremity function have been found to interfere with the ability to complete activities of daily functioning, resulting in physical distress as well.(Hayes et al., 2010, Campbell et al., 2012)

The physical domain of the PL had the strongest correlation with all DASH subscales, which can be explained again by the similarity in items across the two measures. Activity functions

and symptom subscales are separated in the DASH, while they are assessed as one within the physical domain of the PL; possibly explaining the observed association.

The study findings suggest good concurrent validity of the DT&PL for the screening of physical problems in BCSs. The practical and physical domains of the PL seem most appropriate for measuring limitations in physical functioning of the upper extremity in BCSs.

ROC-curve analysis

The ROC-analysis only revealed moderate psychometric properties of the DT when compared to the DASH. The study of Tuinman et al revealed better psychometric properties of the DT when compared to the HADS (Hospital Anxiety and Depression Scale).(Tuinman et al., 2008) They found an area under the curve of 0.80, sensitivity of 85% and specificity of 67% compared to only 0.66, 53% and 68%, respectively in the present study. (Tuinman et al., 2008) First, this may be explained by the fact that for the ROC-analysis, the cut-off score >15 on the DASH was taken as golden standard since no cut-off scores for physical subscales of the SF-36 are available in literature. However, the DASH focused on physical functioning of the upper limb and thus includes not all domains of physical functioning. Second, the DT is one score given by a patient to give an idea of his/her distress level in general. Consequently, this score incorporates both psychological and physical distress levels. As found in the analysis for concurrent validity, especially the physical and practical domains of the PL showed strong correlations with the DASH and are therefore maybe a better reflection of physical distress than the DT.

Study limitations.

There were some limitations to this study. First, concurrent validity of the DT&PL was plotted against the SF-36 and DASH, which utilization is promoted in BCSs. However, to our knowledge the psychometric properties for the DASH have not been estimated for this population.(Angst et al., 2011) Second, the study defined BCSs as women with a history of breast cancer who are beyond the acute diagnosis and treatment phase, this comprised BCSs varying from several months to more than 20 years, causing a bias for age as distress reduces over time.

Third, it is important to consider that the questions of the DT&PL aimed to ensure that reported morbidity related purely to breast cancer treatment, and not to other morbidities. The results of self-administered questionnaires were not discussed and adjusted afterwards. Some participants indicated the difficulty to know whether their morbidity related to their breast cancer treatment or to other morbidities. This implicates that some items of the PL were probably endorsed because of other conditions.(Bulley et al., 2014) Therefore, the authors recommend for the examiner in clinical practice to go through the questions of the PL.

The dichotomous yes/no option of the PL could be a source of bias. It is feasible that BCSs in doubt, were prone to endorse a no; the SF-36 and DASH assessed the extent into which a problem was experienced. Additionally, the much higher number of items in the physical domain of the PL may have influence the degree of correlation. At last, no details on the non-participants is available. Consequently, selection bias is possible.

Future research and clinical implications

Future research should encompass investigation of larger homogenous samples, specific time periods, and validated comparable instruments, to increase the evidence for the validity of the DT&PL in BCSs. Next, future research could focus on longitudinal changes in physical and mental or psychosocial distress during a period of physical rehabilitation. The outcomes of

therapeutic interventions could be evaluated by a standardized screening tool like the DT&PL. This way healthcare providers can further develop survivorship care and accompanying guidelines for symptom prevention and rehabilitation.(Lester et al., 2015, Hayes et al., 2012, Campbell et al., 2012)

Conclusion

Distressed BCSs in this study experience mental and physical distress related to the former diagnoses, the treatments for breast cancer and the disabilities. Besides limitations in physical functioning these BCSs endure problems of the upper extremity.

The present study findings support the concurrent validity of DT&PL for the screening of physical problems. Moderate to strong associations were found between the DT&PL scores and the subscale scores of the SF-36 and DASH. The PL total and especially the physical domain can serve as a quantifier for physical distress.

This study supports the use of the DT&PL as a multidimensional instrument capable of measuring limitations in physical functioning besides mental and psychosocial distress in BCSs and should be used as a standard triage tool to identify BCSs with distress and need for health care intervention(s).

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Table 1. Demographic and treatment characteristics of study participants and differences between the two groups.

Variable		Total	Non-Distressed	Distressed	p-value
N (%)		90 (100)	48 (53)	42 (47)	
Age in years † (mean ± SD, range)		59.8 ± 9.9 (37.5–80.5)	62.6 ± 8.6 (42.2–80.5)	56.5 ± 10.4 (37.5–78.7)	0.003
BMI † (mean ± SD, range)		28.0 ± 5.2 (19.5-45.4)	28.1 ± 5.4 (20.2-45.4)	27.9 ± 5.1 (19.5-42.5)	0.287
Surgery 100% ‡	Lumpectomy N (%)	34 (38)	16 (33)	18 (43)	0.638
	Lumpectomy & AD N (%)	6 (7)	4 (8)	2 (5)	0.843
	Simple mastectomy N (%)	14 (16)	10 (21)	4 (10)	0.140
	Mod. rad. mastectomy N (%)	29 (32)	12 (25)	17 (40)	0.117
	2-sided MRM N (%)	7 (8)	6 (13)	1 (2)	0.074
Surgery dominant side N ‡ (%)		48 (53)	26 (54)	22 (52)	0.576

Time since surgery in years † (mean ± SD, range)	4.5 ± 4.4 (0.2–24.6)	5.3 ± 4.9 (0.4–24.6)	3.6 ± 3.6 (0.2–14.7)	0.064
Radiation therapy † N (%)	58 (64)	31 (65)	27 (64)	0.977
Chemotherapy † N (%)	60 (67)	31 (65)	29 (69)	0.654
Pain medication (yes) N (%)	21 (23)	6 (13)	15 (36)	0.180

N: number; BMI: body mass index; SD: standard deviation; AD: axillary dissection; MRM: modified radical mastectomy; †: independent t-test; ‡: Pearson Chi-square.

Table 2. Differences in distress, problems, QoL and limitations in physical functioning for non-distressed and distressed participants.

Outcome		Total (n=90)	Non-Distress (n=48)	Distress (n=42)	p-value
DT score (mean ± SD, range)		4.1 ± 2.4 (0-8)	2.1 ± 1.3 (0-4)	6.3 ± 1.2 (5-8)	0.000
PL total score (mean ± SD, range)		10.5 ± 7.6 (0-30)	6.3 ± 5.8 (0-28)	15.2 ± 6.7 (5-30)	0.000
Domains PL (mean ± SD)	Practical problems	0.9 ± 1.1	0.5 ± 1.1	1.2 ± 1.1	0.003
	Social problems	0.3 ± 0.6	0.2 ± 0.6	0.4 ± 0.7	0.197
	Emotional problems	2.8 ± 2.6	1.5 ± 2.0	4.3 ± 2.4	0.000
	Spiritual problems	0.3 ± 0.6	0.2 ± 0.5	0.4 ± 0.6	0.168
	Physical problems	6.3 ± 4.8	3.9 ± 3.7	9.0 ± 4.5	0.000
SF-36 subscales ² (mean ± SD)	Physical functioning	68.1 ± 23.9	74.6 ± 19.1	60.8 ± 26.8	0.007
	Social functioning	77.7 ± 23.5	89.5 ± 15.5	64.5 ± 23.9	0.000
	Role limit. physical problem	57.0 ± 42.5	81.9 ± 28.4	29.2 ± 38.2	0.000
	Role limit. emotion. problem	70.8 ± 41.7	86.5 ± 30.8	53.2 ± 45.4	0.000
	Mental health	73.4 ± 16.1	80.9 ± 10.7	65.0 ± 16.9	0.000
	Vitality	58.6 ± 20.2	68.7 ± 14.3	47.3 ± 19.9	0.000
	Bodily pain	68.2 ± 21.5	76.3 ± 17.7	59.3 ± 22.0	0.000
	General health perception	58.9 ± 20.2	65.1 ± 16.8	52.0 ± 21.6	0.002
DASH ³ % (mean±SD)	Total	25.6 ± 17.5	18.3 ± 11.8	33.9 ± 19.3	0.000
	Physical function	25.7 ± 17.8	18.5 ± 12.5	33.9 ± 19.5	0.000
	Symptoms	26.1 ± 19.5	19.6 ± 14.8	33.5 ± 21.6	0.001
	Social function	23.9 ± 23.2	14.4 ± 16.5	34.8 ± 25.1	0.000

SD: standard deviation; DT: Distress thermometer; PL: Problem list; SF-36: ShortForm-36 Health Survey; Role limit. physical problem: Role limitations physical problems; Role limit. emotion. problem: Role limitations emotional problems; DASH: "Disabilities of the Arm, Shoulder and Hand"-Outcome Measure Dutch Language Version.

¹ N=90, with 42 distressed; ² N=89, with 42 distressed; ³ N=88, with 41 distressed.

Table 3. Spearman and Pearson Chi-square correlations coefficients DT&PL ¹ for SF-36 subscales ² and DASH ³.

		SF-36								DASH			
		PF	RP	BP	GH	SF	RE	MH	VT	Total	PhysFunc	Symptom	SocFunc
DT	Score	-0.224*	-0.638**	-0.442**	-0.332**	-0.644**	-0.452**	-0.466**	-0.563**	0.441**	0.427**	0.380**	0.452**
PL	Total score	-0.387**	-0.676**	-0.463**	-0.413**	-0.670**	-0.480**	-0.523**	-0.523**	0.619**	0.613**	0.506**	0.538**
Domains	Practical	-0.326**	-0.525**	-0.442**	-0.339**	-0.505**	-0.368**	-0.123	-0.123	0.522**	0.516**	0.430**	0.459**
	Social	0.019	-0.175	-0.135	-0.081	-0.235*	-0.179	-0.330**	-0.330**	0.182	0.170	0.162	0.127
	Emotional	-0.154	-0.488**	-0.227*	-0.245*	-0.595**	-0.521**	-0.485**	-0.485**	0.364**	0.384**	0.226*	0.274**
	Spiritual	-0.205	-0.284**	-0.097	-0.381**	-0.182	-0.222*	-0.375**	-0.375**	0.244*	0.247*	0.137	0.240*
	Physical	-0.455**	-0.667**	-0.497**	-0.432**	-0.626**	-0.396**	-0.484**	-0.606**	0.645**	0.630**	0.562**	0.574**

* p-value <0.05 (2-tailed); ** p-value <0.01 (2-tailed)

DT: Distress thermometer; PL: Problem list; SF-36: ShortForm-36 Health Survey; PF: Physical functioning; RP: Role limitations physical problem; BP: Bodily pain; GH: General health perception; SF: Social functioning; RE: Role limitations emotional problem; MH: Mental health; VT: Vitality; DASH: "Disabilities of the Arm, Shoulder and Hand"-Outcome Measure Dutch Language Version; T: total; PhysFunc: Physical function; SocFunc: Social function.

¹ N=42; ² N=89; ³ N=88.

Table 4: Sensitivity and Specificity of the Distress Thermometer Scores

DT score ^a	Sensitivity	Specificity
-1.00	1.00	0.000
0.50	0.97	0.21
1.50	0.88	0.29
2.50	0.77	0.39
3.50	0.60	0.61
4.50	0.53	0.68
5.50	0.37	0.82
6.50	0.30	0.89
7.50	0.12	0.96
9.00	0.00	1.000

DT=Distress Thermometer; ^aThe smallest cutoff value is the minimum observed test value minus 1, and the largest cutoff value is the maximum observed test value plus 1. All the other cutoff values are the averages of two consecutive ordered observed test values.

Figure 1: Receiver operating characteristics (ROC) curve of Distress Thermometer Scores versus DASH cut-off scores



