THE PSYCHOMETRICS OF THE CHILDREN'S DEPRESSION INVENTORY WHEN USED WITH CHILDREN WHO ARE CHRONICALLY ILL AND MATCHED COMMUNTY COMPARISONS

by

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ABSTRACT

The Children's Depression Inventory (CDI) can be used to screen for childhood depression in children ages seven to sixteen. While the scale has exhibited reliability and validity with typically developing children, the psychometrics have not been examined in a large cohort of children who are chronically ill. The purpose of this study is to measure the psychometrics (reliability and validity) of the CDI when used with children who are chronically ill (N=350) and matched community comparison peers (N=357). This study endeavors to determine if the psychometrics of the CDI are similar in children who are chronically ill compared to children without a chronic illness. Data were aggregated from previous reports examining social and emotional functioning of children with six chronic diseases (cancer, sickle cell, hemophilia, juvenile rheumatoid arthritis, chronic migraine, and neurofibromatosis) and matched comparisons. CDI scores were collected in the homes of chronically ill children and in the homes of matched community comparison peers. Results showed no significant differences between groups on CDI scores, shapes of distributions, reliability, or validity. Findings suggest that the psychometrics of the CDI are similar for children with chronic diseases and typically developing children. The public health significance of this work suggests the CDI may be an effective screening tool for use in tertiary care pediatric settings, which could increase screening rates and improve mental health in children who are chronically ill.

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1.0 INTRODUCTION

Health and wellness are broad ideas that extend beyond just physical well-being. The World Health Organization defines health as “a state of complete physical, mental, and social well-being, and not merely just the absence of disease or infirmity.” A person’s mental health plays a large role in overall health, and is sometimes overlooked. Making an effort to detect and treat disorders such as depression can greatly improve quality of life. The first step in detecting a disorder is through measuring it. Psychological measurement is a process that is fundamentally necessary to indicate and improve an individual’s mental health. Accuracy of psychological measurement tools is imperative in order to successfully identify disorders, and to effectively treat those who are affected. The scientific process involved in evaluating the quality of psychological measurement tools is a field of study known as psychometrics.[1] The psychometrics of a tool are determined using statistical tests that measure validity and reliability.

The purpose of validity is to evaluate the degree to which a scale measures the construct(s) it has been designed to be measure. Reliability asserts that as long as external circumstances have not changed, a scale will yield similar results every time it is used. A scale that is both valid and reliable is psychometrically robust, and will be dependable in accurately depicting an individual’s psychological well-being.

The purpose of the following study is to determine the psychometrics of a scale known as the Children’s Depression Inventory (CDI) in a large cohort of children who are chronically ill

and in matched community comparison peers. The CDI is a widely used measure to screen for depression in children between the ages of seven and sixteen. Evaluating the scale's psychometric properties is imperative to ensure that it can be used as a dependable screening tool. While the scale has exhibited adequate reliability and validity for use in the general population, the psychometrics of the CDI have not been thoroughly examined in children who are chronically ill. In order for the CDI to be dependably used as a screening measure in tertiary care pediatric settings, its psychometrics should be examined to ensure the scale's ability to detect the disorder in these at-risk populations. Access to a high quality screening tool will allow for more accurate identification of depression, and thus facilitate early detection and treatment of the disorder. This may reduce adversity caused by the disorder, and will in turn improve quality of life for children who are affected. This is the public health significance of the proposed research.

The data analyzed in this study were initially collected for a series of peer-reviewed papers which examined the social and emotional functioning of children with six different chronic diseases including: cancer, sickle cell, hemophilia, chronic migraine, juvenile rheumatoid arthritis, and neurofibromatosis. CDI scores were collected in each of these cohorts and data have been aggregated for the purpose of this paper to examine the psychometrics of the CDI. This study explores whether the CDI works similarly in children who are chronically ill as it does in children who are generally healthy. This study will determine the feasibility of the CDI for use in tertiary care pediatric settings.

Following this introduction is a brief review of depression and the pediatric chronic diseases examined in this study. Then, a third chapter follows with a manuscript which evaluates the psychometrics of the CDI. The manuscript is divided into four sections. The first section

provides an introduction to childhood depression as a disorder and to the CDI as a measurement tool. The next section describes the methodology including how the original data were collected. This is followed by the results of data analysis and a discussion of the findings, followed by future implications of this research. The manuscript will be submitted to the Journal of Pediatric Psychology.

2.0 BACKGROUND

A diagnosis of major depression is characterized by a depressed mood and a loss of interest or pleasure for a period of two weeks or more. Symptoms of the disorder include significant weight loss or gain, insomnia, psychomotor agitation, fatigue, feelings of worthlessness, diminished ability to think or concentrate, and thoughts of suicide. According to the DSM-V, a combination of at least five of nine symptoms must be present nearly every day within this two week period, at least one of which must be either a depressed mood or a loss of interest/pleasure.[2] The cause of symptoms must also not be attributable to the psychological effects of another medical condition.

It is estimated that by the age of eighteen, between eight and fifteen percent of children will have been clinically diagnosed with major depressive disorder.[3, 4] This is approximately two to three children in an average-sized classroom of 20 to 25 people. However, it is important to note that these are clinical estimates, and do not include children who experience symptoms of depressive disorder, but have not been diagnosed by a behavioral health specialist. The actual prevalence of the disorder is likely to be significantly greater than clinically reported. According to the National Comorbidity Survey, an estimated 13.6% of sixteen year-olds actually have a lifetime occurrence of major depressive disorder. Another 9.6% of sixteen year-olds are estimated to have a twelve-month occurrence of major depressive disorder.[5] Findings from the CDC Youth Risk Behavior Surveys (YRBS) show that approximately 30% of high school youth

reported a two week period where they experienced a depressed mood and/or loss of interest or pleasure within the last year.[6]

Along with a generally depressed mood, children with depression tend to be chronically pessimistic, have deficits in peer interaction, and have achievements below their potential in academic, athletic, and social domains.[7] For some children, the disorder can be so severe that it leads to self-harm. This type of risk, namely suicide, is the third leading cause of death in adolescents.[3] According to the CDC YRBS, in 2013, 17% of high school students reported that they had seriously considered attempting suicide.[6] These high rates of depressive symptoms and suicidality highlight the need to screen for the disorder. However, while this disorder is recognized to be widespread, screening for childhood depression to improve early detection is not commonly done, even with youth who are at high risk.

One group who may be at increased risk for depression and depressive symptoms are children who are chronically ill. Chronic illness in childhood is not generally as great a focus as is chronic illness in adulthood. While the prevalence of chronic disease in pediatric populations is fairly low in comparison to adults, it still poses a large public health problem. This study focuses specifically on six different pediatric chronic illnesses including: cancer, sickle cell, hemophilia, juvenile rheumatoid arthritis, chronic migraine, and neurofibromatosis. Each of these are briefly discussed below.

Cancer

Cancer is a disease characterized by uncontrolled cell growth. Common symptoms of disease and treatment include lack of energy, pain, nausea, and lack of appetite.[8] Childhood cancer is one of the most common chronic pediatric disease diagnoses and is the second leading cause of death in children under the age of 14.[9] The most common types of diagnoses include

leukemia and brain tumors. Incidence rates of cancer, particularly of leukemia, have increased in recent years with a currently estimated disease incidence rate of 186.6 per 1 million.[10] The disease is chronic, but once remission is achieved, the illness is not necessarily life-long. Survival rates for pediatric cancer have increased substantially over the past decade, and are continuing to rise.[11] However, increased survival creates an increased need to attend to disease-related morbidities, including depression.

Sickle Cell

Sickle cell is a genetically based disease which is present at birth, but generally exhibits symptoms at six months of age. Severity of the disease differs based on the genetic makeup of the affected individual.[12, 13] The disease also disproportionately affects African American and Hispanic populations.[14] Incidence of sickle cell varies greatly based on geographic region. Patients with sickle cell have irregular "sickle" shaped red blood cells which can clog blood vessels and prevents normal blood flow. This causes decreased delivery of oxygen to vital organs and tissues.[13] Symptoms of the disease include chronic anemia, pain crises, and acute chest syndrome. Pain crises in sickle cell patients are characterized by periods of agonizing musculoskeletal pain and acute chest syndrome refers to a life-threatening condition with symptoms similar to pneumonia.[13]

Hemophilia

Hemophilia, like sickle cell, is a genetically based disease which is present at birth. The disease is found exclusively in males, with an incidence rate of approximately 1 in 5,000 male births.[15] It is a disease in which the patient has a severely decreased ability to clot blood. This leads to severe bleeding episodes from even mild injuries. Depending on the severity of the disease and symptoms, it is generally diagnosed between one month and three years of age.[16]

Further complications of the disease include eventual debilitating chronic joint disease, as well as a higher risk of acquiring blood-borne diseases.[15]

Juvenile Rheumatoid Arthritis

Juvenile rheumatoid arthritis (JRA) is an autoimmune inflammatory disease and is the most common pediatric disease of its type. The incidence of JRA is estimated to range somewhere between 4.1 to 6.1 per 100,000 children.[17] The illness is generally diagnosed before the age of 16, and causes eventual failure of joint function. The earliest clinical symptoms of JRA include joint swelling, tenderness, and early morning stiffness. Other symptoms of the disorder include abnormalities in growth and development, and eventual problems with eyesight. The cause of JRA remains largely unknown, and effective treatments are still being developed.[18]

Chronic Migraine

Chronic migraine is a condition characterized by excruciating headaches that appear and reappear. Diagnosing chronic migraine in childhood is often more difficult than in adulthood because of the difficulty children have in describing their symptoms. Chronic headaches in pediatric populations generally have shorter duration (1-72 hours) than in adult populations.[19] Some migraines occur with an “aura” which is a warning sign that a migraine is coming. An exact incidence rate for pediatric migraines is not available because it varies greatly across age and gender.[20] Early symptoms of the condition, sometimes independent of headaches, include cyclical vomiting, abdominal pain, and episodes of vertigo. Headaches are often present with symptoms such as difficulty thinking, fatigue, and lightheadedness.[19]

Neurofibromatosis

Neurofibromatosis (NF) is a genetically linked disorder which causes the growth of tumors in the nervous system. There are two main types of neurofibromatosis, NF1 and NF2. NF1 is the most common form generally diagnosed in childhood.[21] The incidence rate of NF1 is estimated to be between 1 in 2500 to 1 in 5,000. The most common symptoms of NF are skin abnormalities known as neurofibromas. These are generally cosmetic defects in nature, but become cancerous in three to five percent of patients. Other symptoms of the diseases include headaches, epilepsy, buildup of fluid in the brain, and cardiovascular problems. The disease is usually discovered at the age of ten years.[21, 22]

Children with chronic medical diseases such as any of these discussed above may be at particularly increased risk for depression or depressive symptoms due to their illness, medication, or lifestyle limitations. Having a chronic disease can have consequences such as chronic pain, fatigue, challenges to normal sleep, limitations on activities, changes in physical appearance, and missed school days all of which could lead to a depressive disorder.[23] Current estimates of depressive disorders among children with chronic diseases are mixed. Some studies suggest there are no differences between children with chronic diseases and children without,[24, 25] while other studies suggest that the prevalence of depressive disorders among children with chronic diseases is much greater.[23, 26-29] It is conceivable that the many challenges for children with chronic illnesses may increase their risk for experiencing depressive symptoms.[26, 28, 30] As a result, tertiary care pediatric settings (such as hospitals and offices that offer specialized healthcare for children who are chronically ill) may be an ideal place to screen children and

adolescents for symptoms of depression, especially since children with chronic diseases often require regular visits.

The Children's Depression Inventory (CDI) is a brief 27 item self-report measure used to screen for symptoms of depression in children between the ages of seven and sixteen.[31] This scale has been widely used and has been shown to be reliable and valid.[32-35] The scale can also be administered fairly quickly. Given the brief nature of the measure and its demonstrated psychometric properties, its use in tertiary pediatric settings seems feasible. However, the psychometrics of the CDI when used with children with chronic diseases has not yet been reported.[36] It seems possible that many of the symptoms of disease or side effects of treatment could compromise the efficacy of this measure when used with children with chronic diseases.

The CDI asks children specific questions about the presence of particular symptoms over the past two weeks to screen for depression. While all of the items in the CDI directly pertain to symptoms of depression, some items could occur as side effects of chronic disease. For example, it is feasible that children with chronic illnesses may experience sleep disturbances due to medical symptoms or medication, rather than as a result of depression.[37] While in a child without a chronic disease, marking an inability to fall sleep could be a sign of depression, in a child with a chronic disease, an inability to fall asleep could simply be an effect of their illness. Similarly, the CDI also asks about appearance, school work, fatigue, eating habits, aches and pains, etc., all signs of depression which can be directly affected by circumstances of a chronic illness. Because of these uncertainties, before the CDI can be used as a reliable screening measure, it is important to have a clear understanding of whether its reliability and validity are compromised by these distinct circumstances.

This study aims to examine the psychometric properties of the CDI when used with children who have chronic diseases compared to a group of their peers who were matched on key characteristics. This study aims to determine if the psychometrics of the measure are similar in both populations. The results of this study intend to provide knowledge about the ability of the CDI to screen for depression in children who are chronically ill. The data used for this study were initially reported in a series of peer reviewed papers examining depression in both children with specific chronic diseases and matched comparison peers.[38-43] However, these data have not been aggregated to answer the questions posed by this paper. This study seeks to fill gaps in research knowledge by specifically examining the psychometrics of the CDI for a large group of children with a variety of chronic diseases (N=350), and a large group of matched classroom comparison peers. (N=357)

3.0 MANUSCRIPT

3.1 ABSTRACT

The Children's Depression Inventory (CDI) can be used to screen for depression in children seven to sixteen. However, the psychometrics of the scale have not been examined in a large cohort of children who are chronically ill. The purpose of this study is to measure the psychometrics of the CDI in children who are chronically ill (N=350) and in matched community comparison peers (N=357), and determine if the reliability and validity are similar in both groups. Data were aggregated from previous reports examining social and emotional functioning of children with six chronic diseases and matched comparisons. CDI scores were collected in the homes of all participants. Results showed no significant differences between groups on CDI scores, distributions, reliability, or validity. Findings suggest that the psychometrics of the CDI are similar for children with chronic diseases compared to typically developing children meaning the CDI may be an effective screening tool for use in various populations.

3.2 INTRODUCTION

A diagnosis of major depression is characterized by having a depressed mood and a loss of interest or pleasure for a period of two weeks or more. According to the DSM-V, a combination of at least five of nine symptoms must be present during this two week period.[2] At least one of these symptoms must be either a depressed mood and/or loss of interest or pleasure. Other symptoms of the disorder include significant weight loss or gain, insomnia, psychomotor agitation, fatigue, feelings of worthlessness, diminished ability to think or concentrate, and thoughts of suicide. These symptoms must be present nearly every day within the two week period. The cause of symptoms must also not be attributable to the psychological effects of another medical condition. While some studies may refer to depression as a disease or an illness, the DSM classifies it as a disorder. For the purpose of this paper, depression will be referred to as a disorder.

It is estimated that by the age of eighteen, between eight and fifteen percent of children will have been clinically diagnosed with major depressive disorder.[3, 4] This is approximately two to three children per an average-sized classroom. However, it is important to note that these are clinical estimates, and do not include children who experience symptoms of depressive disorder, but have not been diagnosed by a behavioral health specialist. The actual prevalence of the disorder is likely to be significantly greater than reported. According to the National Comorbidity Survey, an estimated 13.6% of sixteen year-olds actually have a lifetime occurrence of major depressive disorder. Another 9.6% of sixteen year-olds are estimated to have a twelve-month occurrence of major depressive disorder.[5] Findings from the CDC Youth Risk Behavior Surveys (YRBS) show that approximately 30% of high school youth reported a two week period

where they experienced a depressed mood and/or loss of interest or pleasure within the last year.[6]

Along with a generally depressed mood, children with depression tend to be chronically pessimistic, have deficits in peer interaction, and have achievements below their potential.[7] For some children, the disorder can be so severe that it leads to self-harm. This type of risk, namely suicide, is the third leading cause of death in adolescents.[3] According to the CDC YRBS, in 2013, 17% of adolescents self-reported that they had seriously considered attempting suicide.[6] These high rates of depressive symptoms and suicidality highlight the need to screen for the disorder. However, while this disorder is recognized to be widespread, screening for childhood depression to improve early detection is not commonly done, even with youth who are at high risk.

Children with chronic medical diseases may be at a particularly increased risk for depression or depressive symptoms due to their illness, medication, or lifestyle limitations. Having a chronic disease can have consequences such as chronic pain, fatigue, challenges to normal sleep, limitations on activities, changes in physical appearance, and missed school days all of which could lead to depressive disorder.[23] There are mixed data regarding current estimates of the comorbidity of depressive disorders among children with chronic diseases. Some studies suggest rates are not different from typically developing children,[24, 25] while other studies suggest that the prevalence of depressive disorders among children with chronic diseases is much greater.[23, 26-29] It does seem conceivable that the many challenges faced by children with chronic illnesses may increase their risk for experiencing depressive symptoms.[26, 28, 30] As a result, tertiary care pediatric settings may be an ideal place to screen children and adolescents for symptoms of depression, especially since children often require regular visits.

The Children's Depression Inventory (CDI) is a brief 27 item self-report measure used to screen for symptoms of depression in children between the ages of seven and sixteen.[31] The scale has been widely used and has been shown to be reliable and valid.[32-35] Given the brief nature of the measure and its demonstrated psychometrics, its use in tertiary pediatric settings seems feasible. Unfortunately, the psychometrics of the CDI when used with children with chronic diseases has not yet been reported.[36] It seems possible that many of the symptoms of disease or side effects of treatment could compromise the efficacy of this measure when used with children with chronic diseases.

The CDI asks children specific questions about the presence of particular symptoms over the past two weeks to screen for depression. While all of the items in the CDI directly pertain to symptoms of depression, some items could occur as side effects of chronic disease. For example, it is feasible that children with chronic illnesses may experience sleep disturbances due to medical symptoms or medication, not depression.[37] While in typically developing children, marking an inability to fall sleep could be a sign of depression, in a child with a chronic disease, an inability to fall asleep could simply be an effect of their illness. Similarly, the measure also asks about appearance, school work, fatigue, eating habits, aches and pains, etc., all signs of depression which can directly be affected by circumstances of a chronic illness. Because of this, before the CDI can be used as a reliable screening measure, it is important to have a clear understanding of whether its psychometrics are compromised by these distinct circumstances.

This study aims to examine the psychometrics of the CDI when used with children who have chronic diseases and matched community comparison peers. This study aims to determine if the psychometrics of the measure are similar in both populations, and intends to provide knowledge about the ability of the CDI to screen for depression in children who are chronically

ill. The data used for this study were initially reported in a series of peer reviewed papers examining depression in both children with specific chronic diseases and matched comparison peers.[38-43] However, these data have not been aggregated to answer the questions posed by this paper. This study seeks to fill gaps in research knowledge by specifically examining the psychometrics of the CDI for a large group of children with a variety of chronic diseases (N=350), and a large group of matched classroom comparison peers. (N=357)

3.3 METHODS

3.3.1 Overview

The data examined for this study were originally collected for a series of studies examining the social and emotional functioning of children with a chronic illness and classroom comparison peers.[38-43] While previous peer reviewed publications have included the data reported in this study, no previous manuscripts have combined the data to examine the psychometrics of the CDI.

The original studies were conducted in two independent phases, each requiring separate informed consent. The first phase was conducted in classrooms that were selected because they included a child with a chronic illness. Schools attended by children with chronic diseases included a diverse sample with inner city, suburban, private, and rural schools. During this initial phase, peer, teacher, and self-reports on perceptions of social functioning were obtained. The second phase occurred in the homes of both children with chronic diseases and comparison classmates. Comparison peers were matched one-to-one from classrooms on race, gender, and

closest date of birth to each respective child with a chronic disease. The CDI was administered during the second phase of study in the home environment.

3.3.2 Participants

Children with Chronic Diseases

The sample included 350 children with chronic diseases between the ages of 7-16 (all from different classrooms). Participants were recruited through tertiary care pediatric clinics at a large children's hospital and included a variety of chronic diseases including cancer (N=95), sickle cell disease (N=71), hemophilia (N=23), juvenile rheumatoid arthritis (N=64), chronic migraine (N=47), and neurofibromatosis (N=61). Nearly all the patients with these conditions in the region received treatment at this children's hospital. Recruitment was meticulously done so that every eligible child was asked to participate. The only exclusion criteria was for children who were full-time special education or home-schooled, which occurred in less than 5% of patients. Overall rates of recruitment ranged from 76-96% of eligible children with chronic illnesses for the cluster of projects.

Classroom Comparison Peers

During phase one of data collection, children with chronic diseases and all of their classmates were eligible for participation. While all children with chronic diseases returned consent forms and participated, approximately 10% of classmates did not return consent forms and another 10% were absent on the day of data collection. After initial classroom data collection, children with chronic illnesses were matched to their classmates based on the patient's gender, race, and age. Out of eligible controls, the parents of the child who had the closest date of birth to the child with a chronic illness were contacted first. If parents declined

participation, the parents of the child with the next closest date of birth on the list were contacted. Recruitment rates of controls were acceptable, with greater than 80% of first-choice families agreeing to participate, with the exception of controls for children with chronic migraine (62% of first-choice families agreeing to participate). A total of 357 comparison participants were recruited into the study. A loss of 7 children with chronic illnesses between phase 1 and phase 2 (declined to participate in home data collection) accounts for the greater number of comparison peers.

3.3.3 Materials

Children's Depression Inventory (CDI)[31]

The CDI is a 27 item self-report instrument used to screen for depression in children between the ages of 7-17. Each item has three response options, from which the child selects the one that most closely reflects to his or her thoughts and feelings over the past two weeks. Each item receives a score of zero to two points with a highest possible total score of 54. A score of 19 or above is considered to be in the clinical range of depression ($\geq 90^{th}$ percentile)[31] . The CDI is said to have five different measured factors, which include: negative mood, interpersonal problems, ineffectiveness, anhedonia, and negative self-esteem.

The CDI has been widely used in both clinical and non-clinical populations.[44, 45] It has been used extensively to screen for depression in children who are chronically ill.[28, 46-48] The scale has also been used in intervention and therapy research both to characterize depression in children as well as to evaluate effectiveness of these programs.[49-51] A Google Scholar search from 2010 to 2015 yields over 17,000 manuscripts with the use of a combination of specific search terms including childhood depression, social/emotional functioning, and chronic disease.

Within the past five years alone, the CDI has been reported as a measure in several hundred of these studies.

Several studies have been conducted evaluating the reliability and validity of the CDI as a screening tool. The CDI has demonstrated good internal consistency and moderate test-retest reliability.[32, 33, 52] The validity of the scale has also been confirmed through a variety of analyses including correlations supportive of validity, and factor analyses[33] (see Sitarenios and Stein, 2004 for a comprehensive overview). The CDI has been shown to be effective for use in both patients with and without known depressive disorders.[34, 35] While the CDI as an overall screening tool has demonstrated good reliability and validity, the strength of its five-factor structure exhibits mixed results and is not as robust.[53-56] Results on the sensitivity and specificity of the scale have also not reached a clear consensus. Some studies claim that the CDI has both high sensitivity and high specificity while other studies support neither the sensitivity nor the specificity of the scale. [35, 57-59]

While the CDI has been widely used in the general population, there is minimal research on the psychometrics of the CDI in populations of chronically ill children. One study has been conducted specifically evaluating the factor structure and psychometrics of the CDI when used with youth diagnosed with inflammatory bowel disease (IBD).[53] Data were collected from 191 children with IBD between the ages of 11-17. The findings from the study re-grouped the CDI on three distinct factors rather than the five suggested in the manual for this measure.[53] This study found that the CDI has good internal consistency and is a psychometrically valid measurement tool in patients with IBD on three factors. While this study provides an initial report about the psychometrics of the CDI with children who are chronically ill children, knowledge of the scale's psychometric properties for children with chronic illness remains

incomplete. The study utilized data from 181 children, all having the same disease, and lacked a comparison group. There were no reported analyses focusing on the validity of the measure for children with IBD.

Children's Loneliness Questionnaire (CLQ)[60]

The Children's Loneliness Questionnaire (CLQ) is a 24 item self-report instrument used to assess feelings of loneliness in children and adolescents. The questionnaire has 16 items that center around feelings of loneliness and social dissatisfaction and 8 items asking about hobbies and interests used as filler questions.[61] The CLQ has been shown to be effective in identifying loneliness, particularly identifying children who are socially rejected by their peers.[61, 62] The scale has demonstrated reliability for use in children of varying ages from kindergarten through high school.[62]

Self-Perception Profile for Children (SPPC)[63]

The SPPC[63] is a 36 item measure that evaluates a child's self-perception in six distinct domains. For the purpose of this study, we are most interested in the domains of global self-worth and social acceptance. The other domains in the measure (i.e. athletic competence, behavioral conduct, etc.) concentrate on specific areas of self-worth that are less likely to be related to depression. Global self-worth gives an overall score of self-perception while a low score on social acceptance has been previously shown to be associated with depression.[64]

Each item in the measure receives a score between one through four with one representing low self-concept, and four representing high self-concept. The scale has been shown to have acceptable internal consistency[65] and test-retest reliability.[66, 67] The scale has also exhibited concurrent validity through positive correlations with other measures of self-concept.[66]

3.3.4 Procedure

Phase 1 (School Visit)

The parents of each child with a chronic disease were contacted and permission was requested to contact the child's school regarding the study. Out of contacted schools, greater than 80% agreed to participate in the study.

Once schools were identified, parents were contacted, and informed consent was requested for all children in the classroom. After consent was obtained, researchers distributed surveys to all children whose parents agreed to participation. The research was described as the 'friendship study,' and the child with a chronic illness was never mentioned. This was done to ensure that the child with a chronic illness was not stigmatized.

Phase 2 (Home Visit)

After data were collected in classrooms, families with a child who had a chronic disease and matched control subjects were contacted to determine interest in participating in phase two of the study. This part of the study included a lengthy home visit (approximately 3 hours) focusing on child, parent, and family functioning, and was completed at the convenience of the family. For the purpose of the current study, reported data obtained in phase two includes information from the demographic questionnaire; and CDI, CLQ, and SPPC scores.

Analytic Plan

Descriptive statistics will be examined in overall CDI scores and by item (mean, SD, effect size). Overall distributions in both groups will also be examined to ensure there are no differences in skewness. Cronbach's α's will be calculated in both populations and in each disease cohort to determine internal consistency reliability. Convergent validity will be examined

through correlations of CDI scores with other measures conceptually linked to the CDI in both groups.

3.4 RESULTS

Demographic and Background Factors

The participants in this study consist of children between the ages of 7-16 for both the chronically ill and the comparison groups. Collectively, 47% of children were female and 53% were male. Approximately 71% of participants were of Caucasian decent and 28% were African American. Less than 1% of participants were of another race/ethnicity which reflected the demographic characteristics of the region where the data were collected.

Descriptive Statistics

Means, standard deviations, and effect sizes were calculated for total CDI scores and for each of the individual items in both groups (Table 1). Note that the overall CDI scores are in the normal range for both cohorts indicating minimal depression. The distributions of total CDI scores between the chronically ill and comparison children were compared using the two sample Kolmogorov-Smirnov test. No significant differences were found in the shapes of the distributions between the two samples (Figure 1 & Figure 2).

Inferential Statistics

No significant differences were found in overall CDI scores between the chronically ill children (n=350) and comparisons (n=357) in the overall sample. Examination of specific items

in the CDI showed one significant difference. Children with chronic diseases reported having less fun than did comparison children (Table 1).

Note that findings of depression scores have been previously reported for each individual cohort of children with chronic illness and their comparisons. Significant differences were not found in overall CDI scores between chronic disease and comparison groups within individual diseases cohorts with the exception of children with hemophilia. Children with hemophilia showed significantly higher total CDI scores and significantly higher scores on two items: school dislike, and lack of friends.

Internal Consistency

Cronbach's alphas were calculated for the overall groups (CI α =0.85, COMP α =0.84) as well as for each disease cohort (Table 2). All values were acceptable ($\alpha \geq 0.75$).

Convergent Validity

CDI scores were compared in both groups with two other measures of emotional functioning using the Spearman Rho coefficient (Table 3). CDI scores exhibited acceptable correlation coefficients with the Asher CLQ, and the Social and Global subscales of the Harter SPPC. All correlations are significant at the $p<0.01$ level. No significant differences in correlations between the chronically ill and comparison groups were found

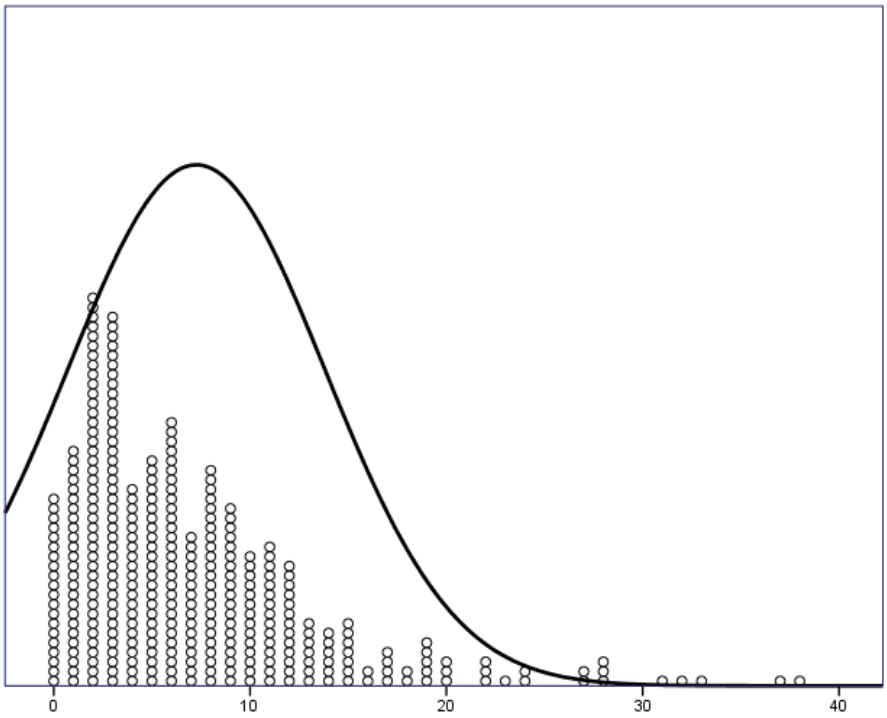

Figure 1. Chronic Illness Distribution

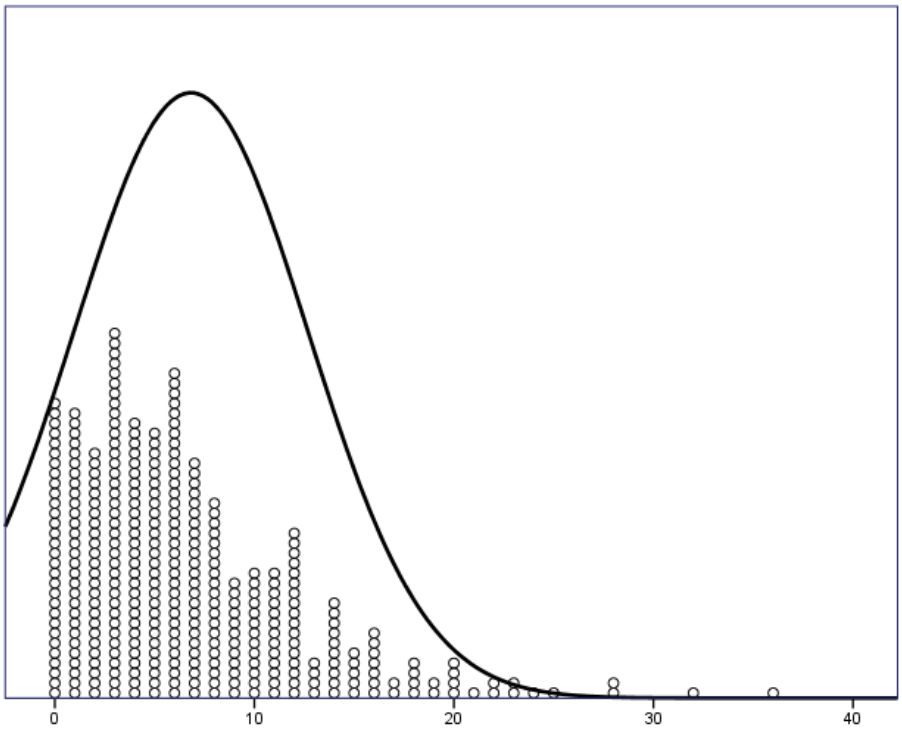

Figure 2. Comparison Distribution

Table 1. Descriptives

Children's Depression Inventory	Chronic Disease		Comparison		Effect Size
	Mean	SD	Mean	SD	
Item 1 (sadness)	0.120	0.397	0.090	0.305	0.03
Item 2 (pessimism)	0.314	0.523	0.283	0.487	0.031
Item 3 (self-deprecation)	0.109	0.363	0.092	0.326	0.017
Item 4 (anhedonia)	0.354	0.514	0.277	0.467	0.077*
Item 5 (misbehavior)	0.097	0.374	0.112	0.380	-0.015
Item 6 (pessimistic worrying)	0.383	0.720	0.333	0.539	0.05
Item 7 (self-hate)	0.114	0.399	0.098	0.342	0.016
Item 8 (self-blame)	0.154	0.406	0.182	0.441	-0.028
Item 9 (suicidal ideation)	0.220	0.454	0.213	0.443	0.007
Item 10 (crying spells)	0.103	0.380	0.087	0.336	0.016
Item 11 (irritability)	0.317	0.596	0.303	0.554	0.014
Item 12 (reduced social interest)	0.129	0.419	0.106	0.351	0.023
Item 13 (indecisiveness)	0.631	0.713	0.644	0.649	-0.013
Item 14 (negative body image)	0.280	0.542	0.333	0.523	-0.053
Item 15 (school work difficulty)	0.440	0.707	0.415	0.668	0.025
Item 16 (sleep disturbance)	0.343	0.622	0.353	0.644	-0.01
Item 17 (fatigue)	0.351	0.628	0.381	0.658	-0.03
Item 18 (reduced appetite)	0.289	0.633	0.283	0.628	0.006
Item 19 (somatic concerns)	0.443	0.643	0.403	0.609	0.04
Item 20 (loneliness)	0.200	0.496	0.157	0.401	0.043
Item 21 (school dislike)	0.403	0.606	0.353	0.560	0.05
Item 22 (lack of friends)	0.246	0.481	0.230	0.447	0.016
Item 23 (school performance decrement)	0.286	0.575	0.249	0.537	0.037
Item 24 (self-deprecation via peers)	0.403	0.615	0.429	0.589	-0.026
Item 25 (feeling unloved)	0.089	0.348	0.048	0.261	0.041
Item 26 (disobedience)	0.283	0.511	0.232	0.461	0.051
Item 27 (fighting)	0.160	0.438	0.134	0.365	0.026
CDI Total:	7.260	6.557	6.821	5.858	0.439

*Significant at $p<.05$

Table 2. Cronbach's Alpha by Disease Cohort

Cohort	Chronic Illness	Comparison
Cancer	0.864 (n=94)	0.873 (n=98)
Hemophilia	0.922 (n=21)	0.771 (n=20)
JRA	0.859 (n=64)	0.760 (n=65)
Migraine	0.806 (n=47)	0.851 (n=51)
Neurofibromatosis	0.851 (n=53)	0.855 (n=51)
Sickle Cell	0.812 (n=71)	0.785 (n=72)

Table 3. Correlations

Measure	Chronic Illness	Comparison
Asher	0.474	0.474
Harter Social	-0.354	-0.359
Harter Global	-0.368	-0.310

3.5 DISCUSSION

This study endeavored to examine the psychometrics of the CDI in a large sample of chronically ill children who were matched one-to-one to comparison peers on gender, race, and age from their elementary or middle school. Findings suggest the psychometrics of the CDI are strikingly similar for children who are chronically ill and matched comparisons. All measures of reliability and validity were similar for the two groups of children.

Means of CDI scores in the overall samples did not differ on total scores and differed significantly in only one (anhedonia) of 27 items. Other studies using the CDI have found mixed

results of the prevalence of depression in children who are chronically ill, specifically some reporting higher CDI scores and others not finding differences.[28] These lack of differences in depression scores have also been previously reported using these data. These results are striking because the physiological impact of disease and treatment, as well as the lifestyle limitations of chronically ill children warrants the possibility of more symptoms of depression than in typically developing children. Inherently, there is a possibility that the experience of having a chronic disease would predispose children to more frequently endorse negative responses on specific items, such as questions asking about problems with sleep, eating, aches/pains, or appearance.

Shapes of the distributions of scores were similar in both overall groups. Both distributions displayed a skew to the right, meaning fewer children had scores indicative of depression in both groups. This further suggests that as a whole, children with chronic diseases report roughly the same levels of depression as do matched controls without chronic illness.

No significant differences in any measures of reliability or validity were found between the chronically ill and comparison groups. The internal consistency reliability of the CDI was acceptable to high in both overall groups and in each disease cohort, suggesting that children generally endorse similar answers across items regardless of disease status. We had thought specific items such as those related to sleep and appearance would be especially problematic in the chronically ill population. However, CDI scores do not appear to vary on distinct items between groups. This suggests that presence of disease does not typically affect answer choices on specific items in the CDI.

The convergent validity of the two groups was examined by comparisons to the CLQ, and with two domains of the SPPC. The CLQ assesses symptoms of loneliness and social dissatisfaction. Results suggest that scores on the CDI as a whole correlate as expected with

other constructs related to depression or depressive symptoms. Correlations were not significantly different between chronically ill children and comparisons suggesting that the scale's validity is similar between the two groups. This further suggests that the CDI is a psychometrically valid tool that is measuring the constructs it has been designed to measure in all children.

These results suggest that children who are chronically ill exhibit some level of resilience. Intuitively, childhood chronic illness might be associated with more symptoms of depression as a result of illness challenges, medication side effects, or limitations on desired activities. While previous studies on the comorbidity of psychiatric disorders with chronic diseases have mixed results, the original manuscripts presenting the data in this study show depression rates did not differ significantly across groups. This could inherently question the effectiveness of the CDI as a screening tool. The CDI has the potential to be psychometrically inadequate when used with children who are chronically ill due to its nature in asking questions directly related to consequences of chronic disease. However, the exhibited psychometrics from the current study suggest that the CDI is adequately measuring depression in children who are chronically ill. This indicates that rates of depression may not differ across groups, and that children who are chronically ill are often resilient to depression or depressive symptoms, at least in the home environment. It does seem feasible that the current results and those reported for earlier cohorts from these data reflect children's status when they are not feeling sick or facing challenging situations in clinic or hospital, and that administering the CDI in the home environment may result in lower scores.

To our knowledge, this is the first study to date which has examined the psychometrics of the CDI in a large cohort of children who are chronically ill. While results of this study suggest

the CDI can be acceptably used as a screening tool in chronically ill pediatric populations, further research is needed due to the lack of research in this field and the limitations of this study.

3.5.1 Limitations

1. The types of reliability and validity that were measurable given the nature of these data were limited. For example, participants were not tested again at a later point to determine test-retest reliability of the scale. Additionally, sensitivity and specificity could not be measured. The addition of a semi-structured psychiatric interview would allow examination of this.

2. These data include only six pediatric chronic diseases. While this study encompasses many common chronic diseases, it is still possible that the CDI may not be as effective for use with chronic diseases that were not included in this study.

3. CDI scores in this sample were collected in the homes of both samples. While children who are chronically ill will often regularly require treatment and doctor visits, for the most part they are not at their sickest when in the home environment. It is possible that CDI scores would be elevated if used with chronically ill children during high intensity periods of disease or symptoms, or in the hospital/clinic.

Results of this study suggest that the CDI can be adequately used as a screening measure in tertiary care pediatric settings. Other measures proposed to be psychometrically robust exist to screen for childhood depression. A somewhat newer measure known as the Patient-Reported Outcomes Measurement Information System (PROMIS) incorporates a scale which measures childhood depression (as well as anxiety). The PROMIS depression measure has exhibited

adequate reliability and validity, and is particularly attractive due to the extremely short nature of the measure.[68] However, the psychometrics of the pediatric PROMIS in children with chronic illness have not been fully studied. To our knowledge, few measures of childhood depression have been thoroughly assessed in children who are chronically ill. The CDI additionally has a short-form of the scale which can be administered in place of the full scale. However, less research exists on the psychometric properties of the short form CDI. Future work could examine the psychometrics of the short form CDI in comparison to the full scale as well as examine the psychometrics of measures such as the PROMIS in children who are chronically ill. Additionally, future work may examine other forms of reliability and validity that this study was not able to assess such as sensitivity and specificity. Further research can also examine the psychometrics of the CDI in disease cohorts which were not included as a part of this study. Psychometrics of the CDI and of other scales can also be examined in different settings such as in hospitals to determine how psychometrics may differ based on how ill a child is feeling.

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