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Emotional and Social Impairments in Primary School Students With Different Attention-Deficit/Hyperactivity Disorder Presentations: A Latent Profile Analysis

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Cultural factors including high academic pressure, collectivist values, and distinct family dynamics among Chinese/Asian cultures may influence the expression and perception of attention-deficit/hyperactivity disorder (ADHD) symptoms. It is thus crucial to explore potential cultural variations in ADHD symptom presentations and intervention needs beyond a Western cultural context. Latent profile analysis, a statistical method that identifies unobserved subgroups within a population, is employed in this study to categorize subtypes among Hong Kong primary school students diagnosed with ADHD ($n = 366$, $M_{age} = 8.62$ years, $SD = 1.20$; 80.1% boys). A three-profile model was selected as the final model: ADHD-C (combined type; 44.0%), ADHD-HI (hyperactive–impulsive type; 36.1%), and ADHD-IA (inattentive type; 19.9%). Each individual was assigned to their highest-probability profile based on ADHD symptoms, compared against a non-ADHD group ($n = 46$, $M_{age} = 8.37$ years, $SD = 1.08$; 78.3% boys) on emotional and social functioning. The ADHD-C group exhibited the most severe ADHD symptoms, emotional dysregulation, and social impairments. Differential profiles and intervention needs were indicated for ADHD-HI, ADHD-IA, and ADHD-C in emotion regulation and social functioning. Students with ADHD-HI may particularly benefit from interventions to address emotional lability and negativity, develop appropriate assertiveness, and reduce overbearing behaviors. Students with ADHD-IA and ADHD-C revealed a heightened need for comprehensive support in broad social skills (including communication, cooperation, responsibility, empathy, engagement, and self-control) and emotion regulation. The findings highlight the importance of careful consideration and adaptation of interventions that address diverse emotional and social intervention needs of children with different ADHD presentations.

Educational Impact and Implications Statement

This study provides critical insights into the varying presentations of attention-deficit/hyperactivity disorder (ADHD) among primary school students in Hong Kong, revealing the impact of ADHD on children's social and emotional well-being. The identification of distinct profiles of social and emotional functioning in different ADHD groups highlights the necessity for personalized intervention strategies. By recognizing the unique challenges faced by each ADHD presentation, educators and clinicians can develop targeted support systems that enhance the social and emotional functioning of affected students. These findings are crucial for improving educational outcomes and fostering a more inclusive learning environment for children with ADHD.

Keywords: attention-deficit/hyperactivity disorder, latent profile analysis, social skills, emotion regulation

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Attention-deficit/hyperactivity disorder (ADHD) is a prevalent neurodevelopmental disorder, affecting 5%–10% of school-aged children worldwide (Polanczyk et al., 2014; Scahill & Schwab-Stone, 2000; Willcutt, 2012). It is characterized by persistent core symptoms of inattention, hyperactivity, and impulsivity (American Psychiatric Association [APA], 2013), which significantly impair various domains of functioning, including social, cognitive, academic, and behavioral aspects (Loe & Feldman, 2007; Mash & Barkley, 2003). Despite the availability of evidence-based treatments that reduce symptom severity and improve academic and behavioral functioning, relatively less research has been conducted to explore the training needs related to social functioning and emotional regulation for individuals with different presentations of ADHD symptoms (Evans et al., 2014).

Subtypes/Presentations of ADHD

The symptom presentation and severity of ADHD vary greatly among individuals, leading to phenotypic heterogeneity and classification controversies (Milich et al., 2001; Nigg et al., 2010). In the *Diagnostic and Statistical Manual of Mental Disorders-4* (*DSM,* APA, 1994), ADHD was classified into three subtypes based on the predominant symptom domain: predominantly inattentive type (ADHD-IA), predominantly hyperactive–impulsive type (ADHD-HI), and combined type (ADHD-C). In the *DSM-5* (APA, 2013) and *DSM-5*-text revision (*DSM-5*-TR, APA, 2022), the term "subtype" was replaced by "presentation" to acknowledge the developmental perspective and phenotypic variability of ADHD. The classification of ADHD into subtypes or presentations has been the subject of ongoing discussion, with different models proposed based on empirical findings. Some studies support the three-subtype model (e.g., Althoff et al., 2006; Hudziak et al., 1998; Volk et al., 2005), while others suggest a two-subtype/presentation model, distinguishing between the inattentive and combined presentations (e.g., de Nijs et al., 2007; Lahey et al., 1988; Park et al., 2020). Moreover, longitudinal studies have shown that ADHD subtypes are not stable over time (Nigg et al., 2010) and may change depending on the individual's developmental stage and environmental factors (Lahey et al., 2005; Todd et al., 2008; Weyandt et al., 2013).

Besides presentation classification, the proportion of different ADHD presentations also varies across studies and populations. Previous estimates suggest that the combined presentation is the most common, accounting for 50%–75% of cases, followed by the inattentive presentation (20%–30% of cases) and the hyperactive–impulsive presentation (around 15% of cases; Kessler et al., 2006; Nijmeijer et al., 2008). Other studies have reported variations in prevalence based on gender, race/ethnicity, age, and geographic location. For example, a study in Spain found that 53.6% of children with ADHD belonged to the combined presentation ($N = 6{,}921$, $\text{range}_{\text{age}} = 3$–5 and 10–12 years; Canals Sans et al., 2021), which is slightly lower than the proportion observed in other European countries (Setyawan et al., 2018). In addition, research has shown that the ADHD-C and ADHD-HI presentations are more common among preschoolers (Molina et al., 2009), while the occurrence of ADHD-IA presentation increases with age and becomes more frequent in school-age girls (Molina et al., 2009; Umar et al., 2018).

The *DSM-5*-TR emphasizes the importance of considering cultural background in the diagnosis of ADHD, acknowledging that cultural factors can significantly affect the expression and recognition of symptoms (APA, 2022). While most studies on ADHD presentations have been conducted in Western countries, research from non-Western regions remains limited (Park et al., 2020). Two studies conducted in China among individuals aged 7–15 reported a three-presentation model (Huang et al., 2017; Jin et al., 2014), similar to findings from Western studies. However, the observed proportions of different ADHD presentations varied notably from those in Western populations. Specifically, the ADHD-IA subtype comprised the largest proportion of cases, accounting for 50%–70%, followed by the ADHD-C subtype (20%–40%), and subsequently the ADHD-HI subtype (8%–9%; Huang et al., 2017; Jin et al., 2014).

The discrepancies in findings between cultures may be attributed to regional variations in informants' decision thresholds when rating ADHD symptoms (W. W. Y. Chan et al., 2022). For example, Chinese parents and teachers often hold stricter expectations for children's self-discipline and self-regulation in contrast to their Western counterparts (Hue, 2007; Leung et al., 2005) and place more importance on academic achievement (Lan et al., 2011). In addition, close-knit family structures, a strong emphasis on intergenerational support, and collectivist values may increase parents' stress regarding their child's behavior (Dai et al., 2024). These cultural differences may lead to stricter rating thresholds for ADHD, particularly if a child's behavior is perceived as disruptive and not conforming to behavioral norms (W. W. Y. Chan et al., 2022). Considering potential cultural variations in ADHD presentations, this study focused on a Hong Kong Chinese sample as a case in point to examine the classification of ADHD presentations and their prevalence in a non-Western cultural context.

Clustering Approaches

To further understand the heterogeneity of the ADHD presentation classification and prevalence of ADHD presentations, various statistical methods have been employed to identify subtypes/presentations within the condition, such as latent profile analysis (LPA) and latent class analysis (LCA). These mixture models allow for identifying unobserved subgroups within a population based on either categorical (LCA; Collins & Lanza, 2009) or continuous (LPA; Oberski, 2016) observed data.

Specifically, LCA has been used to identify distinct classes of individuals based on the presence or absence of specific symptoms. For example, Rasmussen et al. (2004) utilized LCA on a general population sample ($N = 7{,}897$) in America and Australia, identifying a three-subtype ADHD model including six classes with different levels of hyperactivity, inattention, or combined symptom severity (52.42% ADHD-IA, 13.16% ADHD-HI, and 34.41% ADHD-C), corresponding to the *DSM-4* three-subtype model (also see Elia et al., 2009). However, a recent study in Korea found a three-class solution consisting of an ADHD-HI group (31.39%), an ADHD-IA group (39.01%), and a non-ADHD group (29.60%; i.e., a two-presentation model), which varied from the *DSM-4* or *DSM-5* categories, and the proportions of different presentations varied from those found in previous studies (Park et al., 2020).

In contrast, LPA identifies subgroups of individuals who share similar patterns of responses on a set of continuous variables (Oberski, 2016), like continuous symptom dimensions, which can provide a more nuanced understanding of the phenotypic variability in ADHD. For instance, Morris et al. (2021) utilized LPA to uncover significant variations in social functioning among adolescents with ADHD, which suggested that group-level descriptions may not

adequately capture the variability in social strengths and weaknesses among ADHD.

Other approaches, such as hierarchical clustering and k-means clustering, have also been used to classify individuals with ADHD. For example, Adler et al. (2017) found a three-presentation model in the general population sample, consistent with the *DSM-5* (47.6% ADHD-HI, 23.2% ADHD-IA, and 29.2% ADHD-C), while P. J. Marsh and Williams (2004) only found three ADHD-C groups with different levels of symptom severity, and an ADHD-IA group. These methods are based on distance metrics and aim to group individuals who are similar to each other based on their symptom profiles. However, these methods do not provide a probabilistic framework for class membership, which is a key feature of both LCA and LPA (Steinley, 2006).

Given the previous inconsistent findings about the number of distinct presentations that may exist within ADHD, as well as the characteristics and proportions of each presentation, further research is needed to address the controversies surrounding the classification of ADHD presentations and gain a better understanding of the regional differences in their prevalence.

Emotional Dysregulation in ADHD

Cognitive theories emphasizing the role of executive functioning or cognitive control have received considerable attention in understanding the etiology of ADHD (Barkley, 1997; Barkley & Fischer, 2010; Shaw et al., 2014). However, recent research has also highlighted the significance of emotional dysregulation (ED) as a prominent feature of ADHD that contributes to its functional impairments (Barkley & Fischer, 2010; Shaw et al., 2014). ED refers to difficulties in inhibiting or regulating the occurrence, intensity, and duration of emotional states, leading to pronounced emotional lability (Barkley & Fischer, 2010). ED is highly prevalent among children, adolescents, and adults with ADHD, regardless of comorbid mental disorders (Skirrow & Asherson, 2013). Graziano and Garcia (2016) found that children with ADHD were more prone to experiencing intense emotions, and the association between ED and ADHD symptoms became stronger with age. Approximately 30%–45% of children with ADHD experience significant impairments in daily functioning because of anger, rageful outbursts, irritability, and aggressive lashing out (Karalunas et al., 2014; Liu et al., 2019). Shaw et al. (2014) indicated that 34%–70% of adults with ADHD encounter ED issues, and this finding has been supported by two meta-analytical studies (Beheshti et al., 2020; Graziano & Garcia, 2016). Overall, the relationship between ADHD and ED remains strong and persistent across different age groups and settings.

ED can be viewed as a broad construct encompassing specific facets such as impairment in emotion recognition, emotional reactivity, emotional lability, and negative emotional responses (Beheshti et al., 2020). Among these facets, emotional lability and negative responses have been identified as having strong weighted effects on adults with ADHD (Beheshti et al., 2020). Emotional lability refers to a pattern of unstable shifts between emotional states and is with a prevalence of approximately 30% among individuals with ADHD across different age groups (Sobanski et al., 2010). Negative emotional responses such as anger, frustration, sadness, anxiety, and guilt are also likely to be experienced by individuals with ADHD (Barkley, 1997). For example, 13%–43% of individuals with ADHD suffer from pessimism, withdrawal, self-demeaning behaviors, anxiety, and depression (Kearnes & Ruebel, 2011; Murphy & Barkley, 1996). In a meta-analysis on children and adolescents, significant and robust correlations were found between ADHD symptom severity and negative emotional responses and emotional lability (Graziano & Garcia, 2016). These findings collectively support the notion that emotional lability and negative emotional responses play a more definitive role among the dimensions of ED in the context of ADHD.

Studies investigating the relation between ADHD and ED have found a strong link between hyperactivity and emotional lability/negative emotional responses (Pingault et al., 2013; Tseng et al., 2012), but only a weak association between inattentiveness and the latter (Connor et al., 2010). Despite these findings, there has been limited research exploring the impact of specific ADHD presentations on ED. Some studies have suggested that children with ADHD-C are more likely to exhibit intense positive and negative emotional reactions (Sobanski et al., 2010; Vidal et al., 2014), but only one study so far has examined the association between ADHD-HI and ED (Yue et al., 2022). Through LCA, Yue et al. (2022) identified distinct classes with and without ED for the ADHD-C and ADHD-IA presentations, while only one latent class with ED was revealed for the ADHD-HI presentation. Notably, unlike the other two presentations, a distinct class without ED was not identified for the ADHD-HI presentation, suggesting a high proportion of ED in the context of ADHD-HI. However, some individuals classified with ADHD-IA also exhibited ED, indicating a more complex relationship that is not solely defined by hyperactivity alone. The variations in patterns of ED across different ADHD presentations clearly warrant further exploration.

Social Impairments in ADHD

Children and adolescents with ADHD often display inappropriate social behaviors, such as impulsivity, intrusiveness, and hostility, while lacking appropriate social skills, like sharing, cooperation, and turn-taking (Wehmeier et al., 2010). Compared to their typically developing peers, individuals with ADHD tend to have fewer and lower-quality friendships and are more likely to experience peer rejection, neglect, and victimization (Hoza, Mrug, et al., 2005; Nixon, 2001). Social difficulties in individuals with ADHD can hinder their adjustment to formal schooling and perpetuate further interpersonal problems throughout their development (Hoza, 2007; McConaughy et al., 2011). Overall, social dysfunction is one of the most debilitating aspects of ADHD (Nijmeijer et al., 2008), and more attention is required to support individuals with ADHD in their social development and prevent compromised outcomes (Kok et al., 2016).

Social impairments in individuals with ADHD can be attributed to the core symptoms of inattention and hyperactivity/impulsivity (Mikami et al., 2007; Wheeler & Carlson, 1994). Specifically, hyperactivity and impulsivity can lead to overbearing social behaviors (Hoza, 2007), such as oppositionality, disruptive and aggressive behaviors, noncompliance, and defiance (Nijmeijer et al., 2008), resulting in fewer prosocial skills, inappropriate responses in social interactions, and peer rejection (Humphreys et al., 2016; Mikami et al., 2007). Inattentiveness, on the other hand, can cause difficulties in observational learning, leading to challenges in reading social cues, misattributions about peers' behaviors and intentions, and inaccurate interpretations of social success and failure (Gardner &

Gerdes, 2015; Hinshaw & Melnick, 1995; Hodgens et al., 2000; Sibley et al., 2010).

ADHD presentation has been shown to influence social impairments in individuals with ADHD (Hoza, 2007). For example, children with ADHD-C are more likely to experience active rejection, while children with ADHD-IA are more prone to neglect and social isolation (Hodgens et al., 2000; Solanto et al., 2009). This distinction can be attributed to the higher levels of aggression and emotion regulation difficulties seen in ADHD-C, compared to the passivity and shyness often observed in ADHD-IA (Hodgens et al., 2000; Solanto et al., 2009). Blachman and Hinshaw (2002) found that girls with ADHD-C and ADHD-IA demonstrated comparable levels of social impairments. Nonetheless, girls with ADHD-C showed more difficulties establishing friendships, while those with ADHD-IA struggled more with maintaining friendships. Additionally, Cordier et al. (2010) observed that ADHD-HI and ADHD-C children demonstrated significantly less sharing and support and experienced more peer rejections than ADHD-IA children during a cooperative play task. These distinct patterns of social impairment among the various ADHD presentations (Milich et al., 2001) underscore the need to better understand the nuances of heterogeneity and variability of social functioning in children with ADHD.

The Present Study

This study employed LPA to explore the presentations of ADHD symptoms in a sample of primary school students in Hong Kong. While all participants had confirmed diagnoses of ADHD, the specific symptom-based presentations (subtypes) were not preidentified. The aim was to identify potential ADHD presentations within this sample and to determine the proportion of each presentation. We sought to explore whether distinct symptom patterns would emerge, forming several profiles associated with different ADHD presentations. In addition, the study explored potential variations in ED and the heterogeneity of social skills among the different ADHD presentations. We posited exploratory expectations that: (a) The three-presentation model of ADHD classification, consisting of combined type (ADHD-C), inattentive type (ADHD-IA), and hyperactive–impulsive type (ADHD-HI), would be applicable to the Hong Kong sample, revealing distinct subgroups; (b) different ADHD presentations would exhibit varying degrees of ED; and (c) there would be a heterogeneity in social skills among the ADHD presentations. The findings of this study may provide valuable insights into the different social and emotional needs of students with different ADHD presentations, thereby informing the development of targeted interventions that can be tailored to address these distinct needs more effectively.

Method

Participants

A total of 366 students with ADHD (boys: 293, 80.1%; M_{age} = 8.62 years, $range_{age}$ = 5.75–11.42 years; SD = 1.20) and 46 students without ADHD (i.e., non-ADHD group, boys: 36, 78.3%; M_{age} = 8.37 years, $range_{age}$ = 6.08–10.42 years; SD = 1.08) participated in this study. These students were selected from 60 primary schools across all administrative districts in Hong Kong. They were nominated by their schools based on their eligibility for an intervention program that targeted challenges associated with ADHD in students. All participants with ADHD had received a formal diagnosis of ADHD, as indicated in the latest assessment reports by qualified healthcare professionals. The non-ADHD group was also identified through teacher and parent nominations for the intervention program, but not having received any formal clinical diagnosis or exhibiting the full spectrum of ADHD traits. Detailed information on the sample demographics is presented in Table 1. Written consent was obtained from the parents of the participating children. Parents were asked to complete a questionnaire to assess their child's ADHD symptoms, social functioning, and emotion regulation.

Measures

ADHD Symptoms

The Chinese version (Lai et al., 2013) of the Strengths and Weaknesses of ADHD-Symptoms and Normal-Behavior (SWAN; Swanson et al., 2001) rating scale was selected as a measure of ADHD symptoms in this study. The SWAN measure is a 7-point Likert scale (ranging from "−3" to "+3"), consisting of 18 items that evaluate behavioral characteristics related to attention and activity regulation skills. The SWAN includes two subscales, each comprising nine items, which capture the two core dimensions of ADHD outlined in the diagnostic criteria of ADHD in the *DSM-5*-TR, namely inattention and hyperactivity/impulsivity. Higher scores on the scale indicate more severe ADHD traits. The inattentive presentation of ADHD is characterized by a sum of 6 or higher on Items 1 through 9, reflecting frequent inattentive behaviors. Similarly, a sum of 6 or greater on Items 10 through 18 suggests the hyperactive/impulsive presentation, indicating frequent hyperactive and impulsive behaviors. In the present sample, the internal consistencies of the inattention and hyperactivity/impulsivity subscales and the total score were high, with Cronbach's αs of .86, .89, and .90, respectively.

Social Functioning

The Social Skills Improvement System-Rating Scales (SSIS-RS, parent form; Gresham & Elliott, 2008) is a 4-point Likert scale designed to assess social behaviors in students aged 3–18. In this study, the social skills subscale, and the bullying subdomain in the problem behavior subscale of the Chinese version of the SSIS-RS-Parent form were used (Cheung et al., 2017). The social skills subscale consists of 46 items that measure various aspects of social functioning across seven subdomains: communication, cooperation, assertion, responsibility, empathy, engagement, and self-control. The bullying subdomain, with five items in the problem behaviors subscale of SSIS-RS, measures overbearing behaviors. The subdomain and total scores of the social skills subscale, as well as the bullying subdomain score were calculated by summing the item scores. Higher scores indicate a higher tendency to display the respective social behaviors. The internal consistencies of the social skills subscale and the bullying subdomain were high for the present sample, with Cronbach's αs of .91 and .81, respectively.

Emotion Regulation

The Chinese version (R. F.-Y. Chan et al., 2021) of the Emotion Regulation Checklist (ERC; Shields & Cicchetti, 1997) was used to assess children's emotion regulation competence. The ERC is a 4-point Likert scale containing two subscales with 24 items. The emotional lability/negativity subscale of ERC contains 16

Table 1
Demographic Characteristics of the Participants (N = 412)

Demographic characteristic	*M* (*SD*)/count (%)		Group comparison	
	ADHD group, *N* = 366	Non-ADHD group, *N* = 46	t/χ^2	*p*
Age (years)				
M (*SD*)	8.62 (1.20)	8.37 (1.08)	1.37	.18
Range	5.75–11.42	6.08–10.42		
Sex				
Male	293 (80.1%)	36 (78.3%)	0.08	.78
Female	73 (19.9%)	10 (21.7%)		
Comorbidity				
Oppositional defiant disorder	10 (2.7%)	0 (0.0%)	\	\
Diagnosed/suspected dyslexia	101 (27.6%)	0 (0.0%)		
Diagnosed/suspected ASD	34 (9.3%)	0 (0.0%)		
Developmental delay	39 (10.6%)	0 (0.0%)		
Intellectual disability	2 (0.6%)	0 (0.0%)		
Language disorder	47 (12.8%)	0 (0.0%)		
Hearing disorder/visual impairment	4 (1.1%)	0 (0.0%)		
Mental health issues	9 (2.5%)	0 (0.0%)		
Household income (monthly HK$)				
<$5,000	10 (2.7%)	2 (4.3%)	4.99	.55
$5,000–$9,999	23 (6.3%)	4 (8.7%)		
$10,000–$19,999	91 (24.9%)	13 (28.3%)		
$20,000–$29,999	103 (28.1%)	12 (26.1%)		
$30,000–$39,999	55 (15.0%)	7 (15.2%)		
≥ $40,000	82 (22.4%)	7 (15.2%)		
Not reported	2 (0.5%)	1 (2.2%)		
Father's educational level				
Primary school or below	18 (4.9%)	2 (4.3%)	4.43	.35
Secondary school	213 (58.2%)	30 (65.2%)		
Postsecondary colleges	62 (16.9%)	7 (15.2%)		
Bachelor's degree or above	72 (19.7%)	6 (13.0%)		
Not reported	1 (0.3%)	1 (2.2%)		
Mother's educational level				
Primary school or below	17 (4.6%)	0 (0.0%)	5.35	.37
Secondary school	227 (62.0%)	30 (65.2%)		
Postsecondary colleges	42 (11.5%)	9 (19.6%)		
Bachelor's degree or above	67 (18.3%)	3 (6.5%)		
Others	2 (0.5%)	0 (0.0%)		
Not reported	11 (3.0%)	4 (8.7%)		

Note. The diagnoses were reported by parents based on children's latest assessment reports by qualified healthcare professionals. The Chi-squared test is not conducted here, because there was no comorbidity condition among the non-ADHD group, and as a result, there is "\" presented here in the table. ADHD = attention-deficit/hyperactivity disorder; ASD = autism spectrum disorder; HK$ = Hong Kong Dollar.

items, measuring negative emotion-regulation related behaviors, such as ED, mood lability, negative affect, and inflexibility. Higher scores on this subscale reflect poorer emotion regulation (i.e., higher levels of ED). The emotion regulation subscale captures processes central to adaptive regulation, including socially appropriate emotional displays and empathy, which contains eight items. The higher scores on this subscale indicate more appropriate emotional displays. The internal consistencies of the items within the emotional lability/negativity and emotion regulation subscales were found to be satisfactory in the current sample, with Cronbach's α coefficients of .82 and .83, respectively.

Statistical Analyses

Analyses were conducted using the snowRMM module (Seol, 2022) in Jamovi (Version 2.2; The Jamovi Project, 2021; R Core Team, 2021) and the tidyLPA (Rosenberg et al., 2021), emmeans (Lenth, 2020), and car (Fox & Weisberg, 2020) packages in R (Version 4.2.1). LPA is a statistical method employing continuous variables that identifies optimal subgroups within a population by comparing models with varying profiles (Berlin et al., 2014). LPA classifies individuals based on common characteristics or response patterns to maximize within-group homogeneity across items for each profile while allowing for between-group heterogeneity. LPA uncovers data patterns and their connections to relevant variables, offering a robust and efficient model selection process (Lanza et al., 2013). It stands out for its ability to detect latent subgroups without loss of statistical power because of unequal group sizes and reduces the risk of Type I errors by minimizing comparisons required in a single analysis (Lanza & Rhoades, 2013).

Given the use of continuous indicators, we examined alternate specifications for class-varying and class-invariant models, as well as restricted and unrestricted models (Masyn, 2013). The results of these analyses are presented in Table S1 in the online supplemental materials, which provide detailed model fit statistics for each specification. Notably, the class-varying and unrestricted models yielded

identical results (see Table S1 in the online supplemental materials), suggesting that the data did not support additional complexity beyond what the class-varying model could capture. Similarly, the class-invariant and restricted models also produced identical results, indicating that the data's variance and covariance structures were consistent across different classes. Therefore, the class-varying models were selected, as they provided a balance between model fit and complexity, effectively capturing the data's variability without unnecessary complexity.

It should be noted that sample size considerations for LPA are nuanced and depend on various factors, including the number of expected latent profiles, the number of indicators used, and the anticipated size of the smallest profile. However, a sample size ranging from 300 to 1,000 is generally adequate for most fit indices to function properly (Nylund-Gibson & Choi, 2018). Given that this study focused solely on the two core symptoms of ADHD—hyperactivity and inattention—and thus a limited number of latent classes would be anticipated, the current sample size should provide a reasonable balance between precision and practicality in our analyses.

The total scores for Items 1–9 (i.e., inattentive items) and Items 10–18 (i.e., hyperactive/impulsive items) from the SWAN were subjected to LPA to identify different profiles of ADHD presentations. A total of nine models, ranging from one to nine profiles, were fitted to the data to identify distinct presentations based on ADHD symptoms. There was a model convergence issue when fitting the 10-profile model, resulting in an estimation failure. Consequently, the upper limit of nine profiles was established by considering model complexity, interpretability, and the practical constraint of model convergence. To determine the best-fitting model, class enumeration techniques were employed, ranging from one to nine profiles (Berlin et al., 2014). Model fit was assessed using statistical evaluation methods and judgment based on the principles of parsimony and substantive interpretability of the results to select the best-fitting model (H. W. Marsh et al., 2009).

Model fit was evaluated using several criteria, including the Akaike information criterion (AIC; Akaike, 1987), Bayesian information criteria (BIC; Schwarz, 1978), consistent Akaike information criterion (CAIC; Nylund-Gibson & Choi, 2018), and sample-size adjusted BIC (SABIC; Sclove, 1987). Quality of classification was evaluated based on average latent profile probabilities (Jung & Wickrama, 2008) and entropy (Berlin et al., 2014). Lower values of AIC, BIC, CAIC, and SABIC indicate better model fit, as they reflect less unexplained variance remaining in the model. Higher values of average latent profile probabilities indicate a better model fit, with a clear distinction between the identified profiles. The bootstrapped likelihood ratio test (BLRT) p value was also considered. The BLRT p value is used to compare models with different numbers of profiles by testing whether the more complex model (i.e., with more profiles) provides a significantly better fit to the data than the simpler model (McLachlan & Peel, 2000). A significant p value suggests that the more complex model might be preferred. In addition, entropy is a diagnostic tool that signifies accuracy in classification (i.e., higher values indicate more individuals classified correctly; Berlin et al., 2014), with a value greater than .80 considered desirable (Lubke & Muthén, 2007).

Social functioning and emotion regulation were compared between the identified latent profiles and the non-ADHD group using analysis of variance (ANOVA) and post hoc pairwise t tests. In the current study, individuals were assigned to the identified latent profiles using modal assignment, a process forcing each individual into a single profile based on their highest posterior probability that takes classification error into account. While modal assignment provides a clear classification, it may oversimplify the complexities within the profiles by ignoring the inherent uncertainty in profile membership and the potential for individual profiles to change with additional data (Masyn, 2013). To address this limitation, the manual maximum likelihood (ML) three-step approach (Nylund-Gibson et al., 2014; Vermunt, 2010) was employed to compare the identified ADHD profiles on age, social skills, and emotion regulation (i.e., included as distal outcomes), taking classification uncertainty into account (Nylund-Gibson et al., 2019). The results of the ML three-step method are detailed in Tables S2 and S3 in the online supplemental materials.

Transparency and Openness Statement

We followed established guidelines for LPA (Nylund-Gibson & Choi, 2018) when reporting all measures and determining our sample size. No data exclusions or manipulations were applied in this study, and we adhered to the Journal Article Reporting Standards guidelines (Kazak, 2018). All data, analysis code, and research materials are available upon request from the corresponding author, in accordance with data sharing policies and consents of the participants. Analyses were conducted using Jamovi (Version 2.2; The Jamovi Project, 2021) with the snowRMM module (Seol, 2022), and R (Version 4.2.1; R Core Team, 2021) employing tidyLPA (Rosenberg et al., 2021), emmeans (Lenth, 2020), and car (Fox & Weisberg, 2020) packages. This study's design and analysis were not preregistered. The study has been approved by the Human Research Ethics Committee at the authors' affiliated university.

Results

LPA

In the study, we explored the heterogeneity within the ADHD sample by employing LPA. Table 2 shows the model fit statistics for each LPA model. The two-profile model demonstrated the lowest value for the CAIC. However, the BLRT p value for the three-profile model was .01, indicating that this model provided a significantly better fit to the data compared to a two-profile model. In addition, the BIC was lowest for the three-profile model. Although the AIC and SABIC were lowest for the six-profile model, the BIC and CAIC values were higher compared to the three-profile model. The insignificant BLRT p values for the five- to nine-profile models also suggested that adding more profiles beyond the four-profile model did not provide additional explanatory power or a substantially better fit to the data.

Regarding the average latent profile probabilities, though all probabilities across the models were above the recommended threshold of .7 (Nagin, 2005; Nylund-Gibson & Choi, 2018), the three-profile model had probabilities of .85, .84, and .86 for each profile, indicating a relatively clear distinction between the identified profiles. The four-profile model had probabilities of .89, .92, .86, and .72, with the fourth profile showing a lower probability. The five- to nine-profile models had average posterior probabilities ranging from .72 to .97, with some profiles having relatively lower probabilities (e.g., probability of .74 for one of the profiles in the six-profile model), indicating a less clear distinction between profiles and a higher degree of uncertainty in profile membership. Moreover, the three-profile model exhibited an entropy value of .80, which was higher than the .69 observed in the two-profile model and indicated adequate classification accuracy. The three-profile model

Table 2
Model Fit Statistics for the Latent Profile Analysis

Profile	Log-likelihood	AIC	BIC	CAIC	SABIC	Latent profile probability	BLRT *p*	Entropy
1	−2,821.28	5,652.55	5,672.65	5,677.65	5,656.79	1.00	\	\
2	−2,789.35	5,600.70	5,663.58	**5,655.93**	5,610.02	.84, .86	.010	.69
3	−2,780.61	5,595.22	**5,644.93**	5,670.35	5,609.63	.85, .84, .86	.010	.80
4	−2,789.54	5,605.08	5,657.35	5,680.58	5,616.10	.89, .92, .86, .72	.020	.76
5	−2,744.28	5,630.50	5,694.84	5,692.16	5,644.07	.85, .95, .83, .90, .76	.059	.82
6	−2,738.66	**5,571.09**	5,688.05	5,723.05	**5,587.20**	.74, .90, .86, .84, .90, .82	.139	.79
7	−2,732.63	5,626.20	5,712.13	5,753.13	5,644.85	.90, .90, .77, .89, .72, .97, .84	.238	.81
8	**−2,726.68**	5,631.73	5,736.35	5,783.35	5,652.93	.92, .89, .74, .89, .76, .96, .78, .91	.317	.83
9	−2,791.21	5,638.41	5,751.00	5,779.00	5,662.15	.87, .87, .88, .75, .96, .83, .78, .98, .86	.564	.84

Note. The best-fitting model statistics are bolded. The backslash ("\") indicates that the respective test was not conducted and the *p*-value is not reportable. AIC = Akaike information criterion; BIC = Bayesian information criterion; CAIC = consistent Akaike information criterion; SABIC = sample-size adjusted BIC; BLRT = bootstrap likelihood ratio test.

stood out for achieving a good balance between model fit and classification accuracy without excessive complexity, with entropy serving as a supplementary indicator of classification consistency rather than a decisive selection criterion (Masyn, 2013; Nylund-Gibson & Choi, 2018).

We examined the profile plots for the two- to four-profile models (Figure S1 in the online supplemental materials) to provide a qualitative understanding of the distinctions among the profiles within each model. The two-profile model grouped individuals into an ADHD-C group and a profile with borderline hyperactivity/impulsivity symptoms near the SWAN threshold, limiting clinical precision. The four-profile model subdivided ADHD-C into two subgroups with minimal symptom differences and one of which had small sample sizes, introducing interpretive ambiguity and unnecessary complexity (also see in the online supplemental materials for details). In contrast, the three-profile model clearly distinguished ADHD-IA, ADHD-HI, and ADHD-C profiles aligned with dimensional symptom expression. Therefore, the three-profile model was ultimately selected for its favorable model fit indices, simplicity, clarity in profile distinctions, and sufficient classification accuracy, which are essential for meaningful interpretation and practical application of the findings.

As depicted in Figure 1, the three-profile model revealed three distinct types of ADHD presentations. Specifically, Profile 1 was the largest subgroup, including 161 (44.0%) participants displaying both high inattention and high hyperactivity/impulsivity (i.e., ADHD-C). Profile 2 comprised 132 (36.1%) participants characterized by high hyperactivity/impulsivity and relatively low inattention (i.e., ADHD-HI). In Profile 3, 73 (19.9%) students exhibited high inattention and relatively low hyperactivity/impulsivity (i.e., ADHD-IA). The three profiles identified through our LPA—ADHD-C, ADHD-HI, and ADHD-IA—closely reflect the *DSM-5*-TR ADHD presentations. This alignment underscores the heterogeneity of ADHD and sets the stage for our subsequent investigation on the specific impacts of different ADHD presentations on students' social functioning and emotion regulation.

The results of the ANOVA (Table 3) showed significant differences in the levels of inattention, $F(3, 408) = 415.99$, $p < .001$, $\eta_p^2 = .75$, hyperactivity/impulsivity, $F(3, 408) = 240.85$, $p < .001$, $\eta_p^2 = .64$, and the total score on ADHD symptoms, $F(3, 408) = 374.12$, $p < .001$, $\eta_p^2 = .73$, as measured by the SWAN among the three identified profiles and the non-ADHD group. The post hoc tests indicated that students in Profile 1 (ADHD-C) scored significantly higher on inattention ($M = 17.67$), hyperactivity/impulsivity ($M = 14.66$), and the total SWAN score ($M = 32.32$) compared to students in other profiles and the non-ADHD group ($ps < .001$), suggesting that the ADHD-C group displayed the most severe presentation of ADHD symptoms. In addition, students in Profile 2 (ADHD-HI, $M = 8.04$) were rated significantly higher on hyperactivity/impulsivity compared to students in Profile 3 (ADHD-IA, $M = 0.42$, $p < .001$) and the non-ADHD group ($M = -3.37$, $p < .001$). By contrast, students in Profile 3 (ADHD-IA, $M = 13.51$) had significantly higher inattentive scores compared to students in Profile 2 (ADHD-HI, $M = 3.53$, $p < .001$) and the non-ADHD group ($M = 1.43$, $p < .001$).

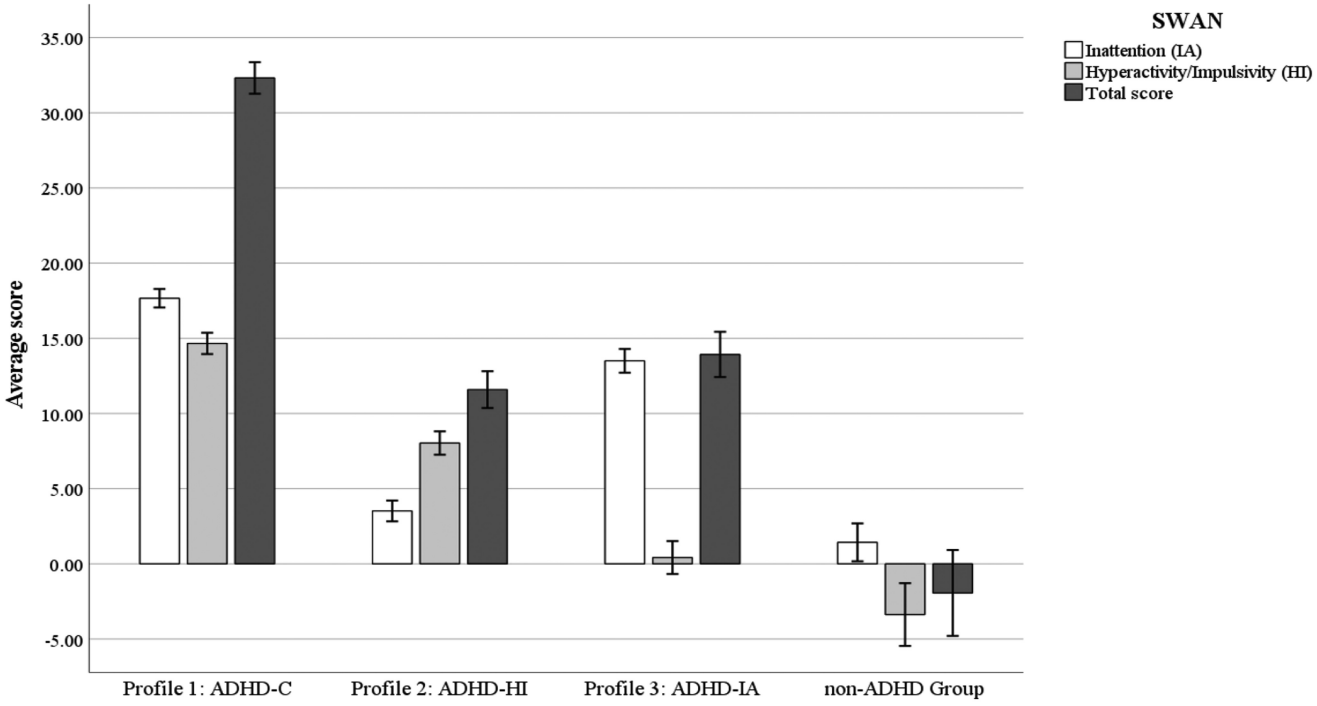
Profile-Specific Impacts on Social Functioning and Emotion Regulation

Table 3 presents descriptive statistics of the measures of social functioning and emotion regulation, along with comparisons of these scores among the three identified profiles and the non-ADHD group. The ANOVA results indicated significant differences in the total social skills score, $F(3, 408) = 48.86$, $p < .001$, $\eta_p^2 = .26$, and all subdomains of social skills and bullying in the SSIS. This finding underscores the variability in social skills among individuals with different ADHD presentations (also see Figure 2). Post hoc tests further showed that students in Profile 1 (ADHD-C) displayed the poorest social functioning among the four groups, with the lowest scores in the social skills domain ($ps < .001$). They also exhibited the lowest scores in the communication, cooperation, responsibility, empathy, engagement, and self-control subdomains of social functioning ($ps < .001$). Students in Profile 3 (ADHD-IA) showed better performance than the ADHD-C group in these subdomains ($ps \leq .005$), but their scores were worse than those of the ADHD-HI ($ps \leq .025$) and the non-ADHD groups ($ps < .001$), who performed similarly in these subdomains ($ps > .05$). Notably, ADHD-IA did not significantly differ from ADHD-C in engagement, but both groups scored significantly lower than the other two groups in this domain. Conversely, students in Profile 2 (ADHD-HI) displayed higher scores in assertion and bullying than the ADHD-IA and non-ADHD groups ($ps < .05$).

The ERC scores further highlighted the differences in emotion regulation competence among the profiles (also see Figure 3). The ADHD-C group showed the highest levels of lability/negativity, $F(3, 408) = 59.62$, $p < .001$, $\eta_p^2 = .31$, and the lowest score in adaptive emotion regulation, $F(3, 408) = 12.00$, $p < .001$, $\eta_p^2 = .08$, suggesting difficulties in managing emotional responses and regulating emotions effectively. Moreover, it is worth noting that both the ADHD-HI and ADHD-IA groups displayed similar levels of

Figure 1

Average Total Scores and Subscale Scores for IA and HI Symptoms on the SWAN for the Three Latent Profiles and the Non-ADHD Group



Note. The three ADHD profiles (ADHD-C, ADHD-HI, and ADHD-IA) are derived from LPA, while the non-ADHD group is an observed comparison group not included in the LPA model. Error bars in the figure represent the 95% confidence intervals of the measured SWAN scores within each profile and the non-ADHD group. Profile estimates are derived from modal assignments according to posterior probabilities, which may not perfectly represent the characteristics of the identified profiles. SWAN = strengths and weaknesses of ADHD symptoms and normal behavior; ADHD = attention-deficit/hyperactivity disorder; ADHD-C = ADHD-combined type; ADHD-HI = ADHD-hyperactive/impulsive type; ADHD-IA = ADHD-inattentive type; LPA = latent profile analysis.

lability/negativity ($p = .83$), which were higher than that of the non-ADHD group ($ps < .001$). With respect to adaptive emotion regulation, both the ADHD-C and ADHD-IA groups, but not the ADHD-HI, were found to exhibit significantly lower scores than the non-ADHD group ($ps < .001$).

Using the manual ML three-step approach, which included age, social skills, and emotion regulation as distal outcomes, we found similar profile-specific performance and differences between the three identified ADHD profiles in social skills and emotion regulation, while there was no significant difference in the age among the three profiles. The results of the ML three-step method are detailed in the online supplemental materials.

Discussion

The present study conducted an LPA on ADHD symptoms to characterize the underlying presentations of ADHD in primary school students in Hong Kong. It also investigated the heterogeneity of ED and social skills profiles among children with different ADHD presentations.

ADHD Presentations in the Current Sample of Primary School Students in Hong Kong

In the LPA, we evaluated models ranging from one to nine profiles to determine the optimal number of subgroups within our sample. After a thorough examination of statistical fit indices and theoretical interpretability, the three-profile model—ADHD-C, ADHD-HI, and ADHD-IA—was selected, which closely aligned with the *DSM-5*-TR criteria. Students with ADHD-C exhibited the most severe ADHD symptoms, exceeding the other identified profiles in terms of inattention, hyperactivity/impulsivity, and overall symptom severity as measured by the SWAN scale. Consistent with the *DSM-5*-TR's framework, the ADHD-HI and ADHD-IA groups exhibited elevated levels of their respective primary symptom dimensions, with ADHD-HI showing higher hyperactivity/impulsivity and ADHD-IA showing greater inattention relative to the non-ADHD group. This finding supports the three-presentation model identified in previous studies (Althoff et al., 2006; Hudziak et al., 1998; Lahey et al., 1988; Volk et al., 2005).

Among the three ADHD presentations, the ADHD-C group (44.0%) was found to be the most prevalent, followed by ADHD-HI (36.1%) and ADHD-IA (19.9%). Our findings are consistent with Aboul-ata and Amin (2018), who also identified the combined subtype as the most prevalent (80.57%) among children aged 6–14 years, followed by the hyperactivity/impulsivity subtype (14.22%) and the inattentive subtype (5.21%), although the specific proportions differ from ours. While our results align with Kessler et al. (2006) in identifying ADHD-C as the largest subgroup, Kessler et al. (2006) focused on adults and reported more cases of the inattentive presentation relative to the hyperactive/impulsive presentation (also see Nijmeijer et al., 2008). In contrast, our results differ from the meta-analysis by Salari et al. (2023), which reported that among children under the age of

Table 3

Comparison of ADHD Symptoms, Social Functioning, and Emotional Dysregulation Between Different Latent Profiles and the Non-ADHD Group

Measure	Profile 1: ADHD-C ($n = 161$)		Profile 2: ADHD-HI ($n = 132$)		Profile 3: ADHD-IA ($n = 73$)		Non-ADHD group ($n = 46$)		F	p	η_p^2	Post hoc analyses[a]
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*				
SWAN												
Inattention	17.67	3.97	3.53	4.02	13.51	3.36	1.43	4.23	415.99	<.001	.75	4 < 2 < 3 < 1
Hyperactivity/impulsivity	14.66	4.55	8.04	4.50	0.42	4.68	−3.37	7.02	240.85	<.001	.64	4 < 3 < 2 < 1
Total score	32.32	6.74	11.59	7.09	13.93	6.45	−1.93	9.63	374.12	<.001	.73	4 < 2 < 3 < 1
SSIS												
Communication	12.58	3.09	15.78	3.08	14.79	2.11	15.98	3.52	33.92	<.001	.20	1 < 3 < 2 = 4
Co-operation	8.15	2.54	12.56	3.33	11.00	2.35	13.43	2.85	77.73	<.001	.36	1 < 3 < 2 = 4
Assertion	14.40	2.69	14.95	2.96	13.90	2.68	13.30	2.95	4.80	.003	.03	4 = 3 < 1 = 2
Responsibility	7.18	2.88	12.33	3.45	9.97	2.72	12.24	2.69	80.60	<.001	.37	1 < 3 < 2 = 4
Empathy	9.25	3.08	12.66	3.14	10.66	2.78	13.26	2.45	41.07	<.001	.23	1 < 3 < 2 = 4
Engagement	13.89	4.00	15.53	3.09	14.33	3.22	16.02	3.18	7.80	<.001	.05	1 = 3 < 2 = 4
Self-control	7.19	3.18	13.18	4.16	10.90	3.21	12.89	3.21	79.54	<.001	.37	1 < 3 < 2 = 4
Bullying	4.45	2.92	3.75	2.80	2.67	2.48	2.52	2.38	10.18	<.001	.07	4 = 3 < 1 = 2
Social skills total score	75.96	16.67	95.55	16.93	86.38	12.76	101.39	17.83	48.86	<.001	.26	1 < 3 < 2 < 4
ERC												
Lability/negativity	41.20	6.48	35.54	6.79	34.75	5.63	27.98	5.61	59.62	<.001	.31	4 < 3 = 2 < 1
Emotion regulation	22.27	3.70	24.03	3.29	22.88	3.30	25.24	3.13	12.00	<.001	.08	1 < 2 = 4, 1 = 3 < 4

Note. ADHD = attention-deficit/hyperactivity disorder; ADHD-C = ADHD-combined type; ADHD-HI = ADHD-hyperactive/impulsive type; ADHD-IA = ADHD-inattentive type; SWAN = strengths and weaknesses of ADHD symptoms and normal behavior; SSIS = Social Skills Improvement System-Rating Scales; ERC = Emotional Regulation Checklist.

[a] Group 4 refers to the non-ADHD group. Profile estimates are derived from modal assignments according to posterior probabilities, which may not perfectly represent the characteristics of the identified profiles.

12, the inattentive subtype showed the highest prevalence (33.2%), followed by the hyperactive/impulsive subtype (30.3%) and the combined ADHD subtype (31.4%). Furthermore, our findings differ from those of prior studies conducted in China, which reported ADHD-IA as the largest population of ADHD cases (Huang et al., 2017; Jin et al., 2014; also see Wang et al., 2017 for a meta-analysis of studies conducted in China). Nonetheless, consistent with these studies (Huang et al., 2017; Jin et al., 2014; Park et al., 2020), we also found a higher proportion of ADHD-C than ADHD-HI.

Discrepancies in the prevalence rates of ADHD presentations among studies conducted in different geographical locations may be partly because of regional variations in informants' decision thresholds when rating ADHD symptoms (W. W. Y. Chan et al., 2022). According to W. W. Y. Chan et al. (2022), despite lower activity levels measured by actometer among Hong Kong children compared to their UK peers, Hong Kong parents rated their children as more symptomatic. W. W. Y. Chan et al. (2022) suggested that this could be linked to cultural expectations regarding children's behavior and performance, which might influence how ADHD symptoms are perceived and reported (also see W. W. Y. Chan et al., 2025) . This cultural variation in behavioral expectations may contribute to a heightened awareness and reporting of hyperactive and impulsive behaviors, potentially explaining the higher proportion of ADHD-HI relative to ADHD-IA that we observed, in contrast to previous Western studies (Kessler et al., 2006; Nijmeijer et al., 2008).

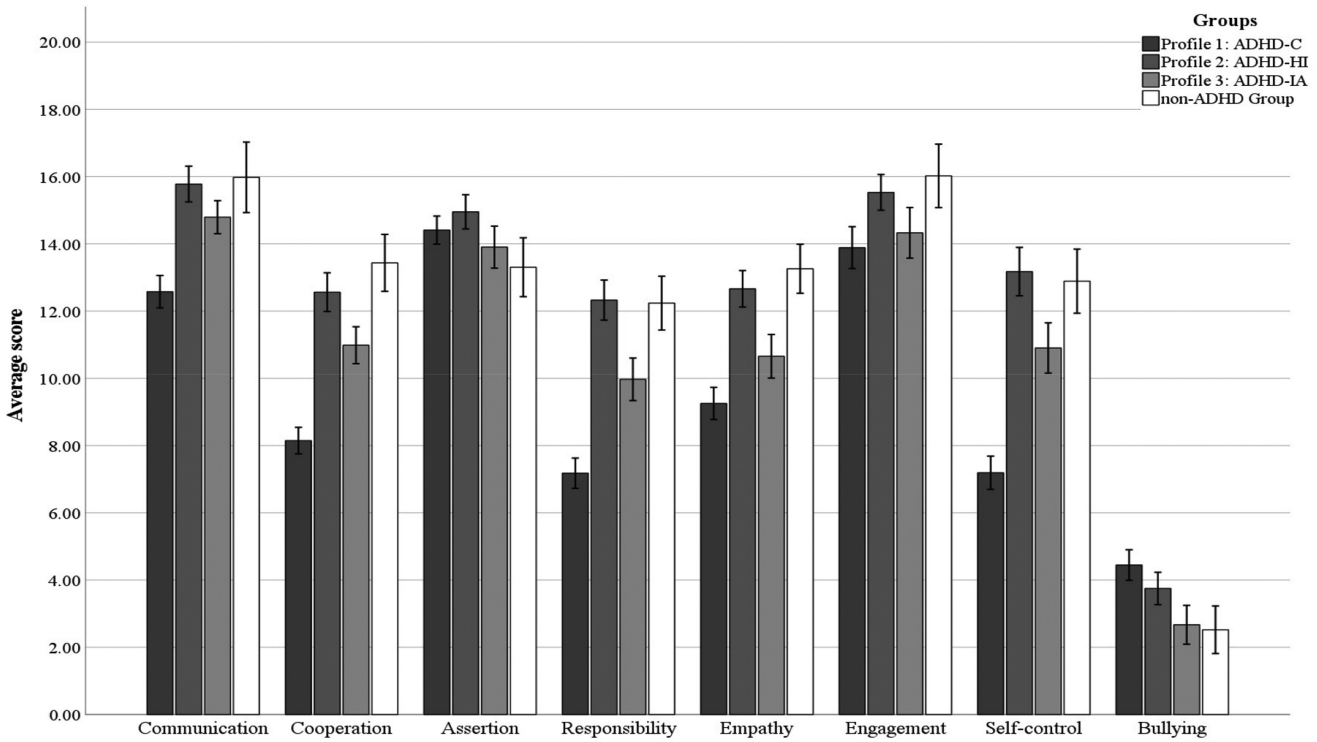
However, this explanation cannot fully account for the differences between our results and those of other studies conducted in China (Huang et al., 2017; Jin et al., 2014), particularly regarding the relative proportion of the ADHD-IA population. The lower proportion of ADHD-IA in our study might suggest the possibility of underdiagnosis of ADHD-IA cases in our community comparing to mainland China. Considering the composition of our sample with confirmed ADHD diagnoses, it appears that individuals with ADHD-C exhibited the most severe symptoms, followed by those with ADHD-IA and then ADHD-HI. This observed gradient in symptom severity might indicate that hyperactive behaviors, characteristic of ADHD-C and ADHD-HI, are more likely to draw the attention of parents and educators, thereby lowering the threshold for seeking a diagnosis. Conversely, for the ADHD-IA subtype, the less overt nature of inattentive symptoms might necessitate a clearer and more significant impairment to be recognized and addressed in a clinical setting. The potential underidentification of ADHD-IA may lead to delayed diagnosis and intervention (Hamed et al., 2015; Milich et al., 2001; Odell, 2020), which can have more severe effects on individuals with ADHD in late adolescence and early adulthood (Cheung et al., 2015; Matheson et al., 2013). Further investigation into the classification and presentations of ADHD in diverse populations is necessary to improve our understanding, diagnosis, and interventions for the condition.

Emotion Dysregulation in Different ADHD Presentations

The current study adds to a growing body of literature supporting the notion that individuals with ADHD, across different presentations, experience significant deficits in emotion regulation. Previous research has noted a high prevalence of comorbid ED in individuals with ADHD (Beheshti et al., 2020; Graziano & Garcia, 2016; Shaw et al., 2014). Our findings align with previous studies, indicating that all three types of ADHD presentations showed higher levels of emotional lability and negativity compared

Figure 2

Average Scores for Communication, Cooperation, Assertion, Responsibility, Empathy, Engagement, Self-Control, and Bullying on the SSIS-RS for the Three Latent Profiles and the Non-ADHD Group



Note. The three ADHD profiles (ADHD-C, ADHD-HI, and ADHD-IA) are derived from LPA, while the non-ADHD group is an observed comparison group not included in the LPA model. Error bars in the figure represent the 95% confidence intervals of the measured SSIS-RS scores within each profile and the non-ADHD group. Profile estimates are derived from modal assignments according to posterior probabilities, which may not perfectly represent the characteristics of the identified profiles. SSIS-RS = Social Skills Improvement System-Rating Scales; ADHD = attention-deficit/hyperactivity disorder; ADHD-C = ADHD-combined type; ADHD-HI = ADHD-hyperactive/impulsive type; ADHD-IA = ADHD-inattentive type; LPA = latent profile analysis.

to the non-ADHD group (Anastopoulos et al., 2011; Banaschewski et al., 2012). While previous research has posited that individuals with ADHD and difficulties in ED could represent a distinct subgroup with unique neural and temperamental correlates (Karalunas et al., 2014), the present study supports the idea that ED difficulties are present in individuals with ADHD regardless of their ADHD presentations. However, it is worth noting that our findings indicate a general trend of association observed for emotional lability and negativity among all three types of ADHD presentations, while the association with adaptive emotion regulation appears to be less pronounced.

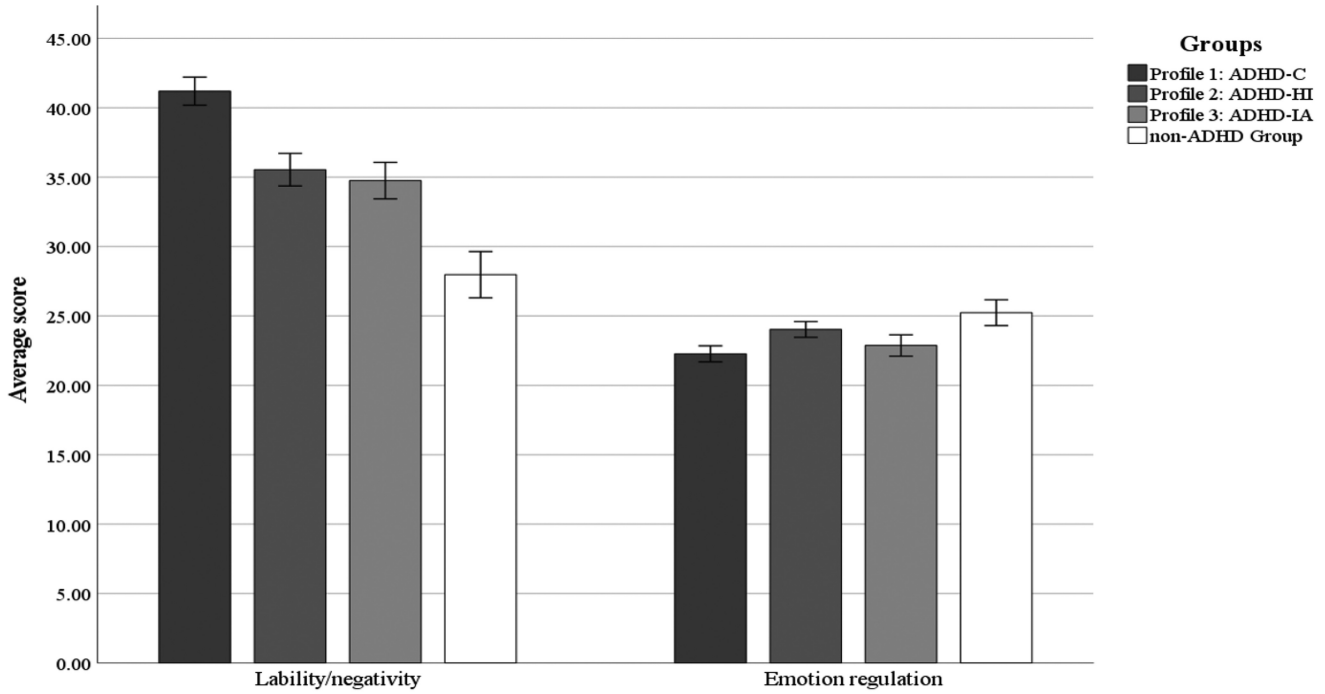
On the other hand, our findings suggest that the severity of ED symptoms varies depending on the ADHD presentation, with children of the ADHD-C type exhibiting the most severe deficits in emotion regulation (Anastopoulos et al., 2011; Banaschewski et al., 2012; Maedgen & Carlson, 2000), characterized by the highest score on lability/negativity and the lowest score on adaptive emotion regulation among the groups. Our results also indicate similar levels of lability/negativity in the ADHD-HI and ADHD-IA groups (but see Connor et al., 2010; Pingault et al., 2013; Tseng et al., 2012). Previous studies have shown that children with ADHD-C are more likely to exhibit intense emotional reactions (Sobanski et al., 2010; Vidal et al., 2014), but few have investigated lability/negativity in the ADHD-HI and ADHD-IA presentations (Yue et al., 2022). We found that children with ADHD-HI or ADHD-IA manifested significantly higher levels of emotional lability and negativity compared to their counterparts in the non-ADHD group, although to a lesser extent than the ADHD-C group.

Importantly, the ADHD-HI group demonstrated comparable adaptive emotion regulation to the non-ADHD group, despite their higher levels of emotional lability and negativity. In contrast, the ADHD-IA group appeared to experience greater difficulties in emotion regulation than the ADHD-HI, as suggested by poorer performance in both lability/negativity and adaptive emotion regulation than their non-ADHD counterparts. This nuanced difference underscores the importance of considering the specific needs of individuals with ADHD-IA, who may benefit from targeted interventions focusing on improving adaptive emotional regulation skills, in addition to interventions that address emotional lability and negativity, which are common across all ADHD presentations.

In sum, these results emphasize the importance of addressing emotion regulation deficits in individuals with ADHD. The recognition of ED as a key feature across ADHD presentations supports the integration of emotion regulation skills into comprehensive intervention plans, tailored to the specific challenges faced by different individuals.

Figure 3

Average Scores for Emotional Lability/Negativity and Emotion Regulation Subscales on the ERC for the Three Latent Profiles and the Non-ADHD Group



Note. The three ADHD profiles (ADHD-C, ADHD-HI, and ADHD-IA) are derived from LPA, while the non-ADHD group is an observed comparison group not included in the LPA model. Error bars in the figure represent the 95% confidence intervals of the measured ERC scores within each profile and the non-ADHD group. Profile estimates are derived from modal assignments according to posterior probabilities, which may not perfectly represent the characteristics of the identified profiles. ERC = Emotion Regulation Checklist; ADHD = attention-deficit/hyperactivity disorder; ADHD-C = ADHD-combined type; ADHD-HI = ADHD-hyperactive/impulsive type; ADHD-IA = ADHD-inattentive type; LPA = latent profile analysis.

Social Impairments in Different ADHD Presentations

The current study offers insights into the social functioning of children with ADHD across different presentations. The group comparisons revealed that children with ADHD-C experienced the greatest challenges in social functioning, as evidenced by their lower total score on the SSIS compared to the ADHD-HI and ADHD-IA groups. Furthermore, the comparison of social skills total scores between the latter two groups indicated a lower level of social functioning in the ADHD-IA group compared to ADHD-HI.

Notably, our findings have contributed to the identification of differential social skills profiles and intervention needs among children with different manifestations of ADHD. Specifically, children with ADHD-HI and ADHD-C demonstrated higher levels of assertion and bullying compared to the ADHD-IA and non-ADHD groups. These results suggest that difficulties with overassertion and bullying are more closely tied to symptoms of hyperactivity/impulsivity. This finding aligns with the observation that individuals with ADHD-HI and ADHD-C often demonstrate reduced levels of sharing, cooperation, turn-taking, and "supporting the play of others," while frequently engage in hostile comments towards others (Cordier et al., 2010; Mikami et al., 2007; Wehmeier et al., 2010). Moreover, the findings highlight the importance of training children with ADHD, especially those with hyperactivity/impulsivity, to develop appropriate assertiveness and reduce overbearing behavior in peer interactions.

In contrast, students identified with ADHD-IA, as well as those with the combined presentation, might require training in a broader range of social skills domains, including communication, cooperation, responsibility, empathy, engagement, and self-control, as they were reported to exhibit more difficulties in these social skills compared to the ADHD-HI and non-ADHD groups. Students with inattentiveness may encounter challenges in reading social cues (Hinshaw & Melnick, 1995), have impaired social-information processing abilities (Sibley et al., 2010; Zentall et al., 2001), and lack insight into appropriate social behaviors (Hoza, 2007). Additionally, they may display shyness and passiveness (Mikami et al., 2007; Milich et al., 2001). These deficits in both social performance and knowledge can further hinder their ability to display appropriate behaviors in peer interactions (Hinshaw, 2002; Hodgens et al., 2000; Maedgen & Carlson, 2000; Nijmeijer et al., 2008; Wehmeier et al., 2010). Our results emphasize the heterogeneity of social impairments across ADHD presentations and suggest that while ADHD-C is associated with the most severe social challenges, ADHD-IA and ADHD-HI also present distinct social skills profiles that necessitate targeted support. It is worth noting that existing pharmacotherapy and psychosocial interventions have demonstrated limited effectiveness in improving social functioning (Morris et al., 2021; Sibley et al., 2014), with limited long-term

improvements in peer relationships for children with ADHD (Hoza, Gerdes, et al., 2005; Mikami et al., 2017). Given the distinct social skills profiles observed in children with different ADHD presentations in this study, it is crucial to tailor interventions to better address the specific needs and strengths associated with each ADHD presentation, even in the absence of subtype diagnoses.

Limitations and Future Directions

This study focused exclusively on primary school students, which may yield different results compared to studies involving participants of different age groups (Huang et al., 2017; Jin et al., 2014). It is well established that symptoms of hyperactivity and impulsivity tend to decrease with age, while symptoms of inattention and ED may persist into adulthood and remain relatively stable in many individuals (Bora & Pantelis, 2016; Lahey et al., 2005; Todd et al., 2008). Moreover, research has indicated that the severity of ADHD symptoms is associated with social impairments in children and adolescents, with inattention playing a more influential role during adolescence (Leopold et al., 2019; Zoromski et al., 2015). These findings suggest that the needs for emotion regulation and social skills training among children with ADHD may change over time as they grow up. Therefore, future research can explore ADHD classification during adolescence or adulthood and investigate how symptom profiles and intervention needs may evolve over time.

Another limitation worth noting is the high proportion of male participants in the current ADHD sample. Although the gender composition (80.1% male) is consistent with previous studies in China (Liu et al., 2019: 85.6%; Yue et al., 2022: 83.7%), it is slightly higher than the ratio of three boys to one girl among children newly diagnosed with ADHD in Hong Kong in 2020 (Child Assessment Service, Department of Health, The Government of the Hong Kong Special Administrative Region, 2022). Research has shown that girls with ADHD-C and ADHD-IA have fewer friendships and less stability in their friendships than their non-ADHD counterparts, with ADHD-C experiencing challenges in establishing friendships and ADHD-IA struggling to maintain friendships (Blachman & Hinshaw, 2002). Therefore, future research should explore the impact of gender on intervention needs, particularly for females with ADHD, who are often overlooked in research and clinical practice (Quinn, 2008).

Moreover, household income and educational level can impact access to healthcare, educational resources, and environmental factors that shape ADHD development and expression (Spencer et al., 2022). In addition, co-occurring conditions like anxiety or depression could exacerbate ED and social impairments, influencing the manifestation of ADHD symptoms and potentially increasing the likelihood of belonging to a specific presentation profile (Shaw et al., 2014). However, our sample size, with 366 participants in the ADHD group, limits our ability to incorporate these demographic variables and co-occurring conditions as auxiliary variables in the model. The complexity of the model, including the number of profiles and auxiliary variables, should be commensurate with the sample size to ensure the stability and reliability of the model (Nylund-Gibson & Choi, 2018). Exploring these variables in future research could provide valuable insights into the etiology of ADHD presentations and help identify potential risk factors and protective factors.

In future intervention studies, it would be beneficial to differentiate ADHD subtypes and provide targeted training that aligns with their specific needs. On the other hand, it would be valuable to compare the effects of targeted programs, where interventions are tailored to specific subtypes, with unclassified training approaches. It is also important to recognize that intervention needs may vary because of changes in ADHD presentation over time. Therefore, future interventions should incorporate continuous monitoring of training progress and develop distinct training goals at different ages to effectively address the evolving needs of individuals with ADHD.

Conclusion

This study offers valuable insights into the distribution of ADHD presentations among primary school students in Hong Kong, revealing a higher proportion of the ADHD-C subtype, followed by ADHD-HI and ADHD-IA. The study reveals that social and emotional impairments associated with ADHD vary across presentations, with ADHD-C individuals exhibiting the most severe deficits. This underscores the need for tailored interventions addressing specific challenges faced by individuals with different ADHD presentations. The recognition of ED as a key feature across ADHD presentations supports integrating emotion regulation skills into interventions. The findings advocate for a nuanced approach to diagnosing ADHD and developing targeted interventions that effectively bolster the social and emotional well-being of children with ADHD.

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