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Associations Between Academic Achievement and Psychosocial Variables in Adolescents With Cystic Fibrosis

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Abstract

Background: Cystic Fibrosis (CF) is a chronic genetic disease that leads to the accumulation of thick mucus in multiple organ systems, leading to chronic lung infection and affecting the body's ability to absorb nutrients necessary for growth and development. This cross-sectional, correlational study examined the potential effects of CF on students' psychosocial and academic development.

Methods: Forty adolescents with CF completed a battery of neuropsychological and psychosocial measures. Their school records were reviewed to abstract information about standardized achievement testing results and grade point average (GPA). Academic outcomes were hypothesized to be associated with (a) self-efficacy, (b) disease and school-specific coping strategies, (c) attitude to school, and (e) depression.

Results: Cognitive and academic scores were within the normal range, and self-efficacy had the strongest association with standardized cognitive and academic measures and high school grades. School absences were associated with GPA, but not standardized test scores.

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Human Subjects Approval Statement

This study was fully approved by the Institutional Review Boards of the two participating Midwestern CF Centers.

Conclusion: Adolescents with CF require supports in school that foster their sense of self-efficacy and accommodations that address the learning time lost from extended health-related absences.

Keywords

Cystic Fibrosis; Academic Achievement; Psychosocial Variables; Self-Efficacy

Introduction

Cystic Fibrosis (CF) is the most common life-shortening, autosomal recessive disorder in Caucasians, yet it affects individuals of most racial/ethnic backgrounds.¹ Approximately 30,000 people in the United States and 70,000 individuals worldwide have the disorder.² CF is a progressive disease that affects the exocrine glands of the lungs, digestive system, and reproductive organs. The accumulation of abnormally thick, sticky mucus make individuals susceptible to lung infections that progressively reduce pulmonary function. Pancreatic ducts become blocked causing digestive insufficiency and nutrient malabsorption resulting in delayed growth and development. CF symptoms include persistent cough, shortness of breath, recurrent lung infections, upset stomach, and excessive appetite with poor weight gain. Additional complications can include delayed puberty, sinusitis, diabetes, renal problems, and arthritis.¹

Medical treatment of CF is directed toward preventing the damaging effects of lung infections and optimizing nutrition.² Daily treatments are rigorous and time-consuming, involving multiple medications and pancreatic enzyme supplements each day, airway clearance involving manual chest percussion or the use of a “flutter vest,”³ and a high calorie diet.⁴ With advances in medical management, the life span of individuals with CF has increased considerably. The median life expectancy was 1 year in the 1940s, whereas it was 37 years in 2006.⁵ Individuals with CF now face issues associated with self-care, the transition to adulthood, and workforce involvement, thus, amplifying the importance of their educational success. However, adolescents with CF frequently experience many health-related stressors over time that can negatively interfere with their academic performance.

Psychosocial Variables

Psychosocial considerations for adolescents with CF include their perceptions of body image, independence with treatment regimens, and ramifications of socially undesirable persistent coughing and passing gas. Intermittent or progressive loss of stamina associated with lung disease can adversely affect participation in sports. School absences can make fulfilling academic requirements stressful.⁶ Psychosocial constructs for the present study were chosen on the basis of theoretical and empirical associations with chronic health conditions and academic achievement.

Self-Efficacy.—As a core construct in social cognitive theory,⁸ self-efficacy refers to individuals’ beliefs that they can produce desired results through their own actions while forestalling detrimental results.⁸ In academic settings, self-efficacy has been associated with engagement in homework, higher grades,⁹ academically-related self-esteem,¹⁰ high career

aspirations,⁸ and post-secondary success.¹¹ For adolescents with CF, self-efficacy might facilitate overcoming educational barriers such as school absences, treatment demands, and differences in physical appearance. Bartholomew and colleagues found that self-efficacy around judging the physical effects of CF and communicating with medical staff was related to cognitive and behavioral CF self-management.¹² Others found self-efficacy to be a stronger predictor of quality of life than objective pulmonary function.¹³ These findings suggest that self-efficacy could be an critical factor relative to academic performance in adolescents with CF.

Depression.—Concerns associated with depression such as difficulty concentrating, lack of motivation, psychomotor slowing, school absences, and poor social relationships can adversely impact school performance.^{14–16} Although depression has been associated with chronic illness,^{17, 18} empirical evidence regarding the prevalence of depression in individuals with CF is mixed, with several studies finding minimal depression^{19, 20} and several finding greater prevalence of depression than healthy peers.^{21, 22} Disease severity, coping style, and family support have been identified as factors mediating psychiatric impairment in patients with CF.²³ Additionally, treatment side effects can contribute to depression.²⁴ Examining depression in individuals with CF is especially important because depression has been associated with lower treatment adherence.²⁵ This complex interaction among depression, school absenteeism, and cognitive functioning highlights the importance of examining these factors relative to academic performance in adolescents with CF.

Coping.—Coping refers to methods by which individuals manage environmental and inner demands.²⁶ This management can take the form of behaviors, thoughts, and feelings intended to preserve well-being and avoid harm.²⁷ Although generally framed as a positive construct, coping can be examined on continuums of effectiveness, competency, and adaptiveness such that individuals might have maladaptive coping processes in response to some stressors and adaptive responses to others. In addition to normative developmental tasks, adolescents with CF must cope with challenges such as extended absences, extensive treatment regimens, demanding nutritional requirements, delayed physical development, progressive lung disease, and a shortened lifespan.^{27, 28} Indicators of positive coping abilities include prolonged lifespan, academic success, vocational attainment, positive mental health, and strong social relationships.^{29, 30} The school environment is highly influential in adolescent development. Therefore, understanding the processes by which adolescents with CF cope with health stressors in school can inform intervention efforts.

Attitude to School.—Negative attitudes toward school have been associated with increased risk of school dropout³¹ low self-appraisal of academic performance,³² and low academic aspiration.³³ Adolescents with CF often encounter an array of challenges in school that can affect their overall attitude toward the school environment. Relationships with peers, teachers, and administrators can influence students' feelings of being supported and successful. The attitudes that adolescents with CF hold toward school can have important implications for their academic success.

Cognitive Abilities and Achievement

CF has not been associated with global cognitive deficits. Thompson and colleagues³⁴ studied 76 children and adolescents with CF and found both intelligence and academic achievement scores to be normally distributed and directly related to their socio-economic status. Stewart and colleagues³⁵ found average neuropsychological functioning in children with CF. Additionally, growth score on the Shwachman measure of disease severity predicted cognitive functioning but not academic performance. Advanced CF symptoms can cause poor oxygen perfusion, fatigue, confusion, and malnutrition, which are factors associated with negative cognitive outcomes.^{24,36,37} Most recently, Kosciuk and colleagues³⁸ described an association between early vitamin E deficiency and later lower cognitive outcomes, which suggests a physiological association with cognitive functioning in individuals with CF. Thus, despite evidence for average-range cognitive abilities, it is important to examine whether school performance reflects cognitive abilities in patients with CF.

One often cited educational concern for children with CF is absences resulting from hospitalizations^{7,24,28,39}. The pattern of absences, the chronic nature of the condition, social-emotional ramifications of the disease, illness complications, and treatment side effects can have a cumulative effect on academic achievement.²⁴ However, it is important to consider how students compensate for learning time lost during extended hospitalizations. If students are not supported in managing their absences, poor access to learning and low grades logically follow.

Research Questions and Hypotheses

Identifying factors that contribute to the academic success of adolescents with CF can inform interventions that facilitate positive outcomes. This study investigated the extent to which self-reported psychosocial variables of depression, self-efficacy, school coping effectiveness, and attitude to school were associated with actual academic outcomes. Grounded in social cognitive theory, we hypothesized that self-efficacy and effective school coping strategies would be associated with positive academic outcomes, whereas a negative attitude toward school and depression would be associated with negative academic outcomes.

Given the high number of school absences that adolescents with CF often experience, this study also examined the association between absences and academic outcomes, and the extent to which adolescents with CF performed academically in a manner consistent with their intellectual abilities. No studies have documented a higher incidence of learning disabilities in individuals with CF; therefore, it was hypothesized that IQ would have significant positive associations with academic achievement despite a high number of school absences.

METHODS

This study was part of a large longitudinal investigation of the benefits and risks of CF newborn screening performed for children born between 1985 and 1994. The current study

employed a cross-sectional design with a subset of the larger sample to examine neuropsychological and psychosocial outcomes of patients with CF.

Sample

Adolescent patients, ages of 16-21 years receiving care through two Midwestern CF Centers, were eligible to participate in this study. The age range was selected as a developmental period when cognitive maturation occurs. Although the ages encompassing the term “adolescent” can vary, we chose the term because it is consistent with guidelines put forth by the National Institutes of Health (NIH)⁴⁰, The American Academy of Pediatrics⁴¹, and the Child Find mandate within the Individuals with Disabilities Education Act (IDEA)⁴², all of which extend the language of children and adolescents in research, medical, and educational contexts to age 21 years. Additionally, patients with CF through age 21 years typically receive health care from pediatric specialists.

Adolescents with CF (n = 40) and their parents or guardians participated in the larger study. The present study did not examine data obtained from parents. The patient sample consisted of 22 males and 18 females with a mean age of 18.6 years, (range 16-21). Most adolescent participants self-identified as Caucasian (97.5%) while the remaining 2.5% identified as Hispanic. This skew toward Caucasian participants is consistent with higher incidence of CF within this racial/ethnic group.

Procedure

Recruitment.—Recruitment procedures varied slightly by recruitment site, in accordance with the terms of IRB approval for each site. Eligible families received one of two recruitment letters based on the CF Center from which they received care. While both letters described the study, one letter offered the option to call the researchers if they did *not* wish to be contacted about the study (“opt-out”). The other letter asked potential participants to return a form indicating their interest in more information (“opt-in”). After approximately a week of either not receiving an opt-out phone call or after receiving opt-in notification, a recruiter contacted patients and their parents to answer questions about the study and to schedule the assessment. All study participants provided written informed consent prior to data collection.

Assessment.—Participants completed assessments of (a) self-efficacy, (b) school coping strategies (c) attitude to school, (d) depression, and (e) academic outcomes which were conducted at one of the two participating CF Centers or at a library closer to their home. A licensed school psychologist or a doctoral student supervised by a licensed psychologist conducted the assessments that lasted approximately five hours. Each adolescent received \$100 after completing the assessment.

Instruments

Self-Efficacy.—The Self-Efficacy subscale of the *Resiliency Scales for Adolescents* (RSA)⁴³ contains 10-items rated by participants using a Likert scale of 0= “never” to 4= “almost always” for statements such as “I do things well.” The scale has an alpha coefficient of .91, indicating strong internal consistency. The RSA was developed for use with

adolescents between the ages of 15-18 years; thus, non-standardized administration of this instrument was used with participants between the ages of 19-21 years. Standard scores for the RSA were derived by comparison to the overall standardization sample rather than specific age intervals.

School Coping.—The *Role-play Inventory of Situations & Coping Strategies* (RISCS)⁴⁴ measures the effectiveness of coping in adolescents with CF. Participants are presented recorded vignettes describing 25 situations that adolescents with CF often face. The two-item School scale was used in this study. One item addresses catching up on homework after hospitalization. The other item involves being reprimanded by a teacher for leaving the classroom to get a drink of water. Participants give verbal tape-recorded explanations of how they would respond to each situation. They also rate the frequency and difficulty of the situations on five-point Likert scales. Audiotapes are transcribed with identifying information edited from the text. Three coders used consensus ratings to categorize responses as 1= “Extremely Incompetent/Ineffective,” 2= “Somewhat Incompetent/Ineffective,” 3= “Somewhat Competent/Effective,” and 4= “Extremely Competent/Effective.” Evidence of moderate convergent validity has been established for this scale.³⁰ The upper age limit in the development sample of the RISCS was 18 years. However, criterion-referenced scoring was conducted such that scores indicate the degree of competency/effectiveness rather than age-based, norm-referenced comparisons.

Attitude to School and Depression.—The *Behavior Assessment System for Children—2nd Edition* (BASC-2 SRP-A)⁴⁵ is a self-report rating scale for adolescents 16 to 21 years of age that assesses a broad range of behavioral and emotional issues. The Attitude to School scale (seven items) measures adolescents’ feelings of alienation, hostility, and dissatisfaction regarding school. The Depression scale (12 items) measures feelings of sadness, hopelessness, and loneliness, and negative mood. This measure yields T-scores ($M=50$, $SD=10$), with high scores indicating negative attitude to school and high frequency of depressive symptoms. The Depression and Attitude to School scales have high internal consistency (coefficient alphas = .86 and .82, respectively) and test-retest reliability (.81 and .84). Strong convergent validity is established through strong correlations between the Depression scale of the BASC-2 and other depression scales such as the Beck Depression Inventory.

Academic variables.—The *Wide Range Achievement Test—3rd Edition* (WRAT-3)⁴⁶ is a standardized measure of academic achievement for ages 3-89 years. It assesses spelling, arithmetic, and reading by presenting participants increasingly difficult spelling words, computational math problems, and decoding of single words. Raw scores on this measure translate to standard scores ($M=100$, $SD=15$), with higher scores indicating better performance. Arithmetic and Reading scores were analyzed for the present study, both of which have demonstrated high internal consistency across adolescent age groups (coefficient alphas: Arithmetic .88-.89, Reading .90-.92). The highest item separation score possible, 1.00, provides strong evidence for the content validity of each scale.

High school grade point averages (GPAs) obtained from school records were also used as a measure of academic performance. Attendance data were coded as the average number of

days absent from full school years reported. While all participants' school records were requested, GPAs were available for 39 participants and attendance data were available for 26 participants, a reflection of the practice not to retain attendance records after students graduate. Consequently, descriptive and associative analysis involving GPA and attendance are based on these smaller samples.

Cognitive functioning.—The *Wechsler Abbreviated Scale of Intelligence* (WASI)⁴⁷ measures intelligence in individuals aged 6-89 years. Subtests include the Wechsler-scale Vocabulary, Similarities, Block Design, and Matrix Reasoning. Verbal, Performance, and Full Scale Composites yield standard scores ($M=100$, $SD=15$), with higher scores representing better performance. Internal consistency for composite scores ranges from .92 to .98. Test-retest coefficients are adequate, ranging from .87 to .92. Construct validity is supported by strong correlations with the WISC-III and WAIS-III.

RESULTS

Descriptive statistics were used for the analysis of cognitive/academic performance, school absences, GPA, attitude to school, depression, self-efficacy, and coping strategies; independent samples t-tests were conducted to examine gender differences across variables. Spearman's rank-order correlation coefficients were calculated to address the research question regarding the extent to which self-report measures are associated with observable academic outcomes. Nonparametric analysis was conducted because several variables—GPA, school absence, and coping effectiveness—do not satisfy the assumption of normal distributions.

Descriptive Analysis

Descriptive data are presented in Table 1. As a group, this sample of adolescents with CF scored within the average range in general cognitive functioning (WASI; $M=107.18$, $SD=13.57$), reading (WRAT-3; $M=103.00$, $SD=11.53$), and arithmetic (WRAT-3; $M=98.93$, $SD=14.61$). In general, participants performed well scholastically, with high school GPAs approximating a "B" average ($M=3.04$, $SD=.80$). Participants were absent from school an average of 23.6 days per year, an attendance rate of 86.9% of a 180-day school year. Attendance rates for all high school students in the state this study was conducted ranged from 92.7% to 93.3% for school years 2006-2009.⁴⁸

Participants also scored within the average range on self-efficacy (RSA; $M=10.03$, $SD=2.35$), attitude to school (BASC-2; $M=46.08$, $SD=8.95$), and depression (BASC-2; $M=46.08$, $SD=6.99$). Overall, participants endorsed positive feelings about their abilities, favorable perceptions of school, and few depressive symptoms. The mean score on RISCS school scale of 2.97 indicates somewhat competent/effective coping with CF-related stressors at school.

Male participants endorsed significantly more negative attitudes toward school and verbalized significantly less effective/competent school coping strategies than female participants. However, the level of negative attitudes toward school among males was not in the clinically significant range.

Associative Analysis

Spearman's rank-order correlation coefficients among psychosocial and academic variables are presented in Table 2. While our primary research question examined associations between self-report variables and academic outcomes, significant associations emerged within academic outcomes and self-report variables. Full scale IQ was significantly associated with standardized reading ($r_s = .791, p < .01$, one-tailed) and standardized arithmetic ($r_s = .594, p < .01$, one-tailed). Standardized reading was significantly associated with arithmetic ($r_s = .496, p < .01$, one-tailed). A significant positive correlation was also apparent between high school GPA and standardized arithmetic scores ($r_s = .303, p < .05$, one-tailed). More school absences were associated with a lower GPA ($r_s = -.414, p < .05$, one-tailed). Participants who reported a greater degree of self-efficacy reported fewer depressive symptoms ($r_s = -.279, p < .05$, one-tailed). Higher depression scores were associated with more effective school coping strategies ($r_s = .347, p < .05$, one-tailed).

Attitude to school and depression were not associated with academic outcomes. However, our hypothesis was supported in that a greater sense of self-efficacy was significantly associated with a higher full scale IQ ($r_s = .346, p < .05$, one-tailed), higher standardized arithmetic scores ($r_s = .322, p < .05$, one-tailed), and a higher GPA ($r_s = .286, p < .05$, one-tailed). Additionally, effective school coping strategies were associated with a higher GPA ($r_s = .277, p < .05$, one-tailed).

DISCUSSION

These results extend previous studies of cognitive performance in individuals with CF^{34, 35, 38} by including related psychosocial variables. In the present study, participant functioning across scholastic domains remains strong despite the likelihood of disease progression. It is also encouraging that participants maintained an adequate GPA despite their high absence rate. This sample of adolescents appears to have obtained the academic skills necessary to pursue post-secondary education. Their academic achievement is commensurate with their cognitive abilities. Nevertheless, the significant negative association between GPA and absences suggests the need for additional academic supports during absences, and scholastic benefits for adherence to treatments to maintain health and prevent hospitalization.

Participants endorsed positive feelings about their abilities (i.e., self-efficacy), verbalized somewhat effective school coping strategies, endorsed favorable perceptions of school, and few depressive symptoms. Only one participant had a depression score in the at-risk range. The low incidence of reported depression is especially encouraging, given the results of previous studies of children and adolescents with a chronic illness.^{17, 18} However, findings suggest that males are at greater risk for dissatisfaction with school than females with CF.

The construct of self-efficacy emerged as the variable most strongly related to GPA and standardized test performance. While the nature of the correlation is bi-directional, it is also logical that self-efficacy and academic performance have a reciprocal relationship. That is, self-efficacy garnered from a wide spectrum of life experiences can be applied to academic tasks while experiences of success and mastery in school over time can also contribute to

one's general sense of self-efficacy. The finding of an inverse association between self-efficacy and depression further supports the benefit of honing an adolescent's sense of efficacy.

The relationship between high depression scores and coping effectiveness was unexpected. However, most scores on this scale were in the sub-clinical range. Perhaps adolescents in this study were able to effectively cope with CF stressors relating to school, but they may need assistance with managing emotional concerns in other domains of their lives. Further investigation into the emotional coping of adolescents with CF may be warranted.

Implications for Future Research

These participants are among the first cohort of patients with CF who were expected, at birth, to live well into adulthood.⁵ Future studies should continue to examine factors that support this cohort's progress through post-secondary education and into employment. Given the positive implications for high self-efficacy beliefs on academic performance and career trajectories⁸⁻¹¹ as well as CF-related health behaviors,¹² future studies should evaluate school-based interventions designed to promote student self-efficacy.

Limitations

Primary study limitations include the relatively small sample size, although the size is typical of studies involving patients with CF. The time demands of CF treatment might have precluded some patients from taking part in the 5-hour assessment, while another possibility is that patients who chose to participate were functioning better—physically, cognitively, and/or psychosocially—than those who declined. The lack of disease severity measure precluded examining the impact of health status on cognitive and academic development in the current sample. Also, the school coping instrument contains only two items, thus unlikely capturing all aspects of coping with CF in school. Finally, the authors acknowledge that two of the assessment instruments (i.e., RSA and RISCs) were administered to participants who were outside the age range for which the instruments were developed. Therefore, the results should be interpreted with caution given a degree of non-standardized administration.

Conclusion

CF is a complex, chronic, and progressive genetic condition that affects increasing numbers of youth within school systems. Individuals with CF can be expected to obtain a vocationally useful education, postsecondary education, and gainful employment. This study demonstrated the importance of self-efficacy for adolescents with CF relative to their cognitive, academic, or psychosocial functioning. Specifically, adolescents who reported strong beliefs in their own abilities tended to have higher IQ scores, better arithmetic performance, a higher GPA, and fewer depressive symptoms. School staff who are well-informed about the needs of adolescents with CF can intervene to promote self-efficacy regarding adherence to medical treatment in school, management of absences, and advocacy for school-based health accommodations.

IMPLICATIONS FOR SCHOOL HEALTH

School professionals can create educational environments in which students with unique health concerns can experience academic success while managing their health needs. Given the finding that self-efficacy has positive implications for global intelligence, arithmetic performance, high school grades, and depression, school professionals may consider ways to facilitate experiences in which students with CF, particularly males, can feel successful. Experiencing success in overcoming obstacles is a primary route towards increasing self-efficacy beliefs.⁸ Therefore, school-based interventions can assist adolescents with CF by facilitating success in managing day-to-day self-care in school by proactively providing unrestricted bathroom privileges, permission to carry enzymes in school, and permission to eat during class. Teachers can also foster self-efficacy regarding academic success by providing these students preferential seating, extensions/flexibility on assignments or exams, and access to education during extended absences.³⁹

While school interventions are likely to be CF-specific, it is also important for school professionals to remember that adolescents with CF also experience normative developmental transitions. If teachers and other school professionals are equipped with knowledge about CF and related implications for education, they will more effectively support students' efforts to maintain health and achieve academic success while preserving their social-emotional wellbeing.

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Table 1

Descriptive Statistics of Study Variables with Analysis of Gender Differences

Measure	Total Participant Mean (SD)	Male Mean (SD)	Female Mean (SD)	t	p
WASI FSIQ	107.18 (13.57)	108.41 (14.91)	105.67 (11.98)	-.63	.532
WRAT-3 Reading	103.00 (11.53)	103.73 (13.04)	102.11 (9.66)	-.44	.665
WRAT-3 Arithmetic	98.93 (14.61)	100.18 (16.78)	97.39 (11.72)	-.60	.554
High School GPA	3.04 (.80)	2.99 (.75)	3.10 (.87)	.41	.683
School Absence	23.64 (17.04)	20.48 (12.71)	26.35 (20.12)	.05	.393
BASC-2 Attitude to School	46.07 (8.95)	49.55 (8.23)	41.83 (8.10)	-2.97	.005**
BASC-2 Depression	46.08 (6.99)	44.73 (7.27)	47.72 (6.45)	1.36	.181
RSA Self-Efficacy	10.02 (2.35)	10.05 (2.52)	10.00 (2.20)	-.06	.952
RISCS School Coping	2.97 (.75)	2.73 (.82)	3.32 (.50)	2.63	.013*

*
 $p < .05$ **
 $p < .01$

Table 2

Spearman's Correlations between Psychosocial and Academic Variables

		Reading	Arithmetic	HS GPA	School Absence	Attitude to School	Depression	Self-Efficacy	School Coping
Full Scale IQ	Corr. Coeff.	.791**	.594**	.194	.077	.218	-.020	.346*	.176
	Sig.	.000	.000	.119	.337	.088	.452	.014	.145
Reading	Corr. Coeff.		.496**	.144	-.014	.117	.023	.116	.123
	Sig.		.001	.190	.421	.235	.445	.238	.231
Arithmetic	Corr. Coeff.			.303*	-.214	.146	-.007	.322*	.019
	Sig.			.030	.147	.184	.482	.021	.456
High School GPA	Corr. Coeff.				-.414*	-.110	-.173	.286*	.277*
	Sig.				.018	.253	.146	.039	.049
School Absence	Corr. Coeff.					-.162	-.319	-.242	-.220
	Sig.					.215	.056	.116	.145
Attitude to School	Corr. Coeff.						.247	-.097	-.004
	Sig.						.062	.275	.491
Depression	Corr. Coeff.							-.279*	.150
	Sig.							.041	.184
Self-Efficacy	Corr. Coeff.								.016
	Sig.								.463

*
 $p < .05$ **
 $p < .01$