THE QUICK INVENTORY OF DEPRESSIVE SYMPTOMATOLOGY, SELF-REPORT (QIDS-SR_{16}): A PSYCHOMETRIC EVALUATION IN PATIENTS WITH ASTHMA AND MAJOR DEPRESSION

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DEDICATION

To my dad

for charting the course

and navigating the waters with me

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Michelle Murray

April 12, 2006
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THE QUICK INVENTORY OF DEPRESSIVE SYMPTOMATOLOGY, SELF-REPORT (QIDS-SR_{16}): A PSYCHOMETRIC EVALUATION IN PATIENTS WITH ASTHMA AND MAJOR DEPRESSION

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THE QUICK INVENTORY OF DEPRESSIVE SYMPTOMATOLOGY,

SELF-REPORT (QIDS-SR_{16}): A PSYCHOMETRIC EVALUATION

IN PATIENTS WITH ASTHMA AND MAJOR DEPRESSION

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Statement of the Problem: Despite research evidence of high comorbidity between depression and asthma, few studies have addressed the performance of assessment tools which may assist physicians in assessing depression among asthma patients. The present study is the first to evaluate the psychometric properties of the self-report Quick Inventory of Depressive Symptomatology (QIDS-SR_{16}), a 16-item measure of depressive symptom severity, in asthma patients.

Methods: The psychometric properties of the QIDS-SR_{16} are compared and evaluated in relation to the self-report Inventory of Depressive Symptomatology (IDS-SR_{30}) and the17-

item, clinician-rated Hamilton Rating Scale for Depression ($HRSD_{17}$) in 73 asthma outpatients treated for nonpsychotic Major Depressive Disorder. Correlations between the depression rating scales and the Mini Asthma Quality of Life Questionnaire (MiniAQLQ) were calculated.

Results: Internal consistency at exit was strong for the QIDS-SR_{16} (Cronbach's α =.87) and the IDS-SR_{30} (Cronbach's α =.95). Total scores for the QIDS-SR_{16} showed high correlations with the $HRSD_{17}$ (.85) and the IDS-SR_{30} (.97) total scores. One-hundred percent of the QIDS-SR_{16} items and 93% of the IDS-SR_{30} item-total score correlations reached statistical significance of $p \leq .0001$. The QIDS-SR_{16}, the IDS-SR_{30}, and the $HRSD_{17}$ showed comparable sensitivity to symptom change, indicating high concurrent validity for all three scales. The total QIDS-SR_{16} baseline to exit change score demonstrated a significant negative correlation to the MiniAQLQ, providing another indicator of concurrent validity.

Conclusions: The QIDS-SR_{16} shows good reliability and impressive construct validity, including test homogeneity, content validity, and concurrent validity. Strong psychometric properties as well as a self-report format, brief administration time, and sensitivity to treatment change make the QIDS-SR_{16} a valuable clinical and research instrument.

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LIST OF ABBREVIATIONS

BDI – Beck Depression Inventory

CTT – Classical Test Theory

DHHS – U.S. Department of Health and Human Services

DSM-IV – Diagnostic and Statistical Manual of the American Psychiatric Association, 4th edition

DSM-IV-TR – Diagnostic and Statistical Manual of the American Psychiatric Association, 4th edition, Text Revision

HRSD – Hamilton Rating Scale for Depression

$HRSD_{17}$ – Hamilton Rating Scale for Depression, 17-item version

$HRSD_{21}$ – Hamilton Rating Scale for Depression, 21-item version

$HRSD_{24}$ – Hamilton Rating Scale for Depression, 24-item version

IDS_{30} – Inventory for Depressive Symptomatology (30-item)

$IDS\text{-}SR_{30}$ – Inventory for Depressive Symptomatology (30-item, Self-Report format)

$IDS\text{-}C_{30}$ – Inventory for Depressive Symptomatology (30-item, Clinician-Rated format)

IRB – Institutional Review Board

IRT – Item Response Theory

MADRS – Montgomery Asberg Depression Rating Scale

MDD – Major Depressive Disorder

MINI – Mini-International Neuropsychiatric Interview

MiniAQLQ – Mini-Asthma Quality of Life Questionnaire

$QIDS_{16}$ – Quick Inventory of Depressive Symptomatology (16-item)

QIDS-SR_{16} – Quick Inventory of Depressive Symptomatology (16-item, Self-Report format)

QIDS-C_{16} – Quick Inventory of Depressive Symptomatology (16-item, Clinician-Rated format)

SCID – Structured Clinical Interview for the *DSM-IV*

SD – Standard Deviation

CHAPTER ONE
Introduction

STATEMENT OF THE PROBLEM

Depression is a major psychiatric concern, with nearly 10% of the United States population meeting the criteria of the Diagnostic and Statistical Manual of the American Psychiatric Association (4th ed., Text Revision; 2000), for a mood disorder in any 12-month period (Kessler, Chin, Demler, & Walters, 2005). Depression alone is debilitating, and it often exacerbates comorbid medical conditions (DiMatteo, 1994). The largest group of treatment providers for depression is general medical practitioners (Wang, Berglund, Olfson, Pincus, Wells, & Kessler, 2005). However, the primary care physician often struggles to recognize depression. Depression rating scales to assist the physician in evaluating depressive symptoms are valuable in facilitating comprehensive patient care.

The Quick Inventory of Depressive Symptomatology ($QIDS\text{-}SR_{16}$) has demonstrated utility in measuring symptom severity in psychiatric populations. Additional research, however, is necessary to establish the performance of this instrument in a variety of general medical conditions. No research studies have been conducted examining the psychometric properties of the $QIDS\text{-}SR_{16}$, as well as the self-report Inventory for Depressive Symptomatology ($IDS\text{-}SR_{30}$) and the clinician-rated Hamilton Rating Scale for Depression ($HRSD_{17}$), in asthma patients undergoing treatment in a general medical setting.

CHAPTER TWO
Literature Review

DEPRESSIVE ILLNESS

Depression can cause patients to experience symptoms in somatic, cognitive, and affective arenas and lead to significantly impaired functioning in work, relationships, and daily activities of living. Table 1 lists DSM-IV-TR symptom criteria for a Major Depressive Episode. Risk factors for depressive illness include a family or personal history of depression, female gender, prior suicide attempts, stressful life events, inadequate social support, and current substance abuse (U.S. Department of Health and Human Services [DHHS], 1993). Depressed patients are at increased risk of suicide; approximately 80% of suicidal patients are depressed (Seligman & Rosenhan, 1998).

One of the most comprehensive epidemiological surveys of the prevalence of mental disorders was the National Comorbidity Survey Replication, performed by Kessler and colleagues in 2005 (Kessler, Berglund, Demler, Jin, & Walters; Kessler, Chin, et al.). The National Comorbidity Survey Replication performed blind diagnostic interviews with the Structured Clinical Interview for the *DSM-IV* (SCID). The data was based upon a sample of 9,282 face-to-face interviews. A wide range of variables was collected, including lifetime prevalence (Kessler, Berglund, et al., 2005) and 12-month prevalence (Kessler, Chin, et al., 2005) distributions of *DSM-IV-TR* disorders. Data indicates a lifetime prevalence of 16.6% for Major Depressive Disorder and 2.5% for dysthymia. In addition, the lifetime prevalence estimate of anxiety disorders was 28.8%. A significantly lower risk for anxiety and mood

disorders was found in Hispanic and non-Hispanic blacks when compared with non-Hispanic whites. A high prevalence of depression in medically ill populations is also well-documented in medical literature; clinically significant symptoms of depression are observable in roughly 12% to 16% of nonpsychiatric general medical patients (DHHS, 1993).

A further analysis of the National Comorbidity Survey Replication indicates that among subjects who met criteria for a mental disorder during the past 12 months, 41.1% received some type of treatment. The largest group of treatment providers, at 22.8%, was general medical practitioners (Wang et al., 2005). Thus, the National Comorbidity Survey Replication indicates that depression and anxiety disorders have substantial lifetime and 12-month occurrence rates and that the general medical practitioner continues to be the major treatment provider.

Table 1

DSM-IV-TR* Symptom Criteria for Major Depressive Episode

Five (or more) of the following symptoms have been present during the same 2-week period and represent a change from previous functioning; at least one of the symptoms is either (1) depressed mood or (2) loss of interest or pleasure.

(1) depressed mood most of the day, nearly every day
(2) markedly diminished interest or pleasure in all, or almost all, activities of the day, nearly every day
(3) significant weight loss when not dieting or weight gain, or decrease or increase in appetite nearly every day
(4) insomnia or hypersomnia nearly every day
(5) psychomotor agitation or retardation nearly every day
(6) fatigue or loss of energy nearly every day
(7) feelings of worthlessness or excessive or inappropriate guilt (which may be delusional) nearly every day
(8) diminished ability to think or concentrate, or indecisiveness, nearly every day
(9) recurrent thoughts of death, recurrent suicidal ideation without a specific plan, or a suicide attempt or a specific plan for committing suicide.

*Additional criteria needed for diagnosis of Major Depressive Episode

In addition to the emotional toll, depression takes a considerable economic toll on the health care system and workforce. Depression was estimated to have cost the United States $83.1 billion in 2000, of which $51.5 billion was accounted for by workplace costs, including missed work days (Greenberg, et al. 2003). Depression was estimated to be the fourth leading cause of disability in the world in 1990; projections indicate that it will be the second leading cause of disability by 2020 (Murray & Lopez, 1997). In terms of indirect costs to the health care system, depressed patients spend more time with physicians during appointments and more frequently utilize the health care system than nondepressed people (Katon, Berg, Robins, & Risse, 1986). In a study (n=12,514) of primary care patients, subjects diagnosed with depression had greater yearly health care costs (p<.001) than nondepressed controls; the

depressed subjects also had comorbid chronic medical diagnoses at higher rates, though these general medical conditions did not entirely account for the greater cost of health care among the depressed subjects (Simon, Von Korff, & Barlow, 1995).

DEPRESSION AND ASTHMA

Like depression, asthma places a burden on the U.S. healthcare system, resulting in over 484,000 hospitalizations, 1.9 million emergency room visits, and 13.9 million outpatient visits in 2002 (Mannino, Homa, Akinbami, Moorman, Gwynn, & Redd, 2002). Asthma is a chronic respiratory disease in which the bronchial tubes become inflamed in response to triggers such as allergens, infections, tobacco smoke, exertion, or weather changes. Subsequently, the airways narrow and may result in coughing, shortness of breath, chest pain and tightness, and wheezing (Mannino et al., 2002). Asthma is estimated to affect approximately 6.8% of adults and 8.3% of children in the United States at a given time (Mannino et al., 2002). Asthma attacks can vary in severity from mild to life-threatening; over 4,200 people died from asthma in the U.S. in 2002 (Mannino et al., 2002).

The high comorbidity of depression and asthma is well-documented in the literature. Estimates of the prevalence of clinically significant depressive symptomatology among asthma patients vary from 13.0% (Yellowlees, Haynes, Potts, & Ruffin, 1988) to 65.8% (Krommydas, Gourgoulianis, Angelopoulos, Kotrotsiou, Raftopoulos, & Molyvdas, 2004). In a large-scale survey of 1,532 households, the Epilepsy Impact Project Group (Ettinger, Reed, & Cramer, 2004) found that among the 395 patients with asthma, 27.8% scored in the

depressed range on the Center for Epidemiological Studies Depression Scale (Radloff, 1977), versus 11.8% of controls without any chronic illness.

Depression may co-occur with asthma at higher rates than with other chronic medical illnesses. A 1994 study by Bennett found that children with asthma may be at greater risk of developing depression than children with other illnesses including cancer and cystic fibrosis. Padur and colleagues (1995) administered the Child Depression Inventory (Kovacs, 1985) to 100 children including a healthy control group and children with asthma, diabetes, and cancer; the asthmatic children in the study scored significantly higher than any of the other groups.

Depression may impact asthma patients for several reasons. Dealing with a chronic illness, its treatment, limitations, and symptoms may trigger depression among some patients (Rubin, 1993). Specific asthma symptoms are associated with depression, and it is possible that experiencing the symptoms may be contributing to the depression. For instance, depression rates measured by the Primary Care Evaluation of Mental Disorders (Spitzer et al., 1994) were higher ($p<.001$) among asthma patients experiencing dyspnea, waking at night, and morning asthma symptoms (Goldney, Ruffin, Fisher, & Wilson, 2003). Scores on the Hospital Anxiety and Depression Scale (Zigmund & Snaith, 1983) indicating depression were correlated with wheezing ($p<.05$), waking up with breathlessness ($p<.01$), chest tightness ($p<.0001$), and attacks of breathlessness both when resting and after activity ($p<.0001$) (Janson, Bjornsson, Hetta, & Boman, 2004). Asthma patients with depression report poorer quality of life than euthymic asthma patients (Eisner, Katz, Lactao, & Iribarren, 2005; Mancuso, Peterson, & Charlson, 2000; Mancuso, Rincon, McCulloch, & Charlson,

2001; Rimington, Davies, Lowe, & Pearson, 2001), suggesting that the depressed patients may be experiencing more functional limitations. Asthma patients are often treated with corticosteroids to reduce airway inflammation, and steroids affect mood in many patients (Brown & Suppes, 1998; Brown, Khan, & Nejtek, 1999). Other researchers have theorized that depression results from an imbalance of adrenergic and cholinergic systems in the brain (Janowsky, el-Yousef, Davis, & Sekerke, 1972); the cholinergic dominance thought to characterize depression may also exacerbate asthma symptoms by increasing parasympathetic activity (Miller, 1987).

PSYCHOSOMATIC HISTORICAL TREATMENTS

Emotional expression in patients was considered an asthma trigger in early psychosomatic theories. From the 1930's through the 1950's asthma was deemed to be one of the foremost psychosomatic illnesses. In his classical treatment of psychosomatic ailments, Alexander (1950) presented a psychoanalytic perspective, viewing asthma as primarily a psychological entity. Alexander believed that asthma resulted from both dependency and aggressive conflicts toward the mother during childhood. These conflicting feelings were repressed out of fear of separation and abandonment, and the repression resulted in an overactivation of the parasympathetic nervous system, thereby producing a constriction of bronchial passages. Life situations which reactivated the repressed emotional conflict would cause asthma attacks. The wheezing of the asthma patient was interpreted as a repressed cry for the mother, and the prescribed treatment was psychodynamic

psychotherapy (French & Alexander, 1941). A second psychosomatic perspective theorized that emotional stimulation caused ventilatory activation, resulting in bronchial constriction (Purcell, 1963; Rees, 1980).

As the pathophysiology of asthma was, in part, elucidated during the 1970's, there was a de-emphasis of psychological factors in asthma. However, subsequent research has clearly established the importance of psychological variables, including anxiety, negative affect, and depression. It is now acknowledged that, although asthma is primarily a pulmonary system disease with allergic and genetic etiology, psychosocial and emotional factors make a major contribution to the expression of the disease (Cluley & Cochrane, 2001).

BASIC RESEARCH

Clinical research postulates a wide range of variables which exacerbate asthma, including specific emotional states such as depression, sadness, or helplessness (Miller, 1987), as well as stressful events and emotional states in general (Rees, 1980). Basic experimental research has shown that stressful stimulation (Levenson, 1979) and general emotional stimulation (Von Leupoldt & Dahme, 2005) result in a mild decline in lung function or in airway resistance in asthma patients. Both positive and negative emotions may affect respiration. Vagal efferent activity is postulated as the most effective mechanism for eliciting emotion-related airway responses (Isenberg, Lehrer, & Hochron, 1992). A review

article by Boiten, Frijda, and Wientjes (1994) documented substantial support for the existence of emotional effects on respiration.

Psychophysiological research has recently delineated the specific effects of emotional arousal on respiration (Ritz, 2004). In general, the studies have examined oscillatory resistance as well as respiratory sinus arrhythmia following laboratory-induced emotional states (Ritz, Thons, Fahrenkrug, & Dahme, 2005). While the findings are not unequivocal, certain trends appear to be emerging from this basic research. Frequently, emotionally arousing pictures are used to elicit the induced emotional response in subjects. Negative emotions increase oscillatory resistance and compromise lung function. The changes in lung function are similar in asthmatic and healthy subjects, although the effect size, at times, appears stronger in asthma patients (Ritz, 2004). Laboratory-induced changes in airway resistance as a result of negative emotional states appear to experimentally validate the concept of emotionally-induced asthma. Of particular relevance to the present study is the finding that depressive emotional stimulation decreases respiratory functioning in asthma patients (Ritz et al., 2005). Findings showing associations between vagal responses and airway restrictions support longstanding observations of the effect of sadness and depression in asthma attacks (Knapp & Nemetz, 1960). Thus, basic laboratory research provides clear support to the relationship between depression and respiratory functioning in asthma patients.

CLINICAL FINDINGS AND OUTCOME STUDIES

When depression occurs in conjunction with a general medical illness such as asthma, differential diagnosis becomes complicated. First, depressed patients often present primarily with somatic complaints, and this presentation may be more common among medically ill patients. Only 49.0% of depressed primary care patients in one sample presented with a complaint of a psychological nature at all (Feightner & Worrall, 1990). Asthma patients with depression often present with primary symptoms of dyspnea or chronic cough (Dudley, Glaser, Jorgenson, & Logan, 1980). In some cases, somatic complaints may be specifically symptomatic of patients' depression (e.g., weight change, fatigue). In other situations, patients may be expressing symptoms of medical illness comorbid to their depression. Some general medical illnesses (e.g. thyroid disease and diabetes) and certain prescription medications (e.g. beta blockers, levodopa) can produce depressive symptoms (DHHS, 1993). Conversely, patients with true major depression who present primarily with somatic symptoms possibly attributable to their general medical illness (e.g. fatigue, insomnia) could be misdiagnosed and not receive the appropriate treatment for their mood disorder.

Asthma patients may frequently go untreated for depressive symptoms. One study found current depression in 25.0% of adult asthma patients, but found that only 25.0% of those with diagnosed depression were receiving antidepressant medication (Brown, Khan, & Mahadi, 2000). Similarly, the Epilepsy Impact Project Group found that among asthma patients whose Center for Epidemiology Studies-Depression Scale (Radloff, 1977) scores were in the depressed range, 68.7% were not currently taking antidepressant medication.

Furthermore, 43.7% of the patients had never discussed their depressive symptoms with a physician and 52.3% had never taken prescription antidepressants (Ettinger et al., 2004). Rubin (1993) suggested that indicators of depression in asthma patients may often include patient reports of debilitating symptoms with little objective medical evidence, feelings of hopelessness or helplessness regarding asthma, social isolation or withdrawal, suicidal ideation, or poor adherence to treatment.

The importance of identifying and treating depression among asthma patients is substantial, since asthma patients with depression may have worse asthma symptoms and a poorer prognosis. Additionally, depression increases the likelihood that asthma patients will use emergency care facilities (Mancuso et al., 2001) and increases the longitudinal risk of hospitalization for asthma (p=.05) (Eisner et al., 2005). The presence of depressive symptomatology was associated with reduced pulmonary functions (p<.05) in asthma patients (Krommydas et al., 2004). Concerns about higher mortality rates among asthma patients with depression are supported by research. A trend toward higher depression rates was found among children who died of asthma-related causes (n=9) than in the larger sample of asthmatic children (n=72), though the findings did not reach levels of statistical significance (Mascia et al., 1989). Two studies found that a history of depressive symptoms distinguished patients who died from asthma from survivors (Picado, Montserrat, de Pablo, Plaza, & Agusti-Vidal, 1989; Strunk, Mrazek, Fuhrmann, & LaBrecque, 1985). The six deceased patients in the study by Picado and colleagues were previously treated with antidepressant medication but were not taking antidepressants at the time of their deaths (Picado et al., 1989). Furthermore, rates of suicide completion, attempt, and ideation have

been reported to be higher among patients with asthma as compared to nonasthmatic controls (Levitan, 1983; Goodwin & Eaton, 2005).

TREATMENT ADHERENCE AND DEPRESSION

Another possible reason for poorer outcomes among asthma patients with depression involves treatment compliance or adherence, since asthma can often be controlled with adequate medical care. A study of 102 adult asthma patients found somewhat higher (though not statistically significant) levels of depression among patients who were noncompliant with inhaler use (Bosley, Fosbury, & Cochrane, 1995). Depressed patients may be less likely to adhere to medical treatment because of feelings of hopelessness, fatigue and lack of motivation, or even depression-associated cognitive problems such as memory and concentration difficulties (Rubin, 1993). Patients with poor adherence may be less likely to attend to warning signs of an impending asthma attack (Thompson, W.L., & Thompson, T.L., 1984). Fatigue and lack of motivation among depressed patients may contribute to decreased activity levels, which in turn may contribute to poorer respiratory functioning in asthma patients, a group that already has reduced pulmonary functions (Rubin, 1993).

Patients' self-management of asthma is a complex undertaking, and depression can compromise psychological and emotional resources available for this undertaking. The individual with asthma must have the cognitive clarity to decide if he or she needs to take specific medication for acute symptom control, or if direct medical intervention, such as hospitalization may be warranted. In addition, the patient may need to take regular

preventive medication, including time-consuming nebulizer treatments, requiring psychological resources to consistently complete. Furthermore, asthma patients must be vigilant to avoid allergens and environmental irritants. Depression and its ability to compromise medical adherence to treatment in asthma patients have been associated with an increase in morbidity (Horn, Clark & Cochrane, 1990).

DiMatteo (1994) addressed how depression can compromise adherence and self-management. As noted previously, depression is frequently linked to compromised cognitive functioning, including attention span, memory, and problem-solving abilities, executive functions which are important for maintaining the treatment and medication regimen necessary for successful treatment. In addition, depressed people frequently withdraw from the support of family and friends, an action which can have a negative effect on treatment compliance. Finally, feelings of helplessness and despair associated with depression may make asthma patients discouraged about their chances of improvement and cause them to see no reason to take their medication or guard their health.

PHYSICAL IMPACT OF DEPRESSION

Other studies indicate that depression may have a more direct impact on asthma. Steroids are often used to treat asthma exacerbations but also depress immune function; some studies indicate that depression can also cause reduced immune functioning (Schleifer, Keller, & Bartlett, 1999). It is suggested that the cumulative effect of steroid use and depression may cause asthma patients to be more susceptible to respiratory infection (Rubin,

1993). Emotional states seem to have direct impact on physiological states in asthma patients, as indicated by studies by Allen, Hickie, Gandevia, and McKenzie (1994) and Miller and Wood (1997). In a sample of children with moderate to severe asthma, greater variability in heart rate and oxygen saturation were measured while the children were watching a sad movie scene than during a happy or more emotionally neutral scene (Miller & Wood, 1997). Asthma patients with scores in the depressed range on the Profile of Mood States (McNair, Loir, & Droppelman, 1971) showed a significantly higher level of impaired voluntary drive to breathe when compared to non-depressed patients (Allen et al., 1994). Possibly the physiological responses which are linked to depression contribute to worse outcomes for patients with comorbid asthma and depression.

DEPRESSION, ASTHMA, AND QUALITY OF LIFE

Health-related quality of life is compromised in individuals with asthma. Severe asthma takes a greater toll on quality of life, but even mild asthma can reduce health-related life quality (Juniper, 1998). The majority of patients with asthma experience poor health and thus are restricted in physical, psychological and social aspects of their lives (Bonala, Pina, Silverman, Amara, Bassett, & Schneider, 2003). Ford and colleagues (2003) conducted a large population-based study which demonstrated lower health-related quality of life in asthma patients. In addition, asthma patients showed almost twice as much physical or mental health impairment, with an average of 10 days of impairment per month, when compared with nonasthmatic patients. Additional support for the link between asthma and

poor health-related quality of life comes from the Medical Outcomes Study, which demonstrated negative effects on daily functioning and well-being of 9,385 adults with chronic medical illness (Stewart et al., 1989). Asthma patients with comorbid depression were found to experience both poorer mental health and physical functioning when compared with less depressed asthma patients (Brown, Khan, Nejtek, Rajan, & Mahadi, 2000; Afari, Schmaling, Barnhart, & Buchwold, 2001). Thus, research has consistently demonstrated that depression exacerbates poor health status and results in a reduction in the quality of life in asthma patients, just as it does in patients with other chronic medical conditions (Lyons, Lo, & Littlepage, 1994). Underlying respiratory symptoms and distress are, in part, a reflection of psychological factors, as well as the physical disease process. In addition, corticosteroid use may result in psychological side effects that imitate a mood disorder. Research confirms that asthma patients often go untreated for their depressive symptoms. This fact is particularly unfortunate because depressed asthma patients may experience worse symptoms and outcomes than nondepressed asthma patients. While difficult, accurate differential diagnosis of depression is important in the comprehensive treatment of the asthma patient.

PSYCHOMETRIC STUDIES IN ASTHMA PATIENTS

Physicians need methods to assess if asthma patients are depressed. No psychometric studies of depression scales in a population comprised exclusively of asthma patients were found in MEDLINE and PSYCINFO searches. (Searches were conducted using keywords depression, depressive, mood disorder, and affective disorder and then combined with

searches of keywords validation, psychometric, validity, reliability, and test. The results of the previous searches were then limited by the keyword asthma.)

PSYCHOMETRIC PROPERTIES OF THE $HRSD_{17}$

The clinician-rated Hamilton Depression Rating Scale was developed almost a half century ago to function as an instrument to assess the efficacy of antidepressant medications. The instrument was originally published in 1960 (Hamilton 1960). There are at least 20 versions of the Hamilton Depression Rating Scale that vary in length. The present research study utilizes the 17-item version ($HRSD_{17}$). Although Hamilton (1960) conceded that the scale had "room for improvement," and that further development was necessary, the $HRSD_{17}$ has become the most widely used measure of depression and is generally considered the gold standard of measures for depression utilized in clinical trials of antidepressant medication (Demyttenaere & DeFruyt, 2003). Significant developments in psychometric theory have been made since the $HRSD_{17}$ was developed in the 1950's, and the $HRSD_{17}$ has produced mixed results when evaluated by current psychometric standards.

The $HRSD_{17}$ has shown adequate internal consistency as reflected in Cronbach's alpha (α) statistic, with recent studies ranging from α=.46 to .97, and the majority of studies reporting α>.70. In addition, the majority of items on the $HRSD_{17}$ show adequate internal reliability, or homogeneity, reflected by item-to-total correlations greater than .20 (Nunnally & Bernstein, 1994). Eleven of the items routinely met the reliability criteria, but one item, labeled loss of insight, was quite inconsistent and may be problematic (Bagby, Ryder,

Schuller, & Marshall, 2004). In a review of research on the $HRSD_{17}$ for the last 23 years using MEDLINE searches, Bagby et al. (2004) found test-retest reliability for the total scale to range from .81 to .98. However, test-retest reliability at the item level was suspect, ranging widely from .00 to .85. Using the Structured Interview Guide for the Hamilton Depression Rating Scale, Williams (1988) obtained mean individual item test-retest reliability of .54. However, even by utilizing a structured interview, only four items met criteria for adequate reliability, defined as $r \geq .70$ (Bagby et al., 2004).

Item Response Theory (IRT) analysis, a method that compares actual item responses to estimated values, was applied to the $HRSD_{17}$ by several researchers. This method is more thoroughly discussed beginning on page 53. The IRT method was used to assess item sensitivity to change and the ability to discriminate a true treatment effect. Santor and Coyne (2001) found that the use of multiple value scoring on individual items was not ideal. Although most items on the $HRSD_{17}$ were sensitive to depression severity, 12 of 17 items had some problems with item response choices being able to discriminate severity of symptomatology. Rasch analysis, which uses mathematical and theoretical reasoning to determine an ideal underlying dimension (a construct being measured) and then analyzes how actual data fits this ideal model, was used to analyze the $HRSD_{17}$ (Bagby et al., 2004). Rasch analysis showed that unidimensionality was best served with a six-item scale composed of items for psychic anxiety, psychomotor retardation, work interest, general somatic symptoms, guilt, and depressed mood (Bech, Tanghoj, Andersen, & Overo, 2002; Maier & Philipp, 1985). A further analysis demonstrated that six items on the $HRSD_{17}$

showed problems related to unidimensionality (Maier, Heuser, Philipp, Frommberger, & Demuth, 1988).

Validity of the $HRSD_{17}$ has also been analyzed. Content validity, which indicates how well items reflect the known parameters of the construct being measured, has been criticized on the $HRSD_{17}$ (Bagby et al., 2004). The $HRSD_{17}$ has remained intact for over 40 years and does not reflect the current *DSM-IV-TR* criteria for depression. The *DSM-IV-TR* criteria were written as the result of clinical and research data based upon expert opinion and serve as the current accepted model for diagnosis. With respect to the *DSM-IV-TR* criteria, the $HRSD_{17}$ does not specifically assess feelings of worthlessness, problems with concentration, decision-making difficulties, hypersomnia, or weight gain.

The $HRSD_{17}$'s ability to statistically reflect change in depressive symptoms with treatment was demonstrated effectively in a meta-analysis by Lambert, Hatch, Kingston, and Edwards (1986) analyzing 36 studies with 1,850 patients. The $HRSD_{17}$ was found to be more sensitive to change in depressive symptoms when compared to the Beck Depression Inventory (BDI; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961) and the Zung Self-Rating Depression Scale (Zung 1965), popular self-report measures. Lambert, Masters, and Astle (1988) found that the $HRSD_{17}$ was more likely to be sensitive to treatment changes after three weeks compared to the BDI, the most widely used self-report measure of depressive symptoms.

Finally, convergent validity, or the degree to which a scale correlates with similar measures, was consistently demonstrated with the $HRSD_{17}$ (Bagby et al., 2004). The $HRSD_{17}$ showed acceptable convergent validity with the BDI (Kobak, Greist, Jefferson,

Mundt, & Katzelnick, 1999), the IDS_{30} (Rush et al., 2003), the Montgomery Asberg Depression Rating Scale (Rehm & O'Hara, 1985) and the Zung Self-Rating Depression Scale (Gottlieb et al., 1988). Research has shown the $HRSD_{17}$ to be effective in discriminating different groups of clinical patients. For example, Zheng and colleagues (1988) found that the Chinese version of the $HRSD_{17}$ could discriminate between mild, moderate, and severe functional depression. Thase and colleagues showed that the $HRSD_{17}$ can differentiate endogenous from non-endogenous depression (Thase, Hersen, Bellack, Himmelhoch, & Kupfer, 1983). In a later study, Kobak and colleagues showed the instrument could discriminate between no depression, minor depression, and major depression (Kobak et al.,1999).

Although the $HRSD_{17}$ has demonstrated generally strong internal consistency, test-retest reliability, and concurrent validity, the $HRSD_{17}$ has been criticized for content validity, particularly for not embracing the current *DSM-IV-TR* diagnostic criteria. Critics of the clinician-rated $HRSD_{17}$ have noted additional limitations, observing that the scale does not include some symptoms of atypical and endogenous depression and gives differential item weighting to some symptoms (Rush, Giles, Schlesser, Fulton, Weissenburger, & Burns, 1986). Because of the clinician-rated format of the scale, the $HRSD_{17}$ requires clinician time for administration. Finally, research has indicated that certain individual items are problematic and that the $HRSD_{17}$ is not a unidimensional scale.

PSYCHOMETRIC PROPERTIES OF THE IDS_{30} AND THE $QIDS_{16}$

The $QIDS_{16}$ and the IDS_{30} were developed to address the limitations of previously developed patient and clinician rating scales of depression. In developing the $QIDS_{16}$ and the IDS_{30}, *DSM-IV-TR* depressive symptom criteria items (see Table 1 on page 18) were used as the basis for scale item development. The IDS_{30} and $QIDS_{16}$ have anchor points that specify the severity and frequency of symptoms and provide equivalent weightings for each symptom using a 0 to 3 value of intensity (Gullion & Rush, 1998; Trivedi et al., 2004). In addition, the scales are able to offer matched patient and clinical ratings. Self-report versions, the IDS-SR_{30} and the QIDS-SR_{16}, rate identical depressive symptoms with equivalent anchors as found in the clinician-rated versions, the IDS-C_{30} and the QIDS-C_{16}. The $QIDS_{16}$ is a shorter version of the IDS_{30} and was developed to be more time-efficient in both clinical and research settings. While the IDS_{30} takes 15 to 20 minutes to complete, the $QIDS_{16}$ only takes 5 to 7 minutes, making it an expeditious choice for the fast-paced modern medical office. The $QIDS_{16}$ scales focus on the nine *DSM-IV-TR* criterion symptom domains and are constructed from IDS_{30} items. The nine *DSM-IV-TR* symptom domains addressed on the $QIDS_{16}$ include sad mood, concentration, self-criticism, suicidal ideation, interest, energy/fatigue, psychomotor agitation/ retardation, change in appetite/weight, and sleep disturbances (including initial, middle, or late insomnia and hypersomnia).

In addition to the domains addressed on the $QIDS_{16}$, the IDS_{30} contains items pertaining to body aches and pains, leaden paralysis, interpersonal rejection sensitivity, sexual interest, digestive problems, capacity for pleasure, anxious mood, panic or phobic

symptoms, irritable mood, mood reactivity, distinct mood quality, and diurnal mood variation (Rush, Gullion, Basco, Jarrett, & Trivedi, 1996).

The IDS_{30} has consistently shown robust psychometric properties. Internal consistency is strong. Based on a sample of 456 subjects, including normal controls and outpatients with major depression, Rush and colleagues (1996) obtained Cronbach's α of .94 for both the self-report and clinician-rated versions. Among subjects with major depression (n=338), the IDS-C_{30} was found to have α=.67 and α=.77 for the IDS-SR_{30}. Corruble and colleagues examined reliability for the IDS_{30} utilizing a sample of 68 adult inpatients with major depression (Corruble, Legrand, Duret, Charles, & Guelfi, 1999). Cronbach's α of .75 for the IDS-C_{30} and .79 for the IDS-SR_{30} were obtained. In a sample of 62 subjects including 28 inpatients and 34 outpatients with major depression, Biggs et al. (2000) found Cronbach's α of .82 and .83 for the IDS-C_{30} and the IDS-SR_{30}, respectively. Thus the two versions of the IDS_{30} consistently show excellent internal consistency.

The more recently developed $QIDS_{16}$ also shows high internal consistency. Rush and colleagues report a study utilizing 596 adult outpatients with nonpsychotic chronic major depression (Rush et al., 2003). The study reported Cronbach's α coefficients of .92 for the IDS-SR_{30} and .86 for the QIDS-SR_{16}. The following year, a study examined the self-report and clinician-rated versions of the $QIDS_{16}$ and the IDS_{30} in a sample of 544 patients with Major Depressive Disorder (MDD) and 402 patients with Bipolar Disorder. For the patients with MDD, Cronbach's α coefficients were reported of .92 for the IDS-SR_{30}, .90 for the IDS-C_{30}, .86 for the QIDS-SR_{16}, and .85 for the QIDS-C_{16}. For the bipolar group, Cronbach's α

coefficients of .89 for the IDS-C_{30} and .81 for the QIDS-C_{16} were reported (Trivedi et al., 2004).

Rush and colleagues (1996) performed a factor analysis of the IDS_{30} with 353 depressed outpatients. They found three factors: 1) anxiety/arousal; 2) cognitive/mood; and 3) sleep and appetite regulation. In 2003, Rush and colleagues analyzed the IDS-SR_{30} and the QIDS-SR_{16} using Item Response Theory (IRT; see page 53) and found the scales to be adequately unidimensional to allow permit successful IRT analysis and to allow for the creation of conversion tables between the two scales and the $HRSD_{17}$.

The IDS_{30} and the $QIDS_{16}$ show strong content validity (Rush et al., 2003). Both instruments are comprised of items that rate the nine core symptom domains included in the *DSM-IV-TR*'s major depression symptom criteria. Both the IDS-SR_{30} and the IDS-C_{30} contain items which assess for endogenous, melancholic, and atypical depressive symptoms. The *DSM-IV-TR* represents the official nosology for psychiatry, and the criteria for depression reflects a consensus regarding developments in research and clinical expert opinion. Thus, the content of individual items on the IDS_{30} and $QIDS_{16}$ directly evolved from the consensual opinion of what constitutes major depression.

An examination of criterion or convergent validity found that the IDS_{30} and $QIDS_{16}$ show a strong correlational relationship to scores obtained with other instruments used to measure depression. An investigation of the relationship between the IDS_{30}, the $HRSD_{17}$, and the 21-item BDI was conducted for 434 outpatients with MDD and 103 nondepressed controls (Rush et al., 1996). Pearson product moment correlations were found of .88 between the IDS-SR_{30} and the $HRSD_{17}$ and of .95 between the IDS-C_{30} and the $HRSD_{17}$.

The relationship between the BDI and the IDS-SR_{30} yielded a correlation of .93, and the correlation between the BDI and the IDS-C_{30} was .86. The correlation between the IDS-SR_{30} and the IDS-C_{30} was .91. Examining correlations at study exit after 12 weeks of outpatient treatment for 596 patients, Rush et al., (2004) found strong correlations between the IDS-SR_{30} and several versions of the Hamilton Rating Scale for Depression, including the $HRSD_{17}$ (.84), the $HRSD_{21}$ (.85), and the $HRSD_{24}$ (.86). The QIDS-SR_{16} showed strong correlations with established measures including the $HRSD_{17}$ (.81), the $HRSD_{21}$ (.82), the $HRSD_{24}$ (.84), and the IDS-SR_{30} (.96). Trivedi and colleagues (2004) found strong correlations between the QIDS-C_{16} and the IDS-C_{30} with a correlation of .81 in a sample of 402 patients with Bipolar Disorder and a correlation of .82 in a sample of 544 subjects with MDD. In addition, a correlation of .83 was obtained between the QIDS-SR_{16} total score and the IDS-SR_{30} total score in 544 adult outpatients with MDD.

Research on the IDS_{30} has shown that it can discriminate between groups of differing diagnostic status. IDS_{30} scores proved effective at differentiating major depression from dysthymic disorder (Rush, Hiser, & Giles, 1987) and nonendogenous depression from endogenous depression (Rush et al., 1987; Domkin et al., 1994). Additionally, the IDS_{30} discriminated between nondepressed and depressed subjects (Jenkins, Carmody, and Rush, 1998; Suris, Kashner, Gillaspy, Biggs, & Rush, 2001).

The IDS_{30} and the $QIDS_{16}$ can indicate change with treatment. In a sample of 434 outpatients with MDD and 103 nondepressed controls, Rush and colleagues (1996) found that the IDS_{30} has comparable sensitivity to change as the $HRSD_{17}$ and the BDI. Corruble and colleagues (1999) found the IDS-C_{30} and the IDS-SR_{30} to be equally sensitive to change

in depressive symptoms as the Montgomery-Asberg Depression Rating Scale, another frequently-used clinician-rated scale (MADRS; Montgomery & Asberg, 1979). In addition, Rush, Carmody, & Reimitz (2000) evaluated the change in depressive symptoms in 993 outpatients with MDD and found the IDS-SR_{30} and the $HRSD_{24}$ to show similar sensitivity to change. The QIDS-SR_{16} was shown to be as sensitive to symptom change as the IDS-SR_{30} and the $HRSD_{24}$, indicating high concurrent validity for all three scales (Rush et al., 2003). This analysis was obtained when symptom change was conceived as a discontinuous variable (response or remission) in a sample of 596 adult outpatients treated for chronic nonpsychotic MDD. In a large study of outpatients with major depression and Bipolar Disorder, Trivedi and colleagues (2004) found the QIDS-SR_{16}, QIDS-C_{16}, IDS-SR_{30}, and IDS-C_{30} to show equal and strong sensitivity to symptom change. In a study (*n*=681) of patients with MDD in three treatment groups; consisting of psychotherapy, combination treatment with psychotherapy and medication, and medication alone; comparable symptom change scores for depression within groups were found for the QIDS-SR_{16}, the IDS-SR_{30}, and the $HRSD_{24}$ (Rush et al., 2005). By basing rates on the $HRSD_{24}$, researchers were able to confirm response and remission rates with the IDS-SR_{30} and the QIDS-SR_{16}. Thus, the $QIDS_{16}$ and IDS_{30} show comparable sensitivity to changes in depression severity during treatment and are effective in distinguishing response from remission (Rush et al., 2003). Both instruments were used to establish between-group treatment effects in medication trials (Rush et al., 1996, 2000, 2003, 2005; Trivedi, Rush, Pan, & Carmody, 2001; Trivedi et al., 2004; Corruble et al., 1999). Sensitivity to symptom change in the IDS_{30} is comparable to or better than discriminant abilities of the BDI (Rush et al., 1996), the MADRS (Corruble et al.,

1999), and the HRSD (Rush et al., 2000, 2003). In addition, the IDS_{30} showed slightly greater sensitivity to lower-range scores (Rush et al., 1996; Corruble et al., 1999).

Research comparing the QIDS-SR_{16} and the IDS-SR_{30} in sensitivity to responders and remitters has shown the two instruments to have excellent agreement of over 90% (Rush et al., 2003). Previous research has found that the QIDS-SR_{16} may be more sensitive to change in depressive symptoms, since the number of patients classified by the IDS-SR_{30} as non-responders and non-remitters and by the QIDS-SR_{16} as responders and remitters is significantly greater than the opposite classification. The QIDS-SR_{16} is seen as being somewhat less sensitive to residual (i.e. non-criterion) symptoms than the IDS-SR_{30} (Rush et al., 2003; Trivedi et al., 2004).

In summary, the IDS_{30} and the $QIDS_{16}$ demonstrate excellent psychometric properties with reference to both reliability and validity. The $QIDS_{16}$ is a newer assessment scale and does not yet boast the body of literature confirming its psychometric properties that the IDS_{30} has amassed, but studies thus far have found robust validity and reliability (Rush et al., 2003, 2006).

CHAPTER THREE
Rationale, Questions, and Hypotheses

RATIONALE AND AIMS

Research literature shows a high 12-month and lifetime incidence of depression in the general population (Kessler, Berglund, et al., 2005; Kessler, Chin, et al., 2005). In addition, Wang and colleagues (2005) found that primary care medical practitioners provide the majority of treatment for mood disorders, pointing to the necessity of having valid screening instruments available to the primary care physician to assist in the detection of depressive illness.

The QIDS-SR_{16} and the IDS-SR_{30} were found to be useful measures of depressive symptom severity in previous studies (Rush et al., 1996, 2000; Biggs et al., 2000; Corruble et al., 1999). The fact that these instruments employ the *DSM-IV-TR* symptom criteria makes them attractive as both clinically viable rating scales and appropriate for research settings. The evaluation of a comprehensive array of depressive symptoms gives the physician important information in individual depressive patterns and may provide for a more thoughtful treatment approach. Establishing the validity and reliability of the QIDS-SR_{16} in a variety of patient populations drawn from general medical practice, as opposed to focusing on predominantly psychiatric populations, may further demonstrate the utility of this evaluation rating scale for the general medical practitioner as well as further establishing its viability as a self-report measure of depression in assessing treatment response in researching depression in specific primary medical populations.

A high level of comorbidity exists between depression and asthma. Estimates of the rate of depression among asthma patients ranges from 13% (Yellowlees et al., 1988) to almost 66% (Krommydas et al., 2004). There are indications that depression may be comorbid with asthma at a higher rate than among other chronic and serious medical conditions (Bennett, 1994; Padur et al., 1995).

Differential diagnosis and the determination of the relative role of emotional distress in asthma are challenging. Asthma patients' primary complaints may be somatic in nature, but psychophysiological research clearly demonstrates the adverse effects of negative emotion and stress on the integrity of airway functioning (Ritz, Claussen, & Dahme, 2001). Brown, Vigil, Khan, Liggin, Carmody, and Rush (2005) showed that the successful treatment of depression in asthma patients resulted in the need for lower dosages of medication to manage the illness in some patients. Thus, it is difficult to determine if the underlying respiratory symptoms and distress are in part a reflection of psychological reactors as well as a result of the physical disease process. In addition, corticosteroids may cause psychological side effects that imitate a mood disorder. Research confirms that asthma patients often go untreated for their depressive symptoms. This fact is of particular concern because depressed asthmatics may have worse symptoms and outcomes than nondepressed asthmatics. While difficult, accurate assessment of depressive symptoms is important in the comprehensive treatment of the asthma patient.

In reviewing relevant research, there appear to be no published studies of psychometric validations of depressive scales in populations comprised of asthma patients exclusively. The present study is an analysis of the psychometric properties of the QIDS-

SR_{16} in asthma patients. The research is important to support the validity of the QIDS-SR_{16} as a depressive symptom measurement tool in asthma patients and to provide the primary care physician with valid, reliable tools to use in achieving quality patient care.

Given the lack of research in this area, the present study seeks to do the following: (1) evaluate the psychometric properties of the QIDS-SR_{16} in an asthma population using Classical Test Theory, including reliability measures and construct and concurrent validity measures; and (2) determine if a relationship exists between the QIDS-SR_{16}, IDS-SR_{30}, and the $HRSD_{17}$ scores using Item Response Theory.

QUESTIONS AND HYPOTHESES

The present study is a data analysis designed to investigate the psychometric properties of the QIDS-SR_{16} (to be extracted from the IDS-SR_{30}) and the utility of this scale in measuring depressive symptoms in asthma patients. Two separate theoretical frameworks of measurement, Classical Test Theory and Item Response Theory, were used to analyze these measures. For a detailed description of these methodologies, see Chapter 5 beginning on page 53.

Classical Test Theory

Research Question One: What are the psychometric properties of the QIDS-SR_{16} in an adult asthma population, utilizing Classical Test Theory?

Hypothesis One: The QIDS-SR_{16} will demonstrate good internal reliability, and individual test means and standard deviations for baseline and exit individual items on the QIDS-SR_{16}, the IDS-SR_{30}, and the $HRSD_{17}$ may be obtained.

Item Response Theory

Research Question Two: What is the relationship between the scores on the QIDS-SR_{16}, the IDS-SR_{30} and the $HRSD_{17}$?

Hypothesis Two: The relationship between individual items on the QIDS-SR_{16}, the IDS-SR_{30} and the $HRSD_{17}$ will be established with the creation of inter-test conversion tables.

Construct Validity

Research Question Three: Does the QIDS-SR_{16} show strong concurrent validity with the IDS-SR_{30} and with the $HRSD_{17}$?

Hypothesis Three: The QIDS-SR_{16} will show strong concurrent validity with the IDS-SR_{30} and with the $HRSD_{17}$.

Research Question Four: Does the QIDS-SR_{16} show test homogeneity, thus measuring a single construct--depression--in asthma patients?

Hypothesis Four: The QIDS-SR_{16} will show good test homogeneity, indicated by item-total correlations.

Research Question Five: Is the QIDS-SR_{16} sensitive to changes in depressive symptoms over treatment duration?

Hypothesis Five: The QIDS-SR_{16} will show sensitivity to change in depressive symptoms over treatment duration.

Research Question Six: Are certain QIDS-SR_{16} items of greater importance in differentiating change in depressive symptoms over the course of the study?

Hypothesis Six: Certain QIDS-SR_{16} items will be of greater importance in differentiating change in depressive symptoms over the course of the study. It is hypothesized that one variable, sleep disturbance, found in previous research to have a relationship to depression in asthma patients, will be predictive of the change in symptomatology over treatment duration.

Research Question Seven: Is the QIDS-SR_{16} in agreement with the IDS-SR_{30} and the $HRSD_{17}$ in identifying remission and response to treatment?

Hypothesis Seven: The QIDS-SR_{16}, the IDS-SR_{30}, and the $HRSD_{17}$ will show comparable effectiveness in identifying response and remission to treatment.

Research Question Eight: Do higher scores on the QIDS-SR_{16} correlate significantly with reduced functional impairment scores on the Mini-Asthma Quality of Life Questionnaire (MiniAQLQ)?

Hypothesis Eight: There will be a significant negative correlational relationship between the QIDS-SR_{16} and MiniAQLQ scores. As depressive symptoms are reduced in intensity, perceived quality of life will increase in asthma patients.

CHAPTER FOUR
Methodology

As previously noted, the present study is an analysis of data which was originally collected by a research team led by principal investigator, E. Sherwood Brown, M.D., Ph.D. The initial study was a randomized, controlled trial of citalopram vs. placebo in asthma patients (Brown et al., 2005), and the study design is described in the following section.

PARTICIPANTS

Ninety patients were recruited for participation in a randomized, double-blind, placebo-controlled trial, with 82 patients returning for at least one post-baseline visit. Table 2 shows the demographic characteristics of participants. Demographic characteristics of treatment and control groups were similar. Both groups were comprised of 33 women (80.5%) and 8 men (19.5%). Mean age of the treatment group was 40.4 years (SD=10.8), and mean age of the placebo group was 42.9 years (SD=10.1). Both study groups were more than 50.0% Hispanic; the treatment group was 39.0% African-American and 4.9% Caucasian, compared to 31.7% and 12.2% of the placebo group, respectively. In the treatment group, 54.0% of the patients spoke English versus 56.0% of the placebo group; all other patients spoke Spanish. Fifty-six percent of all patients reported yearly gross incomes below $15,000.

Table 2

Demographic and Clinical Characteristics of Study Participants (n=82)

	Citalopram (*n*=41)	Placebo (*n*=41)
Mean age ± SD	40.4 ± 10.8	42.9 ± 10.1
Gender, n (%)		
Male	8 (19.5%)	8 (19.5%)
Female	33 (80.5%)	33 (80.5%)
Race/Ethnicity, n (%)		
Caucasian	2 (4.9%)	5 (12.2%)
African-American	16 (39.0%)	13 (31.7%)
Hispanic	22 (53.7%)	23 (56.1%)
American Indian	1 (2.4%)	0 (0.0%)
Primary Language Spoken		
English	22 (54.0%)	23 (56.0%)
Spanish	19 (46.0%)	18 (44.0%)
Annual Gross Income		
$0-$15,000	23 (56.0%)	23 (56.0%)
>$15,000	18 (44.0%)	18 (44.0%)

Some subjects were identified for study participation based on routine screening at the asthma clinic of the Parkland Health and Hospital System, the county hospital serving Dallas, Texas. Other subjects were recruited through flyers, television announcements, or another means of advertisement. Subjects signed IRB-approved informed consent forms which told of risks, benefits, and alternatives to participation in the study. To minimize risk to subjects, frequent follow-up appointments were scheduled, and subjects were provided with telephone numbers to contact investigators 24 hours a day. Additional precautions included pregnancy testing for women of childbearing potential and plans for removal of

patients from the study in the case of worsening asthma or depression, hospitalization, or noncompliance with treatment. Confidentiality of patient records was maintained by storing all data in locked file cabinets or password-protected computers.

Patients included in the randomization initially had to meet criteria for asthma based on physician diagnosis and for depression based on the Mini-International Neuropsychiatric Interview (MINI; Sheehan, LeCrubier, Sheehan, Amorim, Janavs, & Weiller, 1998) and a clinical interview with a psychiatrist. Inclusion criteria consisted of (a) current treatment for asthma, which includes taking asthma medication; (b) current Major Depressive Disorder; (c) current $HRSD_{17}$ score of at least 17; (d) age between 18 and 65 years; and (e) English or Spanish-speaking. Exclusion criteria consisted of (a) current alcohol/substance abuse or dependence; (b) positive urine drug screen; (c) elevated TSH test (thyroid functioning); (d) Major Depressive Disorder with psychotic features; (e) Bipolar Disorder; (f) Schizophrenia or Schizoaffective Disorder; (g) Obsessive Compulsive Disorder; (h) mental retardation or other severe cognitive impairment; (i) current incarceration in prison or jail; (j) pregnant or nursing women or women of child-bearing potential who will not use birth control or abstinence during the study; (k) treatment-resistant depressed persons (i.e. have failed two adequate antidepressant trials); (l) history of allergic reactions, severe side effects, or non-response to citalopram; (m) current antipsychotic therapy; (n) initiation of other psychotropic medications or psychotherapy within the past 4 weeks; (o) high risk for suicide (i.e. at least 3 past suicide attempts or current suicidal ideation with plan or intent); and (p) prior treatment with citalopram. Subjects were paid for their participation and provided with parking passes or bus tokens. As previously noted, 82 patients returned for at least one post-baseline visit,

with 47 patients completing all 12 weeks of the study. IDS-SR_{30} and $HRSD_{17}$ measures with missing items were not used in the data analysis, leaving 73 subjects with baseline data and at least one post-baseline interview.

MATERIALS

Patients were assessed at baseline and weeks 1, 2, 4, 8, and 12 with the following measures:

1. The 30-item self-report version of the Inventory of Depressive Symptomatology (IDS-SR_{30}; Rush et al., 1986, 1996) was used to measure depressive symptoms on an item-by-item severity scale of 0 to 3, with possible total scores ranging from 0 to 84. The psychometric properties are discussed beginning on page 34. The IDS_{30} gives equal weighting to all items, and each item was designed to measure a single symptom construct. The items are scaled to be sensitive to mild levels of symptomatology. Anchor points are specifically worded to facilitate self-report with the smallest amount of subjective interpretation (Rush et al., 2000). The IDS_{30} was designed to serve as a screening instrument for depressive symptoms. It provides a useful guide to treatment planning by helping to subtype depressive symptoms (e.g. atypical vs. melancholic), to evaluate treatment outcomes, and to provide a steady measure to assess the appropriateness of treatment regimen changes (Rush et al., 1986, 1996).

2. Scores for the 16-item self-report Quick Inventory of Depressive Symptomatology (QIDS-SR_{16}; Rush et al., 2003) were derived by computer from the IDS-SR_{30} scores for use in the present study. The psychometric properties of the QIDS-SR_{16} are

discussed beginning on page 34. The QIDS-SR_{16} is comprised of items that correspond to the nine depressive symptom criterion domains from the *DSM-IV-TR*. For symptom domains requiring more than one item (i.e. appetite/weight change, sleep disturbance, and psychomotor agitation/retardation), the response to the highest scored item in the domain is included in the total score. Possible total scores range from 0 to 27.

3. The clinician-rated 17-item Hamilton Rating Scale for Depression ($HRSD_{17}$; Hamilton 1960, 1967) was administered to measure depressive symptoms. Each item is rated on either a 3 or 5 point scale. The $HRSD_{17}$ is considered the gold standard of scales and is the most frequently used in determining the effectiveness of antidepressant medication (Bagby et al., 2004). The HRSD is available in 17, 21, 24, 28, and 31 item versions, and the psychometric properties of the 17-item version are discussed beginning on page 30.

Additionally, the Mini Asthma Quality of Life Questionnaire (MiniAQLQ), a 15-item measure designed to assess functional impairment in adults with asthma (Juniper, Guyatt, Cox, Ferrie, & King, 1999), was administered at baseline and week 12. Items on the MiniAQLQ are concerned with four domains: symptoms, activity limitation, emotional function, and environmental stimuli. Psychometric properties for the MiniAQLQ are very acceptable, with good reliability indicated by an intraclass correlation coefficient of .83 (Juniper et al., 1999). The MiniAQLQ detected change in perceived well-being at p=.0007 (Juniper et al., 1999).

METHODS FOR DEFINING RESPONSE AND REMISSION

A reduction of ≥50% in baseline total score for each scale ($IDS\text{-}SR_{30}$, $QIDS\text{-}SR_{16}$, and $HRSD_{17}$) constituted a response to treatment. Remission threshold was determined based upon the IRT analysis, using the scores on the $IDS\text{-}SR_{30}$ and $QIDS\text{-}SR_{16}$ that corresponded to a score of 7 on the $HRSD_{17}$. The remission threshold of ≤7 on the $HRSD_{17}$ was established *a priori* based upon consensus in research on the measurement of depressive symptoms (Frank, Prien, Jarrett, Keller, Kupfer, Lavori, et al., 1991).

PROCEDURE

After the study design was approved by the Institutional Review Board of the University of Texas Southwestern Medical Center at Dallas, 90 patients were recruited. After signing the informed consent form, subjects at baseline were administered the MINI, a structured interview, to identify Major Depressive Disorder. Diagnosis was confirmed by clinical interview with a psychiatrist. Self-report and clinical assessment was conducted in subjects' primary language. Assessment at baseline, as noted previously, included the $HRSD_{17}$, the $IDS\text{-}SR_{30}$, and the MiniAQLQ, in addition to the Somatic Symptom Scale of the Psychobiology of Recovery in Depression-III (a measure of side effects), and the Asthma Control Questionnaire (a measure of clinical impairment). Subjects were randomly assigned to 12 weeks of treatment with either citalopram (20 mg/day at first) or a placebo which was identical in appearance to the study drug. If response to treatment was not adequate, defined by $HRSD_{17}$ score decrease of less than 30% by week 4 or at least 40% by week 8, medication

dosage or placebo was increased. At each follow-up interval (weeks 1, 2, 4, 8, and 12), current oral corticosteroid use was assessed based on subject report, and the $HRSD_{17}$ and $IDS\text{-}SR_{30}$ were administered.

CHAPTER FIVE
Statistics

PSYCHOMETRIC THEORY AND DATA ANALYSIS

A brief summary of psychometric theory will be presented to serve as a context for the statistical data analysis of this study. A comprehensive treatment of psychometric theory is beyond the scope of this paper, but the interested reader is referred to Nunnally (1978), Michell (1990), and Clark and Watson (1995) for more comprehensive examinations of psychometrics.

The psychometric properties of a scale may be described utilizing two separate theoretical frameworks of measurement. These alternate methodologies are Classical Test Theory and Item Response Theory. The two theoretical approaches can complement one another, with each providing unique information regarding the psychometric properties of a test instrument. Classical Test Theory can provide valuable information regarding the internal consistency of a test instrument, including reliability data and information regarding test homogeneity. In addition, the unidimensionality of a test may be determined using factor analysis. Item Response Theory can be used to equate different measures. Other uses for Item Response Theory include analyzing the viability of individual test items, identifying items as potential sources of test bias, creating test score scales from different test populations or different test forms, and allowing a basis for adaptive testing in computerized assessment (Hays, Morales, & Reise, 2000).

Classical Test Theory (CTT) is often referred to as true-score theory, or a theory of true and error scores. The basic tenet of CTT is that test scores result from two sources. The first is the true score of a stable individual attribute that the test attempts to measure, such as depression. True scores contribute to consistency within the test. The second source is composed of variables which are extraneous to the trait measured and are represented by errors in measurement, or discrepancies between true scores and actual scores on the test. These discrepancies lead to inconsistency in the measure. CTT emphasizes test reliability, which is an expression of error-variance and true-variance influences on actual test scores. Mathematically, reliability coefficients reflect the ratio of the variance of true scores to the total variance of the test scores.

Item Response Theory (IRT) is an alternative perspective for analyzing test data. It is a modern test theory and an increasingly appreciated approach that is being actively developed and researched. Item Response Theory is also called latent-trait theory. As the name indicates, IRT scores are item-based (Cella and Chang, 2000). In contrast to CTT, which generally sums across all scale items, IRT focuses on individual item scores and on a probability model for each item. This model reflects the probability of a response with respect to the subject's level of the measured trait. Hays and colleagues (2000) state, "IRT models yield item- and latent-trait estimates (within a linear transformation) that do not vary with the characteristics of the population with respect to the underlying trait." It is postulated that underlying a person's response on a specific item is a latent trait that may be estimated (Hambleton, 2000), and the relationship between the latent trait and the response can be

determined for each test item by means of a monotonically increasing function known as an item characteristic curve (Clark & Watson, 1995).

IRT assumes that the trait measured is "unidimensional" or that a "single ability or factor is mainly responsible for examinee responses to the item in a test." (Hambleton, 2000). Thus, the IRT assumption in this study is that the items on the IDS-SR_{30} and the QIDS-SR_{16} measure only the single dimension of depression. This latent-trait model can allow for assessing the traits measured, designing tests, and figuring statistics on test items, including analyzing item bias and tailoring tests for different groups and abilities. Of particular importance to the present study, IRT allows for equating, or the ability to compute the equivalent scores on one test with reference to the scores on another test (Hambleton, 2000).

Whether a test is developed by CTT or IRT methodology, or both, test validity, or the adequacy with which a test measures the attribute (in this case, depression) that it was developed to measure, is of critical importance. Various strategies for assessing validity have been established. The most broad-based is construct validity, which seeks to measure a test's validity using multiple approaches (Cronbach & Meehl, 1955). The construct validity approach seeks supportive evidence from content, criterion-based, discriminative, concurrent and predictive studies (Cronbach & Meehl, 1955). For example, the IDS-SR_{30} and the QIDS-SR_{16} demonstrate strong content validity, which is "determined by the degree to which the questions, tasks or items on a test are representative of the universe of behavior the test was designed to sample" (Gregory, 1992). If content validity, therefore, is basically a sampling issue, the IDS-SR_{30} and the QIDS-SR_{16} are a strong representation of depressive symptomatology, since the items are derived from *DSM-IV-TR* criteria. Construct validity

also is concerned with determining that test items measure a single construct. Test homogeneity is often measured by correlating individual test items with total test scores.

Criterion-related validity, which generally is considered to subsume concurrent validity and convergent validity, is demonstrated by relating scores on tests to subjects' performance on other relevant outcome measures. With concurrent validity studies, criterion information and test scores are obtained at the same time. Convergent validity is often determined by correlations between existing tests and a new test, thus validating that the new test measures the same psychological variable as the criterion reference. This correlation is frequently known as a validity coefficient. In the present study validity coefficients will reflect the relationship among the IDS-SR_{30}, the QIDS-SR_{16}, the $HRSD_{17}$, and the Mini-Asthma Quality of Life Questionnaire (MiniAQLQ).

Finally, construct validity may be determined if an intervention (e.g. treatment of depression) affects test scores in a manner that is consistent with the construct. The IDS-SR_{30}, the QIDS-SR_{16} and the $HRSD_{17}$ will be compared to calculate their agreement in identifying treatment response and symptom remission at study exit.

In order to provide a thorough psychometric analysis of the IDS-SR_{30} and the QIDS-SR_{16} in an asthma population, the present study examined multiple validity constructs as well as the properties of the IDS-SR_{30} and the QIDS-SR_{16} using both CTT and IRT. The research questions represent this strategy of data analysis.

STATISTICAL ANALYSIS

Descriptive statistics are reported for the following demographic variables: age, gender, race, primary language, and annual income (see Table 2). Specific statistical analysis was designed to address research questions and hypotheses set forth in this study.

Classical Test Theory

Research Question One: What are the psychometric properties of the QIDS-SR_{16} in an adult asthma population, utilizing Classical Test Theory?

Hypothesis One: The QIDS-SR_{16} will demonstrate good internal reliability, and individual test means and standard deviations for baseline and exit individual items on the QIDS-SR_{16}, the IDS-SR_{30}, and the $HRSD_{17}$ may be obtained.

The first aim of the study was to determine the psychometric properties of the IDS-SR_{30} and QIDS-SR_{16} in an adult asthma population. To this end, baseline and exit means and standard deviations for each of the individual items on the IDS-SR_{30}, QIDS-SR_{16}, and $HRSD_{17}$ were calculated. Additionally, Cronbach's α (Cronbach, 1951) was computed for the IDS-SR_{30}, QIDS-SR_{16}, and $HRSD_{17}$ to determine internal consistency of the measures. In order to maximize the range of scores on all of the measures, exit scores were used in the analysis.

Item Response Theory

Research Question Two: What is the relationship between the scores on the QIDS-SR_{16}, the IDS-SR_{30} and the $HRSD_{17}$?

Hypothesis Two: The relationship between individual items on the QIDS-SR_{16}, the IDS-SR_{30} and the $HRSD_{17}$ will be established with the creation of inter-test conversion tables.

A relationship between QIDS-SR_{16}, IDS-SR_{30}, and $HRSD_{17}$ scores was identified with Item Response Theory (IRT; Orlando, Sherbourne, & Thissen, 2000; Hambleton, Swaminathan, & Rogers, 1991). Utilizing exit scores, the relationship between the QIDS-SR_{16} total score and the IDS-SR_{30} total score, the IDS-SR_{30} total score and the total score on the $HRSD_{17}$, and the QIDS-SR_{16} total score and the total score on the $HRSD_{17}$ was estimated using IRT. IRT assumes that a scale is unidimensional; in other words, it assumes that all items measure the same latent trait. IRT estimates a generalized linear model for each scale item. As change occurs in symptom severity level, an item's estimated model parameters provide the ability to predict how response to the item will change. Symptom severity level is estimated from the data and treated as a latent trait (Hays et al., 2000). A set of model parameters was generated for all IDS-SR_{30} items, QIDS-SR_{16} items, and $HRSD_{17}$ items.

Construct Validity

Research Question Three: Does the QIDS-SR_{16} show strong concurrent validity with the IDS-SR_{30} and with the $HRSD_{17}$?

Hypothesis Three: The QIDS-SR_{16} will show strong concurrent validity with the IDS-SR_{30} and with the $HRSD_{17}$.

Concurrent validity was calculated using Pearson product moment correlations between the IDS-SR_{30}, QIDS-SR_{16}, and $HRSD_{17}$ at exit.

Research Question Four: Does the QIDS-SR_{16} show test homogeneity, thus measuring a single construct--depression--in asthma patients?

Hypothesis Four: The QIDS-SR_{16} will show good test homogeneity.

Individual item-to-total score Spearman correlations using scores obtained at study exit were computed for the IDS-SR_{30}, QIDS-SR_{16}, and $HRSD_{17}$ to demonstrate test homogeneity.

Research Question Five: Is the QIDS-SR_{16} sensitive to changes in depressive symptoms over treatment duration?

Hypothesis Five: The QIDS-SR_{16} will show sensitivity to change in depressive symptoms over treatment duration.

Within-group effect size (baseline to exit) for the IDS-SR_{30}, QIDS-SR_{16}, and $HRSD_{17}$ was computed for the drug and placebo groups. The effect size is measured by subtracting the exit score mean from the baseline score mean and then dividing this difference by the standard deviation of the difference. Analyses of effect size were used to determine sensitivity of the IDS-SR_{30} and QIDS-SR_{16} to changes in depression with treatment.

Research Question Six: Are certain QIDS-SR_{16} items of greater importance in differentiating change in depressive symptoms over the course of the study?

Hypothesis Six: Certain QIDS-SR_{16} items will be of greater importance in differentiating change in depressive symptoms over the course of the study. It is hypothesized that one variable, sleep disturbance, found in previous research to have a relationship to depression in asthma patients, will be predictive of the change in symptomatology over treatment duration.

Within-group effect size (baseline to exit) for the IDS-SR_{30}, QIDS-SR_{16}, and $HRSD_{17}$ was computed for the drug and placebo groups to determine if certain IDS-SR_{30} and QIDS-SR_{16} items were more sensitive to change over time.

Research Question Seven: Is the QIDS-SR_{16} in agreement with the IDS-SR_{30} and the $HRSD_{17}$ in identifying remission and response to treatment?

Hypothesis Seven: The QIDS-SR_{16}, the IDS-SR_{30}, and the $HRSD_{17}$ will show comparable effectiveness in identifying response and remission to treatment.

The IDS-SR_{30} and the QIDS-SR_{16} were compared to the $HRSD_{17}$ to calculate their effectiveness at identifying response and remission at exit. A reduction of $\geq$50% in baseline total score for each scale (IDS-SR_{30}, QIDS-SR_{16}, and $HRSD_{17}$) constituted a response to treatment. Remission threshold was determined based upon the IRT analysis, using the scores on the IDS-SR_{30} and QIDS-SR_{16} that corresponded to a score of 7 on the $HRSD_{17}$. A kappa statistic (κ) was used to measure agreement in the assessment of response and remission between the QIDS-SR_{16} and the IDS-SR_{30}. To assess whether the QIDS-SR_{16}, IDS-SR_{30} or $HRSD_{17}$ had a greater likelihood of misclassifying patients as responders or nonresponders, McNemar's test was calculated.

Research Question Eight: Do higher scores on the QIDS-SR_{16} correlate significantly with reduced functional impairment scores on the Mini-Asthma Quality of Life Questionnaire (MiniAQLQ)?

Hypothesis Eight: There will be a significant negative correlational relationship between the QIDS-SR_{16} and MiniAQLQ scores. As depressive symptoms are reduced in intensity, perceived quality of life will increase in asthma patients.

Spearman correlations were obtained to determine if baseline to exit improvement in total scores on the depression scales correlated with reduced functional impairment on the MiniAQLQ. This analysis was performed in order to assess the relationship between level of depression severity and perceived quality of life. Correlations for individual items on the QIDS-SR_{16} and the IDS-SR_{30} were also examined for their relationship to patient's perceived quality of life on the MiniAQLQ.

CHAPTER SIX
Results

INTERNAL CONSISTENCY

High internal consistency (Cronbach's α) was found for all measures using study exit scores (*n*=73). Internal consistency was equal for the QIDS-SR_{16} and $HRSD_{17}$ (α=.87) and slightly higher for the IDS-SR_{30} (α =.95). Cronbach's α coefficients increased from baseline measures to exit measures on all three scales. On the QIDS-SR_{16}, baseline to exit internal consistency increased from α=.75 to .87. On the IDS-SR_{30}, baseline to exit internal consistency increased from α=.89 to .95. $HRSD_{17}$ baseline to exit internal consistency increased from α=.53 to .87. The IDS-SR_{30} and QIDS-SR_{16} showed much stronger baseline internal consistency (α=.89 and .75, respectively) than the $HRSD_{17}$ (α=.53).

ITEM RESPONSE THEORY

The requirements of unidimensionality for the items on the QIDS-SR_{16}, the IDS-SR_{30}, and the $HRSD_{17}$ were established by an unrotated common factor analysis. The conversions between the QIDS-SR_{16} total score and the IDS-SR_{30} and $HRSD_{17}$ total scores using all subjects (*n*=73) are presented in Table 3. The QIDS-SR_{16} total score multiplied by a factor of 2.7 closely approximated the IDS-SR_{30} total score, and the QIDS-SR_{16} total score multiplied by a factor of 1.6 approximated the $HRSD_{17}$ total score. Table 4 shows the conversion of the total score of the IDS-SR_{30} to the QIDS-SR_{16} and the $HRSD_{17}$ total scores

from the IRT statistical analysis. The IDS-SR_{30} total score, multiplied by a value of .4, approximated the total score of the QIDS-SR_{16}. Similarly, the IDS-SR_{30} total score, multiplied by a value of .6, approximated the $HRSD_{17}$ total score.

Table 3

Conversion Between the QIDS-SR$_{16}$ Total Scores and the IDS-SR$_{30}$ and HRSD$_{17}$ Total Scores Using IRT Analysis at Study Exit[a]

QIDS-SR$_{16}$	IDS-SR$_{30}$	HRSD$_{17}$
0	0-2	0-2
1	3-4	3
2	5-6	4
3	7-8	5-6
4	9-11	7-8
5	12-14	9
6	14-16	10-11
7	17-19	12
8	20-22	13-14
9	23-25	15
10	26-28	16
11	29-31	17-18
12	32-34	19
13	34-37	20
14	37-39	21
15	40-42	22
16	43-45	23
17	46-48	24
18	49-50	25
19	51-55	26-27
20	53-57	28
21	58-60	29
22	61-64	30
23	63-67	31-32
24	67-70	33
25	70-73	34-36
26	73-79	37
27	80-84	38-52

n=73

[a]The only valid conversions that can be made from this table are between 1) QIDS-SR$_{16}$ and IDS-SR$_{30}$ and 2) QIDS-SR$_{16}$ and HRSD$_{17}$.

Table 4

Conversion Between the IDS-SR$_{30}$ Total Scores and the QIDS-SR$_{16}$ and HRSD$_{17}$ Total Scores Using IRT Analysis at Study Exit[a]

IDS-SR$_{30}$	QIDS-SR$_{16}$	HRSD$_{17}$
0	0	0
1	0	1
2	0	2
3	1	2
4	1	3
5	2	4
6	2	4-5
7	3	5
8	3	6
9-10	4	7
11	4	8
12-13	5	9
14	5-6	10
15	6	10
16	6	11
17	7	11
18-19	7	12
20-21	8	13
22	8	14
23	9	14
24-25	9	15
26-27	10	16
28	10	17
29	11	17
30-31	11	18
32-33	12	19
34	12-13	19
35-36	13	20
37	13-14	20
38-39	14	21
40-41	15	22
42	15	23
43-44	16	23
45	16	24

Table 4 continued on page 67

Table 4, continued:

$IDS\text{-}SR_{30}$	$QIDS\text{-}SR_{16}$	$HRSD_{17}$
46-47	17	24
48	17	25
49-50	18	25
51-52	19	26
53-55	19-20	27
56-57	20	28
58-60	21	29
61-62	22	30
63-64	22-23	31
65-66	23	31-32
67	23-24	32
68-69	24	33
70	24-25	34
71	25	34-35
72	25	35
73	25-26	36
74	26	36-37
75	26	37
76	26	38
77	26	39
78	26	39-40
79	26	40
80	27	41
81	27	42
82	27	43
83	27	44
84	27	45-52

n=73

[a]The only valid conversions that can be made from this table are between 1) $IDS\text{-}SR_{30}$ and $QIDS\text{-}SR_{16}$ and 2) $IDS\text{-}SR_{30}$ and $HRSD_{17}$.

The remission cutoff value reflecting the same level of severity as a score of ≤ 7 on the $HRSD_{17}$ was determined from the IRT analysis to be an $IDS\text{-}SR_{30}$ score of ≤ 10. Further utilizing IRT analysis, a remission cutoff score for the $QIDS\text{-}SR_{16}$ of ≤ 4 was established based upon correspondence with a score of ≤ 7 on the $HRSD_{17}$.

BASELINE AND EXIT MEANS AND STANDARD DEVIATIONS

Baseline and exit item and total score means and standard deviations for the $HRSD_{17}$, the IDS-SR_{30}, and the QIDS-SR_{16} are shown in Table 5. There is a consistent trend toward improvement in depressive symptoms in the exit group on all measures. For example, the total score on the $HRSD_{17}$ declined from a mean of 23.70 (SD=4.60) at baseline to a mean of 12.40 (SD=8.40) at exit. The $HRSD_{17}$ mean score for depressed mood fell from 2.68 (SD=.68) at baseline to a mean of 1.15 (SD=1.22) at exit; somatic anxiety decreased from a baseline mean of 2.55 (SD=1.09) to 1.67 (SD=1.31) at exit; and the baseline initial insomnia mean of 1.64 (SD=.63) dropped to an exit mean of .92 (SD=.86).

The IDS-SR_{30}, which encompasses the items of the QIDS-SR_{16}, showed similar improvement trends between baseline and exit mean scores. For instance, the IDS-SR_{30} total score dropped from a mean of 40.10 (SD=14.00) at baseline to an exit mean score of 20.80 (SD=17.20). The sad mood baseline mean of 1.97 (SD=.94) improved to an exit mean of .88 (SD=.99); anxious mood baseline mean of 1.66 (SD=.99) decreased to an exit mean of .81 (SD=.95); and baseline mean for onset insomnia of 2.14 (SD=.98) dropped to an exit mean of 1.12 (SD=1.19). The QIDS-SR_{16} total score decreased from a mean of 15.00 (SD=4.80) at baseline to an exit mean score of 7.80 (SD=6.00).

Table 5

Item and Total Means and Standard Deviations for the QIDS-SR$_{16}$, IDS-SR$_{30}$, and HRSD$_{17}$ at Study Baseline and Exit

	Baseline		Exit	
	Mean	SD	Mean	SD
QIDS-SR$_{16}$				
Sleep Disturbance	2.62	.72	1.89	1.06
Sad Mood	1.97	.94	.88	.99
Appetite/Weight Change	1.90	.96	1.04	1.02
Concentration	1.40	.92	.90	.99
Self Outlook	1.38	1.17	.71	1.16
Suicidal Ideation	.48	.73	.19	.43
Involvement	1.66	1.06	.60	.94
Energy	1.75	.92	.66	.80
Psychomotor Change	1.79	.85	.89	.94
TOTAL	15.00	4.80	7.80	6.00
IDS-SR$_{30}$				
Onset Insomnia	2.14	.98	1.12	1.19
Middle Insomnia	2.32	1.00	1.66	1.10
Early Morning Insomnia	1.79	1.19	.95	1.13
Hypersomnia	.62	.92	.30	.72
Sad Mood	1.97	.94	.88	.99
Irritable Mood	1.68	.98	.86	1.03
Anxious Mood	1.66	.99	.81	.95
Reactivity of Mood	1.38	1.14	.66	.96
Mood Variation	1.30	1.13	.70	1.02
Quality of Mood	1.68	1.10	.78	1.07
Appetite Change	1.66	.97	.73	.98
Weight Change	1.45	1.12	.73	.92
Concentration	1.40	.92	.90	.99
Self Outlook	1.38	1.17	.71	1.16
Future Outlook	1.25	.89	.70	.86
Suicidal Ideation	.48	.73	.19	.43
Involvement	1.66	1.06	.60	.94
Energy	1.75	.92	.66	.80
Enjoyment	1.42	1.01	.58	.90

Table 5 continued on page 70

Table 5, continued:

Sexual Interest	1.58	1.10	1.00	1.20
Psychomotor Slowing	1.29	.89	.51	.73
Psychomotor Agitation	1.30	1.10	.63	.94
Somatic Complaint	1.48	.94	.99	.86
Sympathetic Arousal	1.23	.96	.74	.80
Panic	.89	1.02	.53	.77
Gastrointestinal	.70	.95	.55	.85
Interpersonal Sensitivity	1.22	1.11	.64	.96
Leaden Paralysis	1.45	1.04	.70	.89
TOTAL	40.10	14.00	20.80	17.20
$HRSD_{17}$				
Depressed mood	2.68	.68	1.15	1.22
Guilt	2.01	1.02	.71	1.02
Suicide	.95	1.00	.23	.57
Initial Insomnia	1.64	.63	.92	.86
Middle Insomnia	1.66	.61	.92	.81
Delayed Insomnia	1.41	.72	.89	.86
Work/Interests	2.27	.95	.97	1.15
Retardation	.73	.73	.41	.62
Agitation	.82	.65	.47	.65
Psychic Anxiety	2.15	.89	1.33	1.12
Somatic Anxiety	2.55	1.09	1.67	1.31
Appetite	.71	.79	.41	.62
Somatic Energy	1.55	.55	.78	.82
Libido	1.11	.91	.66	.87
Hypochondriasis	.92	.68	.63	.77
Loss of Insight	.04	.20	.03	.16
Weight Loss	.47	.82	.23	.64
TOTAL	23.70	4.60	12.40	8.40

n=73

EFFECT SIZE

$HRSD_{17}$ within-group effect size for change from baseline to exit is presented in Table 6. The effect size is measured by subtracting the exit score mean from the baseline

score mean and then dividing this difference by its standard deviation. The $HRSD_{17}$ total score shows a large effect size (Cohen, 1988) in the treatment group (1.41). Individual items which show a large effect size in the treatment group and which contribute heavily to the total score effect size include depressed mood (1.30), guilt (1.62), work/interests (1.13), and somatic energy (.95).

Table 6

Effect Size for Change on the $HRSD_{17}$ from Baseline to Exit Within Treatment and Placebo Groups

	Effect Size	
	Treatment Group	Placebo Group
$HRSD_{17}$ Total Score	1.41	1.29
Depressed mood	1.30	1.09
Guilt	1.62	.91
Suicide	.66	.69
Initial Insomnia	.87	.62
Middle Insomnia	.94	.62
Delayed Insomnia	.48	.50
Work/Interests	1.13	1.04
Retardation	.47	.30
Agitation	.33	.45
Psychic Anxiety	.61	.56
Somatic Anxiety	.51	.79
Appetite	.53	.17
Somatic Energy	.95	.80
Libido	.41	.47
Hypochondriasis	.44	.18
Loss of Insight	.09	.00
Weight Loss	.38	.06

Within-group effect size for change from baseline to exit for the $QIDS\text{-}SR_{16}$ is presented in Table 7. The total score effect size for the $QIDS\text{-}SR_{16}$ is 1.20 for the treatment

group. Individual items that showed a large effect size for the treatment group include sad mood (1.05), energy (.92), and sleep disturbance (.83). Within-group effect size for change from baseline to exit for the IDS-SR_{30} is shown in Table 8. Total score effect size for the IDS-SR_{30} was 1.29 for the treatment group. Among the IDS-SR_{30} items, effect sizes that made a substantial contribution to the total effect size were sad mood (1.05), energy (.92), enjoyment (.87), quality of mood (.86), onset insomnia (.85), and appetite change (.83). Total effect size for baseline to exit for both the IDS-SR_{30} and the QIDS-SR_{16} was somewhat larger for the placebo group (1.41 and 1.32, respectively) compared to the treatment group.

Table 7

Effect Size for Change on the QIDS-SR_{16} from Baseline to Exit Within Treatment and Placebo Groups

	Effect Size	
	Treatment Group	Placebo Group
QIDS-SR_{16} Total Score	1.20	1.32
Sleep Disturbance	.83	.46
Sad Mood	1.05	.92
Appetite/Weight Change	.68	.73
Concentration	.56	.38
Self Outlook	.50	.56
Suicidal Ideation	.32	.42
Involvement	.69	1.06
Energy	.92	1.33
Psychomotor Change	.72	.88

Table 8

Effect Size for Change on the IDS-SR_{30} from Baseline to Exit Within Treatment and Placebo Groups

	Effect Size	
	Treatment Group	Placebo Group
IDS-SR_{30} Total Score	1.29	1.41
Onset Insomnia	.85	.60
Middle Insomnia	.43	.50
Early Morning Insomnia	.56	.64
Hypersomnia	.48	.23
Sad Mood	1.05	.92
Irritable Mood	.82	.74
Anxious Mood	.66	1.07
Reactivity of Mood	.64	.65
Mood Variation	.38	.64
Quality of Mood	.86	.54
Appetite Change	.83	.81
Weight Change	.44	.78
Concentration	.56	.38
Self Outlook	.50	.56
Future Outlook	.53	.57
Suicidal Ideation	.32	.42
Involvement	.69	1.06
Energy	.92	1.33
Enjoyment	.87	.70
Sexual Interest	.42	.61
Psychomotor Slowing	.76	.84
Psychomotor Agitation	.44	.64
Somatic Complaint	.61	.46
Sympathetic Arousal	.55	.46
Panic	.37	.40
Gastrointestinal	.25	.00
Interpersonal Sensitivity	.69	.40
Leaden Paralysis	.79	.63

CORRELATIONS AMONG DEPRESSION MEASURES

Total scores on the QIDS-SR_{16} showed high correlations with the IDS-SR_{30} (.97) and the $HRSD_{17}$ (.85) total scores at study exit (*n*=73). The IDS-SR_{30} total score was also highly correlated with the $HRSD_{17}$ total score (.88) at study exit. Baseline total score correlations between the QIDS-SR_{16} and the IDS-SR_{30} were strong (.93). Only moderate correlations were found at baseline between the $HRSD_{17}$ and the QIDS-SR_{16} (.45) and the $HRSD_{17}$ and the IDS-SR_{30} (.53). Baseline to exit change score correlations were very high between the IDS-SR_{30} and the QIDS-SR_{16} (.92), and moderate to high between the $HRSD_{17}$ and the QIDS-SR_{16} (.67), and the $HRSD_{17}$ and the IDS-SR_{30} (.69).

ITEM-TOTAL CORRELATIONS

Exit item-total correlations, measures of test homogeneity, were computed for the QIDS-SR_{16}. It is noteworthy that item-total correlations exceeded .60 on most items. Item-total correlations in rank order included psychomotor change (.81); concentration/ decision making (.78); sad mood (.77); involvement (.72); self outlook (.70); energy/ fatigability (.68); sleep disturbance (.68); and appetite/weight change (.60). Suicidal ideation (.57) was the only item to show more modest item-total correlations. All item-total correlations were significant ($p<.0001$).

On the IDS-SR_{30}, 75% of the items had item-total correlations greater than .60; these items included sad mood (.79); anxious mood (.79); reactivity of mood (.79); quality of mood

(.76); early morning insomnia (.72); onset and middle insomnia (.62); energy/fatigability (.71); leaden paralysis (.69); psychomotor agitation (.68); somatic complaints (.65); gastrointestinal problems (.61); pleasure and enjoyment (.74); and involvement (.69). Other item-total correlations exceeding .60 included concentration/ decision making (.76); self outlook (.69); future outlook (.66); appetite change (.68); and mood variation (.61). As with the QIDS-SR_{16}, a lower item-total correlation was found for suicidal ideation (.56). Other item-total correlations <.60 included sexual interest (.46); psychomotor slowing (.54); panic (.47); sympathetic arousal (.44); weight change (.23); and hypersomnia (.25). All correlations had statistical significance of $p<.05$, and only weight change ($p=.0489$) and hypersomnia ($p=.0323$) failed to meet a level of significance of $p<.0001$.

The $HRSD_{17}$ showed poorer test homogeneity, reflected by lower item-total correlations. Item-total correlations exceeding .60 were found in depressed mood (.76); guilt (.68); middle insomnia (.60); work/interests (.78); psychic anxiety (.73); somatic anxiety (.69); somatic energy (.71); and libido (.65). However, lower item-total correlations were found for suicide (.55); delayed insomnia (.56); retardation (.51); agitation (.36); appetite (.43); hypochondriasis (.40); loss of insight (.08); and weight loss (.15). Thus only 47% of items on the $HRSD_{17}$ had item-total correlations >.60.

RESPONSE AND REMISSION AGREEMENT

Response in the present study was defined as a reduction of >50% in baseline total score for each scale (IDS-SR_{30}, QIDS-SR_{16}, and $HRSD_{17}$). Remission threshold for this study was determined based upon the IRT analysis, using the scores on the IDS-SR_{30} and

QIDS-SR_{16} that corresponded to a score of 7 on the $HRSD_{17}$. The remission thresholds calculated for this sample defined remission on the QIDS-SR_{16} at a score of $\leq$4 and on the IDS-SR_{30} at a score of $\leq$10.

At study exit the κ statistic, which measures the chance-corrected percent agreement between the IDS-SR_{30} and the QIDS-SR_{16}, was .81 for response to treatment. For remission of depressive symptoms, the κ value was .86 at study exit. A κ statistic of .81 to .99 is considered a level of "almost perfect agreement" (Landis & Koch, 1977; Viera & Garrett, 2005). The IDS-SR_{30} and the QIDS-SR_{16} revealed classification agreement of patients as either nonresponders or responders in 90.4% of the subjects. Disagreements in classification were of two types: responders classified on the QIDS-SR_{16} were classified as nonresponders on the IDS-SR_{30} in 5.5% of subjects; responders on the IDS-SR_{30} were classified as nonresponders on the QIDS-SR_{16} in 4.1% of subjects. In response classification by the IDS-SR_{30} and QIDS-SR_{16}, neither showed greater likelihood than the other in classifying a subject as a responder or a nonresponder, according to McNemar's test (p<.7055).

The QIDS-SR_{16} and the IDS-SR_{30} demonstrated agreement on the classification of remitters versus nonremitters for 93.2% of the subjects. Patients classified as remitters on the QIDS-SR_{16} were classified as nonremitters on the IDS-SR_{30} in 4.1% of the subjects. In patients classified as remitters on the IDS-SR_{30}, only 2.7% were classified as nonremitters by the QIDS-SR_{16}. Neither scale showed a greater than chance probability of disagreeing on whether a subject is a remitter or nonremitter according to McNemar's test (p<.6547). Thus, the QIDS-SR_{16} showed comparable sensitivity to the IDS-SR_{30} in identifying remission of depression.

At study exit the κ statistic for response between the IDS-SR_{30} and the $HRSD_{17}$ was .64, and κ=.66 was calculated for remission. Values of κ ranging from .61 to .80 indicate substantial agreement (Landis & Koch, 1977). The $HRSD_{17}$ and IDS-SR_{30} were in agreement on classification of responders and nonresponders in 82.2% of the subjects. Patients classified by the $HRSD_{17}$ as responders were identified as nonresponders by the IDS-SR_{30} in 8.2% of subjects, while patients classified by the IDS-SR_{30} as responders were identified as nonresponders by the $HRSD_{17}$ 9.6% of the time. The difference between these two patterns of classification was not significantly above chance, according to McNemar's test (p<.7815).

The $HRSD_{17}$ and the IDS-SR_{30} agreed on the classification of remission in 83.6% of patients. The $HRSD_{17}$ classified patients as remitters while the IDS-SR_{30} classified the same patients as nonremitters, in only 1.4% of patients. In contrast, the IDS-SR_{30} classified patients as remitters when the $HRSD_{17}$ classified them as nonremitters in 15.1% of subjects. There was a significant difference of p<.0039 according to McNemar's Test, indicating greater likelihood for the IDS-SR_{30} classification of patients as remitters and the $HRSD_{17}$ classification as nonremitters.

Response agreement between the QIDS-SR_{16} and the $HRSD_{17}$ yielded a κ statistic of .56 with remission agreement of κ=.53. A κ range of .41 to .60 is considered "moderate agreement" (Landis & Koch, 1977). Remission agreement between the QIDS-SR_{16} and the $HRSD_{17}$ was 76.7%. A 78.1% response agreement was found between the $HRSD_{17}$ and the QIDS-SR_{16}. Subject response classification disagreement was not statistically greater than chance between the $HRSD_{17}$ and the QIDS-SR_{16}, according to McNemar's test (p<.6171).

The $HRSD_{17}$ classified patients as responders when the QIDS-SR_{16} classified nonresponders in 9.6% of subjects. The QIDS-SR_{16} classified responders when the $HRSD_{17}$ classified nonresponders in 12.3% of subjects. With respect to disagreement in classification in remission, the $HRSD_{17}$ identified remission and the QIDS-SR_{16} identified nonremission in 4.1% of patients. However, patients classified as remitters on the QIDS-SR_{16} were classified as nonremitters on the $HRSD_{17}$ in 19.2% of the subjects. McNemar's test indicated a significant difference ($p<.0076$) in disagreement classification patterns, with the QIDS-SR_{16} classifying patients as remitters and the $HRSD_{17}$ identifying patients as nonremitters significantly more often than the reverse.

CORRELATIONS WITH MINIAQLQ

Spearman correlation coefficients were calculated between the Mini Asthma Quality of Life Questionnaire (MiniAQLQ) scores ($n=40$) and the depression inventories to determine if an improvement in depressive symptoms was correlated to reduced functional impairment. The Spearman correlation (r) for change from baseline to exit between the MiniAQLQ and the IDS-SR_{30} total scores was highly significant ($r=-.58$, $p<.0001$). The IDS-SR_{30} total score accounted for 33.4% of the variance in the change in MiniAQLQ scores. Baseline to exit change in the MiniAQLQ and the QIDS-SR_{16} resulted in a correlation of -.49 ($p<.0014$). The QIDS-SR_{16} change score shared 23.9% of the variance with the MiniAQLQ change score. Change from baseline to exit correlations between the $HRSD_{17}$ and the MiniAQLQ was also highly significant ($r=-.57$, $p<.0001$). The $HRSD_{17}$ total score change showed a covariance of 32.5% with the change in the MiniAQLQ score.

All of the individual item change scores on the QIDS-SR_{16}, from baseline to exit, showed negative correlations with the MiniAQLQ change scores. Five QIDS-SR_{16} items showed significant correlations with $p<.05$. The significant correlations include: energy (r=-.50, p=.0010); sleep disturbance (r=-.49, p=.0013); sad mood (r=-.43, p=.0057); involvement (r=-.39, p=.0140); and concentration (r=-.36, p=.0230).

The change from baseline to exit for the correlation between the IDS-SR_{30} total score and the MiniAQLQ, compared to the QIDS-SR_{16} correlation with the MiniAQLQ, was enhanced because the IDS-SR_{30} has additional individual items that showed significant statistical correlation values ($p<.05$). The individual IDS-SR_{30} item change scores that showed strong correlational relationships with the MiniAQLQ include: gastrointestinal disturbance (r=-.68, $p<.0001$); somatic complaints (r=-.64, $p<.0001$); anxious mood (r=-.51, p=.0008); psychomotor agitation (r=-.40, p=.0099); leaden paralysis (r=-.40, p=.0100); and sympathetic arousal (r=-.36, p=.0235). Thus, the broader depressive symptom profile of the IDS-SR_{30}, compared to the QIDS-SR_{16}, allowed for a greater shared variance between baseline to exit changes with the MiniAQLQ.

As with the QIDS-SR_{16} and the IDS-SR_{30}, all individual item change scores on the $HRSD_{17}$ showed negative correlations with the MiniAQLQ. Significant correlations between individual items on the $HRSD_{17}$ and the MiniAQLQ include somatic energy (r=-.49, p=.0012); depressed mood (r=-.48, p=.0017); work/interests (r=-.43, p=.0062); psychic anxiety (r=-.40, p=.0101); initial insomnia (r=-.39, p=.0132); guilt (r=-.37, p=.0198); somatic anxiety (r=-.37, p=.0193); and delayed insomnia (r=-.33, p=.0367). Thus, the IDS-

SR_{30} and the $HRSD_{17}$ showed comparable shared variances between baseline and exit changes with the MiniAQLQ.

CHAPTER SEVEN
Discussion

A growing body of research literature documents strong psychometric properties for the QIDS-SR_{16} in psychiatric populations (Rush et al., 2003; Trivedi et al., 2004; Rush et al., 2005). Thus far, however, the QIDS-SR_{16} has not been evaluated in a general medical population. The present study is noteworthy because it examines the QIDS-SR_{16} in a sample of patients with asthma. Past research has documented evidence of the high comorbidity of depression and asthma (Ettinger et al., 2004) and the relationship of depression to poor prognosis in asthma patients (Picado et al., 1989; Strunk et al., 1985). The present study demonstrates the performance of the QIDS-SR_{16} in assessing depressive symptoms in asthma patients and in monitoring symptom change. The findings of the study document the psychometric effectiveness of the QIDS-SR_{16} as a sensitive and reliable measure of depressive symptoms in a general medical population, and more specifically, provide a clear marker of the utility of the QIDS-SR_{16} for physicians treating asthma patients. The data may provide the physicians with greater capabilities in screening patients for depression and thus offering comprehensive treatment of patients in order to maximize outcome and improve prognosis.

The results indicate that the QIDS-SR_{16} has highly viable psychometric properties and shows utility in measuring depression in asthma patients. The initial discussion will be organized with reference to the research questions relating to Classical Test Theory, Item Response Theory, and Construct Validity.

CLASSICAL TEST THEORY

Research Question One: What are the psychometric properties of the QIDS-SR_{16} in an adult asthma population, utilizing Classical Test Theory?

Means and standard deviation for individual items were computed at baseline and exit for the QIDS-SR_{16}, the IDS-SR_{30}, and the $HRSD_{17}$ for the asthma patients. High internal consistency, or reliability, at exit was found for all depression rating scales. The IDS-SR_{30} and the QIDS-SR_{16} showed high internal consistency at baseline, but the $HRSD_{17}$ did not demonstrate a high Cronbach's α at baseline. The low $HRSD_{17}$ reliability may reflect the restricted range of scores at the baseline measure; the restricted range makes the scores less representative of the full range of symptomatology the instrument is designed to assess.

However, the suppression of Cronbach's α, while present, was smaller in the QIDS-SR_{16} and IDS-SR_{30} as compared to the $HRSD_{17}$. The greater reduction in baseline internal consistency in the $HRSD_{17}$ may be a function of how symptoms were assessed. The $HRSD_{17}$ was rated by clinicians, while the QIDS-SR_{16} and IDS-SR_{30} were rated by the patient. Clinicians may rate depressive symptoms in a less constant manner than the individual patients' self-reporting. Research has shown that while the $HRSD_{17}$ has generally acceptable reliability, the estimates vary widely (.46 to .97; Bagby et al., 2004). Only 11 of 17 items consistently met reliability criteria, with one item, loss of insight, having the most variable consistency (Bagby et al., 2004). Inter-rater reliability, which assesses the extent to which the same result is found by multiple raters, has also been problematic in studies of the

$HRSD_{17}$ (Potts, Daniels, Burnam, & Wells, 1990). It has been noted that a few of the $HRSD_{17}$ items require direct observation, such as psychomotor changes, and if the clinician is unable to make these observations, then self-report measures may show greater sensitivity to actual variability in depressive symptoms and thus may result in greater disagreement between clinician ratings of these items and self-report ratings of similar items (Rush et al., 2005).

Item-total score correlations are often considered to be an additional dimension of internal consistency (Clark & Watson, 1995). While these correlations are discussed more fully regarding test homogeneity within the concept of construct validity, the total score individual item correlations for the QIDS-SR_{16} and the IDS-SR_{30} deserve mention in Classical Test Theory. Both the QIDS-SR_{16} and the IDS-SR_{30} had excellent item-total score correlations. All items on the QIDS-SR_{16} (100%) showed exit item-total correlations of $p<.0001$, and on the IDS-SR_{30}, 93% of the exit item-total score correlations reached statistical significance of $p\leq.0001$.

ITEM RESPONSE THEORY

Research Question Two: What is the relationship between the scores on the QIDS-SR_{16}, the IDS-SR_{30} and the $HRSD_{17}$?

A relationship was calculated using Item Response Theory equations for the QIDS-SR_{16}, the IDS-SR_{30}, and the $HRSD_{17}$. IRT analysis allowed for the creation of inter-test conversion

tables. The IRT results suggest that, in general, simple conversions can be calculated between the various tests. The QIDS-SR_{16} total score can be multiplied by a constant value to yield an IDS-SR_{30} or $HRSD_{17}$ total score that approximates the IRT conversion, or an IDS-SR_{30} total score multiplied by a value approximates the predicted QIDS-SR_{16} or $HRSD_{17}$ score. The conversion multiples were of greater magnitude than found in a previous study using a larger sample of psychiatric patients with nonpsychotic MDD (Rush et al., 2003). The fact that the IRT analysis provided for equating QIDS-SR_{16}, IDS-SR_{30}, and $HRSD_{17}$ test scores reflects that the QIDS-SR_{16} and the IDS-SR_{30} have acceptable unidimensionality. Although Rush and colleagues (1996) showed three major factors in the IDS-SR_{30} using factor analysis, the IDS-SR_{30} has sufficient unidimensionality for the construct of depression to accomplish the IRT statistical computations.

CONSTRUCT VALIDITY

To examine construct validity for the QIDS-SR_{16} and the IDS-SR_{30}, multiple validity determinants were examined. The QIDS-SR_{16} and IDS-SR_{30} items are taken from the diagnostic criteria of the *DSM-IV-TR* and show strong content validity, primarily reflecting the presence of test items that are representative of the spectrum of symptoms and behaviors which the test seeks to assess.

Research Question Three: Does the QIDS-SR_{16} show strong concurrent validity with the IDS-SR_{30} and with the $HRSD_{17}$?

The QIDS-SR_{16} showed very strong concurrent, convergent validity to the IDS-SR_{30} at baseline and exit. The nearly perfect concurrent validity at study exit, when a fuller range of scores were gathered, suggests that the more time-efficient QIDS-SR_{16} can be substituted for the longer IDS-SR_{30} with almost identical sensitivity to depressive symptoms.

Concurrent validity correlations at exit between the $HRSD_{17}$ and the QIDS-SR_{16} and between the $HRSD_{17}$ and the IDS-SR_{30} were also high. At baseline, the IDS-SR_{30} and QIDS-SR_{16} total scores did not show strong correlations with the $HRSD_{17}$ total scores. These moderate correlations may reflect the more limited range of the total score distribution at baseline or possible baseline inflation since the $HRSD_{17}$ was used as an entry criteria. Correlations at study exit are probably a more valid measure of the relationship between the $HRSD_{17}$ and the QIDS-SR_{16} and between the $HRSD_{17}$ and the IDS-SR_{30}.

Baseline to exit change in score correlations were quite acceptable between the $HRSD_{17}$ and the IDS-SR_{30} and between the $HRSD_{17}$ and the QIDS-SR_{16}. The correlation for change scores across the study on the IDS-SR_{30} and the QIDS-SR_{16} was very high. The concurrent validity analyses further strengthen the case for the QIDS-SR_{16} providing a viable, practical substitute for the more time-consuming IDS-SR_{30} and the more labor-intensive $HRSD_{17}$ in measuring depression.

Research Question Four: Does the QIDS-SR_{16} show test homogeneity, thus measuring a single construct--depression--in asthma patients?

The QIDS-SR_{16} and the IDS-SR_{30} had highly acceptable test homogeneity at exit, as shown in item-total score correlations. The only item to show a more moderate item-total correlation on the QIDS-SR_{16} was suicidal ideation, while all other items showed item-total score correlations >.60. All QIDS-SR_{16} item-total score correlations showed very high probability (p<.0001) of being greater than chance. On the IDS-SR_{30}, 75% of the exit item-total correlations ranged from .61-.79. Ninety-three percent of the IDS-SR_{30} item-total correlations indicated a probability of relatedness greater than chance at the level of $p\leq$.0001. Only weight change and hypersomnia failed to reach the $p\leq$.0001 probability level.

Exit item-total correlations for the $HRSD_{17}$ were less impressive, with only 8 of 17 items (47%) reaching correlation values ranging from .60 to .78. Four other item-total correlations on the $HRSD_{17}$ showed more modest correlation values (.51-.58) and probability of $p\leq$ .0001 greater than chance. Two items showed disappointing item-total correlations (weight loss and loss of insight). Item-total correlations have been shown to be less robust for the $HRSD_{17}$ as compared to the QIDS-SR_{16} and the IDS-SR_{30} in previous psychometric research (Rush et al., 2003).

The QIDS-SR_{16} and the IDS-SR_{30} showed stronger test homogeneity than the $HRSD_{17}$ in this sample of patients. The QIDS-SR_{16} appeared to measure a single construct more effectively than either the $HRSD_{17}$ or the IDS-SR_{30} in the present data sample, showing item-total correlations exceeding .60 for 89% of the items.

Research Question Five: Is the QIDS-SR_{16} sensitive to changes in depressive symptoms over treatment duration?

The QIDS-SR_{16} and the IDS-SR_{30} show sensitivity to change in depressive symptoms in asthma patients over treatment duration. Treatment of depression with citalopram did not produce an improvement in symptom scores significantly better for the drug group than for the placebo group. However, the total IDS-SR_{30} score and the total QIDS-SR_{16} showed a large effect size (>.8) for each test (Cohen, 1988). This effect size indicates that the IDS-SR_{30} and the QIDS-SR_{16} can measure changes in the severity of depressive symptoms across time or across treatment procedures. The $HRSD_{17}$ also showed a large effect size, suggesting sensitivity to change in depression over the study duration.

Although the QIDS-SR_{16} as well as the other depression rating scales show large effect sizes across the study, the lack of improvement in depressive symptoms using citalopram as compared to the placebo group is of interest. The large effect size for all the measures in both treatment and placebo groups suggests that participation in the study itself across time may have had a therapeutic effect and may have improved depression in the sample population (Brown et al., 2005). This conclusion may be supported by an examination of the patients' circumstances.

The subjects, the majority of whom were from low socioeconomic status and ethnic minorities, were receiving treatment for asthma in a large, urban county hospital whose resources are frequently stretched by patient volume and need. Treatment is often dispensed by overloaded staff after patients have waited a long time. Patients were provided with financial incentives for study participation in the form of payment and bus tokens/parking passes, and selection for participation in the study may have been viewed by the patients as

an achievement. It is likely that the study subjects received more attention and concern during the study than they might normally receive. In addition, the subjects may have received better medical care since they were valued for their participation. The additional care and support may have served as a therapeutic intervention that accounted for the improvement in depressive symptoms since the medication did not make a significant contribution beyond study participation effects.

Research Question Six: Are certain QIDS-SR_{16} items of greater importance in differentiating change in depressive symptoms over the course of the study?

Specific items on the QIDS-SR_{16} and the IDS-SR_{30} showed greater sensitivity to change in depressive symptoms in asthma patients. Given that the QIDS-SR_{16} was extrapolated from the longer IDS-SR_{30}, similar items on both measures showed greater effect size over treatment duration. On both tests, items that showed the greatest sensitivity to change in symptoms after treatment were improvement in sad mood, increased energy, and improvement in sleep disturbances. The finding of a strong effect size for sleep disturbance confirms the initial research hypothesis predicting this outcome and supports similar observations in the asthma research literature (Goldney et al., 2003). On the IDS-SR_{30}, additional items that showed a large effect size indicated that asthma patients experienced more enjoyment and pleasure in life activities, less irritability, and higher quality mood, as well as improvements in appetite, over the course of the study.

Research Question Seven: Is the QIDS-SR_{16} in agreement with the IDS-SR_{30} and the $HRSD_{17}$ in identifying remission and response to treatment?

The QIDS-SR_{16} and the IDS-SR_{30} showed equivalent sensitivity to identifying treatment response and remission, agreeing in over 90% of the cases. Neither test showed a greater than chance probability of disagreeing on whether a patient was a nonresponder versus a responder, or remitter versus nonremitter. Thus the shorter QIDS-SR_{16} showed itself to be an effective alternative to the IDS-SR_{30}.

The present finding, demonstrating that the IDS-SR_{30} and QIDS-SR_{16} had no more than chance disagreement in classifying patients as remitters and non-remitters, is not consistent with previous research with psychiatric patients. Assuming that IDS-SR_{30} classification is correct, previous investigations have found the QIDS-SR_{16} to misclassify the IDS-SR_{30} nonremitters and nonresponders as QIDS-SR_{16} remitters and responders. Thus, the QIDS-SR_{16} was seen as more sensitive to symptom change but less sensitive to residual symptomatology than the IDS-SR_{30} (Rush et al., 2003; Trivedi et al., 2004).

Substantial agreement of over 80% in classifying patients as either responders or remitters was found between the IDS-SR_{30} and the $HRSD_{17}$, and moderate agreement of over 76% was found between response and remission classifications for the QIDS-SR_{16} and the $HRSD_{17}$. There was no significant difference between the IDS-SR_{30}, the QIDS-SR_{16}, and the $HRSD_{17}$ in patterns of disagreement on whether a patient was a responder or a nonresponder to treatment. However, the $HRSD_{17}$ was significantly more likely to disagree with both the IDS-SR_{30} and the QIDS-SR_{16} that a patient was a $HRSD_{17}$ nonremitter versus a remitter on

the IDS-SR_{30} and the QIDS-SR_{16}. Therefore, the QIDS-SR_{16} and the IDS-SR_{30} may show greater sensitivity to remission of asthma patients' depressive symptomatology than does the $HRSD_{17}$.

The remission thresholds on the IDS-SR_{30} and QIDS-SR_{16} in the present study were derived from the sample population and are somewhat lower than remission thresholds documented in previous literature. Remission on the IDS-SR_{30}, defined as $\leq$10 in the present study, is defined as $\leq$13 in previous research. Similarly, remission on the QIDS-SR_{16}, defined as $\leq$4 in this study, is defined as $\leq$5 in previous research (Rush et al., 2003). It is possible that the manner in which thresholds were defined in the present study, rather than a unique characteristic of the sample population, made an impact on the statistical significance of levels of agreement and disagreement among the depression scales.

In addition to the effect of the definition of remission thresholds on the disagreement among the various tests on the presence or absence of remission, the actual tests themselves may account for differences in remission disagreements. The IDS-SR_{30} and the QIDS-SR_{16} were created from the same item sample, based upon *DSM-IV-TR* symptom criteria for depression. The $HRSD_{17}$ samples a different array of symptoms; for example, the $HRSD_{17}$ places more emphasis on anxiety, and contains suspect items, such as loss of insight. The more criterion-focused content items on the QIDS-SR_{16} and the IDS-SR_{30} may allow for greater recognition of remission of depression; conversely, the $HRSD_{17}$ may assess residual symptoms of psychopathology not included in the QIDS-SR_{16} and the IDS-SR_{30}.

Additionally, the $HRSD_{17}$ is a clinician-rated scale, while the IDS-SR_{30} and QIDS-SR_{16} are self-report scales. Patient self-reports may be more likely to reflect remission levels

of reduced depressive symptoms than clinicians recognize or score. If such is the case, the $HRSD_{17}$ would be less likely to classify patients as remitters than the QIDS-SR_{16} and the IDS-SR_{30}. The question arises whether patients' self-ratings or clinicians' judgments more accurately reflect remission, and this issue deserves further research.

Research Question Eight: Do higher scores on the QIDS-SR_{16} correlate significantly with reduced functional impairment scores on the Mini-Asthma Quality of Life Questionnaire (MiniAQLQ)?

There was a significant negative Spearman correlation relationship among the QIDS-SR_{16}, the IDS-SR_{30}, and the $HRSD_{17}$ compared with the MiniAQLQ. As depressive symptoms decreased in asthma patients, the patients acknowledged experiencing an increase in the quality of their lives. The IDS-SR_{30}, a broader measure of depressive symptoms, accounted for a larger portion of the change in perceived quality of life, than did the QIDS-SR_{16}. One-third (33.4%) of the variance of the increase in the MiniAQLQ scores shared a covariance with the IDS-SR_{30}. The QIDS-SR_{16} showed almost a 24.0% covariance with the MiniAQLQ scores, reflecting the experience of improved quality of life.

On the QIDS-SR_{16}, the strongest correlation among individual items associated with increased sense of quality of life was improvement in somatic symptoms of depression, including increased energy and improvement in sleep patterns. Better concentration also correlated significantly with an increase on the MiniAQLQ score. Psychological symptoms

that corresponded with increased quality of life included improvement in sad mood and greater involvement in interpersonal and life activities.

Since the QIDS-SR_{16} is extrapolated from the longer IDS-SR_{30}, the IDS-SR_{30} showed the same correlational pattern on comparable items. The IDS-SR_{30} evaluations present a larger array of physical depressive symptoms, and the stronger relationship between changes in the IDS-SR_{30} and changes in the MiniAQLQ reflect in a substantial measure the further assessment of improved physical well-being assessed in the IDS-SR_{30}. Significant contributions to quality of life included improvement in gastrointestinal problems and somatic complaints. Somatic complaints may include headache, back and joint pain, abdominal pain, and heaviness in the limbs. Reduced psychomotor agitation and a decreased experience of leaden paralysis also resulted in enhanced MiniAQLQ scores. Furthermore, fewer concerns related to sympathetic arousal improve perceived quality of life. Sympathetic nervous system symptoms may include sweating, chest pains, hot and cold flashes, dyspnea, tinnitus, tremors, blurred vision, and palpitations. Beyond the QIDS-SR_{16} symptom profile noted previously, the only psychological symptom on the IDS-SR_{30} to make a significant impact on the MiniAQLQ change scores was a reduction in feelings of anxiousness and tension.

The $HRSD_{17}$ showed similar negative correlations with the MiniAQLQ but had items that strongly related to quality of life which were not present in the QIDS-SR_{16}. Items on the $HRSD_{17}$ that were associated with patients' perceived quality of life not found on the QIDS-SR_{16} included guilt, work/interests, and the anxiety items (psychic and somatic).

The $HRSD_{17}$ places a greater emphasis on measuring anxiety, assessing both psychic anxiety and somatic anxiety. Both of the anxiety components of the $HRSD_{17}$ showed significant correlations to perceived quality of life in asthma patients. The associations between improvement in somatic and anxiety symptoms of depression on the $HRSD_{17}$ and enhanced quality of life on the MiniAQLQ may arise from characteristics of the subject population. Because the majority of subjects were of lower socioeconomic status, they may have been less psychologically-oriented and more attuned to physical symptoms and anxiety. Subjects were mostly from racial and ethnic minority groups, and cultural background may also have influenced the findings. On the other hand, the subjects' symptom concerns may be representative of asthma patients or a general medical population, regardless of socioeconomic or cultural status. Additional research is needed to investigate how patients with various medical conditions place subjective emphasis on specific depressive symptoms and the symptoms' relationship to perceived quality of life. Research is also warranted to determine how ethnicity and socioeconomic status influence quality of life measures in relation to improvement in specific depressive symptoms.

The negative correlational relationship with the MiniAQLQ provides additional confirmation of concurrent validity for both the QIDS-SR_{16} and the IDS-SR_{30}. The data confirms that as depression, as measured by the QIDS-SR_{16} and the IDS-SR_{30}, improves, asthma patients experience a reduction in their functional impairment. The inverse relationship is conceptually consistent with the construct of depression. It is of interest to note that in this subject sample, selected from a primary medical population, a sense of improved quality of life was most enhanced by improvement in physical symptoms of

depression. In the individual items that showed significant correlation with increased MiniAQLQ scores in the larger context of depressive symptoms assessed by the IDS-SR_{30}, 73% related to improvement in somatic symptoms and physical well-being. Thus asthma patients may focus predominantly on physical factors over psychological dimensions of depression in their appraisal of the quality of their lives.

LIMITATIONS

The current research study has a number of limitations. First, the sample size is small and may restrict statistical analysis and generalizability, which may be further limited because the patient sample was drawn from a narrow population: asthma outpatients who were predominantly ethnic minorities and from low socioeconomic status. Since a medical outpatient population was used in this study, the severity of depression was not as pronounced as would likely be found in a psychiatric inpatient setting. The study did not include asthma patients receiving treatment for depression in a psychiatric setting of the inpatient or outpatient variety. Also, a large portion of the subject sample was primarily Spanish-speaking, and the performance and item properties of the Spanish versions of the measures utilized in the study may not be identical to the English versions. In addition, educational levels of subjects are unknown, and reading comprehension difficulties could have compromised subjects' understanding of self-report items.

Findings were from a secondary analysis of data from a randomized, controlled trial of citalopram versus placebo in treating depression (Brown et al., 2005), so the original study design was not created to conduct psychometric analyses. Furthermore, data related to

treatment effect size is applicable only to treatment with citalopram. The original data was drawn from a sample of opportunity available in a community asthma clinic and randomization stratified in terms of gender, ethnicity, and socioeconomic status was not possible. Finally, the QIDS-SR_{16} was extracted from the IDS-SR_{30}. The fact that the QIDS-SR_{16} was not independently administered may have resulted in enhanced relationships between the two measures.

PRACTICAL APPLICATIONS

The findings of the present study have a number of practical applications. The QIDS-SR_{16} has characteristics that recommend it as a test with usefulness in research on depression. The items were selected based on a sampling of core *DSM-IV-TR* symptom criteria. High reliability and test homogeneity were established, and the QIDS-SR_{16} shows sensitivity to treatment response and to remission. Time efficiency and self-report format are also virtues for research data collection. While the $HRSD_{17}$ and the Beck Depression Inventory (BDI) are frequently used in depression research studies, both have limitations that the QIDS-SR_{16} does not possess. The $HRSD_{17}$ was not designed around *DSM-IV-TR* diagnostic criteria, and the BDI and various forms of the Hamilton Rating Scale for Depression are longer than the QIDS-SR_{16}. In addition, the $HRSD_{17}$ requires clinician rating, so it is more demanding of professional time. The QIDS-SR_{16} provides a viable, and perhaps preferable, alternative to these two depression rating scales. The QIDS-SR_{16} is also significantly shorter and provides essentially the same screening and monitoring information as the IDS-SR_{30} in the nine core *DSM-IV-TR* criteria for Major Depressive Disorder. Therefore, the QIDS-SR_{16} shows strong

potential as an adjunct to, or substitute for, clinician ratings in research studies on depression. The QIDS-SR_{16} can provide valuable data regarding symptom severity, treatment response, remission, and specific symptom patterns which may be successfully treated or may be more intractable and treatment resistant.

The QIDS-SR_{16} shows strong psychometric properties, making it a clinically viable tool for individual patient assessment in a primary care medical practice. The QIDS-SR_{16} is a self-report scale that takes only 5 to 7 minutes to complete and assesses severity of depressive symptoms as well as changes in depressive symptomatology. As noted before, the administration of the QIDS-SR_{16} does not require clinician time to fill out. The QIDS-SR_{16} shows sensitivity to depression that is comparable to the longer depression rating scales, including the $HRSD_{17}$ and the IDS-SR_{30}. The QIDS-SR_{16} may therefore be a more time-effective means of evaluating the presence of depression and monitoring treatment effectiveness and symptom improvement in patients in a medical facility. The QIDS-SR_{16} can provide information regarding individual patients as well as trends for service delivery in larger health-care systems. The QIDS-SR_{16} shows high sensitivity to both response to treatment and to remission of symptoms, and it can assist the primary care physician or specialist in making decisions regarding treatment efficacy as well as the need to modify medical intervention strategies and medication dosages as treatment for depression progresses over time. In addition to providing a tool to assist with the initial diagnosis of suspected depression, the QIDS-SR_{16} could prove useful as a primary care screening instrument for depression. The fact that the QIDS-SR_{16} was constructed using items that reflect *DSM-IV-TR* criteria makes it an attractive test. The clinician may assess from the

screening whether the patient meets the core *DSM-IV-TR* symptom criteria for a diagnosis of depression and may then determine if a more thorough diagnostic evaluation is necessary to confirm the presence of depression.

DIRECTIONS FOR FUTURE RESEARCH

The present study suggests the need for future research. The psychometric properties of the QIDS-SR_{16} and the IDS-SR_{30} should be evaluated in other general medical populations, including other chronically ill patient groups. In asthma patients, evaluation of the QIDS-SR_{16} using a larger sample size which would reflect a representative, randomized sampling of socioeconomic and ethnic trends in the general population is needed to confirm the generalizability of these findings. The psychometric properties of Spanish-language versions of the IDS-SR_{30} and QIDS-SR_{16} need to be established. In addition, to better assure that findings would generalize to a clinical practice setting, studies might be conducted in which the QIDS-SR_{16} is administered independently of the IDS-SR_{30}.

It would be interesting to explore whether a subject sample drawn from a private clinic with more resources would elicit as large an effect size in the placebo group; the large effect sizes in the present study may be due to nonspecific treatment effects, such as a more attentive clinical environment, compared to the treatment these low-income patients may typically experience in their county hospital (Brown et al., 2005). Patients in this sample were more likely to report a relationship between improved quality of life and improved physical and anxiety symptoms, as opposed to psychological symptoms; therefore, research should be conducted to determine if this relationship is specific to asthma patients or may be

generalized to other patients with chronic medical conditions. The items on the $HRSD_{17}$ (i.e. guilt, work/interest, and anxiety) which are not assessed in the IDS-SR_{30} and QIDS-SR_{16}, yet show moderate to large effect sizes and correlate to quality of life, deserve additional research scrutiny regarding their importance in outcome studies.

Finally, conducting predictive research with the IDS-SR_{30} and QIDS-SR_{16} could yield interesting findings. Long-term follow-up research on factors such as job attendance and stability, medical utilization and outcome, and more qualitative variables such as life satisfaction would be of use in assessing the real-world impact of changes in depressive symptomatology measured by these instruments.

CONCLUSIONS

The results of the present study corroborate a growing body of previous research that has demonstrated highly acceptable psychometric properties for the QIDS-SR_{16} (Rush et al, 2003, 2005) and the IDS-SR_{30} (Gullion & Rush, 1998; Rush et al., 1996, 2000, 2003). The QIDS-SR_{16} shows high reliability and impressive construct validity, including test homogeneity, content validity, and concurrent validity. Furthermore, the present study confirms the utility of the QIDS-SR_{16} as an instrument for the primary care physician to screen for depression in asthma patients, among whom there is a high incidence of depression. It is difficult for busy physicians to identify the presence of depressive symptoms when patients present with complicated symptomatology, including somatic complaints and medication side effects. The QIDS-SR_{16} can provide a short, self-report screening measure to help primary care doctors determine if a more thorough diagnostic

assessment is warranted and then focus their interventions appropriately. Strong psychometric properties, as well as the self-report format, brief administration time, and sensitivity to treatment response and remission make the QIDS-SR_{16} a valuable clinical and research tool. Additional research is needed to replicate these findings and extend the treatment and patient parameters.

REFERENCES

Afari, N., Schmaling, K.B., Barnhart, S., & Buchwald, D. (2001). Psychiatric comorbidity and functional status in adult patients with asthma. *Journal of Clinical Psychology in Medical Settings*, *8*, 245-252.

Alexander, F. (1950). *Psychosomatic Medicine: Its Principles and Applications.* New York: Norton.

Allen, G.M., Hickie, I., Gandevia, S.C., & McKenzie, D.K. (1994). Impaired voluntary drive to breathe: a possible link between depression and unexplained ventilatory failure in asthmatic patients. *Thorax*, *49*, 881-884.

American Psychiatric Association (2000). *Diagnostic and Statistical Manual of Mental Disorders (4th ed., Text Revision)*. Washington D.C.: Author.

Bagby, R.M., Ryder, A.G., Schuller, D.R., & Marshall, M.B. (2004). The Hamilton Depression Rating Scale: has the gold standard become a lead weight? *American Journal of Psychiatry*, *161*, 2163-2177.

Bech, P., Tanghoj, P., Andersen, H.F., & Overo, K. (2002). Citalopram dose-response revisited using an alternative psychometric approach to evaluate clinical effects of four fixed citalopram doses compared to placebo in patients with major depression. *Psychopharmacology (Berl)*, *163*, 20-25.

Beck, A.T., Ward, C.H., Mendelson, M., Mock, J.,E., & Erbaugh, J.K. (1961). An inventory for measuring depression. *Archives of General Psychiatry*, *4*, 561-571.

Bennett, D.S. (1994). Depression among children with chronic medical problems: a meta-analysis. *Journal of Pediatric Psychology*, *19*, 149-169.

Biggs, M.M., Shores-Wilson, K., Rush, A.J., Carmody, T.J., Trivedi, M.H., Crismon, M.L., et al. (2000). A comparison of alternative assessments of depressive symptom severity: a pilot study. *Psychiatry Research*, *96*, 269-279.

Boiten, F.A., Frijda, N.H., & Wientjes, C.J.E. (1994). Emotions and respiratory patterns: Review and critical analysis. *International Journal of Psychophysiology*, *17*, 103-128.

Bonala, S.B., Pina, D., Silverman, B.A., Amara, S., Bassett, C.W., & Schneider, A.T. (2003). Asthma severity, psychiatric comorbidity, and quality of life: correlation with inhaled corticosteroid dose. *Journal of Asthma*, *40*, 691-699.

Bosley, C.M., Fosbury, J.A., & Cochrane, G.M. (1995). The psychological factors associated with poor compliance with treatment in asthma. *European Respiratory Journal*, *8*, 899-904.

Brown, E.S., Khan, D.A., & Mahadi, S. (2000). Psychiatric diagnoses in inner city outpatients with moderate to severe asthma. *International Journal of Psychiatry in Medicine*, *30*, 319-327.

Brown, E.S., Khan, D.A., & Nejtek, V.A. (1999). The psychiatric side effects of corticosteroids. *Annals of Allergy, Asthma, & Immunology*, *83*, 495-503.

Brown, E.S., Khan, D.A., Nejtek, V.A., Rajan, Thomas N., & Mahadi, S.F. (2000). Depressive symptoms and functioning in asthmatic patients. *Primary Care Psychiatry*, *6*, 155-161.

Brown, E.S., & Suppes, T. (1998). Mood symptoms during corticosteroid therapy: a review. *Harvard Review of Psychiatry*, *5*, 239-246.

Brown, E.S., Vigil, L., Khan, D.A., Liggin, J.D.M., Carmody, T.J., & Rush, A.J. (2005). A randomized trial of citalopram versus placebo in outpatients with asthma and major depressive disorder: a proof of concept study. *Biological Psychiatry*, *58*, 865-70.

Cella, D., & Chang, C.-H. (2000). A discussion of item response theory and its applications in health status assessment. *Medical Care*, *38*(suppl II), II-66-II-72.

Clark, L.A., & Watson, D. (1995). Constructing validity: basic issues in objective scale development. *Psychological Assessment*, *7*, 309-319.

Cluley, S., & Cochrane, G.M. (2001). Psychological disorder in asthma is associated with poor control and adherence to inhaled steroids. *Respiratory Medicine*, *95*, 37-39.

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences*. Hillsdale, NJ: Erlbaum.

Corruble, E., Legrand, J.M., Duret, C., Charles, G., & Guelfi, J.D. (1999). IDS-C and IDS-SR: psychometric properties in depressed in-patients. *Journal of Affective Disorders*, *56*, 95-101.

Cronbach, L.J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, *16*, 297-334.

Cronbach, L.J., & Meehl, P.E. (1955). Construct validity in psychological tests. *Psychological Bulletin*, *52*, 281-302.

Demyttenaere, K., & DeFruyt, J. (2003). Getting what you ask for: on the selectivity of depression rating scales. *Psychotherapy and Psychosomatics*, *72*, 61-70.

DiMatteo, M.R. (1994). Enhancing patient adherence to medical recommendations. *Journal of the American Medical Association*, *271*, 79-83.

Domkin, M., Scott, J., & Kelly, P. (1984). What factors predict discrepancies between self and observer ratings of depression? *Journal of Affective Disorders*, *31*, 253-259.

Dudley, D.L., Glaser, E.M., Jorgenson, B.N., & Logan, D.L. (1980). Psychosocial concomitants to rehabilitation in chronic obstructive pulmonary disease, II: psychosocial treatment. *Chest*, *77*, 544-551.

Dyer, C.A.E., & Sinclair, A.J. (1997). A hospital-based case-control study of quality of life in older asthmatics. *European Respiratory Journal*, *10*, 337-341.

Eisner, M.D., Katz, P.P., Lactao, G., & Iribarren, C. (2005). Impact of depressive symptoms on adult asthma outcomes. *Annals of Allergy, Asthma, & Immunology*, *94*, 566-574.

Ettinger, A., Reed, M., & Cramer, J. [Epilepsy Impact Project Group] (2004). Depression and comorbidity in community-based patients with epilepsy or asthma. *Neurology*, *63*, 1008-1014.

Feightner, J.W., & Worrall, G. (1990). Early detection of depression by primary care physicians. *Canadian Medical Association Journal*, *142*, 1215-1220.

Ford, E.S., Mannino, D.M., Homa, D.M., Gwynn, C., Redd, S.C., Moriarty, D.G., et al. (2003). Self-reported asthma and health-related quality of life: findings from the behavioral risk factor surveillance system. *Chest*, *124*, 119-127.

Frank, E., Prien, R.F., Jarrett, R.B., Keller, M.B., Kupfer, D.J., Lavori, P.W., et al., (1991). Conceptualization and rationale for consensus definitions of terms in major depressive disorder: remission, recovery, relapse, and recurrence. *Archives of General Psychiatry*, *48*, 851-855.

French, T., & Alexander, F. (1941). *Psychogenic factors in bronchial asthma*. Washington, D.C.: National Research Council.

Goldney, R.D., Ruffin, R., Fisher, L.J., & Wilson, D.H. (2003). Asthma symptoms associated with depression and lower quality of life: a population survey. *Medical Journal of Australia*, *178*, 437-441.

Goodwin, R.D., & Eaton, W.W. (2005). Asthma, suicidal ideation, and suicide attempts: findings from the Baltimore epidemiologic catchment area follow-up. *American Journal of Public Health*, *95*, 717-22.

Gottlieb, G.L., Gur, R.E., & Gur, R.C. (1988). Reliability of psychiatric scales in patients with dementia of the Alzheimer type. *American Journal of Psychiatry*, *145*, 857-860.

Greenberg, P.E., Kessler, R.C., Birnbaum, H.G, Leong, S.A., Lowe, S.W., Berglund, P.A., et al. (2003). The economic burden or depression in the United States: how did it change between 1990 and 2000? *Journal of Clinical Psychiatry*, *64*, 1465-1475.

Gregory, R.J. (1992). *Psychological Testing: History, Principles, and Applications*. Boston: Allyn and Bacon.

Gullion, C.M., & Rush, A.J. (1998). Toward a generalizable model of symptoms in major depressive disorder. *Biological Psychiatry*, *44*, 959-972.

Hambleton, R.K. (2000). Emergence of item response modeling in instrument development and data analysis. *Medical Care*, *38*(suppl II), II-60-II-65.

Hambleton, R.K., Swaminathan, H., & Rogers, H.J. (1991). *Fundamentals of Item Response Theory*. Newbury Park, CA: Sage Publications.

Hamilton, M. (1960). A rating scale for depression. *Journal of Neurology, Neurosurgery & Psychiatry*, *23*, 56-62.

Hamilton, M. (1967). Development of a rating scale for primary depressive illness. *British Journal of Social and Clinical Psychology*, *6*, 278-296.

Hays, R.D., Morales, L.S., & Reise, S.P. (2000). Item response theory and health outcomes measurement in the 21st century. *Medical Care*, *38*(suppl II), II-28-II-42.

Horn, C.R., Clark, T.J., & Cochrane, G.M. (1990). Compliance with inhaled therapy and morbidity from asthma. *Respiratory Medicine*, *84*, 67-70.

Isenberg, S., Lehrer, P.M., & Hochron, S.M. (1992). The effects of suggestion and emotional arousal on pulmonary function in asthma: a review and a hypothesis regarding vagal mediation. *Psychosomatic Medicine*, *54*, 192-216.

Janson, C., Bjornsson, E., Hetta, J., & Boman, G. (2004). Anxiety and depression in relation to respiratory symptoms and asthma. *American Journal of Respiratory & Critical Care Medicine*, *149*, 930-4.

Janowsky, D.S., el-Yousef, M.K., Davis, J.M., & Sekerke, H.J. (1972). A cholinergic-adrenergic hypothesis of mania and depression. *Lancet*, *2*, 632-635.

Jenkins, C., Carmody, T.J., & Rush, A.J. (1998). Depression in radiation oncology patients: a preliminary evaluation. *Journal of Affective Disorders*, *50*, 17-21.

Juniper, E.F. (1998). Effect of asthma on quality of life. *Canadian Respiratory Journal*, *5*(Suppl A), 77A-84A.

Juniper, E.F., Guyatt, G.H., Cox, F.M., Ferrie, P.J., & King, D.R. (1999). Development and validation of the Mini Asthma Quality of Life Questionnaire. European *Respiratory Journal*, *14*, 32-38.

Katon, W., Berg, A., Robins, A.J., & Risse, S. (1986). Depression: medical utilization and somatization. *Western Journal of Medicine*, *144*, 564-568.

Kessler, R.C., Berglund, P., Demler, O., Jin, R., & Walters, E.E. (2005). Lifetime prevalence and age-of-onset distributions of *DSM-IV* disorders in the National Comorbidity Survey Replication. *Archives of General Psychiatry*, *62*, 593-602.

Kessler, R.C., Chin, W.T., Demler, O., & Walters, E.E. (2005). Prevalence, severity, and comorbidity of 12-month *DSM-IV* disorders in the National Comorbidity Survey Replication. *Archives of General Psychiatry*, *62*, 617-627.

Knapp, P.H., & Nemetz, S.J. (1960). Acute bronchial asthma. I. Concomitant depression and excitement, and varied antecedent patterns in 406 attacks. *Psychosomatic Medicine*, *22*, 42-56.

Kobak, K.A., Greist, J.H., Jefferson, J.W., Mundt, J.C., & Katzelnick, D.J. (1999). Computerized assessment of depression and anxiety over the telephone using interactive voice response. *MD Computing*, *16*, 64-68.

Kovacs, M. (1985). The Children's Depression Inventory (CDI). *Psychopharmacology Bulletin*, *21*, 995-998.

Krommydas, G.C., Gourgoulianis, K.I., Angelopoulos, N.V., Kotrotsiou, E., Raftopoulos, V., & Molyvdas, P.A. (2004). Depression and pulmonary function in outpatients with asthma. *Respiratory Medicine*, *98*, 220-224.

Lambert, M.J., Hatch, D.R., Kingston, M.D., & Edwards, B.C. (1986). Zung, Beck, and Hamilton Rating Scales as measures of treatment outcome: a meta-analytic comparison. *Journal of Consulting and Clinical Psychology*, *54*, 54-59.

Lambert, M.J., Masters, K.S., & Astle, D. (1988). An effect-size comparison of the Beck, Zung, and Hamilton rating scales for depression: a three-week and twelve-week analysis. *Psychological Reports*, *63*, 467-470.

Landis, J.R., & Koch, G.G. (1977). The measurement of observer agreement for categorical data. *Biometrics*, *33*, 159-174.

Levenson, R.W. (1979). Effects of thematically relevant and general stressors on specificity of responding in asthmatic and nonasthmatic subjects. *Psychosomatic Medicine*, *41*, 28-39.

Levitan, H. (1983). Suicidal trends in patients with asthma and hypertension: a chart study. *Psychotherapy and Psychosomatics*, *39*, 165-170.

Lyons, R.A., Lo, S.V., & Littlepage, B.N. (1994). Comparative health status of patients with 11 common illnesses in Wales. *Journal of Epidemiological Community Health*, *48*, 388-390.

Maier, W., Heuser, I., Philipp, M., Frommberger, U., & Demuth, W. (1988). Improving depression severity assessment, II: content, concurrent and external validity of three observer depression scales. *Journal of Psychiatric Research*, *22*, 13-19.

Maier, W., & Philipp, M. (1985). Improving the assessment of severity of depressive states: a reduction of the Hamilton Depression Rating Scale. *Pharmacopsychiatry*, *18*, 114-115.

Mancuso, C.A., Peterson, M.G., & Charlson, M.E. (2000). Effects of depressive symptoms on health-related quality of life in asthma patients. *Journal of General Internal Medicine*, *15*, 301-310.

Mancuso, C.A., Rincon, M., McCulloch, C.E., & Charlson, M.E. (2001). Self-efficacy, depressive symptoms, and patients' expectations predict outcomes in asthma. *Medical Care*, *39*, 1326-1338.

Mannino, D.M., Homa, D.M., Akinbami, L.J., Moorman, J.E., Gwynn, C., & Redd, S.C. (2002). Surveillance for Asthma: United States, 1980-1999. [Electronic version]. *Morbidity and Mortality Weekly Report*, *51*, 1-13.

Mascia, A., Frank, S., Berkman, A., Stern, L., Lampl, L., Davies, M., et al. (1989). Mortality versus improvement in severe chronic asthma: physiologic and psychologic factors. *Annals of Allergy*, *62*, 311-317.

McNair, D., Loir, M., Droppelman, L., (1971). *Profile of Mood States.* San Diego, CA: Educational and Testing Services.

Miller, B.D. (1987). Depression and asthma: a potentially lethal mixture. *Journal of Allergy and Clinical Immunology*, *80*, 481-486.

Miller, B.D., & Wood, B.L. (1997). Influence of specific emotional states on autonomic reactivity and pulmonary function in asthmatic children. *Journal of the American Academy of Child & Adolescent Psychiatry*, *36*, 669-677.

Michell, J. (1990). *An Introduction to the Logic of Psychological Measurement*. Hillsdale, NJ: Erlbaum.

Murray, C.J., & Lopez, A.D. (1997). Global mortality, disability, and the contribution of risk factors: Global Burden of Disease Study. *Lancet*, *349*, 1436-1442.

Montgomery, S.A., & Asberg, M.A. (1979). A new depression scale designed to be sensitive to change. *British Journal of Psychiatry*, *134*, 382-389.

Nunnally, J.C. (1978). *Psychometric Theory, 2nd ed.* New York: McGraw-Hill.

Nunnally, J.C., & Bernstein, I.H. (1994). *Psychometric Theory, 3rd ed.* New York: McGraw-Hill.

Orlando, M., Sherbourne, C.D., & Thissen, D. (2000). Summed-score linking using item response theory: application to depression measurement. *Psychological Assessment*, *12*, 354-359.

Padur, J.S., Rapoff, M.A., Houston, B.K., Barnard, M., Danovsky, M., Olson, N.Y. et al. (1995). Psychosocial adjustment and the role of functional status for children with asthma. *Journal of Asthma*, *32*, 345-353.

Picado, C., Montserrat, J.M., dePablo, J., Plaza, V., & Agusti-Vidal, A. (1989). Predisposing factors to death after recovery from a life-threatening asthmatic attack. *Journal of Asthma*, *26*, 231-236.

Potts, M.K., Daniels, M., Burnam, M.A., Wells, K.B. (1990). A structured interview version of the Hamilton Depression Rating Scale: evidence of reliability and versatility of administration. *Journal of Psychiatric Research*, *24*, 335-350.

Purcell, K. (1963). Distinction between subgroups of asthmatic children: Children's perceptions of events associated with asthma. *Pediatrics*, *31*, 486-494.

Radloff, L.S. (1977). The CES-D scale: a self-report depression scale for research in the general population. *Applied Psychological Measurement*, *1*, 385-401.

Rees, W.L. (1980). Etiological factors in asthma. *Psychiatric Journal of the University of Ottawa*, *5*, 250-254.

Rehm, L.P., & O'Hara, M.W. (1985). Item characteristics of the Hamilton Rating Scale for Depression. *Journal of Psychiatric Research*, *19*, 31-41.

Rimington, L.D., Davies, D.H., Lowe, D., & Pearson, M.G. (2001). Relationship between anxiety, depression, and morbidity in adult asthma patients. *Thorax*, *56*, 266-271.

Ritz, T. (2004). Probing the psychophysiology of the airways: Physical activity, experienced emotion, and the facially expressed emotion. *Psychophysiology*, *41*, 809-821.

Ritz, T., Claussen, C., & Dahme, B. (2001). Experimentally induced emotions, facial muscle activity, and respiratory resistance in asthmatic and non-asthmatic individuals. *British Journal of Medical Psychology*, *74*, 167-182.

Ritz, T., Thons, M., Fahrenkrug, S., & Dahme, B. (2005). Airways, respiration, and respiratory sinus arrhythmia during picture viewing. *Psychophysiology*, *42*, 568-578.

Rubin, N.J. (1993). Severe asthma and depression. *Archives of Family Medicine*, *2*, 433-440.

Rush, A.J., Bernstein, I.H., Trivedi, M.H., Carmody, T.J., Wisniewski, S., Mundt, J.C., et al. (2006). An evaluation of the Quick Inventory of Depressive Symptomatology and the Hamilton Rating Scale for Depression: a Sequenced Treatment Alternatives to Relieve Depression trial report. *Biological Psychiatry*, *59*, 493-501.

Rush, A.J., Carmody, T., & Reimitz, P-E. (2000). The Inventory of Depressive Symptomatology (IDS): Clinician (IDS-C) and self-report (IDS-SR) ratings of depressive symptoms. *International Journal of Methods in Psychiatric Research*, *9*, 45-59.

Rush, A.J., Giles, D.E., Schlesser, M.A., Fulton, C.L., Weissenburger, J., & Burns, C. (1986). The Inventory for Depressive Symptomatology (IDS): preliminary findings. *Psychiatry Research*, *18*, 65-87.

Rush, A.J., Gullion, C.M., Basco, M.R., Jarrett, R.B., & Trivedi, M.H. (1996). The Inventory of Depressive Symptomatology (IDS): psychometric properties. *Psychological Medicine*, *26*, 477-486.

Rush, A.J., Hiser, W., & Giles, D.E. (1987). A comparison of self-reported versus clinician-rated symptoms in depression. *Journal of Clinical Psychiatry*, *48*, 246-248.

Rush, A.J., Trivedi, M.H., Carmody, T.J., Biggs, M.M., Shores-Wilson, K., Ibrahim, H., et al. (2004). One-year clinical outcomes of depressed public-sector outpatients: a benchmark for subsequent studies. *Biological Psychiatry*, *56*, 46-53.

Rush, A.J., Trivedi, M.H., Carmody, T.J., Ibrahim, H.M., Markowitz, J.C., Keitner, G.I., et al. (2005). Self-reported depressive symptom measures: sensitivity to detecting change in a randomized, controlled trial of chronically depressed, nonpsychotic outpatients. *Neuropsychopharmacology*, *30*, 405-416.

Rush, A.J., Trivedi, M.H., Ibrahim, H.M., Carmody, T.J., Arnow, B., Klein, D.N., et al. (2003). The 16-item Quick Inventory of Depressive Symptomatology (QIDS, Clinician-Rating (QIDS-C), and Self-Report (QIDS-SR): a psychometric evaluation in patients with chronic major depression. *Biological Psychiatry*, *54*, 573-583.

Santor, D.A., & Coyne, J.C. (2001). Examining symptom expression as a function of symptom severity: item performance on the Hamilton Rating Scale for Depression. *Psychological Assessment*, *13*, 127-139.

Schleifer, S.J., Keller, S.E., & Bartlett, J.A. (1999). Depression and immunity: clinical factors and therapeutic course. *Psychiatry Research*, *85*, 63-69.

Seligman, M.E., & Rosenhan, D.L. (1998). *Abnormality*. New York: W.W. Norton and Company.

Sheehan, D.V., Lecrubier, Y., Sheehan, K.H., Amorim, P., Janavs, J., & Weiller, E. (1998). The Mini-International Neuropsychiatric Interview (MINI): the development and validation of a structured diagnostic psychiatric interview for *DSM-IV* and *ICD-10*. *Journal of Clinical Psychiatry*, *59*(Suppl 20), 22-33.

Simon, G.E., Von Korff, M., & Barlow, W. (1995). Health care costs of primary care patients with recognized depression. *Archives of General Psychiatry*, *52*, 850-856.

Spitzer, R.L., Williams, J.B., Kroenke, K., Linzer, M., deGruy, F.V. 3rd, Hahn, S.R., et al. (1994). Utility of a new procedure for diagnosing mental disorders in primary care: the PRIME-MD 1000 study. *Journal of the American Medical Association*, *272*, 1749-1756.

Stewart, A.L., Greenfield, S., Hays, R.D., Wells, K., Rogers, W.H., Berry, S.D., et al. (1989). Functional status and well-being of patients with chronic conditions. *Journal of the American Medical Association*, *262*, 907-913.

Strunk, R.C., Mrazek, D.A., Fuhrmann, G.S.W., & LaBrecque, J.F. (1985). Physiologic and psychological characteristics associated with deaths due to asthma in childhood. *Journal of the American Medical Association*, *254*, 1193-1198.

Suris, A., Kashner, T.M., Gillaspy, J.A., Jr., Biggs, M., & Rush, A.J. (2001). Validation of the Inventory of Depressive Symptomatology (IDS) in cocaine dependent inmates. *Journal of Offender Rehabilitation*, *32*, 15-30.

Thase, M.E., Hersen, M., Bellack, A.S., Himmelhoch, J.M., & Kupfer, D.J., (1983). Validation of a Hamilton subscale for endogenomorphic depression. *Journal of Affective Disorders*, *5*, 267-278.

Thompson, W.L. & Thompson, T.L. (1984). Treating depression in asthmatic patients. *Psychosomatics*, *25*, 809-812.

Trivedi, M.H., Rush, A.J., Ibrahim, H.M., Carmody, T.J., Biggs, M.M., Suppes, T., et al. (2004). The Inventory of Depressive Symptomatology, Clinician Rating (IDS-C) and Self-Report (IDS-SR), and the Quick Inventory of Depressive Symptomatology, Clinician Rating (QIDS-C) and Self-Report (QIDS-SR) in public sector patients with mood disorders: a psychometric evaluation. *Psychological Medicine*, *34*, 73-82.

Trivedi, M.H., Rush, A.J., Pan, J.Y., & Carmody, T.J. (2001). Which depressed patients respond to nefazodone and when? *Journal of Clinical Psychiatry*, *62*, 158-163.

.

U.S. Department of Health and Human Services, Public Health Service, Agency for Health Care Policy and Research. (1993). *Clinical Practice Guideline, Number 5: Depression in Primary Care, Volume 2. Treatment of Major Depression*. (AHCPR Publication No. 93-0551). Rockville, MD: Depression Guideline Panel.

Viera, A.J., & Garrett, J.M. (2005). Understanding interobserver agreement: the kappa statistic. *Family Medicine*, *37*, 360-363.

Von Leupoldt, A., & Dahme, B. (2005). Emotions and airway resistance in health and asthma: Study with whole body plethysmography. *Psychophysiology*, *42*, 92-97.

Wang, P.S., Berglund, P., Olfson, M., Pincus, H.A., Wells, K.B., & Kessler, R.C. (2005). Failure and delay in initial treatment contact after first onset of mental disorders in the National Comorbidity Survey Replication. *Archives of General Psychiatry*, *62*, 603-616.

Williams, J.B. (1988). A structured interview guide for the Hamilton Depression Rating Scale. *Archives of General Psychiatry*, *45*, 742-747.

Yellowlees, P.M., Haynes, S., Potts, N., & Ruffin, R.E. (1988). Psychiatric morbidity in patients with life-threatening asthma: initial report of a controlled study. *Medical Journal of Australia*, *149*, 246-249.

Zheng, Y.P., Zhao, J.P., Phillips, M., Liu, J.B., Cai, M.F., Sun, S.Q, et al. (1988). Validity and reliability of the Chinese Hamilton Depression Rating Scale. *British Journal of Psychiatry*, *152*, 660-664.

Zigmond, A.S., & Snaith, R.P. (1983). The hospital anxiety and depression scale. *Acta Psychiatrica Scandinavica*, *67*, 361-370.

Zung, W.W.K. (1965). A self-rating depression scale. *Archives of General Psychiatry*, *12*, 63-70.

VITAE

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