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Original article

Gender differences in occurrence of behavioral and emotional problems at the lower grades of elementary school: Association with developmental and behavioral characteristics at 5 years

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Abstract

Aim: We examined whether developmental status and behavioral problems at age five were related to the occurrence of behavioral and emotional problems in the lower grades of elementary school among non-clinical children who did not receive specialized support for developmental problems in early childhood.

Methods: The participants were 367 (non-clinical: 325) second- and third-grade elementary school children. The mean age at follow-up was 7.63 (SD = 0.62). Parents completed a questionnaire about their children's developmental status and behavioral problems during a community health check-up for 5-year-olds. Behavioral and emotional problems at school age were assessed using the Strengths and Difficulties Questionnaire (SDQ). The association between developmental and behavioral characteristics at age five and each of the SDQ subscales at school age was analyzed with logistic regression.

Results: Hyperactivity/inattention, conduct problems, and emotional problems at school age were associated with developmental and behavioral factors in 5-year-olds. The problem of hyperactivity/inattention at school age was associated with hyperactivity/inattention in both genders, and significant gender differences were identified. The relationship with hyperactivity at the age of five was significant for boys, whereas the relationship with inattention was only significant for girls. Emotional problems were significantly associated with social behaviors and developmental status at five years of age only in girls.

Conclusions: It is necessary for clinicians and teachers to consider the relation of developmental and behavioral characteristics to the background of behavioral and emotional problems at school age and to be aware of gender differences.

Keywords: Mental health; Gender differences; Strengths and Difficulties Questionnaire (SDQ); Preschool children; Developmental disorders

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1. Introduction

A meta-analysis of 41 studies estimated a worldwide prevalence of any mental disorder of 13.4%, any anxiety disorder at 6.5%, any depressive disorder at 2.6%, and major depressive disorder at 1.3%, any attention-defi cit/hyperactivity disorder (ADHD) at 3.4%, any disruptive disorder at 5.7%, any oppositional defiant disorder at 3.6%, and any conduct disorder at 2.1% [1]. There are reports on the relation between developmental disorders and psychiatric comorbidity as follows. A study by Simonoff and colleagues [2] on the rates and type of psychiatric comorbidity associated with autism spectrum disorders (ASD) among children aged 10–14 years old showed that 70.8% of children had at least one current psychiatric disorder.

Additionally, in discussing the relationship between developmental disorders and psychiatric comorbidities, gender differences should be considered. A recent study investigated the lifetime gender ratios of administrative prevalence and incidence in ADHD [3]. The male-to-female ratio of diagnosed prevalence of child/adolescent ADHD (under the age of 20) ranged from 3.9 to 4.3 per year and in adults (aged 20–65 years) ranged from 0.35 to 0.98 per year. In a population-based study of the prevalence of mental illness in adults diagnosed with ADHD, gender differences in the prevalence of comorbidities associated with ADHD were identified with more in women having anxiety, depression, bipolar disorder and personality disorders than in men having any of these [4]. Considering these findings, with respect to ADHD, it is presumed that women are less likely to develop behavioral problems, such as hyperactivity and impulsivity in childhood, but are at risk of experiencing psychiatric problems in adulthood. Regarding ASD, one study reported that adolescent girls with ASD without intellectual disabilities had higher levels of internalizing symptoms than did boys with ASD and typically developing girls [5]. These findings show that paying attention to the gender-based etiology with respect to the occurrence of comorbidities for developmental disorders is in fact necessary.

In Japan, a community health check-up is carried out in all municipalities, and developmental problems can be screened at an early stage. It is common for this screening to be conducted at the key ages of development (e.g., 3–4 months, 10–11 months, 18 months, 3 years), and some municipalities have conducted a health check-up at age 5 since around 2000. In general, the discovery of children who do not have notable intellectual developmental delays but have developmental problems tends to be delayed. Research has reported that maternal support and early intervention were related to a high quality of life for children with high-functioning autism spectrum disorder (HFASD) [6].

In the current study, we aimed to clarify how developmental and behavioral characteristics in early childhood—especially focusing on non-clinical children who did not receive specialized support in early childhood and gender differences—affect mental health in the lower grades of elementary school. The findings of our study can be helpful as the basis for the early detection of mental health problems and thereby improve children's mental health in school age.

2. Methods

2.1. Participants and procedure

We conducted a study to evaluate the behavioral and emotional problems of children in the lower grades of elementary school in 2011. The participants of this study were 1479 second- and third-grade students excluding students enrolled in special education class at a public elementary school in a municipality in Kyoto prefecture of Japan, where community health check-ups targeting 5-year-olds (5-year developmental screening) were performed. The 5-year developmental screening started in 2005 in this municipality and has been implemented with some children of all age groups due to budgetary reasons for five years. The screening was conducted by children in the kindergarten randomly selected by administrative staff. Since the participants of this study were checked as a part of the 5-year developmental screening program with an implementation rate of 50%, half of the children were not checked. We received consent from parents or caregivers whose children had undergone the 5-year developmental screening to use the data that had been kept in the administrative office.

At the 5-year developmental screening, developmental problems were screened for, including communication ability, social ability, hyperactivity, inattention, behavioral control, and motor function. The 5-year developmental screening consisted of three elements: a questionnaire completed by the parents and teachers of the kindergarteners, observations of children's social behavior by experts (e.g., psychologists, physicians, public health nurses, and school teachers), and a doctor's neurological examination. The team of experts evaluates the necessity of support for children based on the results of the 5-year developmental screening.

We received informed consent from 787 parents of the participants, and 380 of these children had data from the 5-year developmental screening. After excluding 13 participants due to missing data, data from 367 participants were analyzed. We divided these 367 children (aged 7–9 years, mean = 7.63, $SD = 0.62$ years) into two groups: 42 were assigned to the clinical group, including 13 children (3.5%) who had already received specialized support before the 5-year developmental

screening, and 29 children (7.9%) who were found to have developmental problems during the 5-year developmental screening and began receiving specialized support. The remaining 325 (88.6%) were classified as being in the non-clinical group (Fig. 1).

2.2. Instruments

2.2.1. Status of development at the 5-year developmental screening (5-year status of development)

Parents had completed a questionnaire about the status of their children's development at the 5-year developmental screening. The responses to the questionnaire were analyzed to infer the status of development at 5-years. The questionnaire consisted of 12 questions that were cited from a previous study (Table S1) [7]. The developmental question contents included motor function, social skill, and cognitive and communication functioning.

In order to set the cutoff value to estimate whether development was delayed or not, the distribution of scores for the non-clinical group was examined. We identified the number of items the participant attained among the 12 questions about the children's developmental status (Table S2). The higher the number, the better the level of development. The highest score was 12, and the lowest score was 4. The percentage of those with an IQ in the range of 70–85, which corresponds to

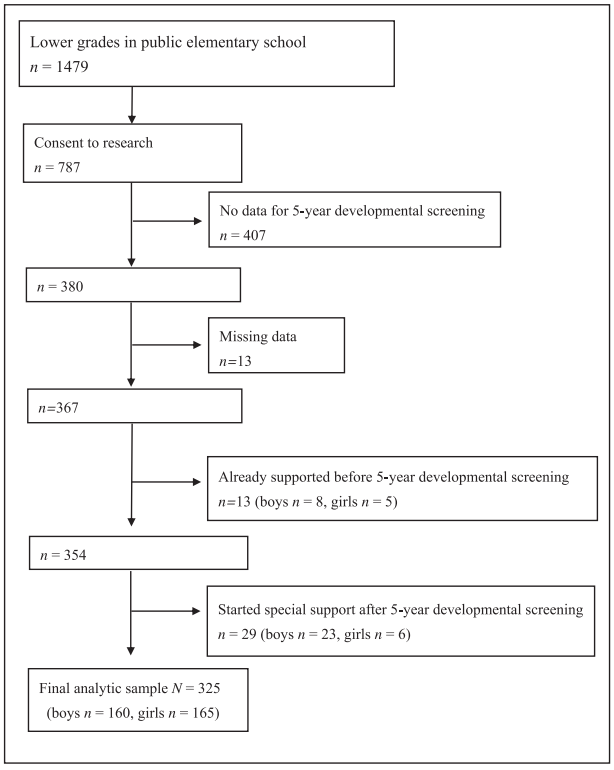


Fig. 1. Flow diagram of the recruitment and inclusion of study participants.

−1 to −2 standard deviations from the mean, was shown to be about 13.6% for standardized batteries that measure IQ [8]. In this study, we categorized participants in this range as being in the "delayed development" group. The proportion of children with scores of 8 or less was 11.4% in our study, and we set the cut-off value for delayed development to be a score of 8 or less.

2.2.2. Behavioral problems at 5-year developmental screening (5-year behavioral problems)

Parents had also completed a questionnaire form concerning behavioral problems at 5y-developmental screening which consists of 17 items extracted from the Attention-Deficit/Hyperactivity Disorder Rating Scale-IV (ADHD-RS) [9], Autism Spectrum Screening Questionnaire (ASSQ) [10], and the criteria for diagnosing oppositional defiant disorder (ODD) based on the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR) [11], which was the latest version when the 5-year developmental screening began in 2005. Although it seems reasonable to include all the questions from the standardized questionnaire, only 17 items were extracted because it is difficult to set large number of questions due to the nature of a community health check-up. The phrasing of the question was slightly revised to make it is easier for parents to understand [12]. The parents rated each item on a 3-point Likert scale with possible responses including *not at all* = 0, *sometimes* = 1, and *often* = 2.

To confirm the factorial structure of the 17 items, we used administrative data obtained from 1228 people, including the participants of this research, who had undergone 5-year developmental screening between 2007 and 2009 years. In order to confirm that the data were suitable for factor analysis, the following scores were calculated. The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.929, and the Bartlett's test of sphericity was χ^2 (16) = 1280.5, $p < 0.0001$. From these results, we considered that the data were suitable to undertake a factor analysis. In an exploratory factor analysis, the maximum likelihood method was used. After Promax rotation of the three extracted factors with the eigenvalues above 1, it was divided into the following factors: factor 1 is a problem of hyperactivity and inattention, factor 2 is a problem of social and communication skills, and factor 3 is a problem of behavioral control (Table S3). The total score for each factor was used for analysis.

2.2.3. Emotional and behavioral problems at the lower grade of elementary school

Emotional and behavioral problems at school age were assessed using the Strengths and Difficulties Questionnaire (SDQ) [13], which was rated by the parents or caregivers when their children were students in lower

grades of elementary school. The SDQ is a brief screening instrument used to detect child and adolescent psychiatric problems and is widely used in clinical and research settings [14,15].

This questionnaire comprises 25 items divided into the following five subscales with five items: Hyperactivity/Inattention, Conduct Problems, Emotional Symptoms, Peer Problems, and Prosocial Behavior. Each item is scored on a three-point Likert scale: *not true* = 0, *somewhat true* = 1, and *certainly true* = 2. The total score of each subscale ranged from 0 to 10. High score indicates negative aspect regarding four of the five subscales (Hyperactivity/Inattention, Conduct Problems, Emotional Symptoms, Peer Problems), whereas high score indicates a positive aspect regarding subscale of Prosocial behavior. The cutoff value is set to three ranges. Approximately 10% of children who have difficulties are in the clinical range, the following 10% are in the borderline range, and the remaining 80% are in the normal range. Standard values of Japanese children are shown in previous studies [16,17]. We use the cutoff values cited by Moriwaki by gender (Table S4) [17]. In this study, if there is more than one subscale of SDQ which fell into the applicable "clinical range," we set the school age emotional and behavioral problems as being screen-positive.

2.3. Statistical analysis

To compare the status of development and behavioral problems at 5-years-old between the clinical group and non-clinical group, the average score of 5-year status of development and 5-year behavioral problems for each of the three factors (5-year hyperactivity/inattention, 5-year behavioral control, and 5-year social behaviors) were compared by Student's *t*-test. The sex differences in the clinical range of SDQ subscales were analyzed using a Chi-square test. To investigate developmental and behavioral factors at five years of age affecting emotional and behavioral problems at school age, the association between developmental and behavioral characteristics at 5-years-old and each of the SDQ subscales at school age was analyzed by logistic regression model. The median of total score of the 5-year behavioral problems (5-year hyperactivity/inattention and 5-year behavioral control, median = 2; 5-year social behaviors, median = 1) was used as an indicator to categorize it into two groups (e.g., 2 or less, 3 or more). The associations were reported as estimated odds ratios (OR) according to gender. Furthermore, as for remarkable outcomes, similar consideration was made for each question of 5-year behavioral problems. The analyses of 5-year behavioral problems were adjusted for the 5-year developmental status. *P*-values < 0.05 were considered statistically significant. The software package JMP Pro ver.12 was used for all statistical analyses.

2.4. Ethical considerations

All study participants provided informed consent, and the study design was approved by the ethics committee of the Kyoto Prefectural University of Medicine.

3. Results

3.1. Comparison of 5-year developmental status and 5-year behavioral problems between the clinical and non-clinical groups

We organized our participants into a clinical group (n = 42 children) and a non-clinical group (n = 325 children). The clinical group had three times as many boys (n = 31) as girls (n = 11), whereas the non-clinical group featured an almost equal number of boys (n = 160) and girls (n = 165). The average score of 5-year status of development and that of 5-year behavioral problems were compared between the clinical and non-clinical groups, including gender differences (Table 1). In boys, the average score of 5-year status of development was significantly lower in the clinical group ($p < 0.001$), and that of behavioral problems was significantly higher (5-year hyperactivity/inattention, $p < 0.001$; 5-year social behaviors, $p < 0.001$; 5-year behavioral control, $p = 0.001$). On the other hand, the significant differences among girls were only evident for 5-year hyperactivity/inattention ($p = 0.045$).

3.2. Developmental and behavioral factors at 5 years affecting emotional and behavioral problems at school age

Table 2 shows the number and percentage of children in the clinical range of SDQ subscales in the non-clinical group by gender. Although there were no gender differences for any subscale, emotional problems and peer problems tended to be more common among girls.

Regarding the associations between the developmental and behavioral factors at five years of age and emotional and behavioral problems at school age, the items in which we recognized the most significant differences are shown in Fig. 2 (All results are shown in Table S5). Conduct problems at school age was significantly associated with 5-year behavioral control in both gender (boys: OR = 4.3, 95% confidence interval [CI] [1.5–14.0]; girls: OR = 4.0, 95% CI [1.5–11.4]) and was associated with 5-year hyperactivity/inattention only in boys (OR = 6.1, 95%CI [2.1–2.6]). Hyperactivity/inattention at school age was associated with 5-year hyperactivity/inattention in both gender (boys: OR = 5.6, 95% CI [1.4–37.9]; girls: OR = 5.8, 95% CI [1.7–22.6]).

Table 1
Mean scores for the status of development and behavioral problems at 5-year developmental screening.

		Clinical Group Mean ± *SD*	Non-Clinical Group Mean ± *SD*	*p* value*
		$n = 42$	$n = 325$	
Total	5y status of development (0–12)	8.4 ± 2.4	10.3 ± 1.5	<0.001
	5y hyperactivity/inattention (0–12)	5.0 ± 3.1	2.3 ± 2.3	<0.001
	5y behavioral control (0–8)	3.5 ± 1.9	2.2 ± 1.8	<0.001
	5y social behaviors (0–14)	3.9 ± 2.6	1.6 ± 1.9	<0.001
		$n = 31$	$n = 160$	
Boys	5y status of development (0–12)	8.3 ± 2.4	10.1 ± 1.5	<0.001
	5y hyperactivity/inattention (0–12)	5.3 ± 3.2	2.7 ± 2.5	<0.001
	5y behavioral control (0–8)	3.8 ± 1.9	2.5 ± 1.8	0.001
	5y social behaviors (0–14)	4.3 ± 2.6	1.9 ± 2.0	<0.001
		$n = 11$	$n = 165$	
Girls	5y status of development (0–12)	8.8 ± 2.7	10.5 ± 1.4	0.063
	5y hyperactivity/inattention (0–12)	4.0 ± 3.0	1.9 ± 2.0	0.045
	5y behavioral control (0–8)	2.6 ± 1.7	2.0 ± 1.7	0.28
	5y social behaviors (0–14)	3.0 ± 2.4	1.4 ± 1.7	0.053

* *p*-value was calculated by Student's *t*-test.

Table 2
Number of children and the percentage of children in the clinical range of SDQ subscales from the non-clinical group by gender.

SDQ subscales	Boys ($n = 160$)		Girls ($n = 165$)		*p* value
	n	%	*n*	%	
Hyperactivity/inattention	11	6.9%	13	7.9%	0.73
Conduct problems	21	13.1%	21	12.7%	0.91
Emotional symptoms	9	5.6%	17	10.3%	0.12
Peer problems	9	5.6%	16	9.7%	0.17
Prosocial behavior	11	6.9%	7	4.2%	0.30

Note. *p*-values were calculated using a Chi-square test.

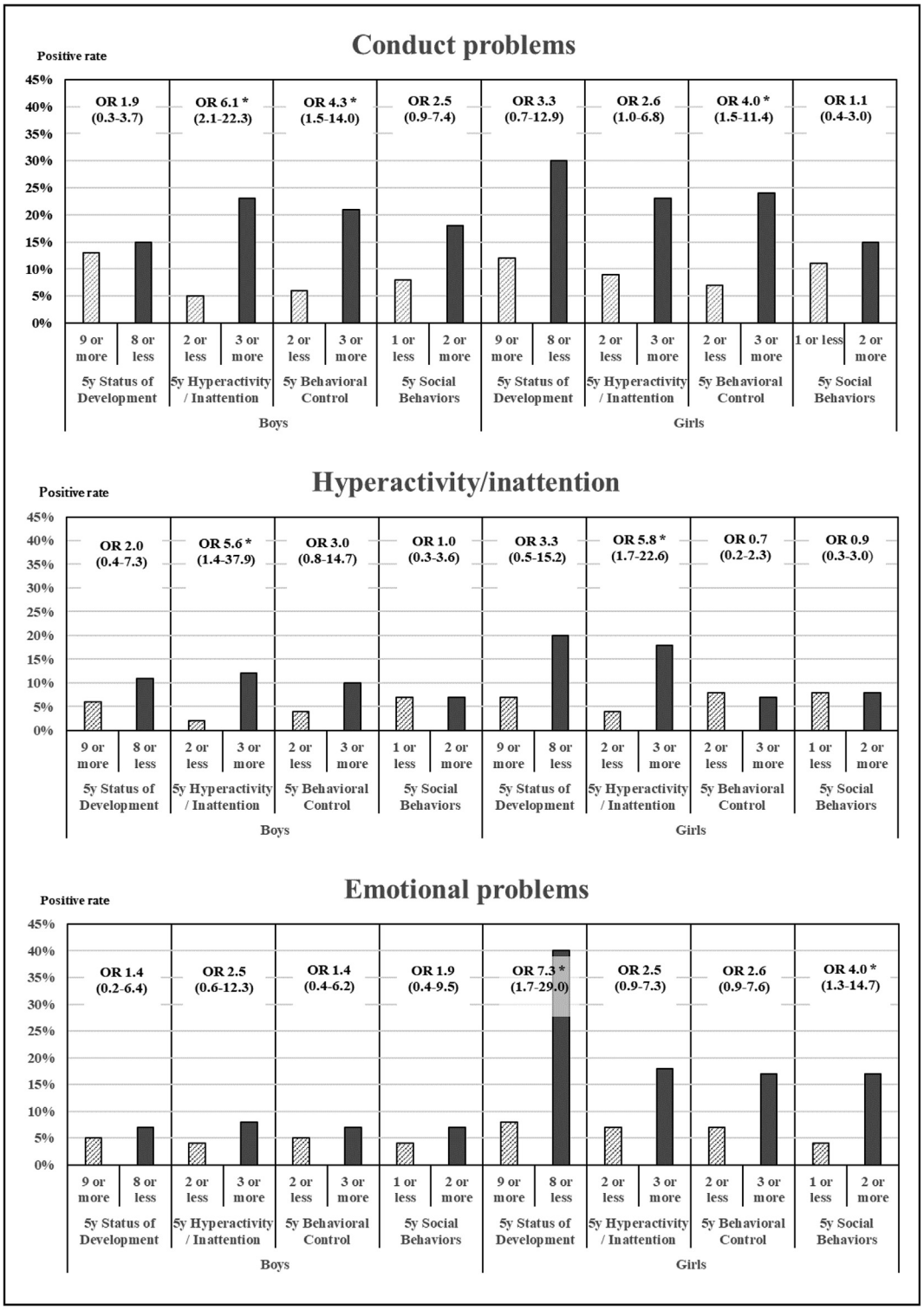
Emotional problems at school age was significantly associated with 5-year social behaviors and 5-year status of development only in girls; 5-year social behaviors (OR = 4.0, 95% CI [1.3–14.7]), 5-year status of development (OR = 7.3, 95% CI [1.7–29.0]).

Table 3 shows the relationships of each question related to 5-year hyperactivity/inattention with hyperactivity/inattention at school age separated by gender. The median (The question, "is often easily distracted by extraneous stimuli," median = 1; other questions, median = 0) of each question was used as an indicator for group categorization (e.g., 1 or 2 versus 0). In two of the six items concerning inattention ("is often easily distracted by extraneous stimuli," "often has difficulty sustaining attention in tasks or play activities"), ORs were significantly high only for girls (OR = 12.3, 95% CI [3.3–46.6]; OR = 4.6, 95% CI [1.4–16.9], respectively). Regarding questions about hyperactivity, three out of four items showed a significant difference for both genders ("often has difficulty awaiting turn," only for girls; "often leaves seat in classroom or in other situations in which remaining seated is expected," and "is often 'on the go' or often acts as if 'driven by a motor'," in both boys and girls; "often fidgets with hands or feet or squirms in seat," only in boys).

Table 4 shows the relationships of each question related to 5-year social behaviors with emotional problems at school age separated by gender. The median for each question was used as an indicator for group categorization (e.g., 1 or 2 versus 0). In one of the seven items ("Lacks empathy"), ORs were significantly high for both genders (boys; OR = 3.8, 95% CI [1.1–13.8], girls OR = 7.1, 95% CI [2.4–22.1]). In three items, ORs were significantly high only for girls ("Wishes to be sociable but fails to make relationships with peers," "Has special routines: insists on no change," and "Is poor at games: has no idea of cooperating in a team, scores 'own goals'"). In one item, ORs were significantly high only for boys ("Often does not follow through on instructions").

4. Discussion

We revealed the epidemiological and developmental characteristics especially focused on non-clinical children who did not begin specialized support during early



Note. OR, odds ratio; text inside parentheses indicates 95% confidence interval; *p < 0.05

Fig. 2. Odds ratios comparing 5-year developmental and behavioral characteristics with emotional and behavioral problems at school age by gender.

childhood because of developmental problems. We acknowledged the influence of gender differences in the occurrence of behavioral and emotional problems at school age as a characteristic finding.

Looking at the frequency of gender in the clinical group, boys were three times more likely than girls to be determined to need specialized support before entering elementary school; this finding is consistent with the

Table 3
Odds ratios comparing each question about 5y-hyperactivity/inattention with hyperactivity/inattention at school age by gender.

Each question about 5y Hyperactivity/inattention		Hyperactivity/inattention at School Age					
		Boys			Girls		
		Positive Rate	OR	95% CI	Positive Rate	OR	95% CI
"Is often easily distracted by extraneous stimuli."	0 or 1	6%	Ref		5%	Ref	
	2	13%	2.1	0.3–9.1	40%	12.3*	3.3–46.6
"Often has difficulty sustaining attention in tasks or play activities."	0	6%	Ref		4%	Ref	
	1 or 2	9%	1.4	0.4–5.1	18%	4.6*	1.4–16.9
"Often has difficulty awaiting turn."	0	6%	Ref		5%	Ref	
	1 or 2	11%	1.9	0.5–6.6	19%	3.8*	1.1–12.7
"Often leaves seat in classroom or in other situations in which remaining seated is expected."	0	3%	Ref		4%	Ref	
	1 or 2	11%	3.7*	1.0–17.3	16%	3.9*	1.2–13.6
"Is often 'on the go' or often acts as if 'driven by a motor'."	0	1%	Ref		5%	Ref	
	1 or 2	14%	13.1*	2.4–244.4	16%	3.3*	1.0–11.0
"Often fidgets with hands or feet or squirms in seat."	0	4%	Ref		7%	Ref	
	1 or 2	16%	4.3*	1.2–15.9	14%	1.9	0.4–7.1

Note. Adjusted for score of 5-year status of development; Ref, reference; $^{*}p < 0.05$.

Table 4
Odds ratios comparing each question about 5y-social behaviors with emotional symptoms at school age by gender.

Each question about 5y social behaviors		Emotional symptoms at School Age					
		Boys			Girls		
		Positive Rate	OR	95% CI	Positive Rate	OR	95% CI
Lacks empathy	0	3%	Ref		6%	Ref	
	1 or 2	14%	3.8*	1.1–13.8	30%	7.1*	2.4–22.1
Wishes to be sociable but fails to make relationships with peers	0	5%	Ref		7%	Ref	
	1 or 2	7%	1.3	0.2–5.4	35%	6.4*	2.1–19.8
Has special routines: insists on no change	0	5%	Ref		7%	Ref	
	1 or 2	13%	3	0.7–10.0	38%	5.1*	1.8–15.0
Is poor at games: has no idea of cooperating in a team, scores "own goals"	0	5%	Ref		7%	Ref	
	1 or 2	8%	2.3	0.7–7.1	26%	3.3*	1.1–9.0
Often does not follow through on instructions	0	4%	Ref		8%	Ref	
	1 or 2	11%	3.8*	1.3–11.8	19%	2.1	0.8–5.7
Uses language freely but fails to make adjustment to fit social contexts or the needs of different listeners	0	6%	Ref		10%	Ref	
	1 or 2	5%	1.7	0.3–6.2	16%	1.7	0.4–5.9
Shows idiosyncratic attachment to objects	0	5%	Ref		5%	Ref	
	1 or 2	6%	2	0.7–6.0	20%	2.2	1.0–5.1

Note. Adjusted for score of 5-year status of development; Ref, reference; $^{*}p < 0.05$.

previous reports about the epidemiology of developmental disorders including ASD and ADHD [18,19]. Based on the comparison between the clinical group and the non-clinical group regarding the status of development and behavioral problems at 5 years of age, boys in the clinical group tended to have more notable developmental and behavioral challenges, whereas there were no significant differences except for the behavioral problem of 5-year hyperactivity/inattention in girls. These suggest that the degree of manifestation of developmental challenges in girls is weaker than in boys in early childhood.

The present study showed that the problem of hyperactivity/inattention in school-aged children was associated with hyperactivity/inattention at age 5. The distinctive point was that the relation with hyperactivity at 5-years-old was more pronounced in boys, whereas with inattention was seen only in girls. Furthermore, the problem of hyperactivity/inattention and behavioral control at age 5 was associated with the conduct problems at school age for boys. Sayal and colleagues [20] described a systematic review of the community and administrative prevalence of ADHD in children and adolescents and indicated the community prevalence globally to be between 2% and 7%, with an average around 5%. Moreover, at least 5% of children have substantial difficulties with subthreshold overactivity, inattention, and impulsivity that fail to meet the full diagnostic criteria for ADHD, particularly in girls. They pointed out that the timely recognition and treatment of children with ADHD-type difficulties provides an opportunity to improve long-term outcomes [20].

In a review of ADHD in women and girls, Quinn described their distinct symptom presentation, with internalizing symptom (e.g., inattentiveness) being more prominent than externalizing symptom (e.g., impulsiveness and hyperactivity) [21]. Our results supported the existence of gender differences in the types of behavioral problems in early childhood which contribute to hyperactivity/inattention problems at school age. Researchers should pay attention to the possibility that problems with inattention could be manifested as a problem requiring intervention especially for girls after entering elementary school. For boys, it is necessary to consider that conduct problems are an externalizing problem at school age that were related to the problem of hyperactivity/inattention and behavioral control at 5-years-old.

We also recognized gender differences between the occurrence of emotional problems and the developmental and behavioral characteristics at 5 years of age. Emotional problems were associated with both social problems and developmental status in early childhood only for girls. A study by Saito and colleagues examined whether the autistic traits of Japanese children at age 5 were related to emotional/behavioral outcomes on the parent-rated SDQ at age 7 years and reported that autistic traits continued to predict later emotional symptoms and peer problems even after controlling for baseline emotional/behavioral scores [22]. The authors concluded that in addition to clinically meaningful ASD, it is also important to focus on subthreshold autistic traits in preschool children for better subsequent emotional/behavioral outcomes [22]. Including our results, it can be inferred that social development may be related to the occurrence of emotional problems at school age. Furthermore, our results suggest that its relevance is particularly noticeable for girls.

Bargiela and colleagues [23] investigated the phenotype for autism in girls and women and its impact on the under-recognition of autism spectrum conditions (ASC) in girls and women. The authors concluded that timely identification could mitigate risks and promote the well-being of girls and women on the autism spectrum. Our finding, which targeted the non-clinical group, suggested that even if not at a level that needed special support, characteristics of social development in early childhood may be associated with later emotional problems. Thus, it is important for clinicians and teachers to be aware of the characteristics of social development to assist with the development of early interventions.

4.1. Strengths and limitations

Our research can be considered unique in that we targeted a non-clinical group excluding children with notable developmental characteristics. We also noted the trajectory of girls' development.

This study has a few limitations. First, we could not use the standardized battery for developmental and behavioral problems assessment as mentioned in the method. To solve this problem, an exploratory factor analysis was carried out with 1228 children who underwent the 5-year developmental screening in the past. We believe that it is possible to guarantee reliability. Further, as the participants of this study were children who had been randomly selected from a municipality, the data of the 5-year developmental screening which were used in our study might be less biased. Second, it was necessary to consider not only the viewpoint of development but also the influence of environmental factors.

5. Conclusions

We examined the developmental and behavioral factors of early childhood as the background for the development of behavioral and emotional problems at school age among non-clinical children who did not receive specialized support for developmental problems in early childhood. As a result, we revealed that hyperactivity/inattention, conduct problems, and emotional problems at school age were associated with developmental and behavioral factors at 5-years-old and the existence of gender differences.

For girls, although the developmental deficits are less likely to be remarkable when compared with boys in early childhood, we suggest that they have a risk of developing inattentive and emotional problems at school age. In boys, the problem of hyperactivity/inattention and behavioral control in early childhood may be associated with occurrence of externalizing problems, such as conduct problems.

We conclude that it is necessary for clinicians and teachers to consider the relation of developmental characteristics to the background of psychiatric problems at school age and consider that gender differences exist. Considering the possibility of psychiatric problems resulting from the interaction of developmental problems and environmental factors, the construction and implementation of a screening system for early intervention is required for school-aged children.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.braindev.2019.06.001.

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