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The Impact of Social Determinants of Health on the Efficacy of School-Based  
Interventions for Adolescents with ADHD

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science at  
Virginia Commonwealth University.

By

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Bachelor of Science  
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## **Abstract**

### THE IMPACT OF SOCIAL DETERMINANTS OF HEALTH ON THE EFFICACY OF SCHOOL-BASED INTERVENTIONS FOR ADOLESCENTS WITH ADHD

By Cathrin Danielle Green, B.S.

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science at  
Virginia Commonwealth University

Virginia Commonwealth University, 2019

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Adolescents with Attention-deficit/hyperactivity disorder (ADHD) often experience impairment in academic functioning in the school and home environment. Because of this, many school- and clinic-based interventions have been developed to target these problems. Initially, clinic-based interventions were mainly used; however, these interventions were associated with many barriers to care, such as lack of transportation, financial resources, and time. Therefore, school-based interventions were developed to address these barriers. However, there has been minimal research evaluating the role of social determinants of health on the efficacy of school-based interventions. In a sample of 222 adolescents with ADHD randomly assigned to receive either a skills-based treatment or contingency management-based treatment, the present study explored the overall and differential impact of social determinants of health, namely income, maternal education, single parent status, and race, on intervention efficacy. Findings revealed a main effect of single parent status, race, and income on school grades and parent and teacher ratings of academic functioning, but no differential effects of these social determinants of health. Further, this study found that social determinants of health matter for school-based interventions and should be acknowledged as integral parts of improving and maintaining the quality of treatment for adolescents with ADHD.

## The Impact of Social Determinants of Health on the Efficacy of School-Based Interventions for Adolescents with ADHD

Attention-deficit/hyperactivity disorder (ADHD) is one of the most common childhood psychological disorders with an estimated 6.4 million youth diagnosed with ADHD in the United States (Bergey & Conrad, 2018). The reported prevalence of ADHD in children varies from 2 to 18 percent depending upon the diagnostic criteria and the population studied. Further, the prevalence of ADHD among children and adolescents has steadily increased with current rates ranging between 9% and 11% (Danielson et al., 2018; Visser et al., 2014). Defining characteristics of ADHD include developmentally inappropriate levels of inattention, hyperactivity, and/or impulsivity. To receive a diagnosis of ADHD, youth must demonstrate the presence of six or more symptoms of either inattention (e.g., difficulty sustaining attention, careless mistakes, difficulty organizing tasks and activities) or hyperactivity/impulsivity (e.g., often fidgets, talks excessively, has trouble playing quietly), or both (APA, 2013). These symptoms must be present before the age of 12, appear in two or more settings, and impair a child's functioning. Importantly, symptoms and impairment associated with ADHD persist over time, and approximately 70% of children diagnosed with childhood ADHD continue to meet diagnostic criteria in adolescence (August, Braswell, & Thuras, 1998; Barkley, Fischer, Edelbrock & Smallish, 1990; Hinshaw, Owens, Sami & Fargeon, 2006).

One of the most common and significant areas of impairment experienced by youth with ADHD is with academic functioning. Significant learning and/or achievement problems are present in up to 80% of youth with ADHD (DuPaul & Stoner, 2014). Youth with ADHD experience significantly lower standardized achievement scores and school grades, and higher rates of grade retention and school dropout in comparison to their same-aged peers (DuPaul & Stoner, 2003; Loe & Feldman, 2007). Academic difficulties are not limited to the school environment, and many youth with ADHD struggle with work completion at home (Power et al.,

2012). Specifically, youth with ADHD frequently procrastinate with homework and studying for tests, have difficulty focusing when completing homework, fail to organize their homework materials adequately, and lose or misplace work (Evans et al., 2009; Langberg, Epstein, Urbanowicz, Simon, & Graham, 2008; Power et al., 2006). The association between ADHD and academic impairment is largely driven by the inattentive symptom domain (Breslau et al., 2009; Chhabildas, Pennington, & Willcutt, 2001; Rabiner & Coie, 2000). Although hyperactive/impulsive symptoms decrease in adolescence, inattention symptoms remain, and as such, educational impairment associated with ADHD persists into adolescence and adulthood in the vast majority of cases (e.g., 75%; Hechtman, 2000). In addition, the long-term connection between ADHD symptoms and delinquency is mediated by low academic achievement (Defoe, Farrington, & Loeber, 2013). Accordingly, it is not surprising that academic impairment is one of the main reasons individuals with ADHD are referred for treatment (Loe & Feldman, 2007), and multiple clinic- and school-based interventions have been developed to address these issues (e.g., Abikoff et al., 2013; Power et al., 2012; Sibley et al., 2016).

Initially, consistent with early mental health delivery models, most of the interventions developed for children and adolescents with ADHD were clinic-based. Although clinic-based treatments were available and effective, there was a recognition that there are many barriers to families receiving (Essau et al., 1999; Wittchen et al., 1999) and adhering to (Barkley et al., 2002; Cunningham et al., 1993) treatment in traditional outpatient settings, particularly for racial/ethnic minorities (Eiraldi, Mazzuca, Clarke, & Power, 2006). As a result, many youth in need of services were not receiving mental healthcare (Burns et al., 1995; Leaf et al., 1996). One such barrier is accessibility, meaning the level of ease at which a patient is able to obtain treatment. In clinic-based interventions, families must commute to the clinic in order to receive services. However, not all families have the means to afford consistent transportation. In fact, some studies suggest that more than half of clients referred to clinics do not end up following through with appointments

(Atkins et al., 2003). Time to partake in mental health care also influences service use (Diala, et al., 2000; Leaf et al., 1987; Takeuchi et al., 1988), and the 8-10 session nature of many clinic-based ADHD interventions can be a significant obstacle for low income families. Yet another barrier to clinic-based interventions is cost. For many individuals, limited financial resources preclude access to treatment. Even with insurance or financial assistance, mental healthcare services can be expensive for families. Moreover, low-income children without healthcare coverage are less likely to be treated for ADHD (Froehlich et al., 2007). Finally, the stigma associated with receiving mental health treatment in a clinical setting prevents many families from accessing care (Knaak, Mantler, & Szeto, 2017).

Largely in response to these barriers, the field of school mental health emerged as a way to increase access to care and the potential for generalization of improvements to the school setting (Catron, Harris, & Weiss, 1998). Schools provide unparalleled access to youth (Adelman & Taylor, 1999; Weist, 1997), and provide a single location through which the majority of children can be reached with intervention (Anglin, 2003). In addition, offering mental health services in a familiar setting such as a school may make treatment more acceptable and remove concerns related to stigma (Catron & Weiss, 1994; Weist, 1999). Moreover, compared to clinic-based interventions, school-based interventions are often briefer and focused largely on the child rather than on the parent, reducing barriers associated with transportation, and minimizing problems with attrition common with clinic-based interventions. Lastly, school-based interventions are usually free and require no out-of-pocket fees, thus ensuring that even families with financial constraints can engage in treatment.

In sum, one of the main reasons school-mental health models of care for ADHD emerged was due to the recognition that social determinants of health played a critical role in the efficacy of clinic-based interventions. However, in contrast to research on the role of sociodemographic factors in clinic-based interventions for youth with ADHD, there has been minimal research

evaluating if or how social determinants of health impact school-based ADHD interventions.

Below, a framework is provided for considering the role of social determinants of health in mental health interventions. This is followed by a review of evidence on the role of social determinants of health in intervention outcomes, with the acknowledgment that these variables have been primarily examined largely in the context of outpatient clinic-based interventions for ADHD (e.g., behavioral parent training [BPT]).

### **Social Determinants of Health Framework**

The social determinants of health framework focuses on understanding the multiple interacting forces that shape an individual's health and well-being and the pathways by which social conditions translate into health effects (Herrman, Saxena, & Moodie, 2005). The World Health Organization (WHO) defines social determinants of health as “the conditions in which people are born, grow, live, work and age”. The present study uses the WHO Commission on social determinants of health conceptual framework (Solar & Irwin, 2010). This framework identifies two main levels at which determinants operate: structural and proximal. Structural determinants are the fundamental structures that generate social stratification, such as education systems, income, and race/ethnicity. Proximal determinants, also called intermediate, are the circumstances of daily life, including the quality of family environment and family composition. This framework proposes that these two levels correspond with environmental spheres of influence affecting a person's health (Viner et al., 2012). Thus, the WHO's social determinants of health approach (Solar and Irwin, 2010) provides an appropriate foundation for the present study's focus on understanding how social determinants of health impact treatment outcomes. This study focuses on three structural determinants: education, income, and race/ethnicity, and one proximal determinant, single parent status.

Socioeconomic status (SES) as a social determinant of health is considered as a fundamental cause of mental health inequalities (Link & Phelan, 1995). SES is often studied in the

context of treatment outcome research as it is associated with individuals having fewer resources to implement treatment and more barriers to accessing treatment (Leaf et al., 1987). Further, during childhood, SES is a predictor of many different outcomes, including physical and mental health, cognitive ability, and academic achievement (Bradley & Corwyn, 2002). SES is a multidimensional construct that includes measures of economic resources in addition to social factors, such as power and prestige (Hackman & Farah, 2009). There are multiple family, psychosocial, and neighborhood characteristics that negatively influence development and vary with SES. Consequently, the measurement of SES is complex, and there is debate about how to best conceptualize and accurately measure the construct. Historically, studies have used an aggregate measure of SES to predict outcomes, and there are several well-known composite measures of SES. For example, the Hollingshead Four-Factor Index of Socioeconomic Status (Hollingshead, 1975) is commonly used in the field of psychological research, and the Duncan SEI & Nam-Powers OSS is used to calculate SES for the United States Census.

Broadly speaking, the advantage of composite measures is that they offer sophisticated scalar quantities useful for cross-tabulating categorized SES measures by outcome. However, a disadvantage of using composite measures is that they combine an array of information (income, occupation, education) without using theory to correctly weight each piece of information. If the weights that combine the information are incorrect, then the outcome scalar is incorrect. Additionally, these composite measures can lead to conclusions that may or may not hold to be true. For example, Duncan's SEI weights occupation significantly heavier than one's income or education, because it views education as a prerequisite for occupation and income as its reward. This would assume that the highest level of education a person has corresponds with his or her occupation. In turn, it is assumed that one's income should also be a reflection of those two factors. However, it is possible for a person to be highly educated and unemployed, so this measure would prove inaccurate for this case. Given the drawbacks of using amalgamated SES

measures, researchers have recommended independently examining a diverse array of SES factors in order to more accurately capture SES (Duncan & Magnuson, 2012; Lawson, Hook, & Farah, 2018). Three of the most commonly evaluated factors include income, maternal education, and single parent status (Milne & Plourde, 2006). Each of these factors are discussed in turn below.

### **Income**

Income plays an integral role in health outcomes. Often annualized, household income reflects the potential social and economic resources that are available to the family (Galobardes, Shaw, Lawlor, & Lynch, 2006). Moreover, income represents the flow of economic resources over a period of time. In general, having a stable income is directly related to having transportation to access healthcare (Raphael, 2009). Children from high-income families are more likely to have the means to access optimal health care (Braveman et al., 2005), while children from low-income families encounter lower treatment contact and lower engagement in treatment due to associated barriers (Lindheim & Kolko, 2010; Reiss, 2013; Singh & Ghandour, 2012; Vanderbleek, 2004). The impact of income has been studied largely in the context of clinic-based BPT interventions for ADHD (Lundahl, Risser, & Lovejoy, 2006; Reyno & McGrath, 2006; Rieppi et al., 2002). Research on the effect of income on ADHD treatment outcomes is limited, but there is some evidence supporting an association. For example, in the Multimodal Treatment of ADHD Study (MTA), Rieppi et al. (2002) found that when considering maternal education, single parent status, and income, household income showed the strongest relation to treatment outcome, such that children from lower income households displayed poorer treatment response. The authors speculated that higher household income may be associated with greater treatment adherence. For example, parents of higher income households may have more time to devote to treatment and be less likely to experience barriers to care. Additionally, two meta-analyses (Lundahl, Risser, & Lovejoy, 2006; Reyno & McGrath, 2006) attempted to combine findings on predictors of outcome across multiple trials of behavioral parenting interventions. Both reviews concluded that children

of disadvantaged parents, specifically low-income parents, showed poorer intervention outcomes compared to children of high-income families.

### **Maternal Education**

Broadly speaking, education is considered to be one of the most stable aspects of SES. It is also the most widely used indicator of SES due to its influence on potential occupational opportunities and earning potential (Backlund, Sorlie, & Johnson, 1996; Braveman et al., 2005). A large body of research has shown the importance of maternal education, specifically, for a wide range of outcomes for children (e.g. conduct problems, emotional problems, decreased cognitive functioning; Bicego & Boerma, 1993; Schady, 2011). For example, maternal education influences child achievement through parental beliefs and behaviors in the home environment (Davis-Kean, 2005). Again, there is a paucity of research examining the impact of maternal education on treatment outcomes, and the available literature is mostly from clinic-based settings. In the MTA study, maternal education was found to moderate the relationship between type of treatment and treatment response (Arnold et al., 2003). Specifically, children of higher educated mothers showed increased benefit from combination (behavioral and medication) treatment in comparison to medication management alone. There are several possible mechanisms through which maternal education might influence treatment outcomes. It could be that more highly educated mothers are better able to understand the disorder and comply with the directions and homework associated with treatment. Additionally, mothers with higher education may have developed the critical and functional skills that are required to interact effectively with healthcare providers (Adler et al., 1993; Kaplan, 1996).

### **Single Parent Status**

Family composition is regarded as a social determinant of health as it is a social and environmental factor that has the potential to determine the health status of an individual. Family structure often refers to family unit composition. More traditionally, the family unit consists of

dual-parent households and their children (Turagabeci et al., 2007). However, the family structure has changed remarkably over the last several decades due to many factors, such as migration and economic fluctuations (Turagabeci et al., 2007). The family structure can now refer to a diverse range of family types, including extended families with cohabiting relatives and single-parent families. There has been some research conducted showing the relationship between family composition and a number of health outcomes. More specifically, children living in single-parent households have been shown to have higher incidences of psychiatric and neurological illness across the life span (Blackwell, 2010; Scharte, Bolte, & GME Study Group, 2012; Victorino & Gauthier, 2009) and lower reported psychological well-being (Fomby & Cherlin, 2007; Krueger, Jutte, Franzini, Elo, & Hayward, 2015) than children living in traditional two-parent households.

The presence of one versus two parents in the household has also been evaluated in the context of BPT for children with behavior problems (see Chronis et al., 2003 for review). Historically, single parenting has been noted as a risk factor for the development of psychopathology in children (Rutter et al., 1975). Single parents are more likely to experience numerous adversity factors and stress and less likely to receive emotional and parental support (Blechman, 1982; Cairney, Boyle, Offord, & Racine, 2003; Webster-Stratton, 1989; Weinraub & Wolf, 1983;). For example, studies have shown that parents of children with oppositional defiant disorder (ODD) and conduct disorder (CD) who faced higher levels of adversity had poorer attendance and engagement in BPT. Moreover, single parent status was shown to predict poorer response to BPT (Kazdin, Mazurick, & Bass, 1993; Webster-Stratton & Hammond, 1990). The authors believed that single parents may find these interventions burdensome and straining and have more difficulty implementing the parenting practices. Given this, BPT interventions have even been developed specifically for single parents and have been found to increase engagement; further highlighting this is an important variable resulting in unique treatment needs (Chacko et al., 2009). Although most of the literature involving BPT and single parents is exclusive to single-

parent families of ODD/CD children, it is reasonable to infer that many of these processes are similar in families of children with ADHD.

### **Race/Ethnicity**

In the United States and many other societies, race and ethnicity is another important social factor that influences health (Braveman, Egerter, & Williams, 2010). While race and ethnicity are two separate constructs, many researchers compound the two. Therefore, the literature will be discussed accordingly. For example, McKay and colleagues (2004) reported that ethnic minority children often experience early attrition of treatment due to minority status-related factors. The effect of race/ethnicity on treatment outcomes has also received some attention in the ADHD intervention literature (Hinshaw, 2007; Jones et al., 2010). For example, the MTA study evaluated racial/ethnic differences in treatment attendance and response to treatment. Findings revealed a significant difference in teacher-rated ADHD symptoms between Black and matched White participants, with Black participants rated as more symptomatic post-intervention (Arnold et al., 2003). However, in this structured, large randomized controlled trial, racial/ethnic minority families were found to have similar rates of engagement and satisfaction with behavioral treatment, relative to nonminority families. In another study by Jones and colleagues (2010), race/ethnicity did not moderate the relationship between treatment and parenting. In contrast, other studies have found that immigrant and racial/ethnic minority parents are less likely to enroll in behavioral parent training programs (e.g, Reid et al., 2001) and more likely to drop out when compared to White parents (e.g., Holden, LaVigne, & Cameron, 1990; Kazdin & Whitley, 2003). Furthermore, Orrell-Valente et al. (1999) found that even when the rate of attendance is similar across racial/ethnic groups, levels of active engagement and participation in treatment may still be lower among racial/ethnic minority parents compared to White parents.

Race may play an important role in clinic-based interventions due to cultural differences in parenting practices and values across minority groups (Forehand & Kotchick, 1996.) Specifically,

researchers have suggested that minority parents may not respond as well as White parents to parent-directed interventions that were originally developed and validated with White samples (Hill et al., 1994; Forehand & Kotchick, 1996; Jones et al., 2010; Wood & Baker, 1999). Parenting practices within a particular culture are influenced by cultural values, heritage, and history that reflect the competencies considered necessary for the survival and success of children (Forehand & Kotchik, 2016). Moreover, cultures have different histories that shape theories about parenting. If parenting interventions are not aware of and sensitive to the impact culture has on parenting, this could hinder positive treatment outcomes, limiting treatment engagement and adherence. For example, Forehand & Kotchick (2002) found that Black families exhibited a great amount of resistance to reinforcing and rewarding children for obedience due to incongruence of beliefs and expectations.

Access to care also appears to differ by race such that Black children are less likely to receive treatment than White children (Bussing et al., 2003). Previous work has attributed this to cultural attitudes of particular ethnic groups that could possibly influence service seeking and service delivery indirectly affecting outcome. For example, research with Black individuals has identified mental health stigmas, difficulty obtaining services that are culturally sensitive, and financial barriers to obtaining services as reasons of not engaging in treatment or dropping out prematurely (National Institutes of Health, 2003).

Lastly, race may influence treatment outcomes indirectly through differences in teachers' ratings of students' behavior. Research on U.S. samples has consistently shown that teachers rate Black children higher (i.e., more severe) on ADHD-related behaviors than White children (Arnold et al., 2003; DuPaul et al., 1998; Hervey-Jumper et al., 2006; Reid et al., 2001). This effect has been demonstrated across multiple scales, including the Swanson, Nolan and Pelham Questionnaire -IV (SNAP- IV) and the Connors (1997). Whether these reported differences are related to true differences in behavior remains unclear (Epstein et al., 2010). Further, the reasons

why these differences might occur have also not been fully elucidated. There is some indication that teachers make differential judgements about behavior based on racially conditioned characteristics, specifically the misinterpretation of students' emotions and expressions in the academic setting. Neal and colleagues (2003) showed that White teachers perceived Black male students' cultural expressions (for example, walking style and neighborhood jargon) to be higher in aggression, and they perceived the male students themselves to be lower in academic achievement and more in need of special education services. Relevant to the present study, Pendergast and colleagues (2017) found that teachers rated White students higher than racial minority students on the Homework Performance Questionnaire (HPQ), suggesting that they perceived White students as having a significantly higher ability to complete homework. Overall, this literature suggests that teachers may generally view Black children as more problematic than White youth in the classroom, though the underlying mechanism is currently unknown.

In sum, there is some evidence to suggest that family income, maternal education, single parent status, and race are important for understanding outcomes in clinic-based ADHD treatments. However, there is almost no research on how these same factors operate in school-based ADHD interventions, and there are several reasons to believe that their impact may be different. For example, school-based interventions are easily accessible, brief, and tend to focus more on the child, removing most of the challenges associated with parental involvement. Indeed, one study of children with depressive and disruptive disorders (Wu et al., 1999) found that children's use of school-based services, compared to community mental health services, was less influenced by social determinants of health, such as occupation, education, and income. Although much has been written about the potential advantages of school-based mental health treatment programs for youth with ADHD (Evans, 1999; Evans, Axelrod, & Sapia, 2000; Weist, 1997), research on the role of social determinants of health in this setting is limited. It may also be that the impact of social determinants of health depends on the type of school-based treatment being

implemented.

### **Skills-Based and Contingency Management-Based ADHD Interventions**

Evidence-based ADHD intervention reviews (e.g., Evans, Owens, Wymbs, & Ray, 2017) state that there are largely two types of ADHD interventions, skills-based and contingency management. Skills-based treatments typically involve working directly with children and adolescents, teaching them strategies and skills, rehearsing and practicing the strategies, and monitoring implementation across time. For example, organization, time management, and planning (OTMP) interventions are skills-based (e.g., Abikoff et al., 2013; Evans et al., 2016). In contrast, contingency management-based interventions focus on manipulating the environment to encourage positive behaviors. For example, teachers specifically define positive behaviors, provide praise and attention when those behaviors occur, and provide consistent feedback and/or consequences for negative behaviors.

Langberg et al. (2018) recently compared the efficacy of a skills-based intervention, the Homework, Organization, and Planning Skills (HOPS) intervention versus a contingency management-based intervention, the Completing Homework by Improving Efficiently and Focus (CHIEF) for improving the homework problems of adolescents with ADHD. The interventions both consist of 16, 20-minute meetings during the school day, and include minimal parent involvement (i.e., two meetings). In HOPS, students were taught OTMP skills, had the skills consistently monitored by school counselors, and established self-monitoring and management plans for skills use. In CHIEF, counselors used contingency management strategies to help students stay focused and to complete homework efficiently during intervention sessions. For HOPS, the parent meetings focused on having parents develop a plan to monitor OTMP skills at home. For CHIEF, the parent meetings focus on establishing a structure and behavior management plan to use during homework completion time. Langberg et al. (2018) found that participants in HOPS and CHIEF made significant improvements in homework problems relative to a waitlist

control, with participants in HOPS making larger improvements on some aspects of OTMP skills. In a follow-up study evaluating the importance of therapeutic processes in both HOPS and CHIEF, Breaux et al. (2018) found that parent engagement was important for the contingency-based treatment, CHIEF, whereas working alliance and adolescent involvement were most important for the skills-based treatment, HOPS. Given these findings, it seems likely that sociodemographic factors could also differentially impact improvements associated with participation in HOPS and CHIEF.

### **Study Aims and Hypotheses**

The current study was part of a larger study that evaluated the effectiveness of two brief school-based interventions. Given the existing literature discussed, the current study had two primary aims.

#### **Aim 1**

Evaluate whether social determinants of health have a differential impact on a skills-based intervention and a contingency management intervention.

**Hypothesis 1.** It was hypothesized that single parent status and income would exhibit a significant three-way interaction, moderating the association between intervention status and post-intervention academic outcomes. Specifically, it was expected that adolescents from single parent families, or adolescents from low-income families, would show a greater response to HOPS than CHIEF due to potential challenges that could make it more challenging for adults to be able to structure the environment and engage in the intervention. It was hypothesized that there would not be differential effects of maternal education and race on academic outcomes.

#### **Aim 2**

Evaluate the impact of social determinants of health on the academic outcomes associated with two school-based interventions for adolescents with ADHD.

**Hypothesis 2.** Given the school-based adolescent focused nature of HOPS and CHIEF, it was hypothesized that there would be no two-way interaction between maternal education and time. In both HOPS and CHIEF, SMH providers delivering the intervention provided a feasible monitoring plan for parents that was specific for each family. All parents left with written expectations, all the necessary forms, and only one or two actions items at most to minimize issues that might arise as a result of education gaps. It was hypothesized that single parent status and income would exhibit a two-way interaction (SDH variable X time).

### **Aim 3**

Evaluate whether the associations between social determinants of health and academic outcomes can be attributed to intervention attendance. This is an exploratory analysis, and therefore no a priori hypotheses were made.

## **Methods**

### **Participants**

Participants were 222 middle school students (72.0% male; *Mean* = 12.00 years, *SD* = 1.02) with ADHD who were randomly assigned to receive the HOPS or CHIEF treatments. For analyses involving race as a predictor variable, the sample size was 194 as only participants who identified as Black and White were included. Seven middle schools in the greater Richmond area were involved in the project, selected to represent a range of school characteristics and settings. Participants were racially diverse, with 56% identifying as White, 28% identifying as Black, 12% identifying as multiracial and 4% identifying with another race or preferring not to report race. Adolescents in this sample came from families with a range of socioeconomic backgrounds: family income of  $\leq$  \$25,000 (14%), \$25,000 –\$75,000 (39%), and  $>$  \$75,000 (47%), and parents with less than a high school diploma (5% for mothers), high school diploma (27% for mothers), some college/associate's degrees (20% for mothers), bachelor's degrees (34% for mothers), and advanced degrees (14% for mothers). Demographic characteristics are shown in Table 1.

<i>Demographic variable</i>	HOPS (N=111) <i>M (SD) or % (n)</i>	CHIEF (N=111) <i>M (SD) or % (n)</i>
<b>Child age</b> (years)	12.00 (1.05)	12.02 (.99)
<b>Child Gender</b> (% boys)	66.7 (74)	77.5 (86)
<b>Child Race</b>		
White	55.9 (62)	59.5 (66)
Black	28.8 (32)	30.6 (34)
Multiracial	15.3 (17)	9.9 (11)
<b>Single Parent Status</b>		
One Parent Household	45.9 (51)	45.0 (50)
Mother	72.5 (37)	78.0 (39)
Father	17.6 (9)	12.0 (6)
Grandparent	9.9 (5)	10.0 (5)
Two Parent Household	50.5 (56)	54.1 (60)
Not reported	3.6 (4)	.9 (1)
<b>Maternal Education</b>		
Less than high school	4.5 (5)	1.8 (2)
High School Diploma/ G.E.D	19.8 (22)	14.4 (16)
Some College	20.7 (23)	17.1 (19)
Bachelor's Degrees	23.4 (26)	33.3 (37)
Advanced Degrees	18.0 (20)	16.2 (18)
Not Reported	13.5 (15)	17.1 (19)
<b>Family Income</b>		
< \$25,000	12.6 (14)	15.3 (17)
\$25,000-\$75,000	39.6 (44)	38.7 (43)
> \$75,000	47.7 (53)	45.9 (51)

Table 1.

*Baseline Participant Characteristics by Treatment Assignment*

Note: ANOVA testing found nonsignificant group differences for all variables.

## **Procedures**

Participants were recruited as part of a randomized controlled trial evaluating school-based treatment programs for middle school students with ADHD. Study procedures were approved by the Institutional Review Board; all caregivers provided signed consent and all adolescents provided assent. The principal investigator went to each school and explained that the interventions focused on homework problems for students with attention and behavior problems. School staff were given recruitment flyers describing the study (e.g., offering “homework treatments for students with attention and behavioral difficulties and/or with ADD/ADHD”). A phone screen was administered to interested parents/caregivers. To be scheduled for an evaluation, parents had to endorse their adolescent as displaying at least four of nine Diagnostic and Statistical Manual of Mental Disorders (4th ed., text rev.; DSM–IV–TR) ADHD inattention symptoms. This threshold was chosen to reduce the number of families who participated in the full inclusion/exclusion evaluation who would ultimately not meet eligibility criteria. Criteria for inclusion in the study required that adolescents (a) attended one of the participating schools; (b) met full DSM–IV–TR diagnostic criteria for ADHD based on the Parent Children’s Interview for Psychiatric Syndromes (Weller et al., 2000) or combined with teacher ratings on the NICHQ Vanderbilt ADHD Rating Scale (Wolraich et al., 2003); (c) demonstrated an IQ of 80 or above as estimated using the Wechsler Intelligence Scale for Children (4th ed.; Wechsler, 2003); and (d) did not meet diagnostic criteria for a pervasive developmental disorder, bipolar disorder, or psychosis. Each participant’s assessment data were reviewed by a licensed clinical psychologist to determine eligibility and diagnoses.

## **Study Interventions**

**HOPS.** The HOPS intervention implemented in this study followed the same manual and procedures as described in Langberg et al. (2011) and Langberg et al., (2012; 2018). The HOPS

intervention was implemented as an individual (i.e., 1:1), 16-session intervention. The first ten sessions occurred twice weekly and the final six sessions occurred once per week. As a result, the 16 sessions were completed over an 11-week period. Three main skills areas were covered: school materials organization and management, homework recording, and planning/time-management.

For materials organization, the school mental health (SMH) provider taught the student a specific system of bookbag, school binder, and locker organization. The student was also taught to implement an organization system for transferring homework materials to and from school. For homework recording, the SMH provider taught the student how to accurately and consistently record homework assignments, projects and tests in a planner. In the planning/time-management portion of the program, SMH providers taught students how to break projects and studying for tests down into small, manageable pieces, and how to plan for the timely completion of each piece. Participants were also taught how to plan out after school activities using an evening schedule to balance extracurricular activities and school responsibilities. Skills instruction was completed by session 10, after which the SMH providers met with students once per week and focused on problem-solving difficulties, self-monitoring, and maintaining skills.

The HOPS intervention included a point system. SMH providers completed skills tracking checklists at every intervention session that included operationalized definitions of materials organization, homework, recording, and time-management. At each HOPS session, students' materials (e.g., binder, bookbag, and planner) were visually inspected by the SMH provider. Students received points and rewards based upon the criteria they met on the skills tracking checklists (e.g., no loose papers in bookbag = 1 point). Overall, adherence to HOPS intervention across sessions and providers was 85.44%.

The HOPS intervention included two 1-hour parent meetings. These meetings were held at the school and included the SMH provider, the student, and parent(s). The first meeting took place early in the intervention and was designed to orient the parent to the program. The second meeting

took place near the completion of the intervention. The goal of the second meeting was to teach the parent how to manage the HOPS checklist completion and reward responsibilities once the intervention period ended. Parents learned about the point system and worked with the SMH provider to establish a plan for providing home-based monitoring and rewards.

**CHIEF.** The CHIEF intervention service delivery model was the exact same as the HOPS model in regard to number of sessions and session length. In terms of content, students were told to bring homework or materials to study from to each meeting. If students did not bring work, the SMH provider consulted with the students' teachers and then provided work for the student to complete at all subsequent meetings. At the beginning of each meeting, the SMH provider and student established an operationalized work completion goal (e.g., make 30 flash cards and memorize 10, or complete 25 math problems with at least 15 of them correct). The student chose what subject to focus on during the meeting but the SMH provider encouraged them to choose their "most difficult subject." Students were told that if they met their work completion goal, they would receive 10 bonus points. During the meeting, SMH providers monitored on-task behavior and put a token in a jar for each minute that the student remained on-task. The manual stated that the SMH provider was also to provide 10 verbal praises during the meeting (e.g., I like how you just checked that problem for accuracy). Students earned one point for each token and combined with the bonus points for work completion goals, had the same number of potential points per session as students in the HOPS intervention. Overall, adherence to the CHIEF intervention was high with, an average of 89.23% of criteria met across sessions.

The CHIEF intervention also included two 1-hour parent meetings. These meetings were held at the school and included the SMH provider, the student, and parent(s). The first meeting took place early in the intervention and was designed to orient the parent/guardian to the program. The second meeting took place near the completion of the intervention. The goal of the second meeting was to teach the parent how to monitor on-task behavior during homework completion, to

set work completion goals, and to implement the point system at home.

## **Predictor Measures**

**Demographic Questionnaire.** Parents completed a demographic questionnaire that included information on primary income, maternal education, single parent status, and race/ethnicity. Primary income was ascertained by parental self-report and dichotomized into two levels, low and high. The income variable was dichotomized using the median household income as reported by the U.S. Census Bureau in 2015 (\$56,516). Families who reported making less than this amount were classified as “low income”, while families who reported making this amount or above were classified as “high income”. In this study, about 30 percent of families ( $N=60$ ) were of low income and about 70 percent of families ( $N=146$ ) were of high income. Maternal educational level was determined with a single question asking the highest educational level achieved. This was then categorized into “low education” (defined as completing less than a high school diploma/GED) and “high education” (defined as earning at least a high school diploma/ GED). About 24 percent of mothers ( $N=45$ ) were classified as low educated and about 76 percent of mothers ( $N=143$ ) were classified as high educated. Single parent status was measured with a single question asking whether both parents live together and dichotomized into one parent and two parent households. Thirty percent of families ( $N = 72$ ) in this study were headed by single mothers, seven percent ( $N = 15$ ) were headed by single fathers, and five percent ( $N = 10$ ) were headed by other single relatives (e.g., stepmothers, grandmothers/grandfathers, and aunts/uncles).

## **Outcome Measures**

Parents and teachers completed ratings pre- and post-intervention for HOPS and CHIEF. Parents were instructed to provide teacher contact information for two core class teachers where the adolescent was having the most difficulty. If the adolescent was not currently having difficulties or if parents were not aware of any difficulties, parents were instructed to provide teacher contact information for the two subjects that were traditionally most difficult for the child.

**Homework Performance Questionnaire (HPQ).** The HPQ (Power et al., 2007, 2015) was completed by parents and teachers. The 13 HPQ items that were administered in this study use a 5-point scale, each with corresponding percentages to indicate the amount of time a given behavior occurs. Items are worded in the positive so that 90%–100% of the time indicates that the child does that behavior consistently well (e.g., student writes down homework assignments independently or manages homework time well). The HPQ has demonstrated convergent validity with other measures of homework (Power et al., 2007; 2015). For the current study, a parent and at least one teacher rated each student’s homework behaviors. Internal consistency was high for parents ( $\alpha = .91$ ) and teachers ( $\alpha = .83$ ). If more than one teacher provided ratings about a student, then their scores were averaged together. The total score was used as an indicator of treatment response, with parent and teacher scores examined separately.

**Grade point average (GPA).** GPA is a numerical system commonly used for quantifying letter grades. Grades for each participant were collected from the school offices at the end of each academic year. All grades were converted into GPA for core subject areas (English/language arts, social studies, math, science) with a range from 0.0 to 4.0 (4.0 = A; 0 = F). School grades for the quarter closest to post intervention were included in the analyses.

**Assignments turned in.** Teachers reported the percentage of assignments (0% to 100%) students turned in on time. This item is similar to one used in the Classroom Performance Survey (Brady, Evans, Berlin, Bunford, & Kern, 2012), which has been used to track homework completion in multiple studies (e.g., Langberg et al., 2016; Meyer, Kelley, & the Parent Monitoring of Homework Behavior and Study Skills, 2007). Scores on this item have demonstrated good clinical utility in distinguishing teacher identified academically impaired students from non-impaired students and good convergent validity with other measures of academic impairment (Brady et al., 2012).

**Parent Attendance.** This variable was coded by SMH professionals during the parent

meetings. Parent attendance is a count variable of whether a participants' parent(s) attended zero, one, or two sessions. For parent meetings, 72% of meetings were attended by mothers, 11% were attended by fathers, 11% were attended by both mothers and fathers, and 6% were attended by another caregiver (e.g., grandmother, grandfather, stepmom, aunt).

## **Covariates**

### **Vanderbilt ADHD Diagnostic Parent Rating Scale (VADPRS; Wolraich et al., 2003).**

The VADPRS is a parent-report scale with good internal consistency, factor structure, and concurrent validity for the assessment of ADHD (Wolraich et al., 2003). This rating scale includes all 18 ADHD DSM–IV symptoms. Parents rated how frequently each symptom occurs on a 4-point Likert scale ranging from 0 (*never*) to 3 (*very often*). The total ADHD score was used in the present study, which consists of the Inattention score (sum of the nine inattention items) and the Hyperactivity/ Impulsivity score (sum of the nine hyperactive/impulsive items), and ODD score (sum of the eight ODD items). The VADPRS has excellent psychometric properties (Wolraich et al., 2003) and internal consistency was .90 in the present study.

## **Data Analytic Plan**

Descriptive statistics, including means and standard deviations for baseline measures for the HOPS and CHIEF groups were examined and independent samples *t*-tests were run to test for differences between groups. The correlation matrix showing bivariate relationships, means, and standard deviations of the independent and dependent variables in Table 2. Data were also checked for violations of the assumption of normality (i.e., skewness and kurtosis between -2 and +2; George & Mallery, 2010). Next, to assess whether data are missing at random, Little's Missing Completely At Random (MCAR) test was performed. Little's MCAR is a chi-square statistic used to assess whether the pattern of missing values is systematic, by assessing whether mean scores on variables of interest significantly differ when cases with missing data are included or excluded (Little, 1988). Multiple imputation within SPSS was then used to estimate missing values. This

approach uses all available data so that any participant with at least one data point is included in analyses. This procedure has been found to produce comparable results to full information maximum likelihood when data are missing at random (Wu & Jia, 2013).

To address the primary aim of this study, a series of three-way repeated measures analysis of variance (ANOVA; social determinants of health variable X intervention X time) analyses were run in SPSS 24 (SPSS, IBM, version 24.0), with HPQ (teacher- and parent-rated), GPA, and percentage of assignments turned in as outcome variables. Total ADHD, ODD, and CD symptoms were included as covariates in each model. Separate models were run for each social determinants of health variable. If a significant three-way interaction was present, follow-up univariate ANOVAs were conducted to evaluate social determinants of health effects on outcomes for each intervention group. If a significant three-way ANOVA was not found for an outcome variable, a two-way ANOVA was run with participants collapsed across intervention conditions. Given the number of hypothesis tests, the Benjamini–Hochberg method (Benjamini & Hochberg 1995, 2000) for adjusting the false discovery rate (FDR) was applied. To conduct a FDR analysis, all observed  $p$ -values were ordered sequentially from low ( $p_1$ ) to high ( $p_m$ ), with  $m$  representing the total number (23) of  $p$ -values, and the largest  $k$  such that  $p_k < 0.05 * k/m$  is found. FDR is less stringent than family-wise error rate control methods, such as the Bonferroni correction, resulting in greater power and a reduced risk of type II errors.

Table 2.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Group	--															
2. Maternal Education	.089	--														
3. Income	.059	.418***	--													
4. Single Parent Status	.022	.093	.127	--												
5. Race	0	.123	.171*	.153*	--											
6. HPQ-PR (T1)	.056	.03	0	.153*	.053	--										
7. HPQ-PR(T2)	-.059	-.004	.155*	.137	.103	.370***	--									
8. HPQ-TR(T1)	-.078	.061	.199**	.068	.243**	.317***	.271**	--								
9. HPQ- TR(T2)	-.053	.166*	.336***	.182*	.267**	.243**	.379***	.569***	--							
10. % of assignments (T1)	-.039	.104	.159*	.06	.240**	.317***	.277***	.753***	.527***	--						
11. % of assignments (T2)	-.043	.196*	.331***	.190**	.245**	.276***	.367***	.475***	.727***	.547***	--					
12. GPA (T1)	.021	.157*	.235**	.255***	.400***	.329***	.329***	.588***	.540***	.571***	.518***	--				
13. GPA (T2)	-.072	.091	.280***	.285***	.341***	.231**	.437***	.481***	.637***	.480***	.579***	.689***	--			
14. ADHD Symptoms	-.086	-.063	-.047	-.134*	-.029	-.427***	-.12	-.009	-.03	-.025	-.032	-.054	-.059	--		
15. ODD Symptoms	-.061	.008	.055	.005	.082	-.178**	-.056	.06	.043	-.012	.003	.018	-.048	.554***	--	
16. CD Symptoms	-.142*	-.061	-.017	-.041	-.098	-.221**	-.137	-.064	-.073	-.054	-.052	-.135	-.182**	.407***	.611**	--
Mean		14.89	84247.57	.53		21.46	33.35	23.67	28.43	63.47	67.48	2.19	2.10	30.69	8.41	2.19
Standard Deviation		2.36	55648.98	.50		11.14	12.10	12.85	13.53	25.42	25.33	.88	.95	9.85	5.51	2.48

*Correlation Matrix*

Note: HPQ= Homework Performance Questionnaire, PR= parent report, TR= teacher report, GPA= Grade Point Average, ADHD= Attention Deficit Hyperactivity Disorder, ODD= Oppositional Defiant Disorder, CD= Conduct Disorder

\* $p < .05$ . \*\* $p < .01$ . \*\*\*  $p < .001$

## Single Parent Status

For percentage of assignments turned in, there was a significant three-way interaction (single parent X group X time),  $F(1, 201) = 4.927, p = .029$ . Follow-up analyses revealed a significant association between single parent status and time among HOPS participants such that single parent families had poorer outcomes post-intervention than two parent families,  $F(1,102) = 10.51, p = .031$ . This relation was not found among CHIEF participants,  $F(1,102) = .421, p = .518$ . However, these analyses were no longer significant after adjusting for multiple testing.

Similarly, for teacher-reported homework performance, a significant three-way interaction (single parent X group X time) was found,  $F(1, 210) = 6.425, p = .012$ . Follow-up analyses revealed a significant association between single parent status and time among HOPS participants, such that adolescents from single parent household made less improvements than adolescents from two parent household,  $F(1,102) = 10.510, p = .025$ . This association was not found among CHIEF participants,  $F(1, 102) = 0.421, p = .518$ . However, these analyses were no longer significant after adjusting for multiple testing.

There was not a significant three-way interaction observed for parent-reported homework performance,  $F(1,210) = .647, p = .526$ , or GPA,  $F(1,210) = 2.691, p = .103$ . Therefore, two-way ANOVAs were run with participants collapsed across intervention conditions for these two outcomes. This analysis revealed no significant two-way interactions of single parent status X time on parent-reported homework performance,  $F(1,212) = .454, p = .501$  or GPA,  $F(1,212) = 1.620, p = .205$ . There was a main effect of single parent status on parent-reported homework performance,  $F(1, 212)=4.053, p < .045$  and on GPA,  $F(1, 187)=19.348, p < .001$ , such that overall, adolescents who live with two parents had higher (better) scores on these measures at both time points than adolescents who lived with one parent. These findings remained significant after adjusting for multiple hypothesis testing. An independent samples *t*-test revealed that there were no significant

differences in intervention attendance when comparing single and two parent families in the sample ( $t_{211} = -1.45, p = .147$ ).

### **Income**

No three-way interactions were observed for income on the parent-reported HPQ,  $F(1,199) = .186, p = .667$ , teacher-reported HPQ,  $F(1,199) = .627, p = .429$ , percentage of assignments turned in,  $F(1,199) = .563, p = .454$ , or GPA,  $F(1,199) = .462, p = .498$ . Therefore, two-way ANOVAs were then run with participants collapsed across intervention conditions. Analyses revealed a significant income X time interaction for parent-reported homework performance,  $F(1, 201) = 10.785, p < .001$ , such that adolescents of high-income families showed greater improvement than adolescents of low-income families across the two intervention conditions on this measure (see Figure 1). This finding remained significant after adjusting for multiple hypothesis testing. No two-way interactions were found on teacher-reported homework performance  $F(1,201) = 2.631, p = .106$ , percentage of assignments turned in,  $F(1,201) = 3.677, p = .057$  or GPA,  $F(1,201) = 1.096, p = .297$ . There were main effects of income observed for teacher-reported homework performance,  $F(1,201) = 6.098, p < .014$ , percentage of assignments turned in,  $F(1,201) = 9.124, p < .003$ , and GPA,  $F(1,201) = 5.995, p < .015$ . These findings remained significant after adjusting for multiple hypothesis testing. There was no main effect of income for parent-reported homework performance,  $F(1,201) = 1.141, p = .287$ . An independent samples  $t$ -test revealed that there were no significant differences in intervention attendance based upon income ( $t_{83.36} = 1.54, p = .127$ ).

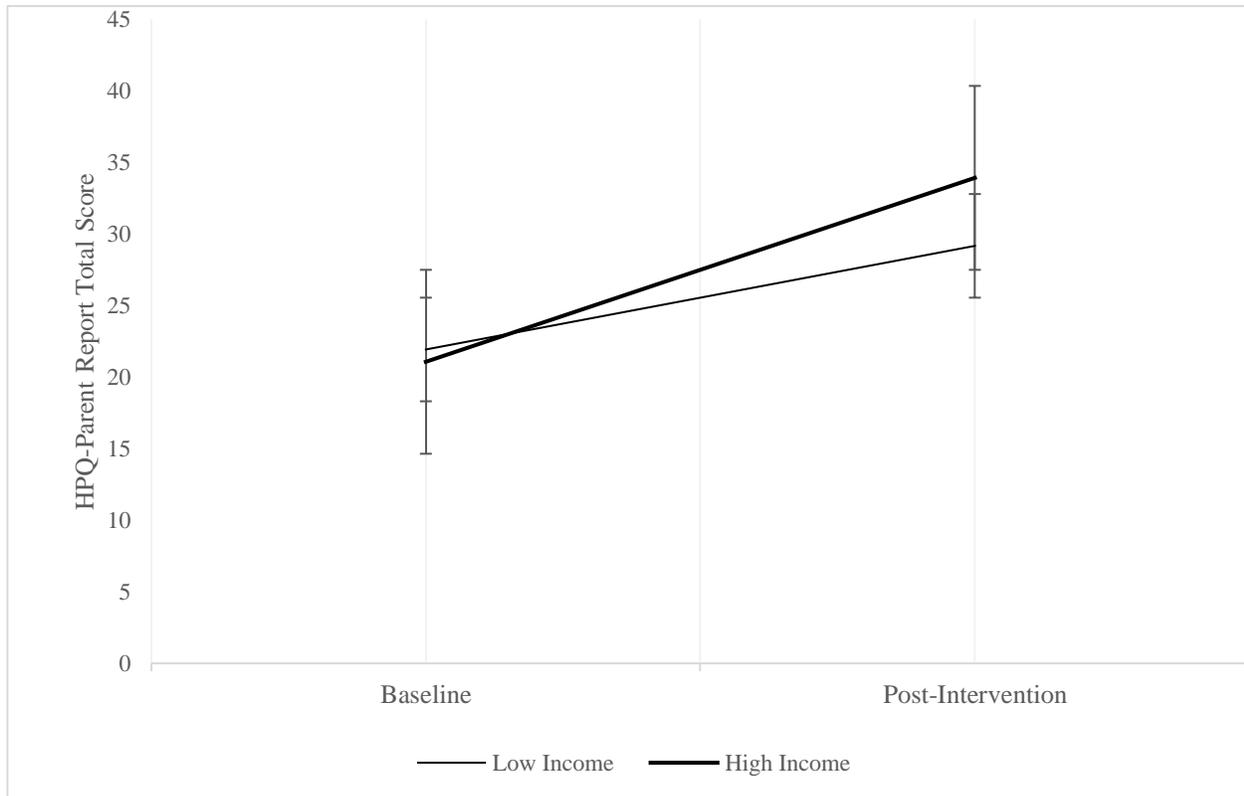


Figure 1. Visualized Two-Way Interaction of Parent-Reported Homework Questionnaire. Higher scores on the Homework Performance Questionnaire (HPQ) represent more positive homework behavior.

## Race

No three-way interactions were observed for race on the parent-reported HPQ,  $F(1,187) = .293, p = .589$ , teacher-reported HPQ,  $F(1,187) = 1.282, p = .259$ , percentage of assignments turned in,  $F(1,187) = .110, p = .741$ , or GPA,  $F(1,187) = .330, p = .567$ . As a result, two-way ANOVAs were then run with participants collapsed across intervention conditions. This analysis revealed no significant two-way interactions of race X time on parent-reported HPQ,  $F(1,189) = .890, p = .347$ , teacher-reported HPQ,  $F(1,189) = 1.022, p = .313$ , percentage of assignments turned in,  $F(1,189) = .241, p = .624$ , or GPA,  $F(1,189) = .143, p = .706$ . Instead, several main effects were observed. For the percentage of assignments turned in, parent-reported homework performance, and GPA, a main effect of race was found,  $F(1,189) = 15.603, p < .001$ ;  $F(1,189) = 15.282, p < .001$ ;  $F(1,166) = 29.841, p < .001$ , respectively, such that White adolescents completed a higher percentage of homework, were rated higher on homework performance by parents, and had higher GPAs than

Black adolescents. There was not a main effect of race found for teacher-reported homework performance,  $F(1,189) = 1.192, p = .276$ . An independent samples  $t$ -test was conducted to explore differences in overall intervention attendance between Black families and White families. This analysis revealed that there were no significant differences in intervention attendance ( $t_{99.09} = -1.37, p = .173$ ).

### **Maternal Education**

No three-way interactions of maternal education X group X time were observed for parent-reported HPQ,  $F(1,181) = .386, p = .535$ , teacher-reported HPQ,  $F(1,181) = .334, p = .564$ , percentage of assignments turned in,  $F(1,181) = .173, p = .678$ , or GPA,  $F(1,181) = .218, p = .641$ . As a result, two-way ANOVAs were then run with participants collapsed across intervention conditions. These analyses revealed no significant two-way interactions of maternal education X time on parent-reported HPQ,  $F(1,183) = .211, p = .065$ , teacher-reported HPQ,  $F(1,183) = .218, p = .641$ , percentage of assignments turned in,  $F(1,183) = .207, p = .649$ , or GPA,  $F(1,183) = .398, p = .529$ . There were also no main effects of maternal education observed on parent-reported HPQ,  $F(1,183) = .090, p = .765$ , teacher-reported HPQ,  $F(1,183) = .926, p = .337$ , percentage of assignments turned in,  $F(1,183) = 3.187, p = .076$  or GPA,  $F(1,183) = 3.439, p = .065$ . Given that there were no significant interactions or main effects found for maternal education on any of the four academic outcomes, differences in intervention attendance were not explored.

### **Discussion**

The present study builds upon prior work by evaluating the importance of social determinants of health on academic outcomes associated with school-based interventions for adolescents with ADHD. Importantly, this study evaluates whether the impact of these variables differs across contingency management (CHIEF) and skills-training (HOPS) interventions. Overall, although single parent status, income, and race were associated with academic outcomes,

contrary to hypotheses, the impact of these variables did not differ across intervention conditions. These findings and potential implications are discussed in more detail below.

The aims of this study were to evaluate associations between several SDH variables, namely maternal education, income, single parent status, and race, and academic outcomes for the HOPS and CHIEF interventions. Given the school-based and adolescent-focused nature of HOPS and CHIEF, it was hypothesized that barriers typically associated with determinants would be minimized in comparison to what has been reported in clinic-based work. With respect to study Aim 1, differential effects of the SDH variables on the HOPS and CHIEF interventions were not consistently found. Specifically, it was hypothesized that both single parent status and income would have differential effects, such that these determinants would matter more for CHIEF than for HOPS due to differences in the structure of the two interventions. CHIEF relies mostly on adults to structure the homework environment, whereas HOPS teaches the adolescent skills and may rely less on parent engagement. In contrast to hypotheses, analyses revealed that intervention moderated the relationship between single parent status and the percentage of assignments turned in and teacher-rated homework performance for the HOPS group. That is, participants from single parent families did not improve as much with the HOPS intervention as participants from two parent families, but this effect was not found for CHIEF participants. There were also significant two-way interactions, whereby overall, intervention participants from lower income families or single parent status did not make improvements at the same rate as intervention participants from higher income families or two parent households.

It is likely that income is an important factor for some of the same reasons as single parent status. Low-income and single parent families also are often faced with multiple stressors and demands, which may need to take precedence over homework and organization monitoring. Specifically, as is common with many behavioral interventions, parents in HOPS and CHIEF were asked to consistently monitor homework related behaviors. This process is potentially more

difficult in single parent households. In the present study, teacher-rated homework performance showed significantly greater improvement for children who lived with two parents as compared to children who lived with only one parent. Research supports the importance of parent involvement in implementing homework interventions (Hoover-Dempsey, 2001; Kelley & Kahle, 1995; Patton, 1994; Robin, 1998). However, single parents often have competing demands as the sole financial support for the family. As such, single parents may have less time available to commit to completing intervention related tasks than can be provided in two-parent homes (Jeynes, 2005). For example, it may be more difficult for a single parent to consistently provide contingencies for the completion of homework related tasks (Rafferty & Griffin, 2010). Although parents were given relatively simple and clear strategies to implement, consistent monitoring and delivering of contingencies would remain challenging. It is important to note that after controlling for multiple hypothesis testing, these findings did not remain significant, with the exception of the two-way interaction for income. As shown in Figure 1, lower income families improved at a significantly slower rate than higher income families. Both HOPS and CHIEF require some level of home-based monitoring and consistent implementation of contingencies. Accordingly, structural differences across HOPS and CHIEF with respect to reliance on parents may not be substantial enough for SDH variables to have a differential effect.

Consistent with hypotheses, maternal education was not associated with intervention improvement for HOPS or CHIEF. This may be because the SMH providers delivering the intervention focused on developing easy to understand and clear plans for parents. All parents left with step-by-step written expectations, all the necessary forms, and only one or two actions items. Further, SMH providers provided psychoeducation about ADHD to ensure that parents understood the rationale for the home-based plan. In addition, the written plan reflected the terminology that the parents used (e.g., rewards v. consequences). Combined with the above noted effects for income and single parent status, these findings suggest that it is not a matter of whether or not

parents understand how to implement the intervention that impacts outcomes, but rather whether they have the time to devote to implementing the plans. Said another way, a parent may understand exactly what needs to be done but if faced with multiple competing demands, may not be able to implement the plan despite the best of intentions. As discussed in more detail below, these findings suggest that SMH providers implementing HOPS and CHIEF may need to involve other adults in the monitoring and rewarding process.

Additionally, the findings of this study supported the hypothesis that race would be associated with academic outcomes (i.e., a main effect), but would not influence the trajectory of improvement. It is important to note that while school-based interventions are able to minimize many of the barriers associated with clinic-based interventions, they do not necessarily exert influence on teachers' perceptions of students' behavior. Previous literature has consistently shown that teachers rate Black and White students differently on a range outcomes and behaviors (Arnold et al, 2003; DuPaul et al., 1998; Hervey-Jumper et al., 2006; Miller et al., 2009; Reid et al., 2001). Consistent with these studies, the findings of the current study showed that White adolescents were rated by teachers as performing better with homework performance both before and after the intervention. Although the literature is consistent regarding differences in teachers' ratings, few studies have explored the reasons behind these differences. Some research suggests that there may be actual differences in student behavior (Epstein et al., 2010), while other research supports the assertion that biases are present in how teachers interpret student behavior (Chang & Stanley, 2003) and/or differences in teachers' expectations for students (Neal et al., 2003). Findings for the more objective outcomes included in the present study (percent of assignments turned in and GPA) showed that White adolescents completed a higher percentage of homework and had higher GPAs than Black adolescents. This suggests that the differences in teacher ratings of homework competence found in this study could, in part be due to actual homework performance rather than bias. However, more information would be needed to support this assertion.

The third aim of this study explored whether the impact of SDH variables could be attributed to differences in intervention attendance. Results showed that groups did not differ in intervention attendance based on social determinants of health. It is important to note that adolescent attendance was above 90% and parent attendance for both intervention groups was relatively high, with 87% of HOPS families and 83% of CHIEF families attending both of the parent meetings, which limits variability in this particular sample. The high attendance rates are likely because meetings were held during the school day for adolescents (i.e., pulled out of electives) and parent meetings were offered in the evenings afterschool. Further, the number of parent sessions was purposely limited ( $N = 2$ ). Overall, it does not appear that the influence of SDH variables in this study can be attributed to associations with attendance. As discussed in more detail below, future research should evaluate additional factors that may explain these associations in the context of school-based intervention.

### **Limitations**

The results of the present study should be considered in light of certain limitations inherent in the design and sample. First, parents were self-identified as single based on a single question in a demographics questionnaire. It is important to acknowledge that a parent can be single yet have a significant other or additional support in the home (e.g., grandparents). Conversely, a parent may not be single, yet still be very much independent in terms of caring for and supporting the child. Fully assessing family composition would be an important next step for future studies. Moreover, future studies could explore possible difference between single and married parents in the areas of personal adjustment, interpersonal relationships, and parenting behavior. Additionally, no information on teacher race/ethnicity was obtained in this study. Understanding how teachers of different ethnicities rate children of the same race/ethnicity or different race/ethnicity would have significantly added to the results and interpretation of this study (Sonuga-Barke et al., 1993). Further, although the sample was diverse from a racial perspective, it is important to acknowledge

that the sample presented with fairly high levels of income and education, which may have enabled greater levels of treatment adherence. Future research is needed to evaluate the impact of social determinants of health factors on behavioral school-based interventions with families from more diverse socioeconomic backgrounds. Finally, although the study recruitment procedures were designed to mirror traditional school identification and intervention practices, concerns about generalization remain as families were motivated to engage in research.

### **Implications and Future Directions**

Despite the lack of differential findings, there are a number of important implications. Based on the findings from this study, single parent status does still seem to be an important SDH factor to consider in school-based intervention development. It may be important to consider alternate ways of monitoring and rewarding skills implementation in school-based behavioral ADHD interventions. Parental involvement and engagement are clearly ideal and associated with positive outcomes (Patton, 1995; Kelley & Kahle, 1995; Robin, 1998; Hoover-Dempsey, 2001). However, it is important to acknowledge that parental involvement may not be feasible in all cases, or at least the level of parental involvement may need to vary. For HOPS and CHIEF, parents were asked to consistently monitor and provide contingencies for homework related behaviors. It may be important to consider how to more formally assess whether parental involvement is feasible and at what level, and to consider alternative options for monitoring and rewarding. One option to consider is an increased focus on self-monitoring.

There has been considerable research examining the efficacy of self-monitoring in reducing homework problems (Anesko, 1982; Carrington et al., 1997; Kahle & Kelley, 1994; Miller & Kelley, 1994; Olympia et al., 1994; Toney et al., 2003; Trammel et al., 1994). Importantly, Meyer and Kelley (2007) compared the effectiveness of self- and parental-monitoring of homework skills in middle school students with ADHD and found that self-monitoring was as effective as parent monitoring in reducing overall homework problems and increasing classroom performance.

Accordingly, future studies of HOPS and CHIEF could evaluate the degree to which parental-monitoring/engagement are important and associated with outcomes, and whether a fully self- or teacher-monitoring approach is equally efficacious. For example, teachers could be used to monitor students' implementation of skills via brief checklists completed twice a week. Another possible option is that other supportive family members, such as grandparents, aunts, uncles, or older siblings could be more actively engaged and could monitor and reward student behavior. Some studies have evaluated the use of adjunctive components for BPT (e.g. ally/support recruitment) targeted specifically for single parents, though evidence of their efficacy is mixed (Dadds & McHugh, 1992; Pfiffner et al., 1990). Regardless, the findings from this study show that it is critical for SMH providers to actively engage parents in conversations about monitoring/rewarding feasibility and to consider alternative options.

As related to the social determinants of health framework, this study found that both structural and proximal factors mattered for school-based intervention. As such, researchers and clinicians should acknowledge the role that social determinants of health have on treatment outcomes. A better understanding of these factors is key to improving and maintaining the quality of treatment for adolescents with ADHD. Future research on social determinants of health and school-mental health interventions could evaluate the impact of other important variables, such as working conditions and public assistance, which have been also been shown to impact treatment outcomes (Comptom & Shim, 2015; Leaver et al., 2007, Viner et al., 2012; Zimmerman 2005). Moreover, future research could also explore potential mechanisms explaining the association between these social determinants of health and school-based interventions. For example, working conditions can help to shape health-related behaviors. Parents or caregivers who work on high-stress jobs without benefits, such as paid leave or flexible working arrangements, are less likely to take off for medical care reasons pertaining to their child, and typically have less time to prioritize mental health treatment (DeRigne, Stoddard-Dare, & Quinn, 2016). In another example, Anand

and Ravallion (1993) proposed that having low levels of income may have less of an impact on treatment outcomes for individuals when basic needs, such as food, housing, and medical care, are being provided by the state. It could be that receiving public assistance might alleviate some of the stress of providing for a family, which would allow for low-income parents to be able to be more involved in treatment. On an individual level, clinicians can broach these issues with clients and help them to access benefits and support services.

## **Conclusions**

The current study sought to examine the impact of social determinants of health on the efficacy of two school-based interventions targeting homework problems in adolescents with ADHD. Results indicate that that both structural and proximal (income, single parent status, race) determinants were associated with academic outcomes overall; however, there was no differential impact between interventions. The results from this study can be used to further refine effective school-based interventions for students with ADHD. Future research should seek to clarify the mechanisms by which these determinants impact intervention efficacy, as well as explore additional social determinants of health.

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