Measuring the Ability to Tolerate Activity-Related Discomfort: Initial Validation of the Physical Activity Acceptance Questionnaire (PAAQ)

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Background: Physical activity (PA) is essential for health, but many adults find PA adherence challenging. Acceptance of discomfort related to PA may influence an individual's ability to begin and sustain a program of exercise. The aim of this study was to evaluate the psychometric properties of the Physical Activity Acceptance Questionnaire (PAAQ). ***Methods***: The PAAQ was administered to 3 distinct samples (N = 418). Each sample completed additional self-report measures; 1 sample also wore accelerometers for 7 days (at baseline and 6 months later). ***Results***: The PAAQ demonstrated high internal validity for its total score (α = .89) and 2 subscales (Cognitive Acceptance α = .86, Behavioral Commitment α = .85). The PAAQ also showed convergent validity with measures of mindfulness, self-reported physical activity levels, and accelerometer-verified levels of moderate-to-vigorous PA (MVPA; *P*-values < .05). The Cognitive Acceptance subscale showed predictive validity for objectively-verified PA levels among individuals attempting to increase PA over 6 months (*P* = .05). Test-retest reliability for a subset of participants (n = 46) demonstrated high consistency over 1 week (*P* < .0001). ***Conclusions***: The PAAQ demonstrates sound psychometric properties, and shows promise for improving the current understanding of PA facilitators and barriers among adults.

Keywords: Acceptance and Commitment Therapy (ACT), exercise, assessment, adherence

Regular and adequate levels of physical activity (PA) provide a myriad of health benefits for adults, including reduced risk of heart disease, stroke, and diabetes, as well as improved weight control and better overall health.[1] Yet adopting and maintaining PA appears difficult, as only 25% of adults in the U.S. engage in the recommended amount of PA.[2] Many environmental factors limit PA, including the increase in television and computer use; labor-saving devices in the office and home; an increase in sedentary jobs; land use patterns and transportation systems outside of urban areas that maximize reliance on automobiles; and the general ability to obtain food and shelter with minimal energy expenditure.[3–7] The literature on barriers to achieving adequate PA is limited, but suggests that low motivation, low self-efficacy, lack of social support, time constraints, and access are common problems.[8–13] Interventions based on addressing these conventional barriers have demonstrated limited effectiveness.[14,15] To promote greater PA, it may be necessary to make policy and environmental changes that increase lifestyle activity, while also developing a greater understanding of the individual differences that are related to PA behaviors.

Emerging research indicates that acceptance and commitment, which are key skills outlined in third-wave behavior therapies,[16] influence health-related behavior change. Third-wave behavioral theory places less emphasis on controlling internal experience than traditional behavioral theory, and greater emphasis on experiential acceptance. Experiential acceptance, a psychological process by which internal experiences are confronted (rather than avoided), has been associated with improvements in binge eating,[17] alcohol abuse,[18,19] smoking,[20] and a range of other maladaptive health behaviors.[21] Conversely,

experiential avoidance has been associated with greater difficulty maintaining important behavior changes (eg, those that maintain weight loss).[22] Behavioral commitment, which is the willingness to tolerate discomfort or forego pleasure in the service of higher order goals and values, also is known to influence health behavior.[23]

As individuals differ in their ability to accept discomfort and engage in difficult behaviors despite discomfort,[24] between-person differences in experiential acceptance and behavioral commitment may influence engagement in PA. PA results in physiological sensations that many find unpleasant, such as fatigue, sweating, and increased heart rate, as well as boredom or urges to slow down or stop moving. Furthermore, physical and emotional discomfort and other barriers related to PA may be magnified by the presence of physical disability[25] or chronic disease, including obesity,[26] cancer,[27] cardiac conditions,[28] and osteoarthritis.[29] Importantly, individuals vary in the extent to which they tolerate or "accept" unpleasant experiences versus feel driven to diminish them psychologically (eg, via suppression or distraction) or behaviorally (eg, by performing an action likely to produce change in the experience).[16] A series of studies has demonstrated links between activity intensity, perceived aversiveness, and choices made in regard to PA.[30,31] This evidence indicates that improving individuals' ability to tolerate discomfort associated with PA could alleviate 1 challenge to PA adherence.

Sustaining high levels of PA likely requires a high level of motivation that is internalized and connected to important values,[32,33] especially for those who find PA inherently unenjoyable. Consistent with this notion, the extent to which motivation is intrinsic predicts adherence to a PA regimen.[34,35] PA interventions that have targeted motivational processes also appear to show improved outcomes.[36–41] Deci and Ryan's self-determination theory[42] suggests that lasting behavior change is facilitated by internalizing values for change and accepting responsibility for autonomous regulation of behaviors. These ideas align with newer behavioral theories that emphasize the necessity of establishing clarity of life values to justify uncomfortable choices.[43,44]

Although scant research has explored the role of experiential acceptance and commitment in PA promotion, preliminary data and

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prevailing theory indicate that these processes may be important in understanding barriers to (and facilitators of) PA. Increased knowledge about the role of experiential acceptance in PA engagement may thus improve interventions that promote PA. For example, Tapper and colleagues[45] demonstrated that participants randomly assigned to an acceptance-based weight loss workshop demonstrated greater increases in PA compared with controls (ie, +2.2 vs. –.6 bouts/week). Another pilot study revealed that female college students who received a brief acceptance- and commitment-focused intervention for weight gain prevention achieved early increases in PA (relative to baseline levels).[46] Conversely, negative evaluations of the emotional experience of exercise have been associated with fewer PA minutes per week.[47–49] As further research is necessary to explicate these relationships, there is need for a PA-related experiential acceptance measure that could facilitate such research. Of note, greater acceptance of pain on the Chronic Pain Acceptance Questionnaire (CPAQ) has been associated with higher levels of moderate-intensity PA.[50,51]

Aims and Hypotheses of the Current Study

At present, there is no validated measure of PA-related experiential acceptance and commitment for use in research or clinical intervention. The current study focused on the development and validation of the Physical Activity Acceptance Questionnaire (PAAQ), a measure of experiential acceptance and behavioral commitment to PA. This study was designed to assess the factor structure of the PAAQ (using Exploratory Factor Analysis [EFA]), and to evaluate the measure's validity and test-retest reliability. Construct validity was examined using data from 3 independent samples, which were chosen to represent populations and topic areas for which this measure may be used in clinical research (ie, weight loss, health psychology, and general promotion of physical activity). Concurrent validity was assessed with objective PA measurement and additional self-report measures. A range of self-report measures were included to test both convergent and divergent validity. Individuals undergoing weight loss treatment also provided data on predictive validity and 1-week test-retest reliability.

Hypotheses were 3-fold:

1. the PAAQ would demonstrate adequate internal consistency and test-retest reliability

2. scores on the PAAQ would positively correlate with accelerometer-measured PA and self-reported mindfulness, as well as negatively correlate with reported depression and overall experiential avoidance (among other constructs associated with low PA engagement). PAAQ scores were expected to show no significant relationships with measures of marital satisfaction and sexual functioning

3. higher PAAQ scores would predict higher levels of PA following a PA intervention program. Such findings would support the PAAQ as a validated measure of PA-related experiential acceptance and commitment, and could be useful in theoretical and experimental research on PA and PA promotion.

Methods

Participants and Procedures

Participants included adults from 3 distinct samples. All 3 respective studies were approved by the Institutional Review Board at a large, urban university. Demographic information for each sample can be found in Table 1. Sample 1 comprised overweight and obese adults recruited for weight loss treatment (n = 282). Mean age was 50.04 years (SD = 10.05), and mean BMI was 37.52 kg/m² (SD = 6.04). A subset of this sample provided 1-week test-retest reliability (n = 46). For the purpose of examining construct validity of the PAAQ, another subset of participants in this sample (n = 174) was administered self-report measures (described below) and had physical activity measured with accelerometers. Participants in this sample completed the PAAQ and other self-report measures (described below); they also completed objective assessment of PA before beginning treatment and repeated objective PA assessment 6 months later (midtreatment).

Sample 2 enrolled adult women with a history of breast cancer (n = 83; mean age = 56.20 years, SD = 8.78). Participants had previously received breast cancer treatment at a local hospital and were contacted by telephone to determine their interest in a larger study of long-term breast cancer survivorship; those who expressed interest completed the self-report battery described below. All women were in remission or had stable disease at the time of the study and were otherwise healthy. Sample 3 included community-dwelling, healthy adults (n = 53) who were recruited to participate in an intervention designed to promote PA. All self-report measures were completed at the start of treatment. The sample's mean age at baseline was 26.81 years (SD = 4.73) and mean BMI was 25.05 kg/m² (SD = 3.43). Please refer to Table 1 for additional demographic information.

PAAQ Measure

The Physical Activity Acceptance Questionnaire is a 10-item self-report measure designed to assess the extent to which an individual is able to accept or tolerate physical or psychological discomfort that often is associated with moderate or vigorous exercise. The initial version of the PAAQ contained 8 items, which focused primarily on reactions to psychological discomfort (ie, negative thoughts or expectations about PA; eg, "I avoid exercising if it is going to make me feel physically uncomfortable, bored, or pressed for time"). The content for these initial 8 items was developed from 2 sources: 1) the clinical impressions of the authors, based on work with individuals who had varying degrees of success initiating and maintaining PA regimens, and 2) acceptance and commitment theory.[44] The structure of the PAAQ was modeled after other measures of acceptance, particularly the CPAQ, which measures acceptance of physical pain.[51] Evaluation of item content was sought from several clinical psychologists who had clinical and research expertise in health-related behavior change. They indicated that additional items should be developed to assess the construct of interest as comprehensively as possible. Seven additional items were developed; these items directly assessed acceptance or tolerance of uncomfortable physical sensations, such as, "When I start to feel out of breath or tired during exercise I find a way to keep going." Three of these items were deleted due to low item-total correlations (ie, $r < .35$) and were included in an EFA. Two additional items were removed due to cross-loading, described below. The final, 10-item scale was administered to the 3 samples described above (N = 418). Additional measures were administered to each sample to assess reliability and validity.

Convergent Validity Measures

Accelerometers (Sample 1 Only). ActiGraph GT3x triaxial, solid state accelerometers were used to measure physical activity in Sample 1. Accelerometers, and in particular models made by Actigraph,[52,53] have been found to be a valid and reliable means of

Table 1   Demographic Information

Weight loss treatment sample		Breast cancer remission sample		Physical activity promotion sample (healthy adults)	
Age, Mean (SD)	52.98 (11.56)	Age, Mean (SD)	56.20 (8.78)	Age, Mean (SD)	26.81 (4.73)
BMI, Mean (SD)	34.44 (4.93)	Race, N (%)		BMI, Mean (SD)	25.05 (3.43)
Gender, N (%)		White	67 (84%)	Gender, N (%)	
Male	28 (26%)	Black	5 (7%)	Male	21 (40%)
Female	80 (74%)	Hispanic/Latina	2 (3%)	Female	32 (60%)
Race, N (%)		American Indian/Alaskan Native	2 (3%)	Race, N (%)	
White	75 (70%)	Other	4 (5%)	White	32 (60%)
Black	29 (27%)	Marital status, N (%)		Black	7 (13%)
Hawaiian or Pacific Islander	1 (1%)	Single	11 (13%)	Asian	12 (23%)
Mixed	2 (2%)	Married	53 (65%)	Mixed	2 (4%)
Marital status, N (%)		In a relationship (not married)	2 (3%)	Marital status, N (%)	
Single	23 (21%)	Divorced	10 (12%)	Single	46 (87%)
Married	60 (55%)	Widowed	6 (7%)	Married	7 (13%)
Separated	3 (3%)	Education, N (%)			
Divorced	20 (19%)	Some undergraduate work (or less)	22 (27%)		
Widowed	2 (2%)	Undergraduate degree/some graduate work	27 (33%)		
		Graduate degree	33 (40%)		
Education, N (%)					
High school graduate/GED	6 (6%)				
Associate's degree/some college	15 (14%)				
Bachelor's degree	38 (35%)				
Graduate/professional degree	49 (45%)				

measuring PA.[54–56] Triaxial accelerometers measure movements in multiple planes and assess activity intensity, thus providing a more accurate and comprehensive measurement of PA and more accurate estimates of energy expenditure than do less sophisticated methods such as pedometers or self-report questionnaires.[54,57–61] Activity parameters used in the present analyses included number of moderate-to-vigorous PA (MVPA) bouts per week, average time per MVPA bout, MET rate (MET = Metabolic Equivalent of Task, or the energy used by the body at rest), and percent of time spent in MVPA.[62] All parameters were derived using the intensity cut-points suggested by Matthews.[63] Parameters were used to test both convergent validity (concurrent) and predictive validity (6 months later).

Reported Physical Activity.   The long form of the International Physical Activity Questionnaire (IPAQ)[64,65] consists of 27 items quantifying PA in the last 7 days across 5 domains: work; transportation; housework, house maintenance, and caring for family; recreation, sport, and leisure-time; and time spent sitting. Participants report the number of days on which the activity was performed (if any), followed by average minutes per day. Total physical activity is expressed in units of MET-minutes per week. Meta-analytic techniques demonstrate convergent validity across PA domains assessed by the IPAQ (eg, vigorous activity, moderate-intensity activity).[66]

Acceptance and Action Questionnaire-II.   The Acceptance and Action Questionnaire-II (AAQ-II)[67] is a 7-item self-report measure of the extent to which an individual demonstrates an accepting attitude toward negative feelings and experiences and the ability to take action even when feeling dysphoric or uncertain. Items are rated on a 7-point Likert scale (1 = *never true* to 7 = *always true*), with higher scores indicating greater levels of psychological flexibility. The AAQ-II has previously demonstrated high internal consistency (Cronbach's α = .84) and test-retest reliability, both at 3 months (.81) and 12 months (.79).

Barriers to Physical Activity.   The Barriers to Being Active scale[68] identifies types of physical activity barriers that undermine one's ability to incorporate regular physical activity into his or her life. Of the 7 categories, 3 categories were examined in the current study: lack of time, lack of energy, and lack of willpower. Nine items assess these barriers to physical activity using a 4-point Likert scale (0 = *very unlikely* to 3 = *very likely*). Higher scores in each category indicate significant barriers to engaging in physical activity. Internal consistency has been estimated at α = .87.

Depression.   The Iowa short form of the Center for Epidemiological Studies-Depression Scale (CES-D)[69] was used in Sample 2. This measure includes 20 items rating depressive symptoms on a 4-point scale (0 = *rarely or none of the time* to 3 = *most or all of the time*). Total scores range from 0 to 60, with higher scores indicating more severe depressive symptoms, and a score of 16 or greater indicating clinically significant depression. Sample 3 completed the Beck Depression Inventory-II (BDI-II),[70] a 21-item measure that assesses current mood. Participants are asked to endorse the

severity of their symptoms on a 4-point scale (0–3); higher scores indicate greater frequency of depressive symptoms. Both the CES-D and the BDI-II consistently have shown high internal consistency (α = .80–.90 across samples and α = .91, respectively) and strong relationships with other measures of depression (eg, the Hamilton Clinician Rating Scale).

Mindfulness. The Five Facet Mindfulness Questionnaire (FFMQ)[71] is 39-item measure of dispositional mindfulness. The FFMQ is scored on a 5-point Likert-type scale (1 = *never true* to 5 = *always true*). The 5 facets of mindfulness reflect 1's tendency/ability to: observe, describe, act with awareness, nonjudge, and nonreact. Reliability across subscales is reported as moderate to high (α = .69 for observe to .90 for describe). Initial validation also showed adequate convergent validity (with self-report measures of personality) and divergent validity (with measures of physical health).

Discomfort Intolerance. The Discomfort Intolerance Scale[72] assesses a person's self-reported ability to withstand physical discomfort. Participants rate the degree to which they identify with statements regarding pain tolerance on a 7-point Likert scale (1 = *not at all like me* to 7 = *extremely like me*), with higher scores indicating greater intolerance (ie, less tolerance). Published reports on the Discomfort Intolerance Scale have shown internal consistency alphas of .72 to .91 and 3-month test-retest reliability of .66.

Defusion. The Drexel Defusion Scale[73] assesses a person's ability to "defuse" (or psychologically separate) from a variety of feelings (eg, anger, cravings, and pain). Participants rate their ability to defuse on a 6-point Likert scale (0 = *not at all* to 5 = *very much*). Higher scores denote greater ability to defuse. The Drexel Defusion Scale has good internal consistency (α = .83), as well as adequate convergent and divergent validity across a range of self-report measures.

Divergent Validity Measures

Sexual Function. The Female Sexual Function Index (FSFI)[74] is a 19-item measure scored on 5- and 6-point Likert-like scales. The FSFI organizes sexual function data across 6 subscales: desire, arousal, lubrication, orgasm, satisfaction, and pain. Total scores range from 2–36, with higher scores reflecting better sexual function. A total score of 26.5 effectively differentiates between women with and without sexual dysfunction as defined by DSM-IV criteria. This measure shows good psychometric properties, including high internal consistency ($\alpha \geq$ .82) and test-retest reliability (.79 to .76 across subscales), and the ability to differentiate between women with and without female sexual arousal disorder.

Marital Satisfaction. Items drawn from the Perceived Social Support/Conflict scale[75] assessed survivors' perceived support from and interaction with their spouse or partner. The resulting marital satisfaction scale consists of 11 items scored on a 4-point Likert scale (1 = *not at all* to 4 = *a lot*). Previous estimates of internal consistency showed alphas of .76 to .84; convergent and divergent validity with self-report measures of psychosocial functioning was shown to be adequate.

Results

Factor Structure of the PAAQ

An Exploratory Factor Analysis (EFA) employed an oblique rotation to allow for correlated factors.[71] Examination of the resulting scree plot and eigenvalues showed that 2 factors met established criteria (ie, factors at or above the "elbow" of a scree plot, with eigenvalues greater than 1.0). These factors were associated with eigenvalues of 4.12 and 1.13, and were correlated at .53. As noted in Table 2, items that loaded on Factor 1 were related to a willingness to engage in physical activity even while having amotivating thoughts and expectations about exercise (eg, "If I have the thought 'exercising today won't be enjoyable,' it derails me from my exercise plan"). This factor is hereafter referred to as PAAQ-Cognitive Acceptance. Items that loaded on Factor 2 were related to a willingness to engage in physical activity even despite difficult feelings and sensations (eg, "Even if I have the desire to stop while I am exercising, I can still follow my exercise plan"). This factor is hereafter referred to

Table 2   Factor Loadings and Item-Total Correlations for Final PAAQ Items

	Item-Total correlations (standardized)	Cognitive acceptance	Behavioral commitment
I need to concentrate on getting rid of my urges to stop exercising or put off exercise.	.49	**.71**	–.07
My thoughts and feelings about physical activity must change before I can make changes in my exercise.	.61	**.71**	.06
If I have the thought "exercising today won't be enjoyable," it derails me from my exercise plan.	.60	**.66**	.08
I will have better control over my exercise routine if I can control my negative thoughts about exercise.	.65	**.57**	.22
I avoid exercising if it is going to make me feel physically uncomfortable, bored, or pressed for time.	.49	**.77**	–.013
Even if I have the desire to stop while I am exercising, I can still follow my exercise plan.	.61	.12	**.66**
I am committing to being physically active no matter what feels uncomfortable or challenging about that.	.61	–.03	**.78**
It is okay to experience discomfort (eg, fatigue, boredom, sweating) while I am exercising.	.41	–.11	**.63**
I can keep my commitment to physical activity even when I get busy with other responsibilities (eg, school, work, family).	.71	.13	**.74**
When I start to feel out of breath or tired during exercise I find a way to keep going.	.63	.01	**.77**

Note. Loadings in bold were associated with the factor labeled in the corresponding column.

as PAAQ-Behavioral Commitment. These 2 factors accounted for 63% of the total variance in item responses.

The 2 factors that emerged from the EFA showed PA acceptance that is focused on thoughts and PA acceptance demonstrated through behavior. Of note, unlike other items on the PAAQ, 2 items explicitly connect thoughts to behavior: "I continue to exercise, even when I have the desire to stay home or do something else" and "Despite the thoughts I have about exercise, I am now sticking to my exercise plan." These items cross-loaded on both factors and were removed.

Internal Consistency and Test-Retest Reliability

The PAAQ demonstrated high internal consistency (Cronbach's α = .87) and item-total correlations at or above .40 (see Table 2). As the deletion of items below .70 did not improve the overall alpha, all 10 remaining items were retained in further analyses. Each subscale also showed high internal consistency (Cognitive Acceptance α = .83; Behavioral Commitment α = .85). A subset of individuals (n = 46) recruited from Sample 1 (adults seeking weight loss treatment) completed the PAAQ at 2 time points before treatment initiation. Average retest interval was 1 week (mean time from initial to repeated test = 6.9 days).[76,77] Correlations between administrations were .83 (P < .0001) for total score, .78 (P < .0001) for the Cognitive Acceptance subscale, and .78 (P < .0001) for the Behavioral Commitment subscale. Intraclass correlation coefficients (ICCs) also indicated that very little of the variability between initial and repeated administrations was due to within-person change over the 1-week interval. ICCs were .82 for total score (95% CI = .54–.91), .78 for Cognitive Acceptance (95% CI = .54–.89), and .78 for Behavioral Commitment (95% CI = .54–.90).

Sample 1: Construct Validity

Average total PAAQ scores for overweight and obese adults seeking weight loss treatment was 30.64 (SD = 16.37) out of 70 (highest possible score). Average subscale scores were 14.16 (SD = 4.59) out of 35 for Cognitive Acceptance, and 16.48 (SD = 10.02) out of 35 for Behavioral Commitment. PAAQ descriptive statistics for total and subscale scores are provided in Table 3. Cronbach's α for PAAQ scores were .85 (total), .82 (Cognitive Acceptance), and .84 (Behavioral Commitment) within this sample, showing good internal consistency.

Table 3 Descriptive Statistics for PAAQ Total and Subscale Scores

	Mean	SD
Weight loss treatment sample		
PAAQ total score	35.87	16.32
PAAQ thoughts about PA	16.89	8.23
PAAQ overcoming barriers to PA	18.98	9.34
Breast cancer remission sample		
PAAQ total score	44.15	19.97
PAAQ thoughts about PA	21.51	8.39
PAAQ overcoming barriers to PA	22.64	8.16
Physical activity promotion sample (healthy adults)		
PAAQ total score	40.84	9.58
PAAQ thoughts about PA	19.25	5.63
PAAQ overcoming barriers to PA	21.59	5.87

PAAQ total and Cognitive Acceptance subscale scores were significantly negatively correlated with overall tendency toward experiential avoidance (Acceptance and Action Questionnaire—II [AAQ-II] score; P-values < .05). Correlation coefficients for these relationships can be found in Table 4. PAAQ total and subscale scores also were inversely associated with reported barriers to physical activity related to energy, willpower, and time (P < .05). Individuals who reported less PA acceptance perceived more barriers to PA, with willpower demonstrating a particularly strong relationship (r = –.46). PAAQ scores also were examined in relation to objectively-measured physical activity levels. As predicted, baseline PAAQ total and subscale scores were positively correlated with MET rate and total number of bouts of MVPA (P < .05) measured at baseline. In a simultaneous regression model, PAAQ total score remained a significant predictor of percent of time spent in MVPA when controlling for the effects of both BMI and overall experiential voidance (β = .22, P = .004).

Although men and women did not differ in age, BMI, or psychological characteristics at baseline, there were significant gender differences in baseline levels of physical activity (eg, MET rate [P < .001] and percent of time in MVPA [P = .006]), with men engaging in greater PA. Consequently, correlations were conducted separately for men and women. In men, baseline PAAQ scores were not associated with objective measures of PA at baseline. Among women, baseline PAAQ scores were correlated with MET rate, number of moderate-to-vigorous bouts of activity, length of time in a bout of MVPA, total calories expended per day, and percent of time overall in MVPA (P < .05).

Predictive validity also was examined. Baseline PAAQ Cognitive Acceptance subscale score significantly predicted MVPA after 6 months of behavioral weight loss treatment, (F[1,132] = 3.89, P = .05), such that higher Cognitive Acceptance score at baseline were related to greater MVPA at 6 months.

Sample 2: Construct Validity

On average, total PAAQ score for women in remission from breast cancer was 44.15 (SD = 14.97) out of 70 (highest possible score). Average subscale scores were 21.51 (SD = 8.39) out of 35 for Cognitive Acceptance, and 22.64 (SD = 8.16) out of 35 for Behavioral Commitment. Thus, women in this sample endorsed scores above the midpoints of all scales, indicating higher acceptance with respect to PA. The PAAQ again demonstrated high internal consistency, both for total score (Cronbach's α = .91) and subscales (Cognitive Acceptance α = .87, Behavioral Commitment α = .89).

As noted, participants completed several self-report measures as part of a larger study on breast cancer survivorship. These measures included reported PA levels, body satisfaction, depression, mindfulness, sexual functioning, and marital satisfaction (see Table 4). As expected, the PAAQ total and subscale scores were strongly associated with overall tendency toward mindfulness (r = .36–.49, P < .001). Examination of mindfulness subscale scores revealed that acting with awareness, description, nonjudgmental stance, and nonaction were related to PAAQ scores (r = .23–.45, P < .04), whereas observation was not (r = .11, P = .33). Description was significantly related to PAAQ total score and Behavioral Commitment subscale score (r = .26 and .37, respectively; P < .02), but was not related to Cognitive Acceptance subscale score (r = .10, P = .34).

A simultaneous regression model showed that, controlling for all other mindfulness subscales, only nonjudgment remained a significant predictor of PAAQ total score (β = .31, P = .008).

Table 4   Construct Validation (Concurrent; Correlation Coefficients)

	PAAQ total score	PAAQ cognitive acceptance	PAAQ behavioral commitment
Weight loss treatment sample			
Acceptance and Action Questionnaire (AAQ-II)	–.14*	–.17*	–.11
Barriers to PA			
Time	–.24**	–.29**	–.19*
Energy	–.20**	–.24**	–.15*
Willpower	–.33**	–.46**	–.19*
Physical activity (accelerometer readings)			
Number of MVPA bouts	.23*	.25**	.18*
Average time per MVPA bout	.12	.11	.12
MET rate	.25*	.29**	.20*
Percent of time spent in MVPA overall	.26**	.29**	.21*
Total calories expended per day	.24**	.27**	.18*
Breast cancer remission sample			
Five-Factor Mindfulness Questionnaire (total)	.47***	.36**	.50***
Observe subscale	.10	.07	.13
Describe subscale	.26*	.11	.37**
Act with awareness subscale	.36**	.29**	.35**
Nonjudgment subscale	.45***	.45***	.37**
Nonreactivity subscale	.36**	.23**	.41**
Body satisfaction	–.38**	–.40**	–.28*
Depressive symptoms (CESD)	–.42**	–.43***	–.33**
Physical activity level (self-report)	.56***	.58***	.45***
Female sexual functioning (total)	.27*	.30**	.18
Arousal	.30**	.33**	.22
Lubrication	.20	.25*	.11
Orgasm	.24*	.28*	.16
Satisfaction	.33**	.34**	.27*
Pain	.23*	.23*	.18
Marital satisfaction	.18	.19	.13
Physical activity promotion sample (healthy adults)			
Acceptance and Action Questionnaire (AAQ-II)	–.21	–.28*	–.15
Discomfort intolerance	–.33	–.27	–.31
Defusion from thoughts	.32*	.11	.52***
Depressive symptoms (BDI-II)	–.44**	–.47**	–.28*

$* P < .05; ** P < .01; *** P < .001.$

Abbreviations: PA, physical activity; MVPA, moderate-to-vigorous physical activity.

PAAQ total and subscale scores also showed the predicted associations with reported PA, indicating that women with greater PA acceptance skills tend to engage in more PA. These women also reported less depression ($P < .0003$), relative to women with poorer PA acceptance skills. Unexpectedly, PAAQ scores were associated with specific domains of sexual functioning. These correlations were noticeably weaker ($r = .04–.33$), however, and most were significant only for PAAQ total score and thoughts about PA subscale. As hypothesized, PAAQ scores were not associated with sexual desire or marital satisfaction ($r < .12, P > .11$).

Sample 3: Construct Validity

Healthy adults recruited for a physical activity intervention also endorsed frequent use of acceptance skills with respect to PA. Mean total PAAQ score was 40.84 (SD = 9.58) out of 70. Mean subscale scores were 19.25 (SD = 5.63) out of 49 for Cognitive Acceptance, and 21.59 (SD = 5.87) out of 35 for Behavioral Commitment. Within this sample, Cronbach's alpha for PAAQ scores were .81 (total), .72 (Cognitive Acceptance), and .79 (Behavioral Commitment).

PAAQ total score and Behavioral Commitment subscale score were related to ability to defuse from thoughts (Drexel Defusion Scale [DDS]; $r = .32$ and $.52$; $P < .03$). PAAQ Cognitive Acceptance subscale score was not related to DDS score, however ($r = .02$, $P = .90$). Thus, participants who endorsed high overall mindfulness and defusion tendencies also endorsed more frequent use of acceptance with respect to PA. As predicted, PAAQ total and subscale scores also showed inverse relationships with depressive symptoms (Beck Depression Inventory [BDI]; $P < .05$), such that participants with less severe depressive symptoms endorsed more frequent use of acceptance with respect to PA. PAAQ Cognitive Acceptance subscale score was associated with experiential avoidance (AAQ-II; $r = -.28$, $P = .04$), though total score and Behavioral Commitment subscale score were not ($r = -.14$ and $-.25$, respectively; $P > .07$). None of the PAAQ scales were related to ability to tolerate discomfort (Discomfort Intolerance Scale [DIS]; $r = -.27$ to $-.33$, $P > .13$).

Discussion

Most research on self-reported predictors of PA has centered on self-efficacy for PA,[78] motivation to exercise,[79] or perceived physical barriers to PA (eg, arthritic pain).[80] Despite these efforts, successful long-term maintenance of high PA levels remains difficult to forecast. The current study extends this research by incorporating perceived physical and emotional states relevant to the general population, such as general discomfort and boredom during PA. To the authors' knowledge, no existing measure has specifically applied the constructs of cognitive acceptance and behavioral commitment to PA.

Thus, the current study is the first to develop and test a measure of acceptance of psychological or physical discomfort related to PA. Results confirm that the PAAQ can meaningfully measure psychological factors that may promote (or obstruct) PA. The final product consists of 10 items and 2 subscales, PAAQ-Cognitive Acceptance and PAAQ-Behavioral Commitment. These subscales accounted for 63% of the variance across items and demonstrated high internal consistency and test-retest reliability when administered 1 week apart. The PAAQ also showed high concurrent validity in the expected directions, including several measures of acceptance, experiential avoidance, mindfulness, and physical activity (self-reported and objectively-verified) across 3 independent participant samples with varied demographics. Furthermore, higher scores on the PAAQ-Cognitive Acceptance factor effectively predicted greater accelerometer-measured MVPA after 6 months of enrollment in a behavioral weight loss program. Existing measures of beliefs and expectations about PA have shown concurrent or predictive associations with self-reported PA,[78,81] but rarely have demonstrated relationships with objectively-verified PA. The PAAQ thus shows added benefit for clinical research and intervention.

These findings indicate that the cognitive experience of PA, as well as expectations for how PA will be affectively and physiologically experienced, may have a lasting impact on an individual's actual engagement in PA. These psychological aspects of exercise appear to be critical for facilitating PA and may be useful intervention targets in PA promotion studies. The PAAQ total score and subscales demonstrated expected correlations with measures of mindfulness, body satisfaction, and depression across all 3 participant samples. Specifically, higher scores on the PAAQ were associated with fewer perceived barriers to PA, greater mindfulness on the FFMQ, and fewer depressive symptoms on the BDI-II and CES-D.

Acceptance and Commitment in Physical Activity Promotion

Understanding what psychological processes are related to engagement in PA is critical for effective PA promotion. Despite efforts to increase PA in the general population, only 25%[2] of all adults, and 2% to 3% of overweight or obese adults, engage in recommended amounts of PA (ie, 30 min/day).[82–84] When individuals are prescribed high levels of PA as part of an intervention (eg, for weight loss), few do so during treatment, and most are unable to sustain high activity levels posttreatment.[85,86] Tate et al[87] found that only 11.9% of overweight or obese participants assigned to an intervention promoting a high level of PA (2500 kcal/wk) were actually doing so at 12-, 18-, and 30-month follow-up assessments. Although some individuals describe PA as pleasurable, individuals frequently describe more sedentary leisure activities, such as watching television, as preferable to PA, and negative evaluations about the experience of PA consistently are associated with less engagement in PA.[47–49] For example, among previously sedentary adults participating in a moderate-intensity PA promotion intervention, affective response to PA at baseline was strongly predictive of amount of PA at 12 months (eg, a difference of 1 unit in rating of positive affect predicted 41 fewer minutes per week of PA at 12 months).[88]

The PAAQ may inform the development and testing of many types of interventions that promote PA, including those that focus on experiential acceptance and behavioral commitment. Acceptance-based interventions foster the ability to tolerate unpleasant internal experiences or forego an activity that is perceived as more pleasurable or requires less effort to engage in one that is more consistent with one's values (eg, going out to walk after dinner rather than sitting on the couch to read a magazine). Environmental, biological, and psychological processes make it challenging for most individuals to consistently engage in a high level of PA. Over the long-term, many individuals may find that making choices to engage in PA is not likely to feel "easy."

Thus, adaptive behavior (ie, engaging in high levels of PA) may depend on the ability to tolerate unpleasant internal experiences (eg, fatigue, boredom, an urge to remain sedentary rather than begin a bout of PA). Willingness to engage in PA even when it is not a preferred activity at that moment may also be important (eg, when one would prefer to remain at work to reduce anxiety about an approaching project deadline, or sleep an additional 30 minutes in the morning). In those moments of decision-making, participants who can tolerate the "distress" that is experienced when one is choosing an activity that is relatively less appealing may be better able to enact PA. Indeed, existing research shows that an intervention focused on acceptance and commitment principles can increase PA engagement among college students.[23] Testing such an intervention among adults, and including the PAAQ to measure the potential mediating effect of PA acceptance, is a logical next step for this line of research.

Strengths, Limitations, and Future Directions

A major strength of the current study is the use of 3 independent and diverse participant samples, suggesting that the present findings may generalize to the broader adult population. An additional strength was the incorporation of a variety of acceptance-oriented measures and both self-reported and accelerometer-measured PA. The overall sample size was large enough to have sufficient statistical power for initial evaluation of psychometric properties; however, confirmatory factor analyses should be performed in larger participant samples. Similarly, an important next step will be to confirm these

findings in a general community sample, as each participant sample in the current study was health-conscious (and 2 were deliberately increasing their PA over time). Examining reliability and validity across the lifespan, including with adolescents and older adults, also will be important.

Tailoring of the PAAQ measure may be necessary to recognize unique development factors, such as physical ability, that can impact PA. Future research will benefit from including additional measures of divergent validity, as well as testing the moderating effects of other factors that might influence the adoption and maintenance of PA (eg, the extent to which an individual inherently enjoys PA) on the prospective relationship between PAAQ score and PA change. Further investigation of relationships between PAAQ subscales and specific aspects of mindfulness (eg, awareness vs. description) may identify specific skills that can bolster PA acceptance and commitment (and thereby, increase PA). Finally, this study examined predictive validity of the PAAQ during the first half of weight loss treatment, and its predictive value over the entire course of treatment (and posttreatment) remains unknown. Future longitudinal research should assess change in PAAQ scores over the duration of treatment and into follow-up.

Conclusions

Most adults fall far short of recommended levels of physical activity despite the negative impact that a sedentary lifestyle has on health, weight, and well-being. Emerging evidence suggests that an ability to accept uncomfortable cognitive, affective, and physiological experiences that are associated with PA is an important factor that may explain the difficulty of many individuals to attain higher levels of physical activity. Better understanding the role of such a construct would be aided by the development and validation of a valid measure, which was the focus of this study. The newly developed measure, the Physical Activity Acceptance Questionnaire (PAAQ), demonstrated excellent convergent, divergent, and predictive validity, as well as internal reliability. The total scale, as well as its 2 factors (Cognitive Acceptance and Behavioral Commitment), should prove a useful addition to investigations seeking to understand PA behavior, as well as the mechanisms of action of PA promotion interventions.

Acknowledgments

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