Prevalence and correlates for adult attention deficit hyperactivity disorder and its subtypes in a Chinese community-based sample

Danyan Yuan[1] · Nalan Zhan[1] · Jian Wang[2] · Fulei Geng[1] · Lan Zhang[1]

Abstract

This study aimed to investigate the prevalence and correlates of attention deficit hyperactivity disorder (ADHD) and its subtypes in Chinese community adults. A total of 7366 adults (mean age = 38.13 years, SD = 7.87, ranging from 18 to 81) completed questionnaires assessing childhood positive experiences, childhood trauma, behavior inhibition, aggression, suicide behaviors, and ADHD symptoms. Logistic regression was conducted to examine the correlations. Multivariate analysis of variance was used to compare the differences in aggressive behaviors between different ADHD subtypes. The prevalence of ADHD was 6.7%, with the inattentive type (ADHD-I) 4.6%, the hyperactive-impulsive type (ADHD-H) 0.8%, and the combined type (ADHD-C) 1.3%. Younger age, low income, poorer physical condition, fewer childhood positive experiences, childhood trauma, and behavior inhibition were significantly related to ADHD symptoms. Regarding ADHD subtypes, young age, low income, less childhood positive experience, childhood trauma and behavior inhibition were related to elevated risk for ADHD-I; poorer physical condition and childhood trauma were significantly related to ADHD-H; childhood trauma and behavior inhibition were significantly associated with ADHD-C. Finally, all subtypes were associated with aggression behaviors, non-suicide self-injury and suicidal behaviors, with ADHD-HI and ADHD-C reporting more aggressive behaviors and suicide attempt. The findings suggest that adult ADHD is a common disorder with high prevalence in the Chinese community population, and multiple psychosocial factors are related to ADHD. Although most adults with ADHD endorsed inattention symptoms, ADHD with hyperactive-impulsive symptoms need more attention in consideration of its related high aggressive behaviors and risk of suicidal attempt.

Keywords Adult ADHD · ADHD subtypes · Risk factors · Aggressive behaviors · Suicide

Introduction

Attention deficit hyperactivity disorder (ADHD), is a neurobehavioral developmental disorder, containing three symptom domains: inattention, hyperactivity, and impulsivity. According to DSM-5, three specific subtypes of ADHD are identified based on the types of symptoms: (1) inattentive type (ADHD-I), (2) hyperactive-impulsive type (ADHD-HI), and (3) the combined type (ADHD-C). ADHD has been assumed to be a condition that exclusively affects children and teenagers. However, prospective studies have suggested that the symptoms of ADHD may last into adulthood (Biederman et al., 2006). Moreover, ADHD may emerge for the first time in adulthood (Pineiro-Dieguez et al., 2016). Previous studies based on representative community samples showed that the estimated prevalence of adult ADHD varied from 1.1 to 7.3% (Caci et al., 2014; De Zwaan et al., 2012; Fayyad et al., 2007; Hesson & Fowler, 2018; Moulin et al., 2018; Park et al., 2011; Simon et al., 2009). Most of them, however, were conducted in the West. In Asia, only Korea has reported the prevalence of ADHD in adults aged between 18 and 59 years (1.1%) (Park et al., 2011). Concerning ADHD subtypes, a study with 107 adult outpatients suggested that ADHD-C was the most common type of ADHD (62.0%), followed by ADHD-I (31.0%) and ADHD-HI (7.0%) (Wilens et al., 2009). Studies based on clinical samples replicated the finding (Groß-Lesch et al.,

✉ Lan Zhang
zhanglan_8194@163.com

1 School of Psychology, Jiangxi Normal University, 99 Ziyang Ave, Nanchang, Jiangxi 330022, China

2 Shenzhen Mental Health Center, Shenzhen Kangning Hospital, Shenzhen, China

2016; Liebrenz et al., 2016). More studies on adult ADHD in various contexts within the general population are needed.

Several socioeconomic risk factors for ADHD have been investigated. Previous studies have shown that male sex, younger age, rural residency, separation and divorce, lower educational attainment, low income and unemployment were significantly related to increased risk of adult ADHD (De Zwaan et al., 2012; Lan et al., 2015; Michielsen et al., 2015; Park et al., 2011; Spencer, 2008). However, research in Germany showed being male may not confer an increased risk for ADHD symptoms (De Zwaan et al., 2012). In a Korean study, rural residency and male sex were not linked to adult ADHD (Park et al., 2011), and in a French study, lower education attainment was not found to be related to adult ADHD (Moulin et al., 2018). The association of adult ADHD with sociodemographic disadvantage seems to vary across countries. In addition, child maltreatment has been reported to be associated with adult ADHD (Ferrer et al., 2017; Lara et al., 2009). Moreover, a previous study demonstrated that behavior inhibition, a temperament trait characterized by fear and withdrawal (Gest, 1997), was negatively related to ADHD (Bacchini et al., 2008). Compared with ADHD, its subtypes have received significantly less attention. Few studies have investigated the association of childhood experiences and behavior inhibition with ADHD subtypes in the general population to date.

ADHD may contribute to the development of aggressive behavior. Aggression could be from hyperactivity and impulsivity associated with ADHD (Patel & Barzman, 2013). Previous research indicated that the ADHD group exhibited more violent problem-solving and anger expressions than the control group (Ramirez et al., 1997). For its subtypes, researchers found that adults with ADHD-C presented the highest symptom severity of oppositional defiant and conduct disorders (Sprafkin et al., 2007). To date, however, whether the aggression symptoms differ between the subtypes remains unclear. In addition to aggression, ADHD is also associated with suicide. A review by Furczyk & Thome suggested that individuals with ADHD were more likely to experience suicide ideation and commit suicide (Furczyk & Thome, 2014). A ten-year follow-up study indicated that self-injury and suicide attempt were highly concentrated in the combined type group (Hinshaw et al., 2012). Another study of medical students revealed a significant association between ADHD-I and ADHD-C and suicide behavior (Shen et al., 2021). Nevertheless, the participants in these studies were relatively young. A large community sample has not determined the relationship between suicide and ADHD.

To date, little is known regarding the prevalence and correlates of adult ADHD and its subtypes in China. Adults with ADHD may not be being treated because of underdiagnosis. Information on the correlates of ADHD and its subtypes can help mental health professionals develop more effective, targeted interventions to improve the care of adults with symptoms of ADHD and avoid adverse consequences of ADHD. The present study investigated the prevalence and correlates of ADHD and its subtypes in a large community sample of Chinese adults aged 18 to 81 years. We aimed to: (1) investigate the prevalence of ADHD and its subtypes; (2) examine specific psychosocial factors of different subtypes; (3) identify subtypes with high aggression and risk of suicide. We expected that being male, younger age, low SES, fewer childhood positive experiences, childhood trauma, and behavior inhibition were related to higher risks of ADHD. Compared to controls, adults with ADHD would report more aggressive and suicidal behaviors. In consideration of few reports about correlates of adult ADHD subtypes, there was no specific hypothesis on these analyses.

Methods

Participants and procedure

The data was from a project designed to investigate the mental health of students and parents in China. The project was carried out in five schools in Jiangxi and Hunan provinces, three in urban areas and two in rural areas. The detailed sampling and procedure are described in our previous studies (Geng et al., 2021; Zhan et al., 2021). Briefly, a total of 8746 questionnaires were distributed to students' family members (mostly parents) during parent-teacher meetings, and 7451 surveys were returned. Participants were excluded from the study because of incomplete answers or obvious errors. In the current study, the data of 7366 Chinese community adults (mean age 38.13 years, SD = 7.87, ranging from 18 to 81) were analyzed.

The survey was performed from November 5 to December 24, 2019. The participants were invited to fill out a structured, self-report questionnaire with the help of psychologists and trained teachers. Written informed consent was received from all the participants and permission was obtained from the target schools. The project was approved by the Ethics Committee of the School of Psychology, Jiangxi Normal University, in Nanchang province of China.

Measures

The ADHD Self-Report Scale (ASRS) was utilized to assess the symptoms of ADHD (Kessler et al., 2005). It comprises two subscales: inattention and hyperactivity-impulsiveness. Each subscale consists of 9 items rated on a Likert 5-point scale from 0 = rarely to 4 = very often. The Chinese version of the ASRS is valid and has been used in previous research

(Geng et al., 2021; Yeh et al., 2008). Participants with a total score of 24 or above on any of the subscales are more likely to have ADHD. Scores of 0–16 mean to be less likely to have ADHD. In the current sample, Cronbach α was 0.91 for the total scale.

The Benevolent Childhood Experience scale (BCEs) was administered to measure the positive childhood experiences of participants before the age of 18 (Narayan et al., 2018). The questionnaire is comprised of 10 items, with each item rated on a 2-point scale (1 = yes, 0 = no). The Chinese version of BCEs has shown good reliability and validity (Zhan et al., 2021). In the current sample, Cronbach α was 0.72.

The Childhood Trauma Questionnaire (CTQ) was used for the assessment of childhood trauma and neglect before the age of 18 (Bernstein et al., 2003). The questionnaire comprises five subscales to assess the severity of sexual abuse, physical abuse, emotional abuse, and physical and emotional neglect. Each subscale has 5 questions rated on a 5-point Likert scale, from 0 (never) to 4 (always). The Chinese version of the scale has good reliability and validity in Chinese college students and depression samples (He et al., 2019). In the current sample, Cronbach α was 0.83.

The Behavioral Inhibition Scale (BIS) (Muris et al., 1999) was adopted to evaluate behavioral inhibition in five aspects: shyness, communication, fear, and smile. The scale is comprised of 4 items scored on 4 point scale. The total score ranges from 4 to 16. In the current sample, Cronbach α was 0.59.

The Buss-Perry Aggression Questionnaire (BPAQ) was administered to measure aggressive behaviors in adults. BPAQ includes four dimensions: physical aggression, verbal aggression, anger, and hostility (Buss & Perry, 1992). It contains 12 items. Each item is rated on a 5-point scale from 1 for "not like me at all" to 5 for "most like me". The Chinese version of BPAQ has demonstrated good psychometric properties (Maxwell, 2008). Cronbach's α was 0.94 in the current sample.

Participants' self-injurious and suicide behaviors were measured by the Self-Injurious Thoughts and Behaviors Interview (SITBI) with four items (Nock et al., 2007): (1) Have you intentionally hurt yourself, but not to kill yourself during the last year?; (2) have you had suicide thoughts during the past year?; (3) "Have you ever actually made a plan to kill yourself during the last year?"; and (4) "Have you ever made an actual attempt to kill yourself during the last year?" Each item has six choices: no, 1, 2, 3, 4, and 5 or more. The variables were recoded into 0 (no) and 1 (at least one time).

Statistical analyses

Descriptive statistics were used to show the details of participants' sociodemographics. Sex, location, education, marriage satisfaction, perceived relative income and self-perceived physical health were categorical variables, and age, childhood positive experiences, behavior inhibition, and childhood trauma were continuous variables. Binary logistic regression was performed to explore the association between the psychosocial variables and ADHD. Multinomial logistic regression was used to assess the correlates of ADHD subtypes further. Multivariate analysis of variance was used to compare the differences in aggressive behaviors between different ADHD subtypes while adjusting for age, childhood positive experience, behavior inhibition, and childhood trauma. Finally, binary logistic regressions were conducted to investigate the associations of ADHD subtypes with suicide while adjusting for demographics, childhood positive experiences, behavior inhibition, and childhood trauma. Statistics were carried out in SPSS 23.0, with statistical significance defined as an alpha level < 0.05.

Results

Table 1 shows the sociodemographic characteristics of the participants. The total prevalence of ADHD was 6.7% (male 6.2%, female 6.9%). ADHD-I, ADHD-HI and ADHD-C accounted for 4.6% (male 3.7%, female 5.0%), 0.8% (male 1.1%, female 0.7%), and 1.3% (male 1.4%, female 1.2%), respectively.

The results of binary logistic regression showed that younger age, low income and poor physical health were significantly associated with elevated risks of adult ADHD. The location, education level and marital status did not differ between adults with and without ADHD. In addition,

Table 1 Sociodemographic variables. *(n = 7366)*

Variables	Categories	Proportion n (%)
Sex	Male	2424 (32.9)
	Female	4942 (67.1)
Age	Mean (SD), years	38.13 (7.87)
Location	Urban	4603 (62.5)
	Rural	2763 (37.5)
Education	Junior high school and below	3912 (53.1)
	High school and above	3454 (46.9)
Marriage satisfaction	Satisfied	6000 (81.5)
	Dissatisfied	962 (13.1)
	Single /Divorced /Widowed	404 (5.5)
Perceived relative income	High	856 (11.6)
	Middle	5924 (80.4)
	Low	586 (8.0)
Perceived physical health	Good	4424 (60.1)
	Fair	2819 (38.3)
	Poor	123 (1.7)

inhibition behavior and childhood trauma were significantly associated with increased risks of adult ADHD. Childhood positive experiences were significantly associated with decreased ADHD symptoms, see Table 2.

The results of multinomial logistic regression revealed that age, income and childhood positive experiences were inversely associated with ADHD-I. Childhood trauma and behavior inhibition were strongly associated with increased risks of ADHD-I. Poor self-perceived health and childhood trauma were associated with increased risks of ADHD-HI. Behavior inhibition and childhood trauma were significantly associated with increased risks of ADHD-C, see Table 3.

Table 4 presents the comparison of ADHD subtypes on aggression behaviors including physical aggression, verbal aggression, anger and hostility. Group differences were significant in four types of aggression. Compared with ADHD-I, ADHD-HI and ADHD-C groups indicated more severe aggressive symptoms.

Table 2 Correlates of adult ADHD

Variables	Unadjusted OR [95%CI]	Adjusted OR [95%CI]
Sex, female	1.00	1.00
Male	0.89 [0.73, 1.09]	0.95 [0.77, 1.17]
Age, years	0.99 [0.98, 1.00]	0.98 [0.97, 1.00] *
Location, urban	1.00	1.00
Rural	1.24 [1.03, 1.49] *	0.94 [0.76, 1.16]
Education, high school and above	1.00	1.00
Junior high school and below	1.42 [1.18, 1.71] ***	1.11 [0.90, 1.37]
Marriage satisfaction, satisfied	1.00	1.00
Dissatisfied	1.64 [1.29, 2.08] ***	1.24 [0.97, 1.59]
Single/Divorced/Widowed	1.61 [1.13, 2.28] **	1.42 [0.98, 2.05]
Perceived relative income, high	1.00	1.00
Middle	1.57 [1.11, 2.22] **	1.44 [1.01, 2.06] *
Low	2.71 [1.78, 4.13] ***	1.93 [1.23, 3.01] **
Perceived physical health, good	1.00	1.00
Fair	1.64 [1.37, 1.98] ***	1.32 [1.08, 1.60] **
Poor	2.07 [1.15, 3.73] *	1.29 [0.68, 2.43]
Childhood positive experiences	0.83 [0.80, 0.86] ***	0.95 [0.90, 0.99] *
Behavior inhibition	1.27 [1.21, 1.33] ***	1.18 [1.12, 1.24] ***
Childhood trauma	1.05 [1.04, 1.06] ***	1.04 [1.03, 1.05] ***

*, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$

The associations of ADHD subtypes with suicide are shown in Table 5. After adjusting for demographics, all ADHD subtypes were significantly associated with non-suicide self-injury, suicide ideation, suicide plan, and suicide attempt. When childhood positive experiences, behavior inhibition, and childhood trauma were further controlled, ADHD-I was associated with non-suicide self-injury, suicide ideation and suicide plan; ADHD-HI was associated with suicide plan and suicide attempt; ADHD-C was associated with non-suicide self-injury, suicide ideation and suicide attempt.

Discussion

To our knowledge, this is the first study of adult ADHD and its subtypes based on community samples in China. Our study reported roughly 6.8% of 6366 adults aged 18 to 81 had ADHD symptoms, which was within the higher range of several community-based studies (1.1–7.1%) (Caci et al., 2014; De Zwaan et al., 2012; Moulin et al., 2018; Park et al., 2011). In the Korean study, 1.1% of 6081 individuals aged 18 to 59 years had ADHD symptoms (Park et al., 2011). Among a sample of 1171 French adults aged 20 to 64 years, the estimated prevalence was 2.99% (Caci et al., 2014). Another recent French research showed that the prevalence in young adults aged 18 to 35 years was 7.71% (Moulin et al., 2018). The German study found that 4.7% of individuals aged 18 to 64 reported ADHD symptoms (De Zwaan et al., 2012). The varying ages of the subjects, different instruments and diagnostic criteria to assess ADHD may explain the discrepancies (Park et al., 2011). Indeed, our samples covered a wider range of ages than the cited study sample, and participants in this study were mainly family members of students and females. Our study demonstrated that ADHD-I (4.6%) was the most prevalent type, followed by ADHD-C (1.3%) and ADHD-HI (0.8%). This pattern was similar to the findings from a community-based study in children (Wolraich et al., 1996) while inconsistent with previous studies based on clinical samples, in which ADHD-C was the most common type, followed by ADHD-I and ADHD-HI (Groß-Lesch et al., 2016; Liebrenz et al., 2016; Sobanski et al., 2008; Wilens et al., 2009). It implies that the majority of ADHD sufferers who endorsed prominent inattention symptoms may not seek treatment. This was probably because they did not exhibit significant externalizing behaviors such as aggression, delinquency and impulsivity. Nonetheless, adults with ADHD-I deserve more attention and receive proper treatment because inattention may lead to impairment of working memory and executive function, which can affect their daily tasks.

Table 3 Correlates of adult ADHD subtypes

Variables	ADHD-I vs. NONE (n=338)	ADHD-HI vs. NONE (n=60)	ADHD-C vs. NONE (n=96)
	Adjusted OR [95%CI]	Adjusted OR [95%CI]	Adjusted OR [95%CI]
Sex, male	1.00	1.00	1.00
Female	0.83[0.64, 1.07]	1.29[0.75, 2.23]	1.23[0.79, 1.91]
Age, years	0.98[0.96, 1.00] *	1.01[0.98, 1.04]	0.98[0.96, 1.01]
Location, urban	1.00	1.00	1.00
Rural	0.90[0.70, 1.15]	1.33[0.74, 2.38]	0.90[0.57, 1.41]
Education, high school and above	1.00	1.00	1.00
Junior high school and below	1.04[0.81, 1.34]	1.17[0.64, 2.15]	1.38[0.86, 2.20]
Marriage satisfaction, satisfied	1.00	1.00	1.00
Dissatisfied	1.31[0.98, 1.76]	1.43[0.75, 2.73]	0.93[0.52, 1.65]
Single/Divorced/Widowed	1.52[0.99, 2.33]	0.91[0.31, 2.67]	1.43[0.63, 3.22]
Perceived relative income, high	1.00	1.00	1.00
Middle	1.53[0.99, 2.37]	1.03[0.43, 2.49]	1.53[0.72, 3.23]
Low	2.41[1.41, 4.13] **	1.92[0.66, 5.53]	0.53[0.15, 1.85]
Perceived physical health, good	1.00	1.00	1.00
Fair	1.24[0.99, 1.57]	1.82[1.04, 3.20] *	1.36[0.89, 2.08]
Poor	1.18[0.54, 2.56]	2.81[0.86, 9.18]	0.62[0.08, 4.74]
Childhood positive experiences	0.93[0.88, 0.98] **	1.00[0.88, 1.13]	0.97[0.88, 1.06]
Behavior inhibition	1.22[1.15, 1.29] ***	0.90[0.79, 1.02]	1.26[1.12, 1.42] ***
Childhood trauma	1.02[1.01, 1.03] **	1.08[1.06, 1.10] ***	1.07[1.05, 1.08] ***

NONE Did not meet screening criteria for any ADHD, *ADHD-I* inattentive type, *ADHD-HI* hyperactive-impulsive type, *ADHD-C* combined type

*, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$

Prior research showed that males were more prone to be affected with ADHD (Moulin et al., 2018), in our study, however, no sex effects on prevalence were found. There is also much evidence for no significant association between sex and adult ADHD (De Zwaan et al., 2012; Fayyad et al., 2007; Kessler et al., 2005; Simon et al., 2009), which to some degree supported our findings. Regarding the subtypes of ADHD, an earlier study has suggested the rate of girls with ADHD-I symptoms was slightly greater than that of the

other ADHD subtypes, and girls with ADHD exhibited less hyperactive and impulsive behaviors than boys (Wolraich et al., 1996). Nonetheless, no significant association between sex and specific subtypes was found in our study.

In agreement with previous studies (Asherson, 2009; De Zwaan et al., 2012; Moulin et al., 2018), our study indicated that fewer ADHD symptoms were reported with increasing age. In other words, adults being younger were at higher risk for ADHD symptoms. For example, in the German study (De Zwaan et al., 2012), ADHD was approximately three times more frequent in the 18–24 years group than in the oldest age group (55–64 years) (De Zwaan et al., 2012). The cited author considered it may indeed reflect a remission of the symptoms with age, but may also be accounted for by a lack of validity of the diagnostic criteria for ADHD when applied to older people. Although no evidence that the diagnostic criteria for adult ADHD are less valid for older people than for younger was found, the applicability of the diagnostic criteria in older people needs further verification. Concerning the relationship between age and subtypes, we observed decreases in ADHD-I symptoms with age. However, no significant association between age and ADHD-HI and ADHD-C was found. In contrast, prior studies demonstrated that hyperactive symptoms tended to decrease with age while inattentive symptoms persisted (Biederman et al., 2000; Wilens et al., 2009).

We found that rural residency, lower education level, less satisfaction with marriages and divorce were not significantly related to adult ADHD after adjusting for childhood trauma and behavior inhibition. The relationships between psychosocial factors and adult ADHD seem to be complex and potentially mediated by other factors. Low income in our study was significantly related to adult ADHD, probably because people with ADHD were more likely to be unemployed (Murphy & Barkley, 1996). The relationship between poor self-perceived physical health and adult ADHD was not significant in our study, which was not in line with previous studies (Landes & London, 2021; Semeijn et al., 2013), probably due to the very low rate of poor self-perceived health (1.7%). Regarding the ADHD subtypes, our results showed a significant association between low income and ADHD-I. Previous studies suggested that ADHD-I symptoms seemed to reflect more impairment in neuropsychological functioning, working memory and executive functioning (Walker et al., 2000). These impairments may lead to lower occupational achievement and higher risks of being fired, ultimately resulting in low income. Furthermore, we did not observe any significant association between self-perceived health and the three subtypes.

In our study, childhood positive experiences were protective factors against ADHD-I. Extensive research has

Table 4 Comparison of ADHD subtypes on aggression behaviors

Variables	ADHD-NONE Mean (SD)	ADHD-I Mean (SD)	ADHD-HI Mean (SD)	ADHD-C Mean (SD)	F	Comparison
Physical aggression	3.61(1.31)	4.33(1.76)	5.77(2.61)	5.95(2.76)	107.30 ***	NONE< I< HI, C
Verbal aggression	4.83(1.81)	6.00(2.03)	7.08(2.42)	7.46(2.54)	99.49 ***	NONE< I< HI, C
Anger	4.78(1.95)	6.68(2.55)	7.67(2.61)	8.18(3.12)	161.92***	NONE< I< HI, C
Hostility	4.10(1.60)	5.22(2.02)	6.53(2.40)	6.55(2.67)	101.48 ***	NONE< I< HI, C

Age, childhood positive experience, behavior inhibition, and childhood trauma were modeled as covariates

NONE Did not meet screening criteria for any ADHD, *ADHD-I* inattentive type, *ADHD-HI* hyperactive-impulsive type, *ADHD-C* combined type

*, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$

Table 5 Associations of ADHD subtypes with suicide as outcomes

Model 1: demographics were modeled as covariates; model 2: demographics, childhood positive experiences, behavior inhibition, and childhood trauma were modeled as covariates

ADHD-I inattentive type, *ADHD-HI* hyperactive-impulsive type, *ADHD-C* combined type

*, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$

Variable	Model	Non-suicide self-injury Adjusted OR [95%CI]	Suicide ideation Adjusted OR [95%CI]	Suicide plan Adjusted OR [95%CI]	Suicide attempt Adjusted OR [95%CI]
ADHD-I	Model 1	4.62[3.24,6.59] ***	4.23[2.96,6.04] ***	5.46[3.21,9.31] ***	2.56[1.20,5.45] *
	Model 2	4.00[2.77, 5.77] ***	3.60[2.48, 5.22] ***	4.33[2.46, 7.65] ***	1.78[0.79, 3.98]
ADHD-HI	Model 1	4.30[1.91,9.69] ***	4.44[2.04,9.67] ***	9.26[3.76,22.84] ***	9.85[3.98,24.41] ***
	Model 2	2.26[0.96, 5.32]	2.15[0.93, 4.97]	3.54[1.31, 9.52] *	3.43[1.23, 9.55] *
ADHD-C	Model 1	5.25[2.85,9.66] ***	5.99[3.34,10.74] ***	8.49 [3.91,18.41] ***	12.18[5.95,24.93] ***
	Model 2	2.57[1.31, 5.04] **	2.72[1.41, 5.25] **	2.11[0.84, 5.29]	3.01[1.25, 7.24] *

demonstrated that both positive and adverse experiences in childhood can shape the architecture of the brain (Hoppen & Chalder, 2018; Lai & Huang, 2011; Miguel et al., 2019). Positive experiences in early life help to build a healthy brain, which may improve executive functioning and reduce the risks of attention deficits (Crandall et al., 2019). Additionally, we found that childhood trauma was positively associated with ADHD and its three subtypes. Findings from prior work have demonstrated that individuals who experienced childhood trauma reported a smaller prefrontal cortex and reduced hippocampal activity (De Bellis et al., 2002; De Bellis & Zisk, 2014; Miguel et al., 2019). These brain areas have been implicated in planning, decision making, regulating emotion, sustained attention and working memory. It is therefore not surprising that childhood trauma confers an increased risk for adult ADHD as well as three subtypes. Furthermore, behavior inhibition was significantly and positively associated with adult ADHD, ADHD-I and ADHD-C. Although the results are inconsistent with the prior work (Bacchini et al., 2008), other studies have shown that children with ADHD-I were more introverted, withdrawn and socially passive than those with ADHD-HI and ADHD-C (Barkley, 2003; Gaub & Carlson, 1997; Koyuncu et al., 2019; Milich, 2001). The finding that there was no relationship between behavior inhibition and ADHD-HI

appeared to be reasonable because individuals with hyperactive symptoms were more extroverted and animated. The association between behavior inhibition and ADHD needs further investigation.

We found adults with ADHD-HI and ADHD-C reported significantly more severe symptoms of aggression than those with ADHD-I, which may imply that impulsive and hyperactive symptoms were related to aggressive behaviors. This is in line with prior studies, in which adults with ADHD-HI and ADHD-C exhibited more symptoms of oppositional defiant disorder (Sobanski et al., 2008) and more hyperactive symptoms (Hesslinger et al., 2001) than those with ADHD-I. In addition, our findings demonstrated that ADHD subtypes were associated with suicide even when demographics, childhood positive experiences, behavior inhibition, and childhood trauma were modeled as covariates. Specifically, ADHD-I was positively and significantly related to non-suicide self-injury, suicide ideation and suicide plan, which indicated that inattention was indeed an impairing factor. However, there was no association between ADHD-I and suicide attempt. Previous research reported that the suicide attempt was related solely to hyperactive and impulsive symptoms (Hinshaw et al., 2012), which supported our findings. Given that all the symptoms (hyperactive, impulsive and antisocial behavior)

of ADHD-HI are presented in ADHD-C, both ADHD-HI and ADHD-C were strongly associated with suicide attempt in our study. In summary, our results indicated that the hyperactive and impulsive symptoms were significantly correlated with aggressive behavior and higher risks of suicide attempt.

Limitations

This is the first study to investigate the prevalence and correlates of the ADHD subtype in community-based samples. Several limitations need to be noted. Firstly, all measures were based on self-reports, which may result in recall bias. The recall bias may influence the memory of childhood experiences of participants, particularly in older people. Secondly, the participants were primarily female and family members of students. Those who have no child were not included. This may impact prevalence estimates and the samples may not be representative of the whole population. Thirdly, the Behavioral Inhibition scale shows low reliability. Fourthly, a cross-sectional study could not determine the causal relationship between the variables. There may be bidirectional interactions between sociodemographic disadvantage and adult ADHD and its subtypes. Finally, the current study did not include some confounders such as the comorbidity of ODD, CD, depression and anxiety that may influence the relationship between suicide and ADHD.

Conclusions

The prevalence of adult ADHD was relatively high in Chinese community samples, most adults with ADHD reported prominent inattentive symptoms. The factors related to adult ADHD were identified such as sociodemographic variables, temperament traits and childhood experiences. Untreated ADHD in adults may lead to adverse outcomes. ADHD-HI and ADHD-C may cause more aggressive behavior, and ADHD-I and ADHD-C may be linked to more suicide behaviors. Identifying the correlates of ADHD and its subtypes can help clinicians diagnose and treat patients more effectively.

Declarations

Conflict of interest None.

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