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Patterns of approach to activity in 851 patients with severe chronic pain: translation and preliminary validation of the 9-item Avoidance-Endurance Fast-Screen (AEFS) into Danish

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Abstract

Objectives: The Avoidance-Endurance Fast-Screen (AEFS) is a 9-item self-report questionnaire that classifies patients with back pain into four activity-related subgroups, based on the avoidance-endurance model (AEM) of pain. The objective of this study was to translate the AEFS into Danish and investigate its discriminative abilities in a large, diverse patient sample.

Methods: 851 specialist care-seeking patients suffering from severe chronic pain conditions participated in this cross-sectional study. Patients were categorized as showing a “distress-endurance” (DER), “eustress-endurance” (EER), “fear-avoidance” (FAR) or “adaptive” (AR) pattern. A principal components analysis (PCA) reduced a large number of psychological variables beforehand. Construct and outcome-based validity were explored using multivariate analyses of variance.

Results: 33.6% were categorized as DER, 29.4% as EER, 22% as FAR and 15% as adaptive. PCA revealed the factors activity-related pain behaviour, affective distress and dysfunctional pain thoughts. The AEFS-DK discriminated all four subgroups in terms of their pain behaviour with EER>DER>AR>FAR. FAR showed less moderate/vigorous activity than DER and EER and more sedentary time than EER. DER and FAR showed higher affective distress, dysfunctional pain thoughts and poorer outcomes than AR and EER.

Conclusion: The results indicate good construct validity of the AEFS-DK discriminating the four AEM-related subgroups with respect to approach to activity behaviour, psychological variables and reported physical activity. Concerning outcome-based validity, two subgroups DER/FAR and AR/EER could be distinguished with inconclusive results for the eustress-endurance subgroup. Future studies are warranted using longitudinal research designs investigating whether AEFS subgroups differ in terms of treatment effects and long-term prognosis.

Keywords: chronic pain, avoidance, endurance, activity, validity
1. Introduction

There is growing evidence that individuals’ responses to chronic pain while engaged in a valued activity widely vary from escape or avoidance to persistence in that activity, the latter often shown despite high levels of pain and labelled as excessive or dysfunctional persistence behavior [1-3]. Recent studies indicate that it is possible to identify contrasting patterns of approach to activity revealing dysfunctional outcomes in terms of pain intensity, disability, and quality of life [2, 4-7]. Better understanding the role of avoidance vs. persistence-related pain responses would allow modification of cognitive-behavioral interventions accordingly with the aim of an increased personalization of pain management.

While most research in activity patterns is exploratory in nature using statistical procedures such as cluster analyses to determine typical subgroups, other studies are theory-driven, e.g. by the fear-avoidance-model [8] or the avoidance-endurance model (AEM, [3, 9]) of pain. The AEM for example, distinguishes between three dysfunctional response styles showing either elevated fear and avoidance behavior or two modes of pain-related persistence behavior, shown despite severe pain, one associated with affective distress (distress-endurance responses), the other with positive mood despite pain (eustress-endurance responses). One adaptive pain response pattern was suggested representing the ability of pacing phases of physical activity and rest in a flexible, self-determining manner [3]. Using different self-reported measures, such as the Avoidance-Endurance Questionnaire (AEQ, [10]) or the Patterns of Activity Measure (POAM-P, [11]), respective subgroups have been identified using different methods such as median split, cluster-analytic approaches or predefined clinical cut-off scores [2, 4-7, 12]. For example, in a prospective trial, Hasenbring and colleagues used cut-off scores derived from a comprehensive AEM-based 37-item screening in a sample of 177 primary care outpatients with subacute low back pain (LBP) [6] reporting data on concurrent, discriminant, and predictive validity using self-report questionnaires. In another study, using an
accelerometer advice to measure physical activity, patients with endurance pain response pattern revealed higher levels of general activity and, more specifically, a higher number of dysfunctional spine positions during an 8-hours observation period than patients with an adaptive and a fear-avoidance pattern [13]. Elevated overt physical activity and self-reported persistence behavior have been shown despite higher levels of pain intensity, independent from mood, in both studies. Patients with an adaptive pattern revealed moderate levels of overt physical activity as well as of persistence behavior and was located between both endurance subgroups with highest and fear avoidance patients with lowest scores. More recently, a short-form of the AEM-based 37-items screening tool has been developed that has been shown to fulfil the trade-off between brevity and precision distinguishing between the four AEM-related patterns of approach to activity [13]. The availability of a short, reliable and valid measure of patterns of pain-related activity allows to reduce the burden of a patient both in clinical practice and in research that mostly has to include a number of questionnaires and domains. Short screening tools may further enable practitioners following international guidelines to provide more individualized and relevant assessments and interventions.

The Avoidance-Endurance Fast-Screen (AEFS) is a 9-item screening tool consisting of the 7-item AEQ-subscale “Pain Persistence” and two items of depressive mood, delivering clinical cut-off scores for the classification of the four AEM subgroups in patients with low back pain, showing good predictive power in terms of pain intensity and disability by receiver operating curve (ROC) analyses [13]. The AEFS has also been shown to discriminate between the four AEM subgroups in a sample of 438 athletes with low back pain compared to a control group of athletes without back pain [14]. While the fear-avoidance and both endurance groups displayed higher levels of pain intensity than the adaptive individuals, the distress-endurance group appeared as the most problematic in terms of dysfunctional pain persistence with highest levels of pain and self-reported disability despite highest reports of activity, assessed in terms of training behavior.
To date, the existence of subgroups based on the AEM has been studied in patients suffering from subacute low back pain [6, 14], chronic low back pain [7, 15, 16], and patients with low back pain six months after undergoing lumbar disc surgery [17]. As different psychological profiles in patients with LBP in primary versus secondary care settings have been reported [18], the question arises whether the AEFS assessed subgroup differences can be translated to patients with diverse chronic pain conditions in a specialist pain treatment setting. Moreover, research on the specific characteristics of the adaptive subgroup is rare. With the AEM it was suggested, that patients showing an adaptive pain response pattern may display high flexibility switching between health-promoting modes of confrontation with pain and short-term avoidance [3]. The concepts of activity engagement and pain willingness, which are strongly related to flexibility, might be appropriate to describe behavioral and mental attributes of these patients [19]. An increase of knowledge on positive specifications of an adaptive pain response pattern may foster targeted treatment approaches that are not only directed to reduce dysfunctional pain behavior but also to specify desirable features of an adaptive pain coping.

The present cross-sectional study explored the AEFS in a large sample of patients with severe chronic pain conditions referred to an interdisciplinary university hospital pain center. With respect to construct validity [20], we expected that patients with an adaptive pain response pattern reveal moderate levels of pain persistence behavior, activity engagement and physical activity in daily life. They are expected to report higher scores than patients with a fear-avoidance pattern and lower scores compared to both endurance groups. Concerning affective distress, the adaptive subgroup was hypothesized showing lower levels than both, fear-avoidance and distress-endurance patients and will not differ from eustress-endurance patients. With respect to outcome-based validity, the adaptive subgroup should show lower scores on pain intensity than all other subgroups. Concerning outcomes, that are known to be rather strongly associated with affective distress and dysfunctional pain thoughts,
such as disability and quality of life [21-23], we expected lower scores for both, the adaptive and the eustress-endurance group compared to the fear-avoidance and distress endurance subgroup [6, 7].

2. Materials and Methods

Study sample and procedure

Patients were all referred to and consulted at the interdisciplinary Pain Center (Smertecenter Syd) at the University Hospital Odense in Denmark in the period from January 2019 to December 2019. All patients had a diagnosis of chronic nonmalignant pain, defined as pain lasting at least 6 months. As part of the routine assessment procedure in public and private pain clinics in Denmark, prior to their initial consultation in the Pain Center, patients were invited to answer questions about their clinical characteristics and adaptations to pain via an electronic questionnaire (PainData, Clinical Pain Registry) sent via a personal link to the patients’ official digital inbox, e-Boks (used by public hospitals, municipalities and other institutions to send official documents to citizens of Denmark).

A total of 1,090 new patients were registered for treatment in the Pain Center within this one year period, 851 (78%, mean age = 49.8 years and an SD of 14.7 years [range = 18–88], 587 women) completed the AE-FS and provided written consent (electronic signature) that data collected in relation to their treatment episode could be used for research purposes, and were thus included in this exploratory study. The data collection in the clinical pain registry was approved by the Danish Data Protection Agency (number 18/35221), and the conduct of the study complied with the Declaration of Helsinki. Under Danish law, this cross-sectional questionnaire-based study did not need ethics approval (Act on Research Ethics Review of Health Research Projects, October 2013, Section 14.2).

Measures
Avoidance-Endurance Fast Screen: The Avoidance-Endurance Fast-Screen (Figure 1) is a 9-item screening tool consisting of 7 items relating to behavior responses when experiencing mild and severe pain during the past two weeks, and 2 items related to mood [13]. The 9-item AE-FS was derived from the 37-item screening questionnaire to determine the AEM subgroups, the latter consisting of 2 subscales form the Avoidance-Endurance Questionnaire (AEQ, [10] and the 21-item Beck Depression Inventory (BDI, [24]. To determine symptoms of mild depression, which were most predictive for future pain in subacute low back pain in previous studies, those items of the BDI has been chosen, which showed the highest item-total score correlation. First, the single correlation for each item was calculated and second, accuracy predicting “mild depression” using ROC analyses has been performed. Since research has shown two items are able to validly represent depression [25], a two item version creating the short AEFS was aspired. The two-item version, consisting of the items “loss of pleasure” and “indecisiveness”, using the cut-off ≥ 2, resulted in a sensitivity of 0.82 and a specificity of 0.92 with an AUC 0.87 (95% CI 0.80 - 0.94). The 7-item AEFS Pain persistence score was derived from the 12-item AEQ Behavioral Endurance Score, which consists of two subscales, the 5-item Humor/Distraction Scale and the 7-item Pain Persistence Scale. Correlational and ROC analyses were used to determine which scale best predicted the total score. Fisher’s z-test was used to prove the difference of significance. Using the cut-off score of “3”, which was established in a series of former studies, the Scale PPS showed higher AUC (0.87, 95% CI 0.80 - 0.93) than the subscale HDS (0.76, 95% CI 0.67 - 0.85).

The 7 items on pain persistence are evaluated on a 7-point Likert scale ranging from 0 (never) to 6 (always). For subgroup classification, the sum of the responses to the 7 items during severe pain is divided by the number of completed items, resulting in a score between 0 and 6 with higher scores indicating higher pain persistence. For each of the 2 mood items two statements are provided with scores of 0 and 1, respectively. Patients are instructed to pick the statement that best describe the way
patients have been feeling during the past two weeks, and the responses are added, getting a score between 0 and 2 with higher scores indicating more depressive mood. Based on the scores on the 7-items pain persistence scale (PPS) and the 2-items depressive mood scale (DMS) patients are classified into one of 4 subgroups (Fear Avoidance Responses: DMS=2, PPS<3; Distress-Endurance Responses: Mood=2, PPS≥3; Eustress-Endurance Responses: DMS<2, PPS≥3; Adaptive Responses: Mood<2, PPS<3).

**Danish translation of the AEFS.**

The German version of the AEFS was translated independently into Danish by two translators fluent in both Danish and German. The two translations were compared and combined into a single translation, which was then back translated into German. The back translation was then discussed, adjusted and approved together with one of the authors of the original AEFS, Monika Hasenbring. During translation, some minor linguistic differences emerged for questions 1, 4 and 6. These differences were discussed with Monika Hasenbring and the translators who believed the small differences of question 1 and 6 to be of no consequence. For question 4, ‘I say to myself: "Don’t make such a fuss!"’ (English version) the final translation was ‘Siger til mig selv: "Lad vær med at skabe dig!"’ (Danish version) as this was the closest to the meaning of question 4 in the original German AEFS (‘sage ich mir: "Stell` dich nicht so an!”’). The Danish translation was then evaluated by a broader group of clinicians (including physicians, physiotherapists, psychologists, social workers, nurses) and researchers with expertise within assessment and treatment of chronic pain. Finally, the translation of the items into Danish was piloted in focus group interviews of chronic pain patients focusing on comprehension and clarity of the questionnaire, which did not lead to any further adjustments. The English version of the AEFS and the final Danish version (AEFS-DK) are shown in Fig. 1.
Demographics

Demographic data on age, gender, height and weight were collected.

Pain, disability, and health-related quality of life

Pain: Patients were asked to indicate the date for pain onset as accurately as possibly, and any use of opioids. Intensity of clinical average pain during the previous 24 hours was assessed using the 0-to-10 numerical pain Rating Scale (NRS) from the Brief Pain Inventory [26] with 0 defined as “no pain” and 10 “as worst imaginable pain”. The NRS has shown good test-retest reliability in patients with chronic pain [27]. Furthermore, patients completed pain drawings indicating all areas with current pain, and the proportion of patients with widespread pain, defined by the American College of Rheumatology as pain localized in both the right and the left side of the body, both above and below the waist plus in the axial skeleton [28] were calculated.

Pain-related disability: Disability was assessed with the Pain Disability Index (PDI), which is a generic pain-related disability scale that assesses the degree to which pain interferes with daily activities (family/home responsibilities, recreational activities, social activities, occupational activities, sexual behavior, self-care activities and life-support activities) [29]. Each item is constructed using an 11-point NRSs in which 0 = ‘no disability’ and 10 = ‘worst disability’. In the present study data was only collected on the 5 voluntary activities items, which yielded a 0 to 50 pain-related disability score as previous psychometric analyses have indicated that the obligatory activation subscale (self-care activities and life-support activities) has low internal reliability in this population [30].

Quality of life: Health-related quality of life (QOL) was assessed using the 0 to 100 Visual Analog Scale (VAS) included in the EuroQol 5-D questionnaire with 100 indicating the best QOL [31].
use of the 0 to 100 VAS assessment of QOL has shown good correlations with the SF-36 scores, as well as with depression scores in patients with chronic conditions [32].

**Psychological variables**

**Fear of Movement:** Fear of movement was assessed using the 17-item Tampa Scale of Kinesiophobia (TSK) questionnaire [33]. Each of the 17 items is rated on a 4-point Likert scale with 1 = ‘strongly disagree’ and 4 = ‘strongly agree’ getting a score between 17 and 68 with a higher score indicating higher levels of fear of movement/kinesiophobia. Sum scores of the two commonly found subscales of Activity Avoidance (8 items, e.g. “Pain lets me know when to stop exercising so that I don’t injure myself”) and Somatic Focus (5 items, e.g. “My body is telling me I have something dangerously wrong”) were also established [34, 35]. TSK has shown good reliability and acceptable concurrent validity in patients with chronic pain [36].

**Pain catastrophization:** Thoughts of pain catastrophization were assessed using the Pain Catastrophizing Scale (PCS) [37]. The PCS instructs participants to indicate the degree to which they experience each of 13 thoughts or feelings when experiencing pain, on a 5-point Likert scale with 0 = not at all and 4 = all the time. The score is between 0 and 52 with a higher score indicating a higher level of pain catastrophizing. Sum scores of the three subscales of Rumination (4 items, e.g. “I keep thinking about how badly I want the pain to stop”), Magnification (3 items, e.g. “I wonder whether something serious may happen”), and Helplessness (6 items, e.g. “I feel I can’t go on”) were also established. The PCS score has demonstrated acceptable test-retest reliability and internal consistency in patients with chronic pain [38].

**Depression:** Depressive symptoms were assessed using the Patient Health Questionnaire-9 (PHQ-9) [39]. Nine items related to the core symptoms of depression are assessed on a 4-point Likert scale, ranging from 0 = ‘not at all’ to 3 = ‘nearly every day’ getting a score between 0 and 27 with a higher
score indicating higher depression severity. The PHQ9 scale has demonstrated good validity and reliability [40], and has been widely used to measure depressive symptoms in chronic pain populations [41].

*General Anxiety:* Anxiety symptoms were assessed with the Generalized Anxiety Disorder-7 (GAD-7) questionnaire [42]. Seven items are assessed on a 4-point Likert scale, ranging from 0 = ‘not at all’ to 3 = ‘nearly every day’ getting a score between 0 and 21 with a higher score indicating higher anxiety severity. The GAD7 scale has demonstrated good validity and reliability [43], and has been widely used to measure anxiety symptoms in chronic pain populations [41].

*Acceptance of chronic pain:* The 20-item Chronic Pain Acceptance Questionnaire [44] was used to assess acceptance of chronic pain. The CPAQ instructs participants to indicate the degree to which they experience each of 20 thoughts, feelings or behaviors when experiencing pain, on a 7-point Likert scale with 0 = never true and 6 = always true. The score is between 0 and 120 with a higher score indicating a higher level of pain acceptance. Sum scores of the two subscales of Activity Engagement (11 items, e.g. “There are many activities I do when I feel pain …”) and Pain Willingness (9 items, e.g. “I will have better control over my life if I can control my negative thoughts about pain …”) were also established [45]. The CAPQ has demonstrated acceptable validity, test-retest reliability and internal consistency in patients with chronic pain [46].

*Physical activity and sedentary time.*

Self-reported physical activity was assessed using the 2-item Nordic Physical Activity Questionnaire (NPAQ) [47, 48], which is found suitable for monitoring the WHO recommendation on physical activity in different populations. The two items ask for duration per week of 1) moderate-to-vigorous physical activity (MVPA) and 2) vigorous physical activity (VPA), combined during leisure time and transport with seven and six categorical response options, respectively. For MVPA the response
options were: “0 min (0)”, less than 30 min (1), ”30-60 min (2)”, “60-90 min (3)”, “90-150 min (4)”, “150-300 min (5)” and “more than 300 min (6)”. For VPA the response options were: “0 min (0)”, “less than 30 min (1)”, ”30-60 min (2)”, “60-90 min (3)”, “90-120 min (4)”, and “more than 120 min (5)”. Sedentary behavior was assessed using a previously validated single item question [49]: “How much time do you sit during a normal day, excluding sleep?” with seven categorical response options: “Virtually all day (0)”, “13–15 h (1)”, “10–12 h (2)”, “7–9 h (3)”, “4–6 h (4)”, “1–3 h (5)” and “Never (6)” with higher scores indicating less sedentary time. Finally, sick-leave (Yes/No) was assessed with a single question.

**Statistical Analyses**

Descriptive data for demographic and pain history variables are reported as proportions (%), e.g. distribution of group membership, opioid use, and sick-leave) or means and SDs. Age, BMI and pain history variables were compared by analysis of variance (ANOVA) and Chi² test were used for dichotomous data. Inspecting differences among the four AEFS-based subgroups for psychological, physical activity and outcome-related variables, we followed the criteria to evaluate the credibility of subgroup analyses [50]. One of the design-related criteria recommended that only a small number of expected effects should be tested. As our study included a large number of psychological measures, a principle components factor analysis (PCA) was used in order to reduce the number of variables [51]. Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was used to determine items that were appropriate for principal components analysis. Catell’s scree test, and parallel analysis were used to determine the number of factors that were appropriate to interpret [52]. As we expected low to moderate correlations between the factors, subsequent oblique rotations (Promax) were used.
Fourth, only items with factor loadings greater than 0.4 were used. The items should not show a substantial cross loading (i.e. a second loading greater than 0.35).

Separate MANOVAs were computed with AEM-pattern as between-subjects fixed factor and 1) psychological variables that resulted from the PCA, 2) measures of physical activity, and 3) pain-related outcomes [53]. Homeostasticity was tested using Levene’s test. Homogeneity of covariances was ascertained by the Box-M test. Pillai’s trace was calculated as the test statistic as it has shown robust against violations of normality and homogeneity of covariance matrices [54]. In case of significant main effects, conservative Bonferroni test correcting for multiple pairwise comparisons were used. P-values < 0.05 were considered statistically significant. Effect sizes of group effects were calculated as partial eta squared ($\eta^2$), with partial $\eta^2 \leq 0.06$ representing a small, partial $\eta^2 \leq 0.14$ representing a medium, and partial $\eta^2 > 0.14$ representing a large effect [55]; effect sizes for pairwise comparisons were calculated as Cohen’s d, with d=0.2 reflecting a small, d=0.5 a medium and d=0.8 a large effect [56]. In case of unequal sample sizes, Hedges g was used. All statistical analyses were run using SPSS Statistics (version 27; IBM Corp, Armonk, NY).

3. RESULTS

Sample characteristics

Characteristics of the whole sample are presented in Table 1. In total, 851 patients participated in this study (69% female) with a mean age of 49.8 (SD 14.7) years. Mean BMI was 28.2 (SD 6.2). Patients reported a mean pain duration of 10.6 (SD 10.0) years, an average pain intensity during the past 24 hours of 6.5 (SD 1.9). N = 313 (36.8%) displayed signs of widespread pain, 336 (39.4%) reported opioid use due to their pain and 247 patients (43.1%) reported being on sick-leave.
AEM-based pain response pattern

Frequencies of AEM patterns, demographics and pain history: Based on the AEFS, 286 patients (33.6%) were classified with a distress-endurance response pattern, 250 patients (29.4%) were classified with an eustress-endurance response pattern, 187 (22.0%) were classified with a fear-avoidance response pattern, and 128 patients (15%) were classified with an adaptive response pattern (Table 1). Table 1 also shows demographic characteristics and pain history variables for the whole sample and for all subgroups. The AEFS-DK mean scores during severe pain (Cronbach’s Alpha: 0.70; Supplementary Table 1) for all patients ranged from 2.5 (I say to myself: Don’t make such a fuss) to 3.9 (I clench my teeth). The greatest differences between groups, expressed in terms of effect sizes were items 6 (I say to myself: I don’t have time for this right now), and 4 (I say to myself: Don’t make such a fuss).

For BMI, the ANOVA revealed a small but significant group effect (F(3,822)=4.117, P=0.007, partial η²=0.015), with post-hoc test showing that patients classified with an adaptive response pattern had lower BMI compared with patients classified with distress-endurance and fear-avoidance response patterns (P<0.038). Age was significant in the ANOVA (F(3,850)=2.675, P = 0.046, partial η²=0.009), but the post-hoc test was not significant (P>0.085). No significant subgroup difference was observed for gender (X²)=6.187, P=0.103. The proportion of patients with chronic widespread pain was significantly different between groups ((X²)=9.89, P<0.019) with post-hoc comparisons demonstrating higher proportions of patients with widespread pain in patients classified with a distress-endurance pattern compared with patients with eustress-endurance or adaptive response patterns (P<0.017). No significant differences were observed between groups for pain duration (Table 1, F(3,812)=0.50, P=0.68, partial η²=0.002) or use of opioids ((X²)=0.119, P=0.989).
**Psychological variables:** The KMO test for sampling adequacy for 11 psychological variables (TSK Activity Avoidance and Somatic Focus, PCS Rumination, Magnification, Helplessness, the CPAQ Activity Engagement and Pain Willingness, PPS Pain Persistence Scale, PHQ, GAD7 and DMS) was .86 indicating appropriateness for PCA, which yielded 3 factors with eigenvalues exceeding one. Together, these factors accounted for 68.04% of the total variance (see Table 2). Factor 1 accounted for 46.61% of the variance, factor 2 for 10.87%, and factor 3 for 10.57%. Inspecting the items, factor 1 was labelled as Dysfunctional Cognitive Pain Thoughts comprising all subscales of the PCS, both TSK subscales and the CPAQ subscale Pain Willingness, the latter with a high negative loading. Factor 2 was labelled as “Affective Distress” comprising the PHQ9, the DMS and the GAD7. The third factor was labelled as Activity-related Pain Behavior, which comprises the Pain Persistence Scale and the CPAQ Activity Engagement subscale.

Due to significant correlations between gender and Pain Behavior ($r = -.12, p < .01$), age and the factor Affective Distress ($r = -.21, p < .01; r = .08, p < .05$), these demographic variables were entered as covariates in a MANcOVA calculating the main effect of the factor AEM-pattern with the three psychological factors as dependent variables. Since the results did not differ from the original MANOVA, results the the latter one are reported here. A significant multivariate effect of AEM-pattern was yielded ($F(9,2253)=133.15, p < 0.001$, partial $\eta^2=0.347$). Subsequent ANOVAs showed that the AEM-patterns differed significantly in all three psychological factors. Bonferroni post hoc tests demonstrated significant differences between all four subgroups for the factor Activity-related Pain Behavior with highest scores in both endurance groups, moderate levels in the adaptive group and lowest in the fear avoidance group (see Table 3). With respect to the factors Affective Distress and Dysfunctional Cognitive Pain Responses, patients with a distress-endurance pattern and a fear-avoidance pattern displayed higher distress and dysfunctional cognitions than both, the adaptive and the eustress-endurance subgroup. As the AEFS subscales Pain Persistence and DMS
were included in this MANOVA, we repeated the MANOVA without these both scales. The multivariate main effect AEM subgroups remained significant (F(9/2253) = 40.68, p < .001, partial η² =.151. The subsequent ANOVAs revealed highly significant F values for all three factors (all p < .001) with partial η²=0.273 for CPAQ subscale Activity Engagement as the single measure for pain behavior, η²=0.237 for factor Affective Distress and η²=0.130 for the factor Dysfunctional Pain Thoughts. Bonferroni corrected post hoc tests of subgroup differences indicated comparable results of statistical significance, the effect sizes are between gHedges = 0.321 und 1.724.

Physical activity: A MANOVA including physical activity per week in terms of moderate-to-vigorous and vigorous activity and sedentary time indicated a significant multivariate effect of AEM-pattern (F(9,2457)=2.823, p < .01, partial η²=0.010) with significant subsequent ANOVAs for moderate-to-vigorous activity and for sedentary behavior. Boferroni post hoc tests yielded significant higher scores for moderate-to-vigorous activity in patients with each of the endurance patterns compared to the fear-avoidance subgroup. The adaptive patients were between these extreme groups without significant differences. The fear-avoidance subgroup revealed significantly more sedentary time than the eustress-endurance group with no further differences between the other subgroups.

Pain-related outcomes: A MANOVA comprising the outcome variables NRS average pain intensity, PDI disability and VAS-EQ5D health-related quality of life yielded a significant multivariate main effect for AEM-pattern (F(9,2466)=17.61, p < .01, partial η²=0.06) with significant subsequent ANOVAs for all outcomes. Bonferroni post hoc tests yielded significant higher scores for average pain intensity in patients with a distress-endurance and fear-avoidance subgroup compared to the adaptive patients. The difference between eustress-endurance patients and the adaptive group failed significance, however yielding an effect size of gHedges = 0.28. Concerning disability and quality of
life, both subgroups, the fear-avoidance and the distress-endurance patients revealed higher scores compared to both, the adaptive and the eustress-endurance patients.

4. Discussion

This is the first study evaluating the Danish version of the 9-item AEFS in a large sample of specialist care-seeking patients suffering from severe chronic pain. The results support the use of the 9-item AEFS Screening tool in order to distinguish four activity-related subgroups based on the assumptions of the avoidance-endurance model (AEM) in this population. The idea, that patients with a chronic pain syndrome should not treated as a homogenous group, following a “patient uniformity myth”, even from a psychological perspective, was pursued in a pioneering review article published in 1990 [57]. Turk proposed to customizing cognitive-behavioral treatment approaches to patients’ patterns of cognitive, affective and behavioral responses to pain, such as “dysfunctional”, interpersonally distressed” and “adaptive coping” [58]. The present study sought to classify subgroups more directly towards their pain-related approach to physical activity, distinguishing patients with an adaptive pattern of pain-related activities from those with physical under- and overactivity.

Construct validity of the AEFS discriminating AEM subgroups

Inspecting construct validity with respect to cognitive-affective and behavioral pain responses, scores of 11 psychological questionnaires were factor analysed in order to reduce the number of dependent variables [50] beforehand. A principal components analysis with oblique rotation yielded the three factors “Activity-related pain behavior”, “Dysfunctional pain thoughts” and “Affective distress”, explaining 68% of the variance. A subsequent multivariate analysis of variance with four AEFS-derived subgroups showed a highly significant multivariate effect with a large partial effect size. The
univariate analyses revealed large partial effects sizes for activity-related pain behavior and affective distress and moderate to large partial effect size for dysfunctional pain thoughts. The factor activity-related pain behavior distinguished significantly and with high effect sizes between all four subgroups, supporting the hypothesis that the subgroup of patients with an adaptive response pattern display moderate values of approach to physical activity and differs from fear-avoidance patients with very low, and two endurance groups with rather high scores. Further support for our expectations came from results regarding affective distress and dysfunctional pain thoughts. In accordance with the AEM, two subgroups (distress-endurance and fear-avoidance) revealed high affective distress and dysfunctional pain thoughts, such as catastrophization and low scores on pain willingness as one aspects of pain acceptance whereas two subgroups (adaptive, eustress-endurance) showed the opposed picture, also showing large between-group effect sizes. As the factors affective distress and pain behavior comprised the classification subscales PPS and DMS of the AEFS, we had repeated the MANOVA without these variables. Pain behavior was now represented by the CPAQ subscale Activity Engagement, affective distress by GAD7 and PHQ9. The multivariate effect remained highly significant with large partial effect size, the CPAQ subscale Activity Engagement again showed a large partial effect size discriminating the four subgroups and large effect sizes between all four AEFS subgroups. The two-item factor affective distress still showed a large, but somewhat smaller multivariate effect size. Further support for construct validity came from the multivariate analysis of reported physical activity. Moderate to vigorous weekly activity was highest in both endurance subgroups and lowest in the fear-avoidance patients whereas sedentary behavior was higher in fear-avoidance patients than in the eustress-endurance subgroup, showing large between group effect sizes. However, overall effect sizes were rather low, as the adaptive subgroup showed scores between these extremes but without significant differences. Comparable subgroup differences, resulting from a more comprehensive AEM screening, have been shown for accelerometer assessed physical activity.
[3]. With respect to a measure of general physical activity (the PAL score), patients with an endurance-related pattern differed merely from the fear-avoidance group; adaptive patients were between these extremes with lacking significance. In contrast, measuring a combined score of constant postures that may cause specific strain on the spine (sitting or standing in an upright or forward bent position), patients with an adaptive pattern revealed a moderate position with significant higher scores than the fear-avoidance patients and lower scores compared to the endurance subgroups. Thus, further research is warranted using the short AEFS for subgroup classification and overt measures of dysfunctional postures. It can be hypothesized that pain persistence behavior is primarily dysfunctional when shown during physical activities that cause increased nociception from a specific strain to e.g. muscles, discs and the spine [59].

**Outcome-based validity of the AEFS**

In accordance with current international recommendations [53], average pain intensity, assessed with a numeric rating scale, pain-related disability and health-related quality of life were used as outcome measures. A MANOVA including these three variables as dependent measures yielded a highly significant group effect but with a small multivariate partial effect size and only a large partial effect size for quality of life. However, post hoc between group differences predominantly supported the hypotheses with higher pain, disability and lower quality of life scores in both, the distress-endurance and fear-avoidance subgroups compared to the adaptive group, which did not differ from the eustress-endurance patients. The hypothesis that also patients with an eustress-endurance patterns are dysfunctional, especially with respect to intensity of pain ratings, was only partially supported. Whereas the Bonferroni-corrected post hoc t-test between eustress-endurance and adaptive patients failed significance (p = .08), the effect size was the same as for the distress-endurance and adaptive group (gHedges=0.28). While existing studies are in line with the present results showing impaired
outcomes for the distress-endurance and fear-avoidance patients [6, 7, 14-16], results on the eustress-endurance subgroup is conflicting. One recent study using the AEFS in a sample of 438 athletes with low back pain revealed significant differences in pain intensity with large effect sizes between the adaptive patients and all three dysfunctional subgroups [14], supporting results of an earlier prospective study in primary care patients with back pain, yielding higher pain intensity scores at a six months follow-up not only for patients with a distress-endurance and fear-avoidance pattern but also for the eustress-endurance group [6]. Maintenance or recurrence of pain was suggested to be caused by physical overuse leading to dysfunctional neuromuscular control and putative small tissue injuries [59]. However, other studies, using the more comprehensive AEM screening, reported only significant pain differences for the distress-endurance and fear-avoidance patients. Hence, the assumption of dysfunctionality especially regarding the maintenance of pain warrants further research for the eustress-endurance group. On the other hand, with respect to disability and quality of life besides the above mentioned low scores on dysfunctional pain thoughts and affective distress, patients with eustress-endurance pain responses nearly perfectly reflect features of a pattern that was described as high pain resilience by some authors [60, 61]. Karoly and Ruehlmann defined pain resilience “as a response pattern consisting of high pain severity in the context of low interference and low emotional burden“[62]. Although most researchers agree that questions about mechanisms best characterize pain resilience, pain acceptance is suggested to play a prominent role [60]. McCracken and Eccleston described pain acceptance as a general willingness to experience pain with the aim to establish involvement in valued activities successfully reaching personal goals without showing avoidance or attempting to control sensations of pain [19]. Pain acceptance scores as part of factor activity-related pain behavior and, moreover, the level of reported moderate to vigorous physical activity in our study were highest for both patient subgroups, the adaptive and the eustress-endurance patients, the latter still surpassing the adaptive group showing highest values. Both subgroups did not
differ in any of the other psychological aspects raising the question whether both groups mirror a similar pattern of pain resilience. Based on the cross-sectional nature of the present study we are not able to answer the question as to whether both subgroups differ in their long-term recovery with a higher risk for a maintenance of pain in the eustress-endurance group, as shown before [6, 14, 63]. Here there is still a need for more research using longitudinal research designs.

A special emphasis of our hypotheses was on characteristics of patients with an adaptive pain response pattern. In their approach to physical activity while having pain they showed a moderate level with large differences to the fear-avoidance patients, who revealed lower activity-related pain behavior, as assessed as a factor consisting of AEFS pain persistence and CPAQ Activity engagement. On the other hand, the adaptive patients also showed large differences to both endurance subgroups, which displayed higher scores. These results were also true for CPAQ activity engagement alone. The adaptive patients further showed lowest pain outcomes in terms of pain intensity ratings, disability and highest for health-related quality of life, further lowest values for dysfunctional pain thoughts and general affective distress. These results support the assumptions of the AEM that the adaptive patients may be able to more flexibly balance out phases of physical activity and rest in a health-promoting manner [3, 9]. Comparable results are reported by a number of studies deploying different measures to assess approach to activity pattern [2, 4, 5], labelling these patients as “medium cycler” [4], “functional performers” [5], or “pacers” [2]. Notwithstanding, more research is warranted to better characterize typical features of this adaptive pain response pattern in order to improve targeted psychologically based treatments fostering adaptive pain behavior.

The main goal of subgrouping patients with a specific disease due to specified characteristics is to inform clinicians about the necessity to select different treatments in accordance with nonmodifiable risk factors (e.g. gender) or to tailor different treatments accustomed to
modifiable risk factors. In case of low back pain, activity related pain behavior, dysfunctional pain thoughts such as catastrophizing and dysfunctional physical activity are known modifiable risk factors of the development of chronic pain [64]. Subgrouping patients according to these risk factors should lead to a differential indication of treatment modalities. For example, patients with a fear-avoidance pain response pattern might benefit mostly from exposure-related forms of treatment [65], whereas patients with an endurance-related pain response pattern may show a better outcome in case of pacing therapies [66]. In contrast, patients with an adaptive response pattern might benefit from low-cost education without the need for more comprehensive approaches. Given the promising results on subgroup differences, as yielded with the short AEFS measure, research is needed to inspect randomized trials for the significance of interaction terms between activity-related subgroups and treatment modality [50].

**Strength and limitations**

The current study included 851 patients, which is somewhat higher than previous studies on avoidance and endurance responses making the estimates more stable and less sample-specific. This study also has a number of weaknesses that could influence interpretation of the results. First of all, the sampling rate was 78%, and therefore the estimates may potentially contain some selection bias. Secondly, no objective data or diagnostic interviews were collected and the use of questionnaires as standard for the psychological variables, physical activity behavior, and outcome variables represents a potential limitation of the study. Third, due to the rather large sample, there is a risk of statistical significance despite smaller effect sizes. Fourth, the generalizability of these findings to other interdisciplinary settings is unknown and may be influenced by the variation in clinical severity between different settings and cultural contexts. Fifth, we did not assess whether any of the included patients gave erroneous responses to any of the questions due to a lack of comprehension. Sixth, re-
test reliability of the AEFS has to be investigated in future studies as an add on to the reported data on internal consistency and finally, the cross-sectional design does not give any insights into the predictive validity of these subgroups which should be established in longitudinal studies in relevant pain populations.

**Conclusions**

The Avoidance-Endurance Fast-Screen (AEFS) tool distinguished four meaningful activity-related subgroups among specialist care-seeking patients suffering from severe chronic pain. In line with previous studies on the Avoidance Endurance Model of pain, 22% of patients were identified with a fear-avoidance response pattern, 63% with an endurance response pattern, and 15% with an adaptive response pattern which suggest that fear avoidance only represents one subset of response strategies in individuals’ responses to chronic pain while engaged in valued activities. Future studies are needed using longitudinal research designs investigating whether subgroups based on the AE-FS differ in terms of treatment effects and long-term prognosis.
References


Figure legends

Figure 1: The English (a) and Danish (b) versions of the Avoidance Endurance Fast Screen (AEFS).

Table 1: Demographic variables and pain history for the total sample (n = 851) and for each subgroup based on the AEFS screening. Data presented as means (± standard deviations), level of statistical significance (ANOVAS) and Bonferroni-Holm post-hoc tests for pairwise comparisons. For dichotomous variables, number, percent and results of Chi2 test are reported.

Table 2: Final factor solution with factor loadings for 11 psychological measures, mean and standard deviation (SD) for each questionnaire.

Table 3: Subgroup differences based on the AEFS for psychological variables, physical activity and outcomes, as analyzed by means (± standard deviations), one-way (post-hoc) analyses of variance (ANOVA) and Bonferroni-Holm post-hoc tests for pairwise comparisons.
**Figure 1:** The English (a) and Danish (b) versions of the Avoidance Endurance Fast Screen (AEFS).

**a**
A number of actions are set out below which we may observe in ourselves when we are in pain. How we behave if often dependent on the severity of this pain at any given moment. Please go through each of the following statements and check both scales to indicate if and how often you have acted in such a way in the past 14 days when you experienced mild and/or severe pain.

Please check one of the numbers on each scale:

<table>
<thead>
<tr>
<th>Statement</th>
<th>Never</th>
<th>Almost Never</th>
<th>Seldom</th>
<th>Sometimes</th>
<th>Mostly</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>I take care not to let myself go.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I try not to take any notice of it.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I clench my teeth.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I say to myself: &quot;Don’t make such a fuss!&quot;.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I keep my appointments even though I don’t feel up to it.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I tell myself: &quot;I don’t have time for this right now!&quot;</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I carry on doing what I am doing no matter what.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

**b**
Herunder er beskrevet en række handlinger og tanker som vi nogle gange kan observere i os selv når vi oplever smerte. Herved handlinger og tanker vi gør, kan afhænge af intensiteten af smerten.

Gennemgå hvert af følgende udsagn og angiv hvilken af de øverste to alternativer du har oplevet under henhæftet mild eller kraftige smerte i løbet af de sidste 2 uger.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Mild Smoker</th>
<th>Severe Smoker</th>
</tr>
</thead>
<tbody>
<tr>
<td>I make decisions</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>I enjoy things as usual</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>I make decisions about as well as ever</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>I am less sure of myself now and try to put off making decisions</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 1. Demographic variables and pain history for the total sample (n = 851) and for each subgroup based on the AEFS screening. Data presented as means (± standard deviations), level of statistical significance (ANOVAS) and Bonferroni-Holm post-hoc tests for pairwise comparisons. For dichotomous variables, number, percent and results of Chi2 test are reported.

<table>
<thead>
<tr>
<th></th>
<th>Total sample</th>
<th>DER</th>
<th>EER</th>
<th>FAR</th>
<th>AR</th>
<th>AEM pattern p-value</th>
<th>Pairwise comparisons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender (N/% female)</td>
<td>587 (69.0)</td>
<td>201 (70.3)</td>
<td>184 (73.6)</td>
<td>120 (64.2)</td>
<td>82 (64.1)</td>
<td>0.103</td>
<td>-</td>
</tr>
<tr>
<td>Age (years)</td>
<td>49.8 (14.7)</td>
<td>48.3 (13.8)</td>
<td>50.8 (16.6)</td>
<td>48.9 (13.4)</td>
<td>52.2 (14.6)</td>
<td>0.046</td>
<td>n.s.</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>28.2 (6.2)</td>
<td>28.4 (6.1)</td>
<td>28.1 (6.3)</td>
<td>29.1 (6.4)</td>
<td>26.6 (5.8)</td>
<td>0.007</td>
<td>DER/FAR&gt;AR (gHedges =0.31, 0.40)</td>
</tr>
<tr>
<td>Pain duration (years)</td>
<td>10.6 (10.0)</td>
<td>10.6 (9.9)</td>
<td>10.7 (8.9)</td>
<td>10.0 (10.3)</td>
<td>11.5 (11.9)</td>
<td>0.684</td>
<td></td>
</tr>
<tr>
<td>Pain areas (N/% with widespread pain)</td>
<td>313 (37)</td>
<td>123 (43.5)</td>
<td>83 (33.3)</td>
<td>70 (37.4)</td>
<td>37 (29.1)</td>
<td>0.019</td>
<td>DER&gt;EER/AR</td>
</tr>
<tr>
<td>Opioid users (N/%)</td>
<td>336 (39.4)</td>
<td>113 (39.5)</td>
<td>97 (38.8)</td>
<td>74 (39.6)</td>
<td>52 (40.6)</td>
<td>0.989</td>
<td>-</td>
</tr>
<tr>
<td>Sick-leave (N/, N=573)</td>
<td>247 (43.1)</td>
<td>90 (46.2)</td>
<td>54 (33.1)</td>
<td>72 (52.2)</td>
<td>31 (40.3)</td>
<td>0.007</td>
<td>DER/FAR&gt;EER</td>
</tr>
</tbody>
</table>

DER: Distress-endurance responses. EER: Eustress-endurance responses. FAR: Fear-avoidance responses. AR: Adaptive responses. p: Level of statistical significance. n.s.: not significant (p > .05). g: Effect sizes for pairwise comparisons of continuous variables were calculated as Hedges’s g for unequal sample size, with g = .2 reflecting a small, g = .5 a medium and g = .8 a large effect.
Table 2: Final factor solution with factor loadings for 11 psychological measures, mean and standard deviation (SD) for each questionnaire.

<table>
<thead>
<tr>
<th>Questionnaire</th>
<th>Factor I Dysfunctional Pain Thoughts</th>
<th>Factor II Affective Distress</th>
<th>Factor III Activity-related Pain Behavior</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSK Activity Avoidance</td>
<td>0.91</td>
<td>-0.25</td>
<td>-0.06</td>
<td>17.86 (4.02)</td>
</tr>
<tr>
<td>TSK Somatic Focus</td>
<td>0.88</td>
<td>-0.14</td>
<td>0.01</td>
<td>13.17 (2.85)</td>
</tr>
<tr>
<td>PCS Rumination</td>
<td>0.77</td>
<td>0.09</td>
<td>0.05</td>
<td>9.19 (3.99)</td>
</tr>
<tr>
<td>PCS Magnification</td>
<td>0.65</td>
<td>0.24</td>
<td>0.11</td>
<td>4.52 (2.98)</td>
</tr>
<tr>
<td>PCS Helplessness</td>
<td>0.65</td>
<td>0.26</td>
<td>0.00</td>
<td>12.25 (5.81)</td>
</tr>
<tr>
<td>CPAQ Pain Willingness</td>
<td>-0.66</td>
<td>-0.03</td>
<td>0.04</td>
<td>23.52 (9.46)</td>
</tr>
<tr>
<td>CPAQ Activity Engagement</td>
<td>-0.21</td>
<td>-0.33</td>
<td>0.52</td>
<td>30.74 (12.38)</td>
</tr>
<tr>
<td>PPS Pain Persistence</td>
<td>0.05</td>
<td>0.11</td>
<td>0.93</td>
<td>3.20 (1.13)</td>
</tr>
<tr>
<td>GAD7 Anxiety</td>
<td>0.07</td>
<td>0.84</td>
<td>0.16</td>
<td>5.96 (5.15)</td>
</tr>
<tr>
<td>DMS Depressive Mood</td>
<td>-0.13</td>
<td>0.79</td>
<td>-0.19</td>
<td>1.36 (0.77)</td>
</tr>
<tr>
<td>PHQ9 Depression</td>
<td>-0.09</td>
<td>0.96</td>
<td>0.12</td>
<td>10.29 (5.70)</td>
</tr>
<tr>
<td>Variance accounted for (%)</td>
<td>46.61%</td>
<td>10.87%</td>
<td>10.57%</td>
<td></td>
</tr>
</tbody>
</table>
Table 3: Subgroup differences based on the AEFS for psychological variables, physical activity and outcomes, as analyzed by means (± standard deviations), one-way (post-hoc) analyses of variance (ANOVA) and Bonferroni-Holm post-hoc tests for pairwise comparisons.

<table>
<thead>
<tr>
<th>Psychological variables*</th>
<th>Total sample</th>
<th>DER</th>
<th>EER</th>
<th>FAR</th>
<th>AR</th>
<th>Main effect AEFS pattern</th>
<th>Pairwise comparisons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity-related Pain Behavior</td>
<td>0.01</td>
<td>0.21</td>
<td>0.66</td>
<td>-0.89</td>
<td>-0.41</td>
<td>F(3,751)=298.83</td>
<td>EER&gt;DER&gt;AR&gt;FAR</td>
</tr>
<tr>
<td></td>
<td>(0.79)</td>
<td>(0.53)</td>
<td>(0.52)</td>
<td>(0.56)</td>
<td>(0.55)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Affective Distress</td>
<td>0.00</td>
<td>0.57</td>
<td>-0.64</td>
<td>0.52</td>
<td>-0.70</td>
<td>F(3,751)=276.52</td>
<td>DER/FAR&gt;AR/EER</td>
</tr>
<tr>
<td></td>
<td>(0.85)</td>
<td>(0.60)</td>
<td>(0.57)</td>
<td>(0.65)</td>
<td>(0.51)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dysfunctional Pain Thoughts</td>
<td>0.01</td>
<td>0.20</td>
<td>-0.22</td>
<td>0.19</td>
<td>-0.25</td>
<td>F(3,751)=34.58</td>
<td>DER/FAR&gt;AR/EER</td>
</tr>
<tr>
<td></td>
<td>(0.59)</td>
<td>(0.56)</td>
<td>(0.44)</td>
<td>(0.59)</td>
<td>(0.44)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical activity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sedentary time/day (0-6, higher scores are less sedentary time)</td>
<td>3.00</td>
<td>3.03</td>
<td>3.29</td>
<td>2.64</td>
<td>2.94</td>
<td>F(3,819)=5.92</td>
<td>EER&gt;FAR</td>
</tr>
<tr>
<td></td>
<td>(1.60)</td>
<td>(1.56)</td>
<td>(1.50)</td>
<td>(1.62)</td>
<td>(1.60)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate/vigorous activity/week (0-6, higher is better)</td>
<td>3.04</td>
<td>3.18</td>
<td>3.20</td>
<td>2.64</td>
<td>2.96</td>
<td>F(3,819)=4.12</td>
<td>DER/EER&gt;FAR</td>
</tr>
<tr>
<td></td>
<td>(1.85)</td>
<td>(1.82)</td>
<td>(1.78)</td>
<td>(1.94)</td>
<td>(1.82)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vigorous activity/week (0-5, higher is better)</td>
<td>1.42</td>
<td>1.43</td>
<td>1.57</td>
<td>1.30</td>
<td>1.27</td>
<td>F(3,819)=1.41</td>
<td>n.s.</td>
</tr>
<tr>
<td></td>
<td>(1.57)</td>
<td>(1.65)</td>
<td>(1.60)</td>
<td>(1.47)</td>
<td>(1.47)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outcome variables</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average pain intensity (NRS 0-10)</td>
<td>6.48</td>
<td>6.86</td>
<td>6.35</td>
<td>6.54</td>
<td>5.84</td>
<td>F(3,822)=9.06</td>
<td>DER/FAR&gt;AR,</td>
</tr>
<tr>
<td></td>
<td>(1.90)</td>
<td>(1.87)</td>
<td>(1.85)</td>
<td>(1.90)</td>
<td>(1.86)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disability (PDI 0-50)</td>
<td>35.28</td>
<td>37.31</td>
<td>32.29</td>
<td>37.22</td>
<td>33.75</td>
<td>F(3,822)=16.39</td>
<td>DER/FAR&gt;AR/EER</td>
</tr>
<tr>
<td></td>
<td>(9.59)</td>
<td>(9.05)</td>
<td>(9.59)</td>
<td>(8.40)</td>
<td>(10.63)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quality of life (EQSD 0-100)</td>
<td>47.25</td>
<td>40.32</td>
<td>58.82</td>
<td>37.73</td>
<td>54.82</td>
<td>F(3,822)=49.61</td>
<td>DER/FAR&gt;AR/EER</td>
</tr>
<tr>
<td></td>
<td>(23.08)</td>
<td>(20.74)</td>
<td>(21.49)</td>
<td>(21.30)</td>
<td>(22.08)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* The psychological variables are expressed as standardized z-scores (mean =0, SD=1), as questionnaire subscale scores with different rating scales represent the three factors.

DER: Distress-endurance responses. EER: Eustress-endurance responses. FAR: Fear-avoidance responses. AR: Adaptive responses. F: F statistic. p: Level of statistical significance. N.s.: Not significant (p > .05). \( \eta_p^2 \): Partial effect sizes of group effects, with \( \eta_p^2 \leq .06 \) representing a small, \( \eta_p^2 \leq .14 \) representing a medium, and \( \eta_p^2 \geq .14 \) representing a large effect. d: Effect sizes for pairwise comparisons were calculated as Hedges’s g for unequal sample size, with g = .2 reflecting a small, g = .5 a medium and g = .8 a large effect.
Supplementary Table 1: Summary statistics for each item on the AEFS-DK in the total sample \((n = 851)\) and for each subgroup. Data presented as mean and standard deviation. P-value based on one-way ANOVA and effect size reported as partial \(\eta^2\).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total ((n=851))</th>
<th>Eustress endurance response ((n=250, 29.4%))</th>
<th>Distress endurance response ((n=286, 33.6%))</th>
<th>Fear avoidance response ((n=187, 22.0%))</th>
<th>Adaptive response ((n=128, 15.0%))</th>
<th>P-value and subgroup comparison</th>
<th>Effect size (Partial (\eta^2))</th>
</tr>
</thead>
<tbody>
<tr>
<td>PPS</td>
<td>3.2±1.2</td>
<td>3.9±0.7</td>
<td>3.9±0.7</td>
<td>2.0±0.7</td>
<td>2.0±0.7</td>
<td>&lt;0.001 (EER/DER &gt; FAR/AR)</td>
<td>0.64</td>
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<tr>
<td>Severe Pain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.001 (DER &gt; EER/FAR/AR), (EER &gt; AR)</td>
<td>0.05</td>
</tr>
<tr>
<td>Item 1: I take care not to let myself go</td>
<td>3.8±1.9</td>
<td>3.8±1.9</td>
<td>4.3±1.5</td>
<td>3.4±2.0</td>
<td>3.1±2.1</td>
<td>&lt;0.001 (EER/DER &gt; FAR/AR), (EER &gt; AR)</td>
<td>0.29</td>
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<tr>
<td>Item 2: I try not to take any notice of it</td>
<td>3.2±1.9</td>
<td>4.1±1.3</td>
<td>3.9±1.7</td>
<td>1.8±1.7</td>
<td>2.2±1.7</td>
<td>&lt;0.001 (EER/DER &gt; FAR/AR)</td>
<td>0.21</td>
</tr>
<tr>
<td>Item 3: I clench my teeth</td>
<td>3.9±1.8</td>
<td>4.5±1.4</td>
<td>4.6±1.3</td>
<td>2.9±2.0</td>
<td>2.7±1.9</td>
<td>&lt;0.001 (EER/DER &gt; FAR/AR)</td>
<td>0.33</td>
</tr>
<tr>
<td>Item 4: I say to myself: Don’t make such a fuss</td>
<td>2.5±2.1</td>
<td>3.3±1.9</td>
<td>3.6±1.9</td>
<td>1.0±1.4</td>
<td>0.8±1.3</td>
<td>&lt;0.001 (EER/DER &gt; FAR/AR)</td>
<td>&lt;0.001 (EER/DER &gt; FAR/AR), (AR &gt; FAR)</td>
</tr>
<tr>
<td>Item 5: I keep my appointments even though I don’t feel up to it</td>
<td>3.4±1.9</td>
<td>4.3±1.5</td>
<td>3.9±1.7</td>
<td>2.0±1.8</td>
<td>2.6±1.9</td>
<td>&lt;0.001 (EER/DER &gt; FAR/AR), (DER &gt; FAR/AR), (AR &gt; FAR)</td>
<td>0.23</td>
</tr>
<tr>
<td>Item 6: I say to myself: I don’t have time for this right now</td>
<td>3.0±2.0</td>
<td>4.0±1.6</td>
<td>3.9±1.7</td>
<td>1.5±1.7</td>
<td>1.0±1.3</td>
<td>&lt;0.001 (EER/DER &gt; FAR/AR)</td>
<td>0.27</td>
</tr>
<tr>
<td>Item 7: I carry on doing what I am doing no matter what</td>
<td>2.7±1.8</td>
<td>3.7±1.5</td>
<td>3.1±1.6</td>
<td>1.3±1.4</td>
<td>1.9±1.7</td>
<td>&lt;0.001 (EER/DER &gt; FAR/AR), (DER &gt; FAR/AR), (AR &gt; FAR)</td>
<td>0.02</td>
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<tr>
<td>Mild Pain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.001 (DER &gt; EER/FAR/AR), (EER &gt; AR)</td>
<td>0.04</td>
</tr>
<tr>
<td>Item 1: I take care not to let myself go</td>
<td>3.0±2.0</td>
<td>2.9±2.1</td>
<td>3.3±1.8</td>
<td>3.1±1.8</td>
<td>2.5±1.9</td>
<td>0.001 (DER &gt; AR)</td>
<td>0.04</td>
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<tr>
<td>Item 2: I try not to take any notice of it</td>
<td>3.8±1.7</td>
<td>4.2±1.6</td>
<td>3.9±1.6</td>
<td>3.4±1.7</td>
<td>3.5±1.6</td>
<td>&lt;0.001 (EER/DER &gt; FAR), (EER &gt; AR)</td>
<td>0.04</td>
</tr>
<tr>
<td>Item 3: I clench my teeth</td>
<td>3.7±2.0</td>
<td>4.0±2.0</td>
<td>4.0±1.9</td>
<td>3.2±1.7</td>
<td>3.1±2.1</td>
<td>&lt;0.001 (EER/DER &gt; FAR/AR)</td>
<td>&lt;0.001 (EER/DER &gt; FAR/AR)</td>
</tr>
<tr>
<td>Item 4: I say to myself: Don’t make such a fuss</td>
<td>2.6±2.2</td>
<td>3.1±2.3</td>
<td>3.2±1.9</td>
<td>1.9±1.9</td>
<td>1.3±1.9</td>
<td>&lt;0.001 (EER/DER &gt; FAR/AR)</td>
<td>&lt;0.001 (EER/DER &gt; FAR/AR), (EER &gt; AR)</td>
</tr>
<tr>
<td>Item 5: I keep my appointments even though I don’t feel up to it</td>
<td>4.8±1.4</td>
<td>5.2±1.1</td>
<td>5.0±1.2</td>
<td>4.1±1.6</td>
<td>4.7±1.5</td>
<td>&lt;0.001 (EER/DER &gt; FAR/AR), (EER &gt; AR)</td>
<td>0.08</td>
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<tr>
<td>Item 6: I say to myself: I don’t have time for this right now</td>
<td>3.2±2.1</td>
<td>3.9±2.0</td>
<td>3.7±1.9</td>
<td>2.5±1.7</td>
<td>1.8±2.0</td>
<td>&lt;0.001 (EER/DER &gt; FAR/AR), (FAR &gt; AR)</td>
<td>0.02</td>
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<tr>
<td>Item 7: I carry on doing what I am doing no matter what</td>
<td>4.3±1.5</td>
<td>4.8±1.3</td>
<td>4.6±1.3</td>
<td>3.5±1.7</td>
<td>4.1±1.7</td>
<td>&lt;0.001 (EER/DER &gt; FAR/AR), (AR &gt; FAR)</td>
<td>0.11</td>
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<tr>
<td>Mood questions</td>
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<td></td>
<td></td>
<td></td>
<td>&lt;0.001 (EER/DER &gt; FAR/AR), (EER &gt; AR)</td>
<td>0.46</td>
</tr>
<tr>
<td>Item 1: Pleasure/enjoy question</td>
<td>0.7±0.4</td>
<td>0.4±0.5</td>
<td>1.0±0.0</td>
<td>1.0±0.0</td>
<td>0.4±0.5</td>
<td>&lt;0.001 (EER/AR &gt; FA/DER)</td>
<td>0.70</td>
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<tr>
<td>Item 2: Decision question</td>
<td>0.6±0.5</td>
<td>0.2±0.4</td>
<td>1.0±0.0</td>
<td>1.0±0.0</td>
<td>0.2±0.4</td>
<td>&lt;0.001 (EER/AR &gt; FA/DER)</td>
<td>0.47</td>
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</tbody>
</table>