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Original article

Predictors of ADHD persistence in elementary school children who were assessed in earlier grades: A prospective cohort study from Istanbul, Turkey

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Abstract

Background: Attention-deficit hyperactivity disorder (ADHD) is the most common neurodevelopmental disorders among school-age children worldwide. In a more recent follow-up study, Biederman et al. found that 78% of children diagnosed with ADHD between the ages of 6–17 years continued to have a full (35%) or a partial persistence after eleven years.

Objective: In this study, it was aimed to identify the factors contributing to the persistence of ADHD symptoms in elemantary school children who were prospectively assessed both in their earlier and upper grades.

Methods: The sample was drawn from a previous community-based study where ADHD symptoms in 3696 first/or second graders were examined in regard to their school entry age. Two years after, the families of the children that participated in the initial study were called by phone and invited to a re-evaluation session. Among those who were reached, 154 were consequently eligible and were assessed with Swanson, Nolan and Pelham questionnaire (SNAP-IV), Conners' rating scales (CRS) and the Kiddie schedule for affective disorders and schizophrenia (K-SADS).

Results: Of the 154 children, 81 had been evaluated to have "probable ADHD" by the initial interview. Among these 81 children, 50 (61.7%) were indeed diagnosed with ADHD after two years. Initial scores of the teacher reported SNAP-IV inattention subscale predicted the ADHD diagnosis after two years, with an odds ratio of 1.0761 ($p = 0.032$, Wald: 4.595).

Conclusions: Our results suggest that high inattention symptom scores reported by the teacher in the earlier grades, might predict an ADHD diagnosis in upper grades.

Keywords: Attention deficit hyperactivity disorder; Age; Children; Elementary school; Persistence

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1. Introduction

Attention-deficit hyperactivity disorder (ADHD) is the most common neurodevelopmental disorders among school-age children worldwide [1]. Compared to the general population, children with ADHD are at higher risk for school failure, substance abuse, and more likely to have other psychiatric and general health problems [1,2]. The worldwide prevalence of ADHD is estimated to be 5.3% in school-age children with a range between 2.5% and 12.5% [3]. A previous community-based prevalence study reported that the prevalence of ADHD was 12.7% in an elementary school sample in Turkey [4]. Longitudinal studies indicate that ADHD symptoms observed in children and adolescents subside with age, remit in adulthood, whereas approximately 15–80% of children diagnosed with ADHD continue to have the disorder during the adulthood, depending on the diagnostic criteria used [5–7]. In a more recent follow-up study, Biederman et al. found that 78% of children diagnosed with ADHD between the ages of 6–17 years continued to have a full (35%) or a partial persistence after eleven years [8]. History of ADHD in the family, psychosocial adversity such as negative life events and exposure to maternal psychopathology at baseline, ADHD symptom severity and psychiatric comorbidity were found to be the predictors of persistence [5,7–9]. Moreover, studies examining ADHD prevalence suggest that the diagnosis of ADHD is associated with poverty and lower parental educational achievement, while higher scores in Swanson, Nolan and Pelham Questionnaire-IV (SNAP-IV) predict more significant impairment in academic, behavioral and social functioning [10,11].

It is known that deficits in executive functions and daily functioning associated with ADHD, improve as the age increases [12]. The frontal lobe development which is responsible for the executive functions, such as attention, planning, response inhibition, set-shifting, interference control, and working memory, is expected to be significant during the period of 72–96 months of age in children [12]. An adequate level of development of the executive functions is crucial for the child's functioning in school [13].

There is increasing evidence from similar studies, reporting that the younger children within the same school year are at an increased risk for the development of ADHD-related outcomes during primary school, and authors suggest that this association represents a causal relationship [14–16]. However, the relationship between the persistence of ADHD symptoms and the age of entry into primary school has yet to be adequately examined, due to a lack of longitudinal studies.

In this study, we aimed to identify the factors that may help in predicting the persistence of ADHD symptoms in upper grades in a representative elementary school sample of children in Istanbul, Turkey, whose ADHD symptom data were reported by their teachers in the earlier grades. We hypothesized that 1. Scores of ADHD symptom scales in earlier grades of elementary school will decrease with age. Competency scores of children will improve with age. 2. Scores of ADHD symptom scales of children with smaller school entry age in earlier grades will decrease in upper grades. Competency scores of children with smaller school entry age in earlier grades will improve in upper grades. 3. Severe ADHD symptoms in earlier grades will persist in upper grades.

2. Method

2.1. Study sample and design

Erenkoy Research and Training Hospital for Psychiatry and Neurology ethics committee approved the study, and the official permission was obtained from the Kadıköy district national education directorate. Participants were drawn from a previous community-based, ADHD screening study conducted in Istanbul, where the ADHD symptoms were assessed in terms of school-entry age. In this former study, 4356 children between 60 and 87 months of age at school entry, attending the 1st and 2nd grades in November-2012 being evaluated, the data of 3696 children were analyzed. Children who received a score of greater than +1-standard deviation from teacher ratings in SNAP-IV and/or Teacher-perceived competence scale (T-PCS) (n = 342, 9.25% of the total ADHD screening study sample) were accepted as "probable" ADHD based on the observed distribution and assigned to the current study [14].

Of the 342 children who had probable ADHD, 211 children were from the 1st grade and 131 children were from the 2nd grade, who then became third and fourth grades at the time of the present study.

The control group included children attending the same grades and was randomly matched for age and gender with the probable ADHD group, whose teacher ratings in SNAP-IV and/or T-PCS were below the +1-standard deviation of the 3696 children.

In order to reach the contact information of the children who were identified as the probable ADHD group (342 children) and control group (342 children), the relevant school directorates were interviewed. Forty-three children from one of the study sample schools did not agree to participate in the study despite the official permission from the national education directorate, and 83 children's contact information was not available in the related schools. Five hundred fifty-eight children's phone numbers were obtained, but 111 children could not be reached via telephone. Of the 447 children who were interviewed by telephone, 266 did not accept psy-

chiatric evaluation. Of the 266 children who did not accept psychiatric evaluation, parents of 106 children stated that their children had changed schools, 54 stated that they did not want their children to be labeled, 51 stated that they did not have time, 10 stated that their children had ADHD treatment already, 10 stated that their children did not need such kind of evaluation, 9 reported that their children had health problems, 5 mentioned that they were out of the city, and 21 did not accept the evaluation without any reason. One hundred eighty-one of the children were given an appointment. Of these 181 children, 25 did not come for evaluation without any reason, one came but mentioned that they did not have time, and one came but rejected the evaluation by stating that they did not want their child to be labeled. Therefore, two years after the first assessment, we were able to re-evaluate 154 children of the selected sample of 684 (342 probable ADHD and 342 controls) and conducted a comprehensive diagnostic evaluation (Fig. 1).

Written informed consent from one parent of each child was obtained. The children and their parents who agreed to participate in the study, were subjected to Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present Version (K-SADS-P) at school, administered by child psychiatrists who were blinded to the group of the participant. Following the interview, parents completed SNAP-IV and Conners' Parent Rating Scale (CPRS). Conners' Teacher Rating Scale (CTRS), SNAP-IV and T-PCS were filled out by the teachers for the second time, two years after the screening study.

2.2. Measures

2.2.1. Sociodemographic Form

This form included questions about sociodemographic information that involves the age, age of entry into primary school, gender, past mental health referrals, history of pharmacological treatments of the children and educational level of parents (1. Illiterate, 2. Literate, 3. Primary school, 4. Secondary school, 5. High school 6. University). The informed consent form was attached as the front page of each sociodemographic form.

2.2.2. Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present Version (K-SADS-P)

The K-SADS-P is a semi-structured interview developed by Kaufman et al. (1997) [17], which is used to determine the present affective disorders in children and adolescents based on DSM-IV (APA, 1994) diagnostic criteria. The Turkish version of the KSADS-P was reported to be valid and reliable for use in Turkey [18]. The K-SADS-P was used to determine the presence of psychiatric disorders in the participants, and at least one parent who could provide information about their child participated in the assessment process.

2.2.3. Teacher- Perceived competence scale (T-PCS)

The T-PCS is a three-item competency scale, reflecting the children's competence in the social and academic domains as well as their overall behavior. The three domains showed a satisfactory level of internal consistency (Cronbach's alpha = 0.86). Each item is rated

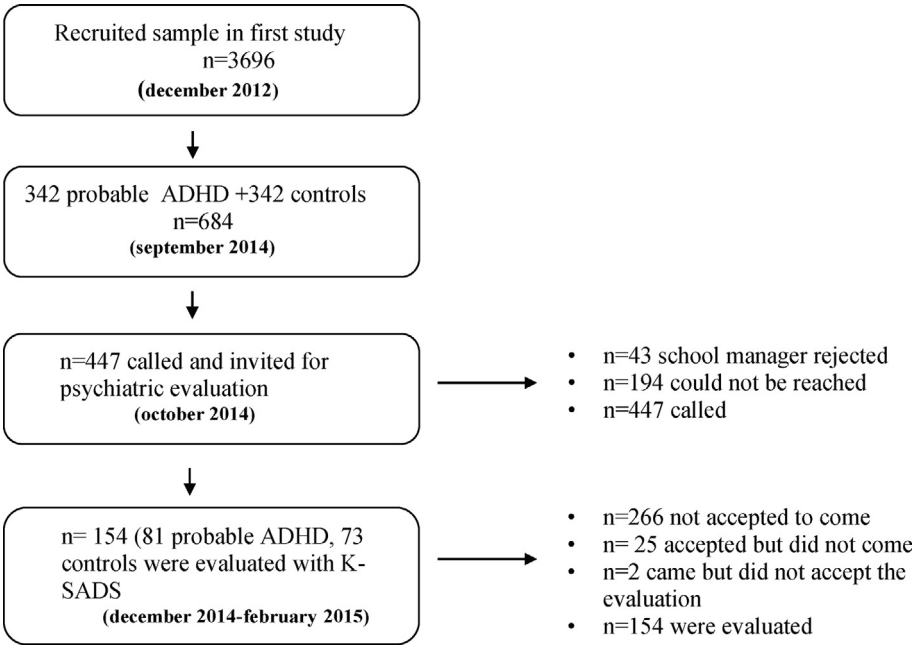

Fig. 1. Fig. 1 represents description of our sample design.

on a 5-point scale with higher scores reflecting greater competence.

This scale was developed in a community-based study, to assess the functioning level of children in response to intervention after an earthquake in Turkey [19]. The T-PCS was also used in a school-based study of informant discrepancy in ADHD in the same school district as the current study [11]. In this scale, teachers are asked to rate general competence of the child between 1 and 5 (1 = very poor, 2 = poor, 3 = fair, 4 = good, and 5 = very good), as in 3 domains of functioning: social (e.g., relationships with peers and authority figures), academic (e.g., participation, learning, assignments), and behavioral (e.g., after the class, adherence with rules). We used the T-PCS as a measure of impairment. The higher scores represent better competence and less impairment.

2.2.4. Swanson, Nolan and Pelham Questionnaire-IV (SNAP-IV)

The SNAP-IV is an 18-item scale derived from DSM-IV criteria for ADHD, which can be completed by parents or teachers. Each item is rated from 0 to 3 as; 0 = not at all; 1 = just a little, 2 = quite a bit, 3 = very much. In accordance with DSM-IV, there are nine items for inattention and nine items for hyperactivity/impulsivity. The SNAP-IV has been used as an outcome measure in clinical trials [20] and in community surveys to identify children with probable ADHD [21]. It has solid psychometric properties with coefficient alpha values on parent ratings of 0.94 for the total score, 0.90 and 0.79 for inattention and hyperactivity scores, respectively; the alpha coefficients for teacher ratings are 0.97, 0.96, and 0.92 for total, inattention, and hyperactivity scales, respectively [21]. In the current study, the SNAP-IV was completed by parents and teachers and was considered as complete if all of the 18 items were scored.

2.2.5. Conners' parent Rating scale (CPRS)

CPRS is composed of 48 items that are scored on a 4-point scale from 0 (not true or never) to 3 (entirely true or very often) [22]. Its validity and reliability were shown in Turkish; and it has a Cronbach alpha internal consistency coefficient ranging between 0.67 and 0.92 for four subscales (‘‘Defiant behavior,’’ Attention Deficit,‘‘ ’’Hyperactivity,‘‘ and ‘‘Disrupted Behavior’’) [23]. Parents answer the questions in the 4 point Likert type scale.

2.2.6. Conners' teacher Rating Scale-Revised (CTRS-R)

The short version of the CTRS-R consisted of 28 items scored on a 4-point scale from 0 (not true or never) to 3 (entirely true or very often). CTRS-R is a measurement instrument used to assess oppositional defiant disorder and ADHD behavior at school with subscales of conduct behavior hyperactivity and inattention [22].

2.3. Statistics

Statistical analyses were performed using the computer software SPSS Complex Samples Statistics (IBM SPSS Statistics version 20.0). Group comparisons were conducted using X^2 tests for categorical variables. The Wilcoxon Signed Rank Test was used to compare repeated measures of scale scores. Independent sample student T test was used to compare continuous variables.

The associations between the independent variables and ADHD diagnosis were examined with a logistic regression model using a 95% confidence interval (CI). The independent variables were used in regression model which differed statistically in groups who had ADHD or not in previous analyses.

3. Results

Mean school entry age of 154 children who were participated in this study was 74.84 ± 5.5 months and mean age of 3553 children who did not participated in this study but analyzed in our first part of study was 76.87 ± 4.5 ($p = 0.011$, t: −4.204). 69.2% of the 154 children were 1st grade and 57.6% of the 3553 children who did not participated in this study were 2nd grade at first assessment ($p = 0.006$, $X^2 = 7.619$). Initial mean SNAP-IV teacher inattention subscale score, SNAP-IV teacher H/I subscale scores which were reported two years ago were statistically higher in 154 children (1.19 ± 1.02; 0.89 ± 1.0) who were participated in this study than other 3553 children (0.58 ± 0.72; 0.51 ± 0.69 ($p < 0.001$, $t = 6.269$; $p < 0.001$, $t = 4.524$). Initial T-PCS total scores were statistically lower in 154 children (11.08 ± 3.3) than other 3553 children who were not participated in this study (12.97 ± 2.18) ($p < 0.001$, $t = -6.704$).

One hundred fifty-four cases were included in the analyses of this second part of our study. Number and percentage of children according to ADHD diagnosis are shown in Table 1. Children were diagnosed with ADHD according to KSADS-P.

In group who had probable ADHD at the initial evaluation, 10.6% had inattentive type of ADHD, 6.4% had Hyperactive/ Impulsive (H/I) type, and 83.0% had com-

Table 1
Number and percentage of children diagnosed with ADHD or not at present evaluation.

	ADHD + N (%)	ADHD – N (%)	Total N (%)
Probable ADHD initially	50 (79.3)	31 (34.0)	81 (52.6)
Not probable ADHD initially	13 (20.6)	60 (65.9)	73 (47.4)
Total	63 (100)	91 (100)	154 (100)

ADHD: Attention Deficit Hyperactivity Disorder.

bined type of presentation, while in group who had no probable ADHD initially 30.8% had inattentive type of ADHD, 15.4% had H/I type, and 53.8% had combined type of presentation (x^2 = 5.008, p = 0.034). 36.4% (n = 56) of the total cases were female, 28.6% (n = 18) of the ADHD group and 41.8% (n = 38) of the non-ADHD group were female (p > 0.05, X^2 = 2.797). 67.5% (n = 104) of the cases were from 3rd grade and 32.5% (n = 50) were from 4th grade. 77.8% of the ADHD group were from 3rd grade and 60.4% of the non-ADHD group were from 3rd grade (p = 0.024, X^2 = 5.104).

The mean age of children diagnosed with ADHD and not diagnosed with ADHD were 8.8 ± 0.6 (min 7.7-max 10.1) and 9.1 ± 0.8 (min 7.4-max 11.0) years, respectively (t = −1.965, df = 143.6, p = 0.51). The mean age of beginning primary school in children who were diagnosed with ADHD was 6.3 ± 0.4 (min 5.2-max 7.0) and the mean age of beginning primary school in children who were not diagnosed with ADHD was 6.2 ± 0.4 (min 5.3-max 7.5) (t = 0.579, df = 148, p > 0.05). Further sociodemographic features among groups are shown in Table 2.

In all, 52.3% of the ADHD group and 18.7% of the non-ADHD group had at least one psychiatric diagnosis other than ADHD (x^2 = 15.473, p < 0.001). 34.9% of the ADHD group and 18.7% of the non-ADHD group had one comorbid diagnosis, 14.3% of the ADHD group and 4.4% of the non-ADHD group had two comorbid diagnoses and 3.2% of the ADHD group had more than two comorbid diagnoses.

The rates of psychiatric diagnosis other than ADHD were as follows in ADHD and non-ADHD group, respectively; PDD (Pervasive Developmental Disorder): 1.6%, 0%; ODD (Oppositional Defiant Disorder): 9.5%, 0%; CD (Conduct Disorder): 1.6%, 0%; Tic Disorders: 15.9%, 3.3%; Major Depressive Disorder: 3.2%, 1.1%; Social Phobia: 4.8%, 2.3%; Specific Phobia: 14.3%, 9.9%; Generalized Anxiety Disorder (GAD): 7.9%, 1.1%; Separation Anxiety Disorder (SAD): 7.9%, 2.2%; Obsessive Compulsive Disorder (OCD): 3.2%, 1.1%; Enuresis: 4.8%, 5.5%; Encopresis: 1.6%, 0%, Post Traumatic Stress Disorder (PTSD): 3.2%, 0%.

SNAP-IV teacher ratings total and subscale scores, CTRS-R total score, T-PCS total and subscale scores, which were filled out two years ago did not differ statistically between groups who had present ADHD diagnoses or not in both probable ADHD and not probable ADHD groups (p > 0.05) (Table 3). We compared teacher reported scale scores initially and two years later in groups, represented in Table 4. In the group who had probable ADHD initially and had present ADHD diagnoses; CTRS-R total scores decreased, and T-PCS total scores raised statistically in two years (p < 0.05).

Table 2
Sociodemographic features among groups.

	Probable ADHD initially,ADHD (+)n:50	Not probable ADHD initially,ADHD (+)n:13	Probable ADHD initially,ADHD (–)n: 31	Not Probable ADHD initially,ADHD (–) n:60
	mean ± SD (min–max)	mean ± SD (min–max)	mean ± SD (min–max)	mean ± SD (min–max)
Age (year)	8.9 ± 0.1 (7.8–10.1)	8.5 ± 0.1 (8.0–9.1)	9.0 ± 0.1 (7.7–10.4)	9.1 ± 0.1 (7.4–11.1)
Age of beginning school (month)	74.8 ± 0.8 (62–84)	73.7 ± 1.4 (66–83)	74.9 ± 1.0 (64–89)	75.1 ± 0.7 (63–90)
	%	%	%	%
Grade (3th)	72.0	100	58.1	61.7
Gender (male)	70.0	76.9	54.8	60.0
Educational level (mother)				
Illiterate	2	0	6.5	0
Literate	18	15.4	6.5	1.7
Primary school	22	0	45.3	25
Secondary school	16	15.4	12.9	20
High school	32	38.5	19.4	36.7
University	10	30.8	9.7	16.7
Educational level (father)				
Illiterate	4	0	0	0
Literate	2	0	0	0
Primary school	24	15.4	41.9	15
Secondary school	22	15.4	12.9	18.3
High school	32	46.2	29.0	40.0
University	16	23.1	16.1	26.7
Referred to clinic	44.0	23.1	3.2	1.7
Treated with drug	24.0	15.4	0	0

ADHD: Attention Deficit Hyperactivity Disorder.

Table 3
Comparison of ADHD and T-PCS scores reported two years ago among groups.

	Probable ADHD initially Mean ± SD		TOTAL	Not Probable ADHD initially Mean ± SD		TOTAL
	ADHD (+) (n:50)	ADHD (–) (n: 31)	Statistics	ADHD (+) (n:13)	ADHD (–) (n: 60)	Statistics
SNAP-IV TRF Total	1.83 ± 0.7	1.67 ± 0.7	p = 0.289 z = −1.061	0.58 ± 0.1	0.52 ± 0.0	p = 0.625 z = −0.489
SNAP-IV TRF IA	2.04 ± 0.7	1.91 ± 0.7	p = 0.324 z = −0.986	0.44 ± 0.1	0.60 ± 0.1	p = 0.987 z = −0.940
SNAP-IV TRF H/I	2.04 ± 0.7	1.91 ± 0.6	p = 0.480 z = −0.706	4.1 ± 7.7	2.9 ± 4.9	p = 0.850 z = −0.190
CTRS-R	43.3 ± 20.9	38.0. ± 22.2	p = 0.267 z = −1.11	8.3 ± 14.2	9.5 ± 12.4	p = 0.650 z = −0.453
T-PCS academic	2.5 ± 1.5	2.7 ± 0.9	p = 0.442 z = −0.769	4.6 ± 0.7	4.5 ± 0.8	p = 0.347 z = −0.940
T-PCS social	2.9 ± 0.9	3.0 ± 0.8	p = 0.676 z = −0.418	4.6 ± 0.6	4.6 ± 0.6	p = 0.795 z = −0.259
T-PCS behavioral	2.8 ± 0.9	2.6 ± 1.0	p = 0.559 z = −0.418	4.6 ± 0.5	4.7 ± 0.8	p = 0.824 z = −0.222
T-PCS Total	8.1 ± 2.2	8.6 ± 2.3	p = 0.170 z = −1.371	14.1 ± 1.7	13.9 ± 1.7	p = 0.625 z = −0.489

Mann Whitney U test.
ADHD: Attention-Deficit/Hyperactivity Disorder.
CTRS-R: Conners' Teacher Rating Scale-Revised.
SNAP-IV TRF Total: SNAP IV Teacher Report Form Total Score.
SNAP-IV TRF IA: SNAP IV Teacher Report Form Inattention Scores.
SNAP-IV TRF H/I: SNAP IV Teacher Report Form Hyperactivity/Impulsivity Scores.
T-PCS: Teacher Perceived Competence scale.

Table 4
Comparison of the teacher- reported scale scores reported two years ago and at present in groups.

	Probable ADHD, ADHD (+) (n = 50)	**Not probable ADHD, ADHD (+) (n = 13)**	**Probable ADHD, ADHD (–) (n = 31)**	**Not Probable ADHD, ADHD (–) (n = 60)**
SNAP-IV IA score- initially*	2.03 ± 0.7	0.28 ± 0.4	1.91 ± 0.6	0.35 ± 0.5
SNAP-IV IA score- 2 years later	1.93 ± 0.6	0.88 ± 0.6	1.25 ± 0.7	0.42 ± 0.3
Statistical Analyses	p = 0.368 z = -0.900	**p = 0.028 z = -2.203**	**p = 0.005 z = -2.787**	p = 0.138 z = -1.481
SNAP-IV H/I score initially*	1.65 ± 0.0	0.45 ± 0.8	1.43 ± 0.9	0.28 ± 0.5
SNAP-IV H/I score two years later	1.50 ± 0.8	0.81 ± 0.6	0.91 ± 0.8	0.40 ± 0.44
Statistical Analyses	p = 0.309 z = -1.017	p = 0.124 z = -1.539	**p = 0.016 z = -2.402**	p = 0.061 z = -1.875
CTRS-R total score initially*	47.4 ± 29.0	8.3 ± 14.2	38.0 ± 22.2	9.5 ± 12.4
CTRS-R total score two years later	38.8 ± 16.9	21.4 ± 13.0	28.6 ± 16.2	15.1 ± 16.6
Statistical Analyses	**p = 0.029 z = -2.178**	**p = 0.033 z = -2.134**	p = 0.153 z = -1.430	**p = 0.005 z = -2.803**
T-PCS total score initially*	8.1 ± 2.1	14.0 ± 2.0	8.4 ± 2.4	13.9 ± 1.7
T-PCS total score two years later	9.5 ± 2.6	12.5 ± 2.4	11.4 ± 3.1	13.5 ± 1.8
Statistical Analyses	**p = 0.002 z = -3,068**	p = 0.089 z = -1.703	**p = 0.003 z = -2.950**	p = 0.189 z = -1.312

Wilcoxon
ADHD: Attention-Deficit/Hyperactivity Disorder; IA: Inattention; H/I: Hyperactivity/Impulsivity; CTRS-R: Conner's teacher rating scale-revised; T-PCS: Teacher–Perceived Competence Scale; SNAP: Swanson, Nolan, and Pelham Version-IV Rating Scale *initially: reported two years ago.

In the group who had no probable ADHD initially and had present ADHD diagnoses, SNAP-IV teacher inattention subscale score and CTRS-R total scores increased significantly in two years ($p < 0.05$). In the group who had probable ADHD initially and were not diagnosed with ADHD at present, SNAP-IV teacher inattention subscale score and SNAP-IV teacher H/I subscale scores decreased, and T-PCS total scores increased significantly in two years ($p < 0.05$). CTRS-R total scores increased significantly in the group who had no probable ADHD initially and were not diagnosed with ADHD at present in two years ($p < 0.05$) (Table 4).

Table 5 represents the comparison of SNAP-IV, Conners' and T-PCS Scores in children diagnosed with ADHD or not. SNAP-IV, CTRS initial scores, SNAP-

Table 5
Comparison of SNAP-IV, Conners' and Perceived Competence Scale Scores in children diagnosed with ADHD or not.

	ADHD (+) N = 63 Mean ± SD(%95 CI)	ADHD (−) N = 91 Mean ± SD(%95 CI)	T test t (df)
SNAP-IV IA TRF/initially	1.69 ± 0.97	0.88 ± 0.97	−5.006 (152)*
SNAP-IV H/I TRF/initially	1.38 ± 1.08	0.70 ± 0.88	−4.265 (152)*
CTRS-R initially	35.88 ± 24.48	19.04 ± 21.15	−4.524 (149)*
T-PCS academic initially	2.97 ± 1.34	3.94 ± 1.19	−7.717 (134)*
T-PCS social initially	3.27 ± 1.12	4.06 ± 1.05	4.433 (152)*
T-PCS behavioral initially	3.07 ± 1.26	4.07 ± 1.14	5.099(152)*
SNAP-IV IA TRF	1.69 ± 0.76	0.71 ± 0.70	−7.717(134)*
SNAP-IV H/I TRF	1.34 ± 0.86	0.56 ± 0.60	−6.111(132)*
SNAP-IV IA PRF	1.58 ± 0.75	0.54 ± 0.49	−10.026(143)*
SNAP-IV H/I PRF	1.45 ± 0.81	0.55 ± 0.51	−8.225(146)*
CTRS-R	42.70 ± 24.48	24.39. ± 18.33	−5.003(135)*
T-PCS academic	2.96 ± 1.21	4.20 ± 1.08	6.236(139)*
T-PCS social	3.69 ± 1.07	4.28 ± 0.95	3.472(139)*
T-PCS behavioral	3.43 ± 0.92	4.42 ± 0.78	6.878(139)*

Student T test *p < 0.001
ADHD: Attention-Deficit/Hyperactivity Disorder; IA: Inattention; H/I: Hyperactivity/Impulsivity; CTRS-R: Conners' Teacher Rating Scale-revised; T-PCS: Teacher–Perceived Competence Scale; SNAP: Swanson, Nolan, and Pelham Version-IV Rating Scale, PRF: Parent Report form, TRF: Teacher Report Form, initially: Reported two years ago.

Table 6
Predictors of persistence of ADHD (Logistic regression analyses).

Independent Variables	ADHD			
	Wald	Exp(B)	%95 CI	Sig
Age	1.180	0.977	0.938–1.019	0.277
Initial SNAP-IV IA TRF scores	4.595	1.071	1.006–1.141	**0.032***
Initial SNAP-IV H/I TRF scores	0.075	1.010	0.943–1.081	0.784
Initial CTRS-R total	0.115	1.004	0.980–1.029	0.673

*p < 0.05.
ADHD: Attention-Deficit/Hyperactivity Disorder, IA: Inattention; H/I: Hyperactivity/Impulsivity; SNAP: Swanson, Nolan, and Pelham Version-IV Rating Scale, TRF: Teacher Report Form., CTRS-R total: Conners' Teacher Report Form Total Score, Initial: reported two years ago.

IV, CTRS and SNAP IV Parent Report Forms' present scores are statistically higher in children diagnosed with ADHD.

T-PCS initial scores and T-PCS teacher reported present scores were statistically lower in children diagnosed with ADHD ($p < 0.001$) (Table 5).

Table 6 represents logistic regression analyses of predictors of diagnostic persistence of ADHD. Independent variables are, age of children, teacher reported initial SNAP-IV inattention scores, hyperactivity/impulsivity scores and teacher reported initial CTRS-R total scores. Initial SNAP-IV teacher inattention scores predicted ADHD two years later with an odds ratio of 1.071 ($p = 0.032$, Wald: 4.595) (Table 6).

4. Discussion

In recent years, the adoption of a dimensional approach during categorical assessment seems to be increasingly advocated in the literature on ADHD. In accordance with this perspective, revisions were made concerning the age of onset and the persistence of ADHD symptoms in DSM-5, so that the diagnosis and persistence of ADHD would be better clarified. This is a two-year cohort study that evaluated children in upper grades of elementary school, who were previously determined to have a risk of ADHD [14].

The results of the study indicated that: 1) There was a significant increase in teacher-reported SNAP-IV inattention scores in children who were previously deemed "no probable ADHD", but currently are diagnosed with ADHD; 2) There was a significant decrease in both teacher reported SNAP-IV inattention and hyperactivity/impulsivity scores, and an increase in T-PCS scores in children who were previously considered as "probable ADHD" , but were not currently diagnosed with ADHD; 3) Previous SNAP-IV inattention scores reported by the teacher in earlier grades, were the most significant predictors of the persistence of ADHD symptoms through upper elementary school grades; 4) Age of entry into primary school did not differ between children

who were diagnosed with ADHD and were not diagnosed with ADHD in upper grades.

Firstly, 17.8% of the sample who had been considered as "no probable ADHD" in the initial evaluation, were diagnosed with ADHD in the following two years, in line with an increase in their teacher-reported ADHD symptoms scores. This finding is consistent with DSM 5 criteria, indicating that the symptoms of ADHD could begin up to 12 years. However, this rate was higher than the prevalence of ADHD in the community sample [4]. This was probably because the children who had more ADHD symptoms were more likely to accept to participate in the study.

High comorbidity rates in ADHD is one of the most important predictors of both functional impairment and persistence of symptoms. Recent studies suggest that the prevalence rates of psychiatric comorbidity vary from 52.0% to 56.3%, with ODD, tic disorders, anxiety disorders, and learning disorders being the most common comorbidities; as also consistent with the findings of our study [7]. Previous research reported inconsistent results regarding the predictive significance of comorbid psychiatric disorders on the persistence of ADHD [8,24–26]. In our study, the predictive value of comorbid disorders could not be assessed due to the relatively small sample size.

The relation between the different presentations of ADHD and the persistence pattern is a relatively new era to investigate. It is known that hyperactivity/impulsivity symptoms are predominantly seen in childhood, whereas inattention symptoms are more prominent in adulthood [27]. Moreover, Kessler et al. (2005) [26] reported that children with mild inattention accompanying at least some hyperactivity symptoms, are more likely to have their ADHD persist into adulthood.

In our study, the participants who were assessed as probable ADHD initially but were not currently diagnosed were presented with decreased SNAP-IV teacher inattention subscale score and SNAP-IV teacher H/I subscale scores, whereas their T-PCS total scores increased significantly.

Moreoever, children with persistent ADHD received higher hyperactivity and inattention scores and lower competency scores during the first evaluation compared to the non-persistent group, although these differences were not statistically significant; which may partly be accounted for by the small size of the study sample. However, these results are consistent with previous studies. The symptoms of ADHD gradually decrease over time [28,29] and these findings might support the abnormal neurodevelopmental theory of ADHD [30].

In the literature, the familiality of ADHD, psychosocial adversity, ADHD symptom severity, and psychiatric comorbidity were found to be the predictors of persistence [24–26].

We examined the association between the ADHD diagnosis and the age of children, inattention and hyperactivity/impulsivity symptoms reported in earlier grades. Our results revealed that the initial SNAP-IV teacher-reported inattention score, was the only predictor of the persistence of ADHD symptoms. This result is consistent with previous research indicating that the inattention scores determine the continuity of ADHD, given the hyperactivity symptoms subside with maturation [26,27].

Based on the findings of the previous research, we postulated that any relative age effect would be strongest for younger ages and that a relative age effect would exist in the earlier but not in the later study period [15,16,31,32].

Consistent with the literature, in our study, the age of entry into school did not differ between children who were and were not currently diagnosed with ADHD. However, mean school entry age of 154 children who were participated in this study was statistically smaller than children who were not participated in this study but analyzed in previous study and the age of entry to school was younger in the persisting ADHD group, although the relation was close but not statistically significant. Thus, the effect of relative age which is expected to diminish in later years, was still partly significant in our sample.

Results from several studies suggest that the symptom severity is one of the strongest predictors in the persistence of ADHD [20,27]. This relatively greater significance of attention deficiency in childhood compared to hyperactivity, should also be considered in clinical approach; given that the hyperactivity largely remains a greater focus of concern in the treatment of younger children with ADHD. Taken together, it might be useful to focus on inattention symptoms during early school ages in order to prevent the persistence of the symptoms and further functional impairment.

5. Strengths & limitations

This is one of the few cohort studies conducted in the relevant field in Turkey. One important limitation of the study is the relatively small sample size, which may have resulted from the problems in obtaining permission from some schools and the few number of students (families) who volunteered to participate in the research. Moreover, the results may partly be biased given that the families who agreed to participate in the study are also most likely to be the ones with higher levels of ADHD symptoms and impairment. Our results could be affected by this bias. Finally, only the the teachers' symptom ratings were used from the previous evaluation; hence, parents' ratings and semi-structured interviews could not be compared.

6. Ethical standards

The manuscript does not contain clinical studies or patient data.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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