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Treatment Outcomes with Low Income Children and Adolescents with Attention Deficit

Norbert B. Ralph
Behavioral Pediatrics, Inc.

Douglas Oman
University of California, Berkeley

Willard Forney
Behavioral Pediatrics, Inc.

We describe observations made on 76 low-income children with a diagnosis of attention deficit hyperactivity disorder (ADHD). Data were gathered on each child at clinic visits (average=7.6 per child) regarding medication status, and on measures of inattention and defiance. Parents of seventeen percent of children took a voluntary parenting skills course before medication was initiated. Statistical modeling was used to assess associations of medication usage and parent classes with child inattention and defiance at follow up visits. Statistically significant beneficial associations were found between inattention and both treatment modalities, and between defiance and parenting skills classes. These results support the efficacy of the treatment model used in the clinic for providing service to low-income children with ADHD.

Developing practical and effective models for the treatment of children and adolescents with attention deficit hyperactivity disorder (ADHD), who also have Medicaid insurance is an important issue. The development of such models assumes heightened salience given the imminent changes in health care nationwide, and the introduction of managed care with Medicaid populations in California. Despite the large clinical literature on ADHD, little has been written about service models for low income populations. This article presents such a model, and a methodology for evaluating factors effecting treatment outcomes in the turbulent "real life" context of a county hospital based clinic for low income ADHD children and adolescents.

Prevalence, Developmental Sequelae, and Impact of ADHD

ADHD as described in the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (DSM-IV) (American Psychiatric Association,

Requests for reprints should be sent to Norbert Ralph, Behavioral Pediatrics, Stanislaus Medical Center, 2501 McHenry #E, Modesto, CA 95350. [nralph@concentric.net]

1994), is characterized by behavioral disturbances including significant attention problems, hyperactivity, and impulsivity. Barkley (1990) reports that current research views ADHD as a disorder in brain function that most likely is related to genetic factors, and perinatal or later life injury. ADHD is presently conceptualized neuropsychologically as failure of behavioral inhibition that delays the ability to utilize executive functions to sequence purposeful behaviors in time towards a future objective, and neuroanatomically it is related to dysfunctions of the prefrontal cortex, part of the cerebellum, and the basal ganglia (Barkley 1998). Barkley (1998) reports that the estimated prevalence of ADHD is 2-9.5% of school age populations worldwide, and is higher in populations below the poverty level. Barkley notes that boys with this condition outnumber girls 3:1 in community based prevalence studies, and this rises to 6:1 in clinic populations.

ADHD has significant effects on the child's later life adjustment. Approximately 80% of ADHD children will still have significant symptoms into adolescence and 50% of ADHD children will have such symptoms into adulthood (Ralph and Barr, 1989). Lambert (1988), in a prospective study of ADHD children used a nonpatient cohort sample. She found that when this cohort reached adolescence, ADHD children when compared to non-ADHD children, were more likely to attend special schools, not finish high school, fail to go on to college, drop out of school, run away, live in foster or residential settings, and be on probation or parole. Likewise ADHD poses a significant problem for health care. Barkley (1990) estimates that 50% of referrals to child guidance clinics have ADHD as one diagnosis. ADHD is one of the major chronic health problems of childhood comparable to asthma which has a prevalence of 4.3% (Halfon and Newacheck, 1993). Like asthma, the prevalence of ADHD increases in low income populations (Barkley, 1990). Obtaining services for ADHD children receiving Medicaid poses several challenges. In the authors' experience, relatively few physicians are interested in providing care for ADHD children, and even fewer for children receiving Medicaid insurance. In one study half of the prescriptions for those under 18 were written by 5% of the pediatricians (Rappley, Gardiner, Jetton, and Houang, 1995). Both medical and behavioral science components of care are required for this population according to Taylor (1994).

Factors Affecting Treatment Outcomes

Factors relevant to treatment outcomes in ADHD children may be divided into the following three categories: 1. treatment factors, 2. child characteristics, and 3. parent characteristics.

1. *Treatment Factors*: The primary treatments used with ADHD children and adolescents are: a. psychotropic medication, b. parent training, and c. combined approaches.

a. *Psychotropic Medication*: Stimulant medications have been used since Bradley's report of their effectiveness in his 1937 paper (Bradley, 1937). Kelly and Geller (1993) report that stimulant medications are the first choice for the treatment of ADHD. Methylphenidate is the most widely used stimulant medication. Pemoline is another type of stimulant that is less effective than methylphenidate but is better tolerated by some patients. Tricyclic antidepressants are more effective than placebo in reducing restlessness and hyperactivity, and the most widely studied is imipramine. Pliszka (1987) reported that ADHD children with prominent anxiety and depressive symptoms have a more favorable response with imipramine compared to methylphenidate. Popper (1997) reports that none tricyclic antidepressants are as effective as psychostimulants for treating attentional and cognitive symptoms, but they can help reduce impulsive and hyperactive behavior. Cardiac effects in controlled studies with imipramine have not proven to be a contraindicative factor (Johnson, Giuffre, and O'Malley, 1996). Because of its longer half life, imipramine reaches higher average blood levels than the stimulants if used regularly (Kelly and Geller, 1993).

b. *Parent Training*: Barkley (1990) reported ten studies showing the salutary effects of parent training on ADHD symptoms, including two studies which are consistent with Barkley's educational and behavioral approach (Pisterman, Firestone, McGrath, et al., 1992; Pollard, Ward, and Barkley, 1983). This model has been described in Barkley's *The Defiant Child* (Barkley, 1987). Cunningham (1990) reported significant improvements using a family system approach to parent training. He reports that while the effects of this treatment on primary ADHD symptoms are modest, improvements are noted in child management skills of the parents, and fewer noncompliant behaviors.

c. *Combined Approaches*: While authoritative guidelines for treatment recommend a combined behavioral and pharmacological approach (The American Academy of Child and Adolescent Psychiatry, 1997), relatively few studies have been undertaken to assess the separate effects of both appoaches in the same study sample. Ialongo, Horn, Pascoe, et al. (1993) report that effects were found for medication at posttest, but not for behavioral interventions. However, nine months after the termination of the behavioral interventions, there was qualified support that combined treatments conditions produced greater maintenance of treatment gains than would medication alone. Currently, the National Institute of Mental Health Collaborative Multimodal Treatment is studying this issue with a sample of 576 children at six study sites comparing: (1) medication alone, (2) psychosocial treatment alone, (3) the combination of both, (4) or a community comparison.

2. *Child Characteristics*: Age, Gender, and Aggression: Age has been studied with respect to its effect on treatment outcomes for ADHD children. Barkley states that for children under four stimulant medications have a somewhat decreased effectiveness and a higher level of side effects (1990). Mayes, Crites, Bixler, et al. (1994) report that ADHD children who are of preschool age and who have co-existing neurological disorders benefit from methylphenidate. Other studies have reported success with group behavior training for parents of preschoolers (Pisterman, Firestone, McGrath, et al., 1992). Anastopolous and Barkley (1990), suggest that children whose mental age is under three may not benefit when their parents are provided parent training.

Gender has also been studied with respect to the effects of medication. Pelham, Walker, Sturges, et al. (1989) report that methylphenidate showed no differences in effectiveness between boys and girls being treated for ADHD. No studies are currently available examining the effect of the child's gender on treatment outcomes for parent training.

Aggression has also been studied as a predictor of treatment outcome. Methylphenidate in one study decreased aggression for both a high and low aggression groups on direct observation measures, but no differential effects between groups were reported. On a laboratory provocation task, methylphenidate had only minimal effects (Murphy, Pelham, and Lang, 1992). No studies are available regarding the effect of a child's initial aggression level on the treatment effectiveness of parent groups.

3. *Parent characteristics*: The effects of maternal depression on treatment outcomes in ADHD children have not been studied. Several studies, however, have reported the association of ADHD symptoms and maternal depression without examining its effect on treatment outcomes. Fergusson and Lynskey (1993) report that the association between maternal depressive symptoms and externalizing behavior in early adolescence were not clinically or statistically significant when confounding factors (poverty and marital instability) were controlled. In another study, Fergusson, Lynskey, and Horwood (1993) reported there was evidence of small but significant associations between maternal depression and child conduct disorder and attention deficit behaviors.

This article presents methods to evaluate the influence of various factors in treatment outcomes in low income ADHD children. The factors included are child and parent characteristics, and treatment factors. The methods used could assess relationships between, for example, the child's age, or the mother's level of depression and treatment outcomes. Also the separate influences of parent training and medication with treatment outcomes are assessed.

Methods

Subjects: The subjects of the study were consecutive outpatient admissions at an outpatient county health clinic for children and adolescents with a primary diagnosis of ADHD. The clinic was located in Modesto, California in Stanislaus County, and the area has primarily an agricultural and food processing economy. It is located 90 miles east of San Francisco, in the Central Valley of California. The unemployment rate in the Modesto metropolitan area was above 15% in 1993 (California Statistical Abstract, 1994). According to U.S. Census estimates, Stanislaus County had an estimated population of 420,000 in 1995, and 79,595 were ages five to seventeen (California Cities, Towns, and Counties, 1996). The Stanislaus County Department of Social Service reported that 31,000 children were currently receiving AFDC and Medi-Cal (the California version of Medicaid at the time of this study (Cavaness, 1994), and living below the federal poverty level. Prevalence rates for ADHD are higher in low income populations according to Barkley (1990), and if an estimate of a 7% prevalence rate is used for ADHD for families living below the poverty line, there would be approximately 2,170 ADHD children and adolescents in Stanislaus County receiving Medicaid.

There were 76 new admissions between 7/92 and 7/93 to the outpatient clinic who subsequently came to a total of 575 office visits. Nine of these sub-

jects did not return for any follow up visits. The remaining 67 returned, coming for between 2 and 18 total visits, with an average of 7.6 total visits. The number of full months between the first and final visits for each patient ranged from 0 to 24. Of the seventy-six patients, eighty-eight percent (n=67) of patients were males and twelve percent (n=9) were females. Their ages ranged from 2.8 years to 14.3 years with a mean age of 8.0 and seventeen percent (n=13) were less than 6 years old. Seventy-five percent (n=57) were white, five percent (n=4) Hispanic, thirteen percent (n=10) African American, and seven percent (n=5) were of another ethnicity, including children of mixed ethnic background. Twenty-nine percent (n=22) were in special education classes, primarily learning handicapped. Fifty-one percent (n=39) were living with the mother only, eleven percent (n=8) with the father only, twenty-one percent (n=16) with both mother and father, and seventeen percent (n=13) with grandparents, adoptive parents, foster parents or other arrangements. The distribution of patients by length of treatment was as follows: Eleven patients were seen for less than a month, 13 from one to five months, 29 from seven to twelve months, 18 from 13-18 months, and five from 19-24 months. Below we refer to the caretaker of the child as the "parent". All subjects were receiving Medi-Cal.

Treatment Model: The treatment model consisted of several interrelated components: 1. a pediatric neuropsychological assessment, 2. parent training and follow up counseling, 3. medication management, 4. a clinical outcomes system, and 5. a model of symptomatology in ADHD. The professional staff consisted of: 1. a pediatric clinical neuropsychologist who conducted all assessments, and supervised counseling services; 2. a masters level psychologist who conducted parent groups and provided short term family counseling; and 3. a pediatrician and a pediatric nurse practitioner, both of whom conducted the initial pediatric evaluation and provided ongoing medication consultations.

1. *Pediatric Neuropsychological Assessment*: All patients were given a neuropsychological assessment for attention deficit disorder at admission. Taylor (1994) recommends a comprehensive evaluation of ADHD children, given the high levels of comorbid conditions such as oppositional, conduct, and learning disorders, as well as the high levels of comorbidity in parents. The neuropsychological assessment consisted of: an interview with the parent and child, standardized behavior rating scales completed by parents and school personnel, intelligence, neuropsychological, and academic testing with the child, and an assessment of the family environment and parenting styles.

2. *Parent Training and Counseling*: The parent skills course was based on Barkley's (1987) *Defiant Children: a Clinician's Manual for Parent Training*. Participation in the parent skills group was voluntary, and 17% (N=13) of parents of children in our sample attended. Parents usually attended these groups after the initial assessment. The class met each week for one hour, for a total of 8 classes. The parents were taught how to identify dysfunctional parent/child interactions, to avoid administering discipline when arguing, angry or upset, and how to develop more effective interventions by using positive reinforcement, extinction, cost response techniques, and timeouts. Parents were invited back for additional "as needed" family therapy "booster" sessions after they had completed the 8 week course to maintain the skills they had learned.

3. *Medication Management*: Imipramine was used as the medication of first choice since in the medical director's opinion, it has the best tradeoffs when therapeutic effects, side effects, and abuse potential are considered. Imipramine has an advantage in that it can be prescribed by a nurse practitioner, whereas methylphenidate requires a triplicate prescription completed by a licensed physician. Also imipramine does not have an abuse potential. Though methylphenidate and pemoline may have superior impact on improving impulsiveness and inattention for most individuals, imipramine has a significantly longer half life, and reduces insomnia, anxiety, depression, and enuresis. This is not the usual choice with most practitioners. As noted above, stimulant medications are regarded as the most effective for the treatment of ADHD (Kelly and Geller, 1993).

If an inadequate therapeutic effect was observed with the use of imipramine, then pemoline was added to imipramine, rather than methylphenidate because of pemoline's longer half life. If side effects were too severe with imipramine, pemoline was used alone without imipramine. If pemoline still wasn't effective, or caused adverse side effects such as insomnia or liver panel changes, then methylphenidate was used but again in combination with imipramine if it was of some benefit. The addition of imipramine often appeared to help with reducing secondary stimulant induced insomnia. Other medications were tried only when none of the above options showed adequate effectiveness, or the side effects of other medications were too severe.

4. *Clinical Outcomes Measures*: At admission and at each follow up appointment, parents were administered the IOWA Conners' Teacher's Rating Scale (Loney and Milich, 1982). This was used as the outcome measure in the present research. This instrument consisted of two scales: an Inattention scale,

and a Defiance scale.[1] Changes were noted from previous visits. The content of the scales is suitable for parent administration and does not, for example, include items specifically regarding classroom behaviors.

The IOWA Conners Teacher Rating Scale was developed by selecting 10 items from the original Conners Teacher Rating Scale. Five of these items were highly related to observed problems with inattention and overactivity, what we will refer to as the Inattention scale. Five were highly related to defiant behaviors, which will describe as the Defiance scale. Loney and Milich (1982) reported test-retest reliability coefficients of 0.86 for Defiance, and 0.89 for Inattention. Since each scale consists of only five items, the scale could be scored by hand in 30 seconds. Presently DSM-IV (American Psychiatric Association, 1994) describes three types of ADHD: a hyperactive type, an inattentive type, and a combined type. A limitation of the IOWA Conners' is that its items do not differentiate these two subtypes, but is able to assess changes resulting from treatment. The scale was used to assess changes in treatment, not for diagnostic purposes.

5. *A Model of Symptomatology in ADHD*: The use of the IOWA Conners Teacher Rating Scale as an outcome measure was consistent with the model which the clinic used to conceptualize children and teens with ADHD as usually exhibiting significant defiant behaviors. The behaviors measured by the Inattention scale are symptoms usually associated with ADHD while behaviors measured by the Defiance scale may be viewed as part of a separate disorder, Oppositional Defiant Disorder. The primary reason for referrals for treatment for ADHD in the authors' experience is defiant behavior. Medication, according to the literature noted above, can most improve inattention, while parent education can most improve defiant behaviors. The clinic model offered a combined pharmacological and behavioral approach to optimally treat both inattentive and defiant behaviors in ADHD children. As noted above, only 17% of families chose to use behavioral services, however.

Study Instruments and Measures: The dependent measures used in this study were the Inattention and Defiance scales of the Iowa Conners' Teacher

[1]The scale names used on the IOWA Conners Teacher Rating Scale were: 1. the Inattention and Overactivity Scale, and 2. the Aggression Scale. The name "aggression" is somewhat misleading since the item content consists primarily of oppositional or defiant behaviors towards adults. We are describing the scales in this article as the Inattention scale and Defiance scale for the sake of conceptual simplicity and brevity.

Rating Scale (Loney and Milich, 1982), which were administered at admission and at each follow up medication visit.

Covariates which measured child/parent characteristics used in statistical analyses were: 1. gender of child, 2. age of child (greater than six, or six or less), 3. ethnic group, 4. initial level of child aggression as measured by the Aggression Scale of the Child Behavior Checklist (CBCL) (Achenbach, 1986), 5. parental depression at admission assessed by Depression Scale from the MMPI-168 (Greene, 1980).[2]

Treatment factors used in the statistical analyses were: 1. whether the child was on medication or not at the time of the visit, 2. whether the parent had participated in the parent group and adjunctive counseling or not, and 3. total time since the first visit to the clinic.

Statistical Methods: Bivariate relationships were assessed to see which covariates might confound or modify the relationships between treatments and outcomes. Stratum-specific means were calculated for: (a) the total sample, (b) the different levels of each treatment, and (c) the different levels of each possible explanatory factor. The calculated means were: (1) the percentage of visits during which the child was taking medications, (2) the intake Aggression (CBCL) and Inattention scale scores, (3) the pooled per-visit outcome measures (Defiance and Inattention scale scores), and (4) the "per-child" outcome measures obtained by calculating child-specific average outcomes and then averaging these per-child averages. P-values for the significance of differences observed between strata were calculated using: (1) T-test for assessment of differences in per-visit means of child scores on Inattention or Defiance on/off medication or before/after completing parent group, (2) Wilcoxon rank sum tests for the per-child percentages on medication treatment, (3) analysis of variance (or regression for continuous covariates) for intake scores, and (4) a linear mixed model with a random effect for each child (as described in the next paragraph) for overall outcomes.

Significance testing and multivariate adjusted modeling of outcomes (the Inattention scale or Defiance scale) used a linear mixed effects model (Diggle, Liang, and Zeger, 1994) to adjust for the fact that outcomes measured on different visits by a particular child will be correlated. A single observed outcome measure of a particular child on a particular visit was modeled as the sum of

[2]The Aggression Scale of the Child Behavior Checklist (CBCL) (Achenbach, 1986) was completed by the parent at the time of the initial evaluation. The MMPI-168 is a version of the Minnesota Multiphasic Personality Inventory, which uses shorter versions of the same clinical and validity scales as the original inventory (Greene, 1980). The MMPI-168 is the most reliable of the short forms and shows a high correlation with the standard MMPI scales.

three components: 1. the effects associated with and linearly modeled in terms of known covariates such as age, gender, or treatment type (these are called "fixed effects"); 2. effects associated with a particular child, but not explainable in terms of known, measured covariates ("random effects"), and 3. the visit-specific variation unexplainable by fixed effects (measured covariates) or random effects (individual child's overall level), but probably associated with the child's daily variation and the errors introduced by the measurement process ("residual variation"). The linear mixed effects modeling used S-Plus software (Spector, 1994) and the NLME subroutine package (Pinheiro, Bates, and Lindstrom, 1993). Two tailed tests of significance were used.

Multivariate analyses combined both treatments (medications and the parent skills group) with covariates significant ($p<.10$) in univariate analysis to obtain adjusted estimates for treatment effects. Optimal coding for time since service was explored through using dummy variables for 3-month periods (1-3 months, 4-6 months, 7-9 months, 10-12 months, 13+ months). Covariates not significant in final models were dropped, and interactions of each remaining explanatory variable with the coefficients were examined. These analyses produced final adjusted multivariate models for Inattention scores and Defiance scores.

Comparisons between different drug combinations were examined by replacing the binary indicator variable for medications in the final multivariate models with a multi-level medication variable. This multi-level medication variable used not-on-medications as the reference group and used a different dummy variable for each combination of medications.

Results

Of the total office visits (n=575), the breakdown of the child's medication status was as follows: 36.0% were on no medication, 28.0% were on imipramine only, 10.6% were on methylphenidate only, 8.3% were on pemoline only, 5.6% were on imipramine and pemoline, 2.8% were on imipramine and methylphenidate, 0.7% were on imipramine and a medication other than pemoline or methylphenidate, and 8.0% were on some other medication combination. The large number of patients not on medication is explained by the fact that 15% of visits were first visits, and many patients came in for visits not being on medication because of summer vacation or other holidays, having taken a "therapeutic holiday" from medication, or having run out of medication and being unable to obtain a refill.

The parents of 17% (N=13) of the 76 children chose to take parenting classes. After these parents commenced classes, their children came for 104 more office visits. Thus 18% of the 575 office visits were from children whose parents had commenced classes.

Table 1 shows the mean per visit Inattention and Defiance scores for treatment and non-treatment groups for each of the two treatments, not adjusting for covariates. The T-test for difference in means was used to compare differences. These unadjusted results suggest that medication was associated with a decrease in inattention, but not defiance. The parenting skills class was not associated with a significant improvement.

Table 1
Means of Inattention and Defiance Scores per Visit

		Visits		per-Visit Mean		Visits
Treatment	Level	#	%	Inattention	Defiance	% on Meds
Medications	On (any)	368	64.0	113.7	130.7	100
	None	207	36.0	119.8	128.1	0
Difference				6.1*	-2.6	
Parenting						
Skills	After	104	18.1	114.6	130.3	83.7
	Not after	471	81.9	116.2	129.6	59.7
Difference				1.6	-0.7	
Total		575	100	115.9	129.8	64.0

* $p<.001$ two tailed T-test.

Table 2 shows the Inattention and Defiance scale means for several possible confounding variables.

Table 2
Percent on Medications, Means of intale Inattention, Aggression, Defiance Scores

Covariate	Level	% on Meds	Mean Inattention Intake	:hild	/visit	Mean Aggre. and Defiance Intake aggre.	/child defi-ance	/visit defi-ance
Number of Clinic	5	42.4	122.1	19.2	119.0	67.1	135.4	130.1
Visits by Child	6-10	61.4	125.1	18.4	118.2	68.1	126.3	125.6
	11	71.4†	124.3	14.1	113.9	67.9	131.4	131.7
Inattention (IO)	Top 5% (□125)	67.8	-	20.9	119.3	69.6	131.9	131.8
(intake)	(□124)	60.7	-	14.5‡	112.9	66.1*	131.3	128.0
Aggression (CBCL)	Top 5% (□67)	68.9	125.2	18.3	116.4	-	139.3	136.4
(intake)	(□66)	58.0	121.8*	16.1*	115.3	-	122.0‡	121.6
Gender	Male	62.2	123.8	17.7	116.5	67.7	131.8	129.6
	Female	73.1	122.6	14.1	112.9	67.7	130.3	130.7
Ethnicity	White	65.2	122.9	16.1	114.6	67.5	130.9	129.8
	Hispanic	65.8	122.5	12.7	114.1	62.5	117.5	118.0
	Afr.-American	61.5	128.1	23.2	123.8	71.4	138.4	135.6
	Other	45.8	124.2	22.5*	121.1	65.6	137.0†	132.4
Special	Yes (en-rolled)	65.1	121.5	16.8	115.1	67.0	132.3	129.4
Education	No	63.5	124.5	17.5	116.2	67.9	131.3	129.9
Living	Mother	64.3	122.1	15.7	113.8	67.5	132.6	130.3
Situation	Father	73.8	122.1	18.8	117.5	68.4	130.5	134.3
	M+F	55.7	126.8	18.6	116.5	66.4	129.5	127.6
	Other	65.4	125.5	19.4	120.1	69.2	131.6	127.7
Age	6	66.2	123.2	17.1	115.7	67.0	131.1	129.1
	5	51.7	125.9	18.4	116.7	70.7	133.9	133.4
Parental	Clinical (□70)	69.4	120.2	15.2	116.3	66.8	132.1	126.2
Depression	Dysphoria (60-69)	62.9	121.1	15.5	112.6	70.9	133.7	129.2
	Avg. Range (<60)	64.8	125.8†	18.7†	118.0	65.9†	130.0	129.5
Total		64.0	123.7	17.3	115.9	67.7	131.6	129.8

†p<.10 *p<.05 **p<.01 ‡p<.001 in linear mixed effects models, linear regressions, or Wilcoxon rank-sum tests.

The overall mean inattention per visit is slightly lower than the overall mean per child, which was obtained by calculating the per child mean for each of the 76 children and then averaging these 76 numbers. The difference indicates that children who went to more treatment sessions had lower average inattention scores than those who went to fewer sessions. The top three rows of Table 2 show that the average per-child inattention scores declined from 119.2 to 118.4 to 114.1 as the child's number of visits increased from less than 5 to 6-10 to greater than 11.

In Table 2, few significant or marginal relationships were found between outcomes and possible confounders. Intake aggression as measured by the CBCL Aggression Scale significantly positively predicted outcome inattention. Ethnic group was significantly associated with the outcome inattention and marginally with outcome defiance. Parental depression was marginally negatively associated with outcome inattention but marginally positively associated with outcome defiance. Intake aggression significantly positively predicted outcome inattention and defiance. Intake inattention was not surprisingly associated with outcome inattention.

Most of the effects from time since intake occurred in approximately the first six months, with little average change observed thereafter. Time since intake was therefore coded to be zero at intake, grow linearly to be one at six months, and to remain at one thereafter. Its fitted coefficient is interpreted as the change per six months, up to six months, with stability after six months assumed.

Table 3 shows the adjusted multivariate model for inattention. The interaction between time since intake and having taken parenting skills classes was significant ($p=.048$). Therefore two separate time-since-intake coefficients are included, one for children whose parents had taken classes and the other for children whose parents hadn't. Although there were no main effects or interactions, gender and age were retained in the model because of their importance in many studies. Ethnic group was changed to binary (African American/all other) because the significance came primarily from the difference between African Americans and others.

Table 3
Multivariate Inattention Scores Model

Variable	Effect	95% CI		P (2 tailed)
Age (<6)	-1.16	-6.43	4.11	0.6665
Gender (Female)	-1.17	-7.01	4.67	0.6941
Ethnicity (African American)	3.16	0.27	6.05	0.0323*
Depression (D>60)	-4.51	-8.61	-0.42	0.0308*
Intake Aggression	0.313	0.119	0.507	0.0016**
After Par.Ski.	4.67	-4.51	13.85	0.3186
Time since intake (half-years) Not After Par.Ski.	-5.3	-8.19	-2.41	0.0003***
After Par.Ski.	-14.9	-24.14	-5.67	0.0016**
On Medications	-4.91	-7.16	-2.66	0.0000***
Computed Contrast: After Par.Ski. v. Not After Par. Ski. 6 months after intake	(-4.93)	(-9.59)	(-0.28)	(0.0377)*

Note: The unadjusted (intercept-only) mixed model had residual SDs of 7.71 for child and 10.6 for visit. Including covariates reduced them slightly to 7.19 for child and 9.75 for visit.
*p<.05 **p<.005 ***p<.0005

Table 4 shows the adjusted multivariate model for the Defiance scale. Gender and age again were retained although there were no main effects or interactions. After fitting, only baseline aggression and parenting skills classes were significant predictors of defiance.

Table 4
Multivariate Defiance Scores Model

Variable	Effect	95% CI		P (2 tailed)
Age<6	-1.6	-8.74	5.55	0.6611
Gender (Female)	0.51	-7.23	8.25	0.8976
Intake Aggression	1.22	0.96	1.48	0.0000***
On Medications	0.22	-2.73	3.17	0.8842
After Par.Ski.	-8.76	-14.83	-2.7	0.0046**

Nore: The unadjusted (intercept-only) mixed model had residual SDs of 14.89 for child and 15.12 for visit. Including covariates reduced them to 9.31 for child and 15.04 for visit.
*p<.05; **p<.005; ***p<.0005.

Table 5 shows the results of multivariate adjusted modeling of inattention by type of medication. Although they do not appear in the table, the analysis controlled for all the variables contained in Table 3. The value column of Table 5 shows the effect upon the Inattention score of each drug combination relative to the child's not taking medications. All medication combinations were associated with lowering Inattention scores, and all except the imipramine and pemoline combination were significant (p<.05). The 95% confidence levels of all these combinations overlapped in the region [-6.84,-5.23], and did not suggest different effects for any combination.

Analyses were also conducted of the effect of individual medication combinations upon the Defiance score. Only one combination (imipramine plus a second medication) was significantly different from no medication. It had an effect size in the full model from Table 4 of -23.4 (SE=8.6, p= .006). This combination also had a large effect size for reduction of inattention, as noted in Table 5. The data for this combination came from only two children (and four visits). One child took imipramine and amitriptyline on three visits and the other child received imipramine and thioridazine on a single visit.

Table 5
Medication combinations with Inattention scores

	N	%	Value	CI (95%)		P (2 tail)
Imipramine only	161	43.8	-4.32	-6.84	-1.8	0.0008***
Methylphenidate only	61	16.6	-5.23	-10.04	-0.42	0.0330*
Pemoline only	48	13.0	-9.24	-13.24	-5.23	0.0000***
Other Combination	46	12.5	-4.6	-8.74	-0.46	0.0294*
Imipramine + Pemoline	32	8.7	-2.82	-7.34	1.69	0.2202
Imipramine + Methyl-phenidate	16	4.3	-9.44	-15.42	-3.46	0.0020**
Imipramine + Second	4	1.1	-15.69	-26.63	-4.74	0.0050**

Note: Adjusted for age, gender, ethnicity, depression, intake aggression, after parenting skills, and time since intake.
*p<.05 **p<.01 ***p<.001

Discussion

The present study examined treatment outcomes for low-income children being treated for ADHD at a community clinic. The variables that had the strongest association with a lower Inattention score were: being on medication, lower aggression at admission, having parents participate in parent group, and longer time in treatment. The variables that had the strongest association with lowering Defiance scores were: lower initial child aggression, and having a parent participate in the parent group.

The mean initial scores[3] at intake of this sample on inattention and defiance were 124 (the 95th percentile) and 131 (the 98th percentile) respectively, both in the clinical range. If the statistical models developed in this study are interpreted to reflect causal effects from treatments, the changes in a hypo-

[3]This analysis used age adjusted norms for a nonpatient population reported in Loney and Milich (1982). The metric used is the same as an I.Q. score with a mean of 100 and standard deviation of 15. The percentiles reported here assume an exact normal distribution, which is an approximation used for heuristic purposes in this hypothetical example.

thetical "average" child can be calculated using sample means on relevant variables. The hypothetical "average child" not on medications initially, who had an Inattention score of 124, and whose parents participated in the parent group, would have his/her score drop after approximately 6 months to 114 (the 82nd percentile of a nonpatient population). If the child also went on medications their scores would drop further to 109 (73rd percentile). For a child with an initial Defiance score of 131, if the parents participated in the parent group, the child's Defiance score would decline to 122 or the 93rd percentile, also in the borderline clinical range.

The findings of this study can be discussed in the context of previous research on ADHD. The improvement of ADHD children over time while in treatment has been noted in the study by Ialongo, Horn, Pascoe, et al. (1993). This improvement over time does not appear related to decreases in the Inattention score as the child gets older, since as noted above, Inattention scores did not significantly increase with age in this sample.[4] It may be that there is a treatment effect of multiple contacts over time during treatment, and parents and children learn to manage the disorder more effectively. The improvement in attention over time in the present study was (significantly) more pronounced among children whose parents who have taken the parenting skills classes.

The age of the child (as measured by less than six, or six or greater) did not show significant interactions with treatments with either dependent variable. The 11 children age five or less in our group did as well as other age groups. Consistent with past research (Murphy, Pelham, and Lang, 1992) there were no differences between girls and boys with regard to treatment outcomes. The finding that African American children had higher initial scores on the Inattention scale than other ethnic groups is puzzling. The reason for this would be a matter of speculation.

All medications showed an association with a decline in the Inattention scale compared to no medication. The medication combinations did not differ significantly from each other except that imipramine plus pemoline did not show a significant effect. However, the small differences between the fitted effect sizes for this drug combination and the other combinations suggest that an adequate explanation for its nonsignificance is lack of adequate statistical power to reliably detect the effect.

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[4]This assumes that the findings of no significant association with age in the cross sectional analysis, would also be the case if this population were studied longitudinally which may not be the case.

Parental depression was associated with reduction in the Inattention score. In this sample 32.4% of parents had a T-score in the range 60-69 which was associated with mild dysphoria, and 8.5% had a T-score above 70 which is associated with clinical depression. Affective symptoms such as depression or anxiety do have an adaptive function, and are "signals" to the organism to respond to environmental stressors. Higher initial maternal depression may have indicated a "signal" to parents to seek assistance, and for the parent to work harder to improve the child's functioning. This effect has not been previously reported in the ADHD literature in this context, although it has been observed in the chemical dependency literature (Ralph and Morgan, 1991).

The treatment model used here conceptualized children with ADHD as exhibiting significant symptoms along two dimensions: 1. inattentive behaviors, and 2. defiant behaviors. Consistent with past research, medication was associated with improved attention. Surprisingly, participation in the parent group was also associated with improvement in this area that has not been previously noted. Inattention can be viewed as a lack of "fit" between the child and the novelty and structure of a given setting, instead of a static trait of the child. Parent reports of decreased inattention might be related to parents managing the fit of child/setting in improved ways. For example, the standard recommendations for the behavioral management of ADHD are to provide predictability, structure, use of positive reinforcers, warmth, patience and humor. If these are used judiciously, they might be consistent with a lowering of the inattention score.

Consistent with past research, participation in the parent group was associated with a decline in oppositional and noncompliant behaviors, although medication was not. These findings support the view that an approach which addresses both inattention and defiant behaviors through combined pharmacological and parent behavioral interventions provides optimal treatment outcomes. There is little existing empirical research investigating the validity of this view, as noted above, although authoritative sources support this vision of optimal treatment (The American Academy of Child and Adolescent Psychiatry, 1997). It would be consistent with finding from meta-analyses of the literature on chronic pain, which showed combined approaches had twice the treatment effect as single modality programs (e.g., medical treatment or physical therapy solely) (Flor, Fydrich, and Turk, 1992),

The model used here would suggest that if a medication only is used for ADHD children, then defiant behaviors which are frequently associated with this condition, will go untreated. Attempts to reduce defiant behaviors associated with ADHD solely by pharmacological measures, will likely not be effec-

tive. We could not locate studies that describe the percent of parents of ADHD children who receive medication who also received parent training. It is our opinion that most parents of ADHD children do not receive parent training. The managed care version of Medicaid to be used in California beginning January 1998, sets forth that primary care physicians will be the initial provider of care for psychiatric conditions, including ADHD (Pettigrew, 1997). Several studies indicate, however, that psychiatric conditions are under diagnosed and not given adequate treatment, when treated by primary care providers (Penn, Boland, McCartney, 1997; Schulberg, Block, Madonia et al., 1996). Eppright, Bradley, Vogel, et al. (1998) report in a survey of family practice physicians, that behavioral interventions are undervalued. Reliance on primary care physicians for treatment of ADHD has the prospect of similar difficulties.

The treatment model discussed here is suitable not only for Medicaid populations, but the general pediatric population. The clinical outcome measures used, the IOWA Conners' Inattention and Defiance scales, are qualified alternatives to longer instruments for assessing outcomes of medication and behavioral treatments.[5] These scales are most useful as a brief quantitative method to assess clinical progress, but not for initial diagnosis. These scales have the advantages of being readily scoreable and easily administered. It is the authors' experience that longer forms that require scoring keys, or computer processing, aren't used routinely, and if used, not scored. The result is that much of ongoing treatment with ADHD children has no quantitative assessment component.

The methodological advantage of randomized experimental designs is to eliminate "rival hypotheses" to the treatment factor. The approach of the present study is observational rather than experimental. A variety of hypotheses exist for the association of treatment factors such as the parent group or medication with decreased Inattention or Defiance scores. The main rival hypothesis to a treatment effect for medication is a placebo or expectancy factor that the present design cannot rule out. With regard to the therapeutic effects of the parent group, allocation bias is the most likely rival hypothesis, e.g., that perhaps more motivated parents took the parent group, and the improved scores relates to parental motivation rather than to the effects of the parent group.

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[5]An instrument's test/retest reliability may be improved by either adding more items or by increasing the average correlation among the items. A longer test with more items has a higher test/retest reliability, so that a longer form of a test is in general more likely to have higher reliability (Hintze, 1995). The longer version of the Conners' would almost certainly be more reliable.

The sample under treatment had low participation (17%) in the voluntary parent group. The average adjusted difference (and upper and lower 95% confidence intervals) at outcome between those participating and not participating in the parent group and counseling on the Inattention and Defiance scales after 6 months were 4.9 (.3, 9.6) and 8.8 (2.7, 14.8) points respectively using the model described here. It appeared that parents who had children with higher scores on the Inattention and Defiance scales at intake were more likely to participate in the parent groups. The impact of parent training on this group may in part be due to this group being more motivated because their children had higher levels of symptoms. Presently this clinic requires all parents to take the parent training course, and it is unclear when participation is not voluntary, whether the beneficial results would be as significant.

Mental health interventions particularly for children, in the authors' experience, is often determined by clinical "conventional wisdom" regarding what will help children, and not an empirical review of the literature what is the most cost effective treatment is for a given population. Allocation of resources should be based on outcome studies which can determine the effectiveness of a given treatment. The methodology used here is similar to that discussed in Pincus's article, "Are Randomized Controlled Clinical Trials Always the Best Answer?" (Pincus, 1997). The methodology described here has the prospect of providing information on assessing complex interventions when the use of control groups, or other rigorous methods are not available or as a supplement to them.

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