Factors Associated With Treatment Mode and Termination Among Preschoolers With ADHD in Taiwan

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Objectives: This study examined the extent to which characteristics of family and health care providers predict treatment initiation, treatment mode, and treatment termination among preschool children with newly diagnosed ADHD.

Methods: A cohort of 3,583 preschoolers with ADHD was identified from the National Health Insurance Research Database of Taiwan. Individual characteristics and health care records, including medication and nonmedication treatment, were documented. Logistic regression and time-dependent survival analyses were used to evaluate association estimates.

Results: Over 80% of the children with newly diagnosed ADHD received initial treatment within a month of diagnosis, with 41% starting with combined treatment. Only one-quarter remained in treatment by the end of 12 months. In the first year, the termination rate was lowest for those who received rehabilitation treatment only (log-rank test, $p<.001$). Predictors of termination varied by treatment mode. For combined treatment, factors that marginally increased the likelihood of treatment termination were coming from a family in poverty (adjusted hazard ratio [AHR]=1.72) or from a rural region (AHR=1.40). Receiving initial treatment from a psychiatrist was associated with an increased likelihood of treatment termination for children receiving psychosocial treatment (AHR=1.80, 95% confidence interval [CI]=1.46–2.22) and combined treatment (AHR=1.38, CI=1.20–1.60).

Conclusions: Family and service provider characteristics appeared to have differential effects on initial receipt and mode of treatment and on one-year treatment termination among preschoolers with ADHD in Taiwan's universal health insurance program. Future efforts should aim at reducing access barriers to comprehensive and continuous health care for very young children with mental or developmental disorders.

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Over the past two decades, considerable attention has been directed toward the increasing prevalence of neurodevelopmental disorders, including attention-deficit hyperactivity disorder (ADHD) (1). ADHD, characterized by inattention, hyperactivity, and impulsivity, is an early-onset neurodevelopment disorder affecting approximately 5.3% of children worldwide and 7.5% of children in Taiwan (2,3). Among U.S. preschoolers, the prevalence of ADHD is estimated to be between 2.0% and 5.7% (4). A pioneer three-year study that followed U.S. children ages four to six with a diagnosis of ADHD found that most still met full diagnostic criteria after they entered elementary school, suggesting stability of the diagnosis in early childhood (5). ADHD symptoms that occur in childhood may persist into adolescence and even adulthood (6). Children with untreated or ineffectively treated ADHD often experience academic and social difficulties (7–9). Although several adverse outcomes related to untreated ADHD have been reported, less than one-third of children with ADHD receive health care services, according to an Australian study (10).

Medication and psychosocial therapy are two of the most widely recommended treatment approaches for children and adolescents with ADHD (11–16). Currently, the U.S. Food and Drug Administration and the Medicines and Healthcare Products Regulatory Agency in the United Kingdom recommend that medications for ADHD, including methylphenidate and atomoxetine, be used only with children age six and older. Nevertheless, the number of U.S. preschoolers with ADHD receiving methylphenidate has increased over the past decade (17,18). Initial evidence has indicated that stimulants (methylphenidate) are effective for the treatment of young children with ADHD (19). However, a recent report indicated that psychosocial therapy is more effective than medication (20), and the American Academy of Pediatrics has recommended psychosocial treatment as a first-line treatment for preschoolers with ADHD (21).

A number of studies, mostly using cross-sectional designs, have identified important factors affecting treatment of young children with ADHD, such as sociodemographic characteristics (for example, age, gender, and race-ethnicity) and clinical

TABLE 1. Characteristics of 3,583 preschool-age children in Taiwan with a new diagnosis of ADHD

Variable	N	%[a]
Gender		
Male	2,720	76
Female	863	24
Premium category		
Poverty	68	2
Near poverty	778	22
Middle income	1,659	46
High income	1,078	30
Primary insured		
Father	2,089	58
Mother	1,383	39
Other	111	3
Urbanicity		
Urban	1,369	38
Suburban	1,985	55
Rural	187	5
Residential region		
Northern	2,154	60
Central	605	17
Southern	766	21
Eastern	42	1
Comorbid mental disorder[b]		
Any[c]	1,578	44
Developmental delay	1,442	40
Autism	255	7
Mental retardation	132	4
History of catastrophic physical illness		
No	3,463	97
Yes	120	3
Age at initial diagnosis		
3	1,111	31
4	1,366	38
5	1,106	31
Specialty of physician making initial diagnosis		
Physiatrist	2,081	58
Psychiatrist	1,148	32
Pediatrician	321	9
Other	33	1
Medical institution for initial diagnosis		
Clinic	942	26
District hospital	381	11
Regional hospital	1,161	32
Medical center	1,099	31
Different physicians at first 3 visits		
No	2,238	62
Yes	1,345	38
Initial treatment		
None	571	16
Medication only	142	4
Psychosocial	903	25
Rehabilitation only	473	13
Combined	1,494	42

[a] Percentages may not add to 100% because of missing data.
[b] Diagnosis received before ADHD diagnosis
[c] *ICD-9-CM* codes 290–316, excluding 314.XX

history (for example, comorbid mental disorders) (22–27). However, these studies generally focused on medication treatment (22,24,26,27). Family characteristics beyond the issue of health insurance status (for example, family structure) await exploration. Because pharmacological treatment is recommended only for children age six and older, the rapid growth of preschoolers with a diagnosis of ADHD heightens the urgency to better understand factors affecting the use of nonpharmacological treatments.

In addition, a small but growing body of literature addresses the roles of health service providers in delivering services to children with mental health problems, including ADHD (27–29). For example, a survey of primary care pediatricians and child and adolescent psychiatrists found specialty-related variation in pediatricians' perceived responsibility to identify, treat, and refer children with ADHD (29). Nonetheless, these studies did not directly investigate the association between continuity of care and physician and practice characteristics related to treatment options.

We sought to address gaps in previous studies in regard to the potential effects of socioeconomic and service provider factors on the multiphase process of identifying medical needs, making treatment decisions, and obtaining continuous health care by examining data from a cohort of preschoolers who had recently received an ADHD diagnosis. We examined whether family socioeconomic characteristics and provider-level factors explain differences in initial treatment status and treatment mode among children in Taiwan's universal health insurance program. We also looked at one-year utilization patterns.

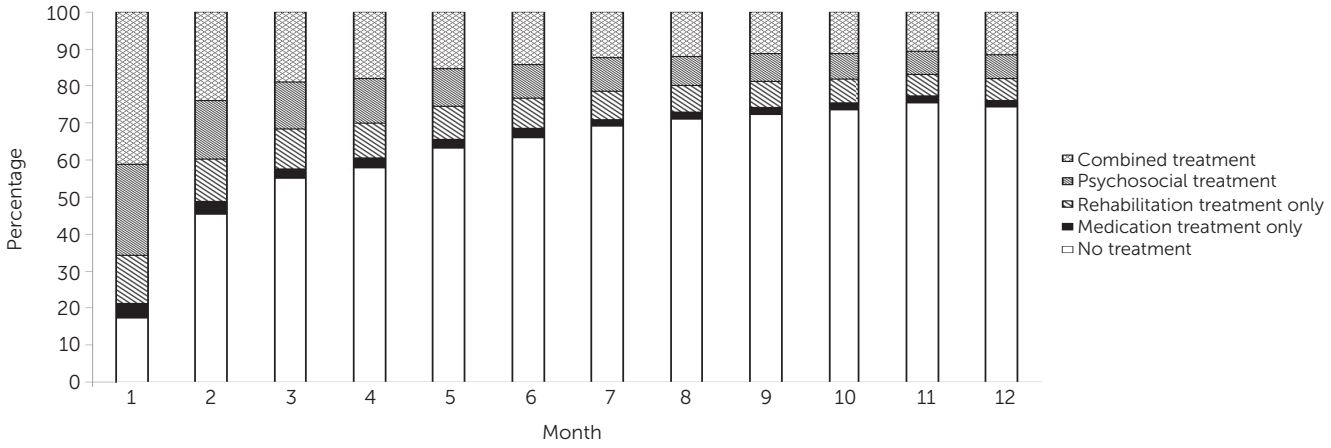
METHODS

Data Source

This study used 2001–2007 data from the National Health Insurance Research Database (NHIRD) in Taiwan. The database is derived from Taiwan's National Health Insurance Program (NHIP), which has provided comprehensive medical care coverage to all civilian residents since 1995. The database is maintained by the National Health Research Institute (NHRI) for research purposes. The 2004 coverage rate for individuals younger than 19 years was estimated at 98.7% (30). Each beneficiary has a unique encrypted identification number in the NHIRD that links all insurance information and health care records. Because referrals are not required, beneficiaries who contribute different registration fees and copayments can access health care providers of any specialty or at any medical institution level. The NHRI's institutional review board approved this study.

We used a retrospective longitudinal design. The original sample included children born between 2001 and 2003 who were initially given a diagnosis of ADHD (*ICD-9-CM* code 314.XX) between the ages of three and five (from 2004 to 2006) (N=7,196). To accurately diagnose ADHD among preschoolers, careful clinical and diagnostic assessments and behavioral observations, which may require two or three outpatient visits, are necessary. To ensure the validity of diagnoses, the study

FIGURE 1. Receipt of treatments in the year after initial ADHD diagnosis among 3,583 preschool-age children in Taiwan



included only patients who had at least two outpatient visits for ADHD in a six-month period after the initial diagnosis. Thus the final sample included 3,583 children, whose health care records from birth through one year after the initial ADHD diagnosis were retrieved.

Measures

Information on individual demographic (for example, gender, age, and region), clinical, and socioeconomic characteristics was obtained from the beneficiary registry data files. History of mental disorders was categorized as positive if before the initial ADHD diagnosis, the child had received a mental disorder diagnosis other than ADHD (*ICD-9-CM* code 290–316, excluding 314.XX). Several major mental disorders were individually specified, including autism (299.0X), mental retardation (317, 318.0, 318.1, 318.2, and 319), and developmental delay (315.XX). History of catastrophic physical illness (for example, congenital deficiency and cerebral palsy), as defined by the NHIP, was also assessed from birth onward. Since the NHIP premium was income based during the study period, we grouped insurance premium into four levels (high income, middle income, near poor, and poverty), which served as a proxy measure for the child's socioeconomic status (31). The person designated as "primary insured" was recorded (father, mother, or other) as the employed individual responsible for the child's insurance. The insured individual's residential urbanicity was documented as a measure of health care resource accessibility.

Medical institution and physician were two major service provider variables. First, we classified all medical institutions into four categories according to specifications of the Hospital Accreditation System of Taiwan. Specialist physicians, such as psychiatrists, pediatricians, physiatrists, and others (for example, family medicine specialists), were identified, and data were separately retrieved. In the NHIP, physiatrists can provide care by prescribing medications (for example, methylphenidate) and providing alternative therapy (for example, sensory integration training or physical exercise training) for ADHD treatment (32,33). For each child, ADHD service volume for diagnosing physicians was defined on the basis of the percentage of ADHD visits in the calendar year before the initial diagnosis. A similar measure was created for the physicians who provided initial treatment. Change of physician was noted in cases when a preschooler had received the ADHD diagnosis from two or more physicians during the first three visits.

ADHD treatment was first categorized in two ways: medication and nonmedication. During the study period, methylphenidate was the only ADHD medication covered by the NHIP. Reimbursed nonmedication treatment included psychotherapy (for example, behavior modification, supportive psychosocial psychotherapy, and family therapy) and rehabilitation therapy (for example, physical exercise, sensory integration training, and occupational therapy). On the basis of health care received in the two months after the initial diagnosis, initial treatment mode included none, medication treatment only, psychosocial treatment, rehabilitation treatment only, and combined treatments (both medication and nonmedication treatment). For any treatment mode, termination was defined as occurring when a child did not receive treatment for 90 days.

Statistical Analysis

Descriptive statistics for family, clinical, and health care provider variables were first calculated by cross-tabulation. The association of initial treatment status and mode with family and health care provider variables was assessed by using binary and multinomial logistic regression analyses. Next, we used Kaplan-Meier survival curves to estimate the cumulative probability of treatment retention among children who initiated treatment within two months of receiving the initial ADHD diagnosis, with the log-rank test to examine differences in survival functions across the four major treatment modes in Taiwan. Finally, to investigate factors associated with treatment termination, we used a Cox proportional hazards model. The addition of a new treatment

TABLE 2. Associations between family and provider characteristics and initial treatment among 3,583 preschoolers with a new diagnosis of ADHD

			Nonmedication treatment															
	No treatment (N=571)		Psychosocial (N=903)		Rehabilitation only (N=473)		Medication only (N=142)		Combined treatment (N=1,494)		AOR and 95% CI (N=3,583)[a]		AOR and 95% CI (N=3,012)[b]					
Characteristic	N	%	N	%	N	%	N	%	N	%	Any vs. none		Rehabilitation only vs. psychosocial		Medication only vs. psychosocial		Combined vs. psychosocial	
Family and clinical																		
Premium category																		
High income (reference)	171	30	279	31	145	31	41	29	442	30								
Middle income	263	46	418	46	201	43	70	49	707	47	.90	.70–1.17	.98	.66–1.45	1.28	.80–2.06	1.05	.86–1.29
Near poverty	127	22	190	21	119	25	28	20	314	21	.98	.72–1.33	1.08	.68–1.73	1.02	.56–1.85	.99	.77–1.27
Poverty	10	2	16	2	8	2	3	2	31	2	.70	.23–2.12	6.98	1.52–32.17	2.55	.44–14.79	1.31	.60–2.83
Primary insured																		
Father (reference)	327	57	522	58	276	58	87	61	877	59								
Mother	226	40	353	39	185	39	49	35	570	38	1.14	.91–1.43	.77	.54–1.09	.63	.41–.97	.98	.82–1.18
Other	18	3	28	3	12	3	6	4	47	3	1.17	.52–2.65	.22	.06–.76	.88	.23–3.36	1.07	.58–1.96
Urbanicity																		
Urban (reference)	227	40	390	43	135	29	57	40	560	37								
Suburban	304	53	452	50	308	65	72	51	849	57	1.29	1.02–1.64	1.26	.86–1.82	1.10	.71–1.71	1.22	1.01–1.48
Rural	33	6	48	5	27	6	11	8	68	5	1.10	.65–1.86	.97	.44–2.17	1.71	.69–4.25	.84	.53–1.31
History of mental disorder																		
No (reference)	296	52	538	60	253	53	69	49	840	56								
Yes	275	48	365	40	220	47	73	51	654	44	.93	.74–1.16	1.06	.76–1.48	1.81*	1.20–2.73	1.26	1.05–1.50
History of catastrophic illness																		
No (reference)	553	97	872	97	455	96	140	99	1443	97								
Yes	18	3	31	3	18	4	2	1	51	3	1.29	.70–2.37	.65	.28–1.50	.26	.06–1.27	.83	.51–1.33
Health care provider																		
Specialty of physician making initial diagnosis																		
Physiatrist (reference)	554	97	419	46	465	98	108	76	535	36								
Pediatrician	7	1	104	12	1	0	10	7	199	13	3.95**	1.79–8.72	.03**	.00–.20	1.53	.71–3.28	1.26	.95–1.69
Psychiatrist	3	1	377	42	3	1	20	14	745	50	44.52**	13.95–142.06	.02**	.01–.06	.17**	.09–.33	1.60**	1.27–2.02
ADHD service volume of initially diagnosing physician																		
<50% (reference)	502	88	692	77	441	93	87	61	1,018	68								
≥50%	69	12	211	23	32	7	55	39	476	32	1.54	1.08–2.18	.23**	.12–.43	3.09**	1.67–5.72	.99	.77–1.28
Different physicians at first 3 visits																		
No (reference)	502	88	446	49	419	89	100	70	771	52								
Yes	69	12	457	51	54	11	42	30	723	48	1.81**	1.32–2.46	.23**	.16–.35	.79	.51–1.23	.88	.74–1.05

continued

TABLE 2, *continued*

	No treatment (N=571)		Nonmedication treatment: Psychosocial (N=903)		Nonmedication treatment: Rehabilitation only (N=473)		Medication only (N=142)		Combined treatment (N=1,494)		AOR and 95% CI (N=3,583)[a]		AOR and 95% CI (N=3,012)[b]					
											Any vs. none		Rehabilitation only vs. psychosocial		Medication only vs. psychosocial		Combined vs. psychosocial	
Characteristic	N	%	N	%	N	%	N	%	N	%								
Medical institution for initial diagnosis																		
Clinic (reference)	426	75	30	3	300	63	72	51	114	8								
District hospital	71	12	76	8	100	21	31	22	103	7	3.02**	2.20–4.13	.10**	.06–.19	.23**	.12–.44	.35**	.21–.58
Regional hospital	42	7	513	57	39	8	37	26	530	35	13.29**	9.29–19.01	.01**	.00–.01	.04**	.02–.08	.27**	.18–.42
Medical center	32	6	284	32	34	7	2	1	747	50	11.17**	7.35–16.96	.02**	.01–.04	.00**	.00–.02	.65	.42–1.00

[a] Adjusted odds ratios (AORs) were obtained via logistic regression with simultaneous adjustment for gender, residential region, history of catastrophic disease, and all listed variables.
[b] Analysis included only those who received treatment. AORs were obtained via polytomous logistic regression with simultaneous adjustment for gender, residential region, history of catastrophic disease, and all listed variables. Reference group is the children receiving psychosocial treatment only.
* p<.01, **p<.001

(that is, the add-on treatment) was treated as a time-varying covariate in the final model. All tests were two-sided, and an alpha value of .01 was used to reduce the risk of type I error. The data were prepared and the analyses were performed with SAS 9.2 software.

RESULTS

Table 1 presents data on selected individual and service provider characteristics of young children with ADHD. More than three-quarters of the children were from middle- or high-income families, and nearly 60% were insured under their working fathers. Most children received the initial ADHD diagnosis from physiatrists and psychiatrists (58% and 32%, respectively) and at a medical center or regional hospital (31% and 32%, respectively).

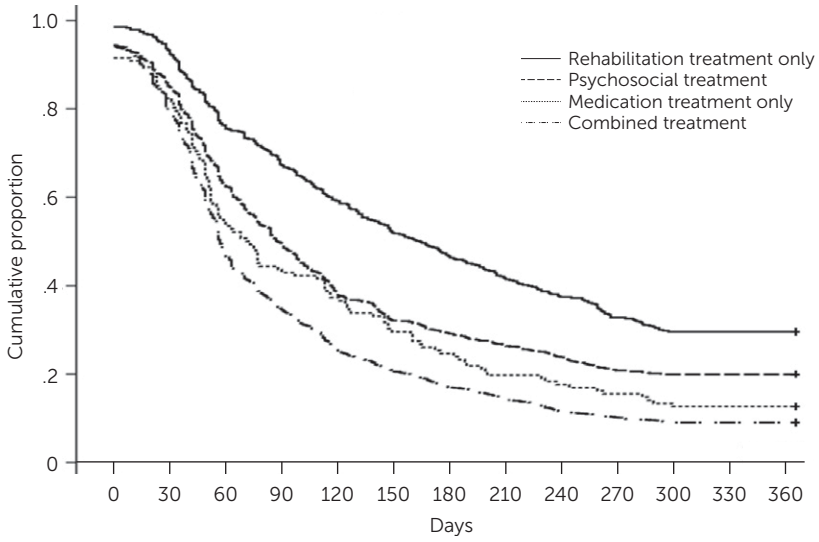
Over half of the children were not receiving treatment at the end of the third month after the initial diagnosis (Figure 1). The decline in treatment use reached a plateau at nine months after the diagnosis. Only 11.6% were still receiving combined treatment at 12 months, similar to the proportion receiving nonmedication treatment (psychosocial and rehabilitation only) (12%).

When the main confounders were adjusted simultaneously, results indicated that none of the socioeconomic characteristics examined was associated with initial ADHD treatment status or treatment mode (Table 2). Two factors were associated with increased ADHD treatment initiation: receiving the first diagnosis from a psychiatrist or pediatrician (adjusted odds ratios [AOR]=3.95 and 44.52, respectively, $p<.001$) or from a high-level hospital (district hospital, AOR=3.02; regional hospital, AOR=13.29; and medical center, AOR=11.17; $p<.001$). Among children who received treatment within the first two months (N=3,012), those who received the initial diagnosis from a psychiatrist were 1.6 times more likely to initiate combined treatments and less likely to receive medication treatment only (AOR=.17, $p<.001$) or rehabilitation treatment only (AOR=.02, $p<.001$), compared with peers receiving psychosocial treatment.

For children who received rehabilitation treatment only (Figure 2), approximately 45% remained in such treatment at the end of six months. The corresponding estimates for psychosocial treatment, medication treatment only, and combined treatment were 29%, 25%, and 17%, respectively. The observed patterns of treatment retention differed significantly by mode at 12 months after treatment initiation (log-rank test, $p<.001$).

Predictors of treatment termination at one year varied by treatment mode (Table 3). For combined treatment, children from families in poverty (adjusted hazard ratio [AHR]=1.72, $p<.05$) or from a rural region (AHR=1.40, $p<.05$) tended to terminate treatment more quickly. For psychosocial treatment, receiving initial treatment from a psychiatrist increased the likelihood of treatment termination (AHR=1.80, $p<.001$). For rehabilitation treatment only, receipt of initial treatment from a physician with higher ADHD service volume increased the likelihood of treatment termination

FIGURE 2. Retention in treatment in the year after initial ADHD diagnosis among preschool-age children in Taiwan[a]



[a] Retention rate differed significantly by mode at 12 months after treatment initiation (log-rank test, $p<.001$).

(AHR=3.02, $p<.001$). Having a history of other mental disorder lowered the likelihood of early treatment termination (AHR=.6, $p<.001$).

DISCUSSION

Three major findings emerged from our study of a population-based cohort of 3,583 young children in Taiwan who had recently received a diagnosis of ADHD. First, over 80% of the children received treatment within a month of the initial diagnosis, and more than half of the treated children received combined treatments. Second, children who received the initial diagnosis from a physician with a specialty in psychiatry or pediatrics or at a high-level medical institution were more likely to start treatment within the first two months of diagnosis. Finally, the one-year termination rate was lowest for children who received rehabilitation treatment only. Predictors of treatment termination differed by treatment mode; by and large, the role of health care providers appeared more salient than that of family socioeconomic status.

The first year after the initial diagnosis has been identified as critical in terms of early intervention and treatment (21). Effective intervention can not only reduce ADHD-associated social and learning problems, but it can also provide optimal opportunity to improve developmental outcomes (14). In this study of preschoolers, we found that nonmedication treatment (alone or in combination with medication) was more common than prescription of stimulant medication as the initial treatment. In previous studies (34), the age ranges and clinical profiles (for example, ADHD severity and comorbid mental disorders) of the children may have differed from those in our sample. In addition, medical professionals' recommendations and cultural or societal variations in parental preferences in regard to ADHD treatment may explain the lower use of medication in our study (32,35).

Our estimate of use of stimulant medication as the initial treatment (approximately 45%) is generally consistent with rates in prior cross-sectional studies (25,34). However, the proportion of children receiving methylphenidate in our study dropped to 17% at six months after the initial diagnosis (14.2% for combined treatments plus 2.5% for medication only), our estimates of stimulant use were lower than in previous reports. The relatively lower rates of treatment continuity probably resulted from the limited availability and accessibility of pediatric developmental care in primary care settings, because almost 50% of the children in the study had received their initial diagnosis at a medical center. Other reasons may include caregivers' lack of information about ADHD treatment, concerns regarding the stigma of ADHD, perceived benefit of treatment, and relatively low school adjustment stress (32,36,37).

In contrast to prior research (22,24), our findings suggest that neither urbanicity nor family income was related to the initial treatment received or to treatment retention. Such discrepancies may result from differences in sample characteristics associated with insurance eligibility (for example, U.S. Medicaid versus the Taiwan NHIP) and coverage for ADHD treatment (25,34). Another plausible explanation is that the case definition of three or more outpatient visits for ADHD in this study may have limited our sample to children with similar socioeconomic status or medical conditions. Finally, regardless of treatment mode, the add-on treatment had no effects on retention, indicating that for preschoolers with ADHD in Taiwan, sequenced treatment alternatives are either uncommon (most started with combined treatment) or are adopted at the end of the treatment course. The former explanation is also supported by the observation that the treatment shift rate was lower than rates reported in prior research (25).

Our analysis demonstrated that the specialty of service providers played a significant role in both treatment initiation and termination. Specifically, receiving the initial ADHD diagnosis from pediatricians or psychiatrists may increase the likelihood of treatment initiation; however, receiving initial treatment from psychiatrists was associated with a more rapid termination of psychosocial treatment, medication treatment only, and combined treatment. This seemingly paradoxical observation may be partially explained by specialty-related variation in the practice guideline for treatment of children with ADHD and in awareness of and adherence to clinical guidelines in treating children with psychotropic medication

TABLE 3. Analysis of family and provider characteristics as predictors of 12-month treatment termination among 3,012 preschoolers with a new diagnosis of ADHD who received treatment

	Nonmedication treatment							
	Psychosocial (N=903)		Rehabilitation only (N=473)		Medication only (N=142)		Combined treatment (N=1,494)	
Characteristic	AHR[a]	95% CI	AHR[a]	95% CI	AHR[a]	95% CI	AHR[a]	95% CI
Family and clinical								
Premium category (reference: high income)								
Middle income	1.09	.92–1.31	1.12	.86–1.45	1.60	.97–2.64	1.05	.93–1.20
Near poverty	1.19	.97–1.47	.98	.71–1.34	.84	.44–1.59	1.05	.90–1.23
Poverty	.45	.18–1.01	.74	.20–2.70	.69	.14–3.36	1.72	1.09–2.70
Urbanicity (reference: urban)								
Suburban	1.04	.89–1.23	.97	.76–1.25	1.42	.86–2.35	.92	.82–1.04
Rural	1.07	.73–1.57	.85	.50–1.44	1.03	.36–2.94	1.40	1.06–1.85
Primary insured (reference: father)								
Mother	1.03	.88–1.21	.88	.70–1.12	.87	.54–1.40	1.11	.99–1.24
Other	1.31	.76–2.26	2.30	.91–5.80	1.94	.62–6.05	.74	.51–1.08
History of other mental disorder (reference: no)	.86	.74–1.01	.60**	.47–.76	.75	.50–1.12	.76**	.67–.85
History of catastrophic illness (reference: no)	.57*	.36–.92	.51	.26–1.01	2.63	.61–11.43	.85	.62–1.16
Add-on treatment (reference: no)[b,c]	1.05	.84–1.33	.90	.56–1.44	1.29	.63–2.63	na	na
Health care provider								
Specialty of physician prescribing initial treatment (reference: physiatrist)								
Pediatrician	1.27	.97–1.67	9.60	.85–108.00	1.34	.59–3.05	1.01	.84–1.22
Psychiatrist	1.80**	1.46–2.22	na		2.15	1.15–4.04	1.38**	1.20–1.60
≥50% ADHD service volume of initially treating physician (reference: <50%)	1.16	.93–1.45	3.02**	2.02–4.51	.67	.39–1.14	1.05	.90–1.23
Diagnosis and treatment by different physicians (reference: no)	.82	.57–1.20	1.27	.64–2.51	2.36	.87–6.42	.72	.56–.92
Medical institution for initial treatment (reference: clinic)								
District hospital	.65	.37–1.15	.62*	.46–.83	.47	.24–.91	1.05	.79–1.40
Regional hospital	.73	.44–1.20	.91	.54–1.52	.99	.50–1.96	1.08	.86–1.36
Medical center	.75	.45–1.27	1.30	.31–5.42	.93	.19–4.58	.99	.80–1.23

[a] Adjusted hazards ratios (AHRs) were obtained via survival analyses with simultaneous adjustment for gender, residential region, age at initial ADHD diagnosis, and all listed variables.
[b] Time-dependent variable
[c] Either medication or nonmedication (psychosocial or rehabilitation)
* p<.01, **p<.001

(12,38). For example, given the fact that the course of psychosocial treatment for children with ADHD (for example, family therapy or behavioral consultation) often lasts no longer than six months in Taiwan, the rapid termination in psychosocial treatments related to receiving treatment from a psychiatrist may simply reflect treatment completion.

Of note, the ADHD service volume of health care providers also had an effect on the initial treatment option and long-term treatment retention. Among children who initiated treatment, receiving the diagnosis from a physician with a higher ADHD service volume was associated with an increased likelihood of medication treatment. However, receiving rehabilitation treatment from a physician with a higher ADHD service volume also led to more rapid termination. This observation may have resulted from differences in patient profiles associated with treatment indication or option (for example, ADHD severity), or it may have been the result of limited availability of outpatient appointments for nonmedical treatments or limited appointments resulting from high ADHD service volume.

We found that receiving the initial diagnosis from a higher-level medical institution was generally associated with greater odds of initiating treatment. The results remained robust after statistical adjustment for individual and clinical characteristics, suggesting a greater gap in accessing specialist pediatric mental health care (for example, clinical psychologists) in primary care clinics, and may highlight the need to improve access to specialist treatment in local communities (39). Finally, among young children who received initial treatment, the observed differences in treatment mode by medical institution level may be partly explained by the variation in the referral network and by the expertise and specialties of medical team members.

This study had several limitations. First, because our analyses were based solely on NHIP data sets, children whose treatment or health care was paid for out of pocket or by government funding (for example, early intervention programs) were not included, which may have led to an underestimated treatment rate. Another limitation was the lack of clinical validity of ADHD diagnoses. The criterion of three or more outpatient visits that we adopted to enhance clinical validity may have introduced some bias. To illustrate, post hoc analyses indicated that children who were excluded from the study because they had fewer than three visits tended to have a lower premium ($p<.001$), suggesting that the children in our study may have come from families of relatively advantaged socioeconomic status. For sensitivity analyses, we repeated the series of analyses with patients who had at least one outpatient visit after the initial ADHD diagnosis (N=5,172); the results were generally similar in terms of direction and magnitude of the association.

Notwithstanding these limitations, the study is among the first to investigate ADHD treatment options in a preschool-age population. In addition, having a large, nationally representative sample allowed us to explore treatment options more closely. Analyses that consider changes in treatment options over time may provide a unique opportunity to evaluate clinical characteristics (for example, hospital-level factors and specialty of the physician making the initial diagnosis) from a long-term perspective. Finally, our focus on incident cases may have reduced susceptibility to bias resulting from reciprocal relationships (for example, certain clinical characteristics may change as a result of ADHD treatment). In addition, the nature of the longitudinal follow-up in this study helped establish a temporal sequence for observed association.

CONCLUSIONS

This population-based longitudinal study demonstrated an unmet health care need among young children with ADHD in Taiwan. Our findings reinforce the importance of developing consensus across specialties regarding diagnosis, management, and referral in the preschool-age population with ADHD. To ensure that children receive high-quality continued treatment for ADHD, community-based comprehensive and coordinated pediatric developmental care should be considered to address the medical and social welfare needs of children with ADHD and their families (for example, medical homes) (40). Additional research is needed to identify organizational structures and insurance mechanisms that drive specialty-related differences in health care–seeking processes.

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REFERENCES

1. Rowland AS, Lesesne CA, Abramowitz AJ: The epidemiology of attention-deficit/hyperactivity disorder (ADHD): a public health view. Mental Retardation and Developmental Disabilities Research Reviews 8:162–170, 2002
2. Gau SS, Chong MY, Chen TH, et al: A 3-year panel study of mental disorders among adolescents in Taiwan. American Journal of Psychiatry 162:1344–1350, 2005
3. Polanczyk G, de Lima MS, Horta BL, et al: The worldwide prevalence of ADHD: a systematic review and metaregression analysis. American Journal of Psychiatry 164:942–948, 2007
4. Lavigne JV, Lebailly SA, Hopkins J, et al: The prevalence of ADHD, ODD, depression, and anxiety in a community sample of 4-year-olds. Journal of Clinical Child and Adolescent Psychology 38: 315–328, 2009
5. Lahey BB, Pelham WE, Loney J, et al: Three-year predictive validity of DSM-IV attention deficit hyperactivity disorder in children diagnosed at 4–6 years of age. American Journal of Psychiatry 161: 2014–2020, 2004
6. Turgay A, Goodman DW, Asherson P, et al: Lifespan persistence of ADHD: the life transition model and its application. Journal of Clinical Psychiatry 73:192–201, 2012
7. Kendall T, Taylor E, Perez A, et al: Diagnosis and management of attention-deficit/hyperactivity disorder in children, young people, and adults: summary of NICE guidance. British Medical Journal 337:a1239, 2008
8. DuPaul GJ, McGoey KE, Eckert TL, et al: Preschool children with attention-deficit/hyperactivity disorder: impairments in behavioral, social, and school functioning. Journal of the American Academy of Child and Adolescent Psychiatry 40:508–515, 2001
9. Mannuzza S, Klein RG, Bessler A, et al: Adult outcome of hyperactive boys: educational achievement, occupational rank, and psychiatric status. Archives of General Psychiatry 50:565–576, 1993
10. Sawyer MG, Rey JM, Arney FM, et al: Use of health and school-based services in Australia by young people with attention-deficit/hyperactivity disorder. Journal of the American Academy of Child and Adolescent Psychiatry 43:1355–1363, 2004
11. Remschmidt H: Global consensus on ADHD/HKD. European Child and Adolescent Psychiatry 14:127–137, 2005
12. Subcommittee on Attention-Deficit/Hyperactivity Disorder and Committee on Quality Improvement, American Academy of Pediatrics: Clinical practice guideline: treatment of the school-aged child with attention-deficit/hyperactivity disorder. Pediatrics 108: 1033–1044, 2001
13. Canadian ADHD Practice Guidelines, 3rd ed. Toronto, Ontario, Canadian Attention Deficit Hyperactivity Disorder Resource Alliance, 2011
14. Daley D: Attention deficit hyperactivity disorder: a review of the essential facts. Child: Care, Health and Development 32:193–204, 2006
15. Attention Deficit Hyperactivity Disorder: Diagnosis and Management of ADHD in Children, Young People and Adults. London, National Institute for Health and Clinical Excellence, 2012

16. Daly BP, Creed T, Xanthopoulos M, et al: Psychosocial treatments for children with attention deficit/hyperactivity disorder. Neuropsychology Review 17:73–89, 2007
17. Greenhill L, Kollins S, Abikoff H, et al: Efficacy and safety of immediate-release methylphenidate treatment for preschoolers with ADHD. Journal of the American Academy of Child and Adolescent Psychiatry 45:1284–1293, 2006
18. Zito JM, Safer DJ, dosReis S, et al: Trends in the prescribing of psychotropic medications to preschoolers. JAMA 283:1025–1030, 2000
19. Chacko A, Pelham WE, Gnagy EM, et al: Stimulant medication effects in a summer treatment program among young children with attention-deficit/hyperactivity disorder. Journal of the American Academy of Child and Adolescent Psychiatry 44:249–257, 2005
20. Charach A, Dashti B, Carson P, et al: Attention Deficit Hyperactivity Disorder: Effectiveness of Treatment in At-Risk Preschoolers; Long-Term Effectiveness in All Ages; and Variability in Prevalence, Diagnosis, and Treatment. Rockville, Md, Agency for Healthcare Research and Quality, 2011
21. Wolraich M, Brown L, Brown RT, et al: ADHD: clinical practice guideline for the diagnosis, evaluation, and treatment of attention-deficit/hyperactivity disorder in children and adolescents. Pediatrics 128:1007–1022, 2011
22. Cox ER, Motheral BR, Henderson RR, et al: Geographic variation in the prevalence of stimulant medication use among children 5 to 14 years old: results from a commercially insured US sample. Pediatrics 111:237–243, 2003
23. Robison LM, Sclar DA, Skaer TL, et al: Treatment modalities among US children diagnosed with attention-deficit hyperactivity disorder: 1995–99. International Clinical Psychopharmacology 19: 17–22, 2004
24. Visser SN, Lesesne CA, Perou R: National estimates and factors associated with medication treatment for childhood attention-deficit/hyperactivity disorder. Pediatrics 119(suppl 1):S99–S106, 2007
25. Stein BD, Klein GR, Greenhouse JB, et al: Treatment of attention-deficit hyperactivity disorder: patterns of evolving care during the first treatment episode. Psychiatric Services 63:122–129, 2012
26. Winterstein AG, Gerhard T, Shuster J, et al: Utilization of pharmacologic treatment in youths with attention deficit/hyperactivity disorder in Medicaid database. Annals of Pharmacotherapy 42: 24–31, 2008
27. Zito JM, Safer DJ, dosReis S, et al: Psychotherapeutic medication patterns for youths with attention-deficit/hyperactivity disorder. Archives of Pediatrics and Adolescent Medicine 153:1257–1263, 1999
28. Stein REK, Horwitz SM, Storfer-Isser A, et al: Attention-deficit/hyperactivity disorder: how much responsibility are pediatricians taking? Pediatrics 123:248–255, 2009
29. Heneghan A, Garner AS, Storfer-Isser A, et al: Pediatricians' role in providing mental health care for children and adolescents: do pediatricians and child and adolescent psychiatrists agree? Journal of Developmental and Behavioral Pediatrics 29:262–269, 2008
30. Chen CY, Liu CY, Su WC, et al: Factors associated with the diagnosis of neurodevelopmental disorders: a population-based longitudinal study. Pediatrics 119:e435–e443, 2007
31. Chen L, Lu HM, Shih SF, et al: Poverty related risk for potentially preventable hospitalisations among children in Taiwan. BMC Health Services Research 10:196, 2010
32. Tzang RF, Chang YC, Chen CC: Barriers to seeking help among children with attention deficit hyperactivity disorder in Taiwan. Asia-Pacific Psychiatry (Epub ahead of print, March 5, 2013)
33. Ghanizadeh A: Sensory processing problems in children with ADHD, a systematic review. Psychiatry Investigation 8:89–94, 2011
34. Rappley MD, Mullan PB, Alvarez FJ, et al: Diagnosis of attention-deficit/hyperactivity disorder and use of psychotropic medication in very young children. Archives of Pediatrics and Adolescent Medicine 153:1039–1045, 1999
35. Brinkman WB, Epstein JN: Treatment planning for children with attention-deficit/hyperactivity disorder: treatment utilization and family preferences. Journal of Patient Preference and Adherence 5:45–56, 2011
36. Leslie LK, Plemmons D, Monn AR, et al: Investigating ADHD treatment trajectories: listening to families' stories about medication use. Journal of Developmental and Behavioral Pediatrics 28: 179–188, 2007
37. Horwitz S, Demeter C, Hayden M, et al: Parents' perceptions of benefit of children's mental health treatment and continued use of services. Psychiatric Services 63:793–801, 2012
38. Gleason MM, Egger HL, Emslie GJ, et al: Psychopharmacological treatment for very young children: contexts and guidelines. Journal of the American Academy of Child and Adolescent Psychiatry 46:1532–1572, 2007
39. Garland AF, Haine-Schlagel R, Brookman-Frazee L, et al: Improving community-based mental health care for children: translating knowledge into action. Administration and Policy in Mental Health and Mental Health Services Research 40:6–22, 2013
40. Toomey SL, Finkelstein J, Kuhlthau K: Does connection to primary care matter for children with attention-deficit/hyperactivity disorder? Pediatrics 122:368–374, 2008