

BMJ Open

BMJ Open is committed to open peer review. As part of this commitment we make the peer review history of every article we publish publicly available.

When an article is published we post the peer reviewers' comments and the authors' responses online. We also post the versions of the paper that were used during peer review. These are the versions that the peer review comments apply to.

The versions of the paper that follow are the versions that were submitted during the peer review process. They are not the versions of record or the final published versions. They should not be cited or distributed as the published version of this manuscript.

BMJ Open is an open access journal and the full, final, typeset and author-corrected version of record of the manuscript is available on our site with no access controls, subscription charges or pay-per-view fees (<http://bmjopen.bmj.com>).

If you have any questions on BMJ Open's open peer review process please email info.bmjopen@bmj.com

BMJ Open

Correlations of impulsivity and aggressive behaviors under the general aggression model among adolescent students in Shanghai, China

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2020-043785
Article Type:	Original research
Date Submitted by the Author:	17-Aug-2020
Complete List of Authors:	Yu, Chunyan; Shanghai Institute of Planned Parenthood Research, Department of Epidemiology & Social Science Zhang, Jiashuai; Shanghai Institute of Planned Parenthood Research, Department of Epidemiology & Social Science; Fudan University School of Public Health Zuo, Xiayun; Shanghai Institute of Planned Parenthood Research Lian, Qiguo; Shanghai Institute of Planned Parenthood Research Tu, Xiaowen; Shanghai Institute of Planned Parenthood Research, Dep. of epidemiology & social science Lou, Chaohua; Shanghai Institute of Planned Parenthood Research, Department of Epidemiology & Social Science
Keywords:	Child & adolescent psychiatry < PSYCHIATRY, PUBLIC HEALTH, Impulse control disorders < PSYCHIATRY

SCHOLARONE™
Manuscripts



I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

1
2
3
4
5
6
7 **Correlations of impulsivity and aggressive behaviors under the general aggression model**
8 **among adolescent students in Shanghai, China**
9

10
11
12
13
14 Chunyan Yu ^{1†}, Jiashuai Zhang ^{1,2†}, Xiayun Zuo¹, Qiguo Lian¹, Xiaowen Tu¹, Chaohua Lou^{1*}
15

- 16
17 1. NHC Key Lab. of Reproduction Regulation (Shanghai Institute of Planned Parenthood
18 Research), Fudan University, Shanghai, PR China.
19
20 2. NHC Key Lab. of Reproduction Regulation (Shanghai Institute of Planned Parenthood
21 Research), School of Public Health, Fudan University, Shanghai, PR China.
22
23
24

25
26 †: Contributed equally.

27
28 *: Correspondence to: Professor Lou C, Department of Epidemiology and Social Science,
29 Shanghai Institute of Planned Parenthood Research. *Postal Address: 779 Old Hu Min Road,*
30 *Shanghai 200237, PR China. Email: louchaohua60@163.com. TEL:86 21 64771589.*
31
32
33
34

35
36 Key words: Adolescent; Impulsivity; Aggressive behavior; neighborhood support
37

38 Word counts: 3520 words
39

40 Total Pages: 20
41

42 Tables: 4
43

44 Figures:1
45

46 Supplementary files: 1
47
48
49
50
51
52
53
54
55
56
57
58
59
60

ABSTRACT

Objective: To describe the aggressive behavior, impulsive level of young adolescents in a sample of Chinese middle school students, as well as to explore the relationship between aggressive behavior and impulsivity.

Design: A Computer-Assisted Self-Interview was used to access the correlation of aggressive behavior and impulsivity among young adolescent students. The Barratt Impulsivity Scale was used to measure impulsivity. Aggressive behaviors were determined by self-reports. Chi-square test and binary logistic regression were applied to examine the effect of impulsivity on aggressive behavior.

Setting: Three middle schools located in relatively poor communities of Shanghai.

Participants: Adolescent students from middle schools in grades 7-9.

Results: Totally 1451 students aged 11 to 15 were included in this study (52.01% of boys), and 7.79% of participants reported aggressive behaviors toward others during the past 6 months. Results of logistic regression suggested that high impulsivity is associated with a higher risk of aggressive behavior after adjusting for potential confounders (OR=2.412, 95%CI: 1.427-4.074). Besides, male adolescents with poor family care and poor neighborhood support, being bullied in the past six months, living with brothers or sisters were more likely to behave in aggressive ways.

Conclusions: The present study indicates a positive association between impulsivity and aggressive behavior in Chinese adolescent students. Furthermore, adolescent aggressive behavior was affected by multifaceted factors from individual, family, school, and community. Comprehensive intervention strategies such as controlling the aggressor's impulsivity, helping them better channel their anger, creating a better family, school and neighborhood environment and providing support and services for violence victims are needed.

Keywords: Adolescent students; Impulsivity; Aggressive behavior

Strengths and limitations of this study :

1. The study used a reliable and validated scale to access impulsivity among the participants.
2. The findings warrant further exploration of the factors critical to the understanding of aggressive behaviors.
3. The study may be underpowered to test for specific hypotheses such as the relationship between migrant status and aggressive behavior.
4. The possibility of under-reporting on aggressive behavior and the exclusion of participants because of the absence of key variables may introduce selection bias.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

For peer review only

1. Introduction

Aggression is a complex concept and it has traditionally been classified into two distinct subtypes, impulsive or premeditated. The former is characterized by uncontrolled and exaggerated responses to the stimuli which provoke them, while the latter is defined as a planned or conscious aggressive act, not spontaneous or related to an agitated state^[1]. Though aggression is one of the basic human traits aiding in the mechanism of survival, there are culturally bounded limits on acceptable levels of aggression or violent behaviors. Those over the limits of acceptable levels are considered harmful^[2].

Adolescence is a critical period for curtailing aggressive behaviors, as this developmental window is often accompanied by changes, stresses, and disparities which could arouse the anger^[3]. Previous studies have indicated that aggressive behavior was associated with a range of negative outcomes in adolescence, such as the increased risk of depressive symptoms, delinquency, internet addiction, and suicide attempts^[4-7]. In the school setting, aggressive behavior was related to low scores in academic performance and higher peer rejection^[4, 8]. At the family level, significant relationships were observed between aggressive behavior on the one hand, and family conflict and low family cohesion on the other^[4]. More importantly, if aggressive behaviors become prevalent during this stage of development, they can be escalated and persist^[3]. Evidence from longitudinal research has demonstrated that adolescents with higher levels of aggression are at greater risk of criminal activity and violence, peer victimization, rule-breaking behaviors, internalizing symptoms, and narcissistic and borderline personality features in the future^[9,10]. Furthermore, adolescents with higher aggressiveness tend to have difficulties in controlling waves of anger in adulthood and to have consistently poorer outcomes across domains of life success^[11,12]. Also, research has shown that high levels of aggression may result in high social costs because a range of services and resources are needed for the delinquency, incarceration, and unemployment^[5,10].

Aggressive behavior in adolescence is a complex phenomenon that cannot be explained by a single factor. The general aggression model (GAM) provides an integrative explanation of aggressive behavior based on three stages^[13]: 1) inputs: personal and situational factors; 2) routes or individual internal states: affect, cognition, and arousal; 3) outcomes: decision processes with a (non) aggressive result. In this model, the aggressive acts are influenced by genetic, neuropsychiatric, hormonal, cultural, familial, socioeconomic, and environmental factors. Elements involved in each of the three stages may increase or decrease the probability of behaving aggressively. Thus, identification of these risk factors is critical to the understanding of the aggressive behaviors among adolescents.

In recent years, the role of impulsivity on aggressive behavior has been attracted more and more attention^[14]. Aggression among adolescents takes the form of both impulsive and premeditated

1
2
3 behavior^[15]. As a personality trait with a strong biological foundation, impulsivity was described as a
4 quick and unplanned response for internal or external stimuli regardless of the negative consequences
5 for an individual or others^[16]. Thus, the definition of impulsivity could easily lead us to the intuitive
6 relationship between impulsivity and impulsive aggression. However, researches have shown that
7 impulsivity is present in any type of aggressive act and does not make a distinction between acts of
8 premeditated or impulsive aggression^[15,17]. A great number of studies in western countries have
9 demonstrated a positive association between impulsivity and aggression^[18-20].

10
11
12 In China, although adolescent impulsivity or aggression has been reported in many studies,
13 researches related to adolescent impulsivity was mainly focused on its relationship with internet
14 addiction and self-injury or suicidal behavior^[21-23]. The association between impulsivity and
15 aggressive behavior has been rarely reported. We carried out a school-based cross-sectional study
16 based on the first follow-up of The Global Early Adolescent Study (GEAS) in Shanghai, which is part
17 of a multinational longitudinal cohort study that focused on early adolescents in disadvantaged urban
18 environments. This paper was to examine the relationship between impulsivity and aggressive
19 behaviors under the GAM model among Chinese students aged 11 to 15.

2. Methods

2.1. Study design and participants

20
21
22 Three public primary middle schools in two sub-districts of the Jingan district were selected for
23 the present study. The sites were selected because of ongoing research partnerships and also because
24 they are located in the relatively underdeveloped areas in Shanghai. The criteria for participant
25 selection include: currently studying in grades 7 to 9 (the initial GEAS conducted in grades 6 to 8),
26 aged 11 to 15, living in the geographic division of the study areas, and their parents or guardians
27 consented their participation.

28
29
30 A total of 1578 adolescents were enrolled in the investigation. Among them, 127 (8.05%) were
31 excluded because they were aged over 15 years old or lack of key information. And finally, 1451
32 eligible students were included in the present study (**Figure 1**).

2.2. Procedure

33
34
35 The data collection was carried out by Computer-Assisted Self-Interview (CASI) using tablets
36 from November to December in 2018. Parental informed consent was collected by head-teachers
37 during parent-teacher meetings. Students who assented to take part in the survey were asked to fill in
38 the electronic questionnaires independently during lunch breaks or psychology courses. If they had
39 any questions, as they did so, they could raise their hands to ask the available investigators. Tablets
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 were returned after the process and checked by the investigators to ensure that all necessary questions
4 were answered before submission.
5

6 It took approximately 30-60 minutes to finish the electronic questionnaire and each student was
7 compensated for their participation with a small gift valuing about 20 CNY.
8
9

10 **2.3. Measures**

11 **2.3.1. Aggressive behavior**

12 Aggressive behavior in the present study was assessed by two items: 1): During the past 6 months,
13 have you bullied or threatened another boy or girl for any reason? 2): During the past 6 months, have
14 you slapped, hit or otherwise physically hurt another boy or girl in any way that they did not want?
15 Each item comprises six answer options: 1) no; 2) yes, both for girls and boys; 3) yes, for boys; 4) yes,
16 for girls; 5) don't know; 6) refuse to answer. The options 5 to 6 are treated as missing values in data
17 analysis. The participant was considered to be an aggressor if both or one of the two behaviors listed
18 above exists.
19
20
21
22
23
24

25 **2.3.2. Impulsivity and other factors**

26 The impulsivity in the present study was measured by the Barratt Impulsivity Scale (BIS-11), a
27 valid and reliable instrument developed by Barratt in 1959 and was revised by Patton in 1995 [24]. The
28 BIS-11 is one of the most often used tools to assess impulsivity. It is composed of 30 items and the
29 items are grouped into three sub-scales: Attentional impulsivity (AI, 8 items) describes the tendency
30 to inattention or to make a quick decision; Motor impulsivity (MI, 11 items) is about the propensity to
31 act solely on the spur of the moment despite the consequences; Nonplanning impulsivity (NPI, 11
32 items) indicates the lack of a plan for daily or long-term actions [24]. Items are rated on a 4-point Likert-
33 type scale ranging from 1 "rarely/ never" to 4 "almost always/ always". Among 30 items, eleven of
34 them are inverted because they relate to lower impulsivity. The re-coded responses of items were
35 summed into total scores of the full scale and sub-scales with higher scores signaling greater
36 impulsiveness. Previous studies have demonstrated the high reliability and validity of BIS-11 when
37 used in Chinese children and adolescents [25]. In the present study, we assessed the internal consistency
38 of the three subscales and the total scale. The Cronbach's alpha value was 0.50 for AI, 0.78 for NPI,
39 0.65 for MI, and 0.81 for the total BIS, respectively. Later, the mean score of impulsivity (MSI) was
40 calculated, which is obtained by dividing the total score of BIS-11 or sub-scales by the number of
41 relevant valid items. Scores were further dichotomized (\leq median, $>$ median) using median thresholds
42 of all participants when doing multivariate data analysis.
43
44
45
46
47
48
49
50
51
52
53
54
55

56 Demographic and environmental factors considered in the present study include participants' age,
57 gender, ethnicity, religion, family structure, family cares, and neighborhood support, etc.
58
59
60

2.4. Data analysis

The primary target of data analysis was to detect the association between impulsivity and aggressive behaviors (as dependent variables). The analysis began with the comparison of the score of BIS-11 and its sub-scales between aggressors and non-aggressors by the independent sample *t*-test. After that, the Chi-square (χ^2) test was applied to assess the differences in aggressive behavior between two groups with high and low impulsivity. Thirdly, multivariate logistic regression was conducted to assess the associations between impulsivity and aggressive behavior. For the dependent variable, four models were explored: 1) model using MSI in BIS-11 (30 items); 2) model using MSI in Attentional sub-scale (8 items); 3) model using MSI in Motor sub-scale (11 items); 4) model using MSI in Nonplanning sub-scale (11 items). In each model, socio-demographic characteristics (age, gender), as well as related social and environmental factors (such as family cares, neighborhood support, et al), were controlled. The statistical analyses were conducted by Stata SE version 15, the level of significance was set at 0.05 (two-tailed).

2.5. Ethical considerations

The present study was approved by the ethical committee of the Shanghai Institute of Planned Parenthood Research (Approved No. PJ2017-27).

2.6. Patient and public involvement

Young adolescents were invited to test the face validity of the questionnaire in the designing stage. During the survey, all participants were provided with an information sheet about psychosocial resources available to them, as well an option within the survey to indicate interest in supported referrals to services. Adolescents are going to be invited to join the interpretations of the findings and dissemination stages of the study as well.

3. Results

3.1 Background characteristics of participants

A total of 1451 students (51.21% of boys) aged 11 to 15 with a mean age of 13.47 ± 0.96 were included in this study, the proportion of students in grades 7, 8, 9 is 33.29%, 37.08%, and 29.50%, respectively. The background characteristics of eligible participants are described in **Table 1**. More than four-fifths (83.46%) of participants had Hukou of Shanghai, and almost all (92.49%) of them were taken care of primarily by their parents. More than 70% of participants reported that they had no religion, while nearly 20% of them are Buddhist, and the proportion of Christians or Catholics is 5.44%.

Table 1 Basic characteristics of eligible participants

Variables	Frequency (n)	Percent (%)
Age (years)		
11~13	720	49.62
14~15	731	50.38
Gender		
Male	743	51.21
Female	708	48.79
Ethnic group*		
Ethnic Han	1425	98.21
Others	25	1.72
Shanghai Hukou*		
Yes	1211	83.46
No	136	9.37
Primary caregiver*		
Self-care	3	0.19
Parents	1342	92.49
Others	94	6.48
Religion*		
No	1040	71.67
Buddhism	278	19.16
Christianity or catholicism	79	5.44
Islam	9	0.62
Others	19	1.31

*: percentages may not add to 100% due to missing data.

3.2 Score of impulsivities between aggressors and non-aggressors

113 (7.79%) of participants reported that they had ever conducted aggressive behavior in the present study. **Table 2** shows the comparison of the scores of impulsivities between aggressors and non-aggressors. The mean score of BIS-11 in aggressors was 68.47, significantly higher than non-aggressors (60.55, $P < 0.001$). Moreover, the mean score of three sub-scales of BIS-11 in aggressors was also higher than their counterparts (17.98 vs 15.82, 25.23 vs 21.84, 25.38 vs 22.99, respectively), the results of t -test indicated that the differences are statistically significant ($P < 0.001$).

Table 2 Score of impulsivities, grouping by aggressive behavior

Style of impulsivity	Aggressive behavior			No aggressive behavior			P -value
	n	Mean	S.D	n	Mean	S.D	
Total score of impulsivity	96	68.47	11.41	1220	60.55	9.67	< 0.001
Score of attentional impulsivity	105	17.98	3.55	1290	15.82	3.01	< 0.001

Score of motor impulsivity	105	25.23	5.60	1291	21.84	4.44	< 0.001
Score of nonplanning impulsivity	102	25.38	5.22	1281	22.99	5.08	< 0.001

Note: The analysis excluded those participants if any items in BIS-11 or sub-scales were missing; the differences between the two groups were compared by a two-independent t-test.

3.3 Influence factors of aggressive behavior

In the present study, the Chi-square test and multivariable binary logistic regression model were applied to evaluate the effect of impulsivity on aggressive behavior (**Table 3** and **Table 4**). The results indicate that aggressive behavior was present in 11.61% of students with high impulsivity, which is significantly higher than their counterparts with low impulsivity (3.87%; OR=2.412, 95%CI: 1.427-4.074). Furthermore, all of three sub-types of impulsivity were positively associated with the dependent variable; the results of the multivariate analysis suggested that all components of impulsivity (attentional, motor, non-planning) could significantly increase the risk of aggressive behavior (OR₁=2.270, 95%CI: 1.388-3.711; OR₂=2.454, 95%CI: 1.505-4.002; OR₃=1.830, 95%CI: 1.113-3.007, respectively) (**Table 4**).

The results of the multivariable analysis also suggested that female adolescents may be less likely to be aggressors compared with their male counterparts (OR: 0.459–0.495). Those who perceived very much care from caregivers were less likely to be aggressors (OR: 0.558–0.580). Having brothers or sisters live together (OR: 1.782–1.907), being bullied within the last six months (OR: 9.062–9.358) may greatly increase the risk of conducting aggressive behaviors. However, adolescents' age, number of close friends showed no significant impact on the dependent variable in this study (**Table 4**).

Table 3 Percentages of aggressive behavior, grouping by personal variables

Variables	No. of participants (n)	Percent (%)	χ^2	P-value
Age (years)				
11~13	720	7.64	0.044	0.834
14~15	731	7.93		
Gender			20.562	<0.001
Male	743	10.90		
Female	708	4.52		
Number of close friends			0.704	0.703
0~3	528	7.01		
4~6	449	8.24		
7~	474	8.23		
Primary caregiver care about you			21.156	<0.001
Not very	706	10.76		
Very	716	4.33		
Have brothers or sisters live together				

1					
2					
3	Nobody	1143	7.00		
4	At least one	299	10.37	3.786	0.052
5					
6	Neighbors will help each other				
7	Never or seldom	294	12.93		
8	Sometimes	509	7.66	19.391	<0.001
9	Always	567	4.59		
10					
11	Bullied within 6 months				
12	No	872	1.95		
13	Yes	507	18.15	115.53	<0.001
14					
15	Score of impulsivity				
16	Low	749	3.87		
17	High	689	11.61	30.683	<0.001
18					
19	Score of attentional impulsivity				
20	Low	837	4.18		
21	High	601	12.31	33.016	<0.001
22					
23	Score of motor impulsivity				
24	Low	840	4.40		
25	High	598	12.04	29.07	<0.001
26					
27	Score of non-planned impulsivity				
28	Low	741	5.26		
29	High	697	10.04	11.714	<0.001
30					

NOTE: The percentages between groups are compared by the Chi-square test.

Table 4 Factors associated with aggressive behavior: results of a multivariable binary logistic regression model

Variables	Model 1		Model 2		Model 3		Model 4	
	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI
Age (years)								
11~13	ref		ref		ref		ref	
14~15	0.861	(0.539-1.376)	0.839	(0.524-1.341)	0.878	(0.448-1.405)	0.862	(0.541-1.376)
Gender								
Male	ref		ref		ref		ref	
Female	0.467	(0.285-0.765)	0.495	(0.302-0.812)	0.487	(0.298-0.798)	0.459	(0.280-0.752)
Number of close friends								
0~3	ref		ref		ref		ref	
4~6	1.097	(0.616-1.951)	1.113	(0.625-1.984)	1.118	(0.628-1.991)	1.083	(0.610-1.924)
≥7	1.392	(0.792-2.447)	1.326	(0.757-2.324)	1.307	(0.743-2.299)	1.406	(0.801-2.469)
Primary caregiver cares about you								
Not very	ref		ref		ref		ref	
Very	0.576	(0.346-0.956)	0.58	(0.347-0.965)	0.558	(0.336-0.927)	0.569	(0.343-0.943)
Brothers or sisters living together								
Nobody	ref		ref		ref		ref	
At least one	1.782	(1.067-2.977)	1.907	(1.141-3.188)	1.854	(1.106-3.107)	1.845	(1.106-3.078)
Neighbors will help each other								
Never or seldom	ref		ref		ref		ref	
Sometimes	0.665	(0.385-1.147)	0.69	(0.400-1.191)	0.7	(0.404-1.211)	0.695	(0.404-1.197)
Always	0.448	(0.242-0.828)	0.454	(0.246-0.840)	0.465	(0.251-0.863)	0.451	(0.244-0.834)
Bullied within 6 months								
No	ref		ref		ref		ref	
Yes	9.07	(4.921-16.715)	9.206	(5.00-16.963)	9.062	(4.914-16.710)	9.358	(5.079-17.240)

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46

Score of impulsivity

Low	ref		ref		ref		ref	
High	2.412	(1.427-4.074)	2.27	(1.388-3.711)	2.454	(1.405-4.002)	1.83	(1.113-3.007)

Note: the impulsivity in models 1, 2, 3, and 4 refers to the total impulsivity, attentional impulsivity, motor impulsivity, non-planning impulsivity, respectively.

For peer review only

4. Discussion

The present study sought to add to our knowledge of the relationship between impulsivity and aggression in Chinese adolescents by exploring this relationship using the GAM model in a sample of primary/middle school students. Consistent with similar research in other populations^[3,18,20], adolescents with higher impulsivity were significantly more likely to perform aggressive behaviors. Furthermore, positive associations were found between all subtypes of impulsivity and aggressive behaviors, demonstrating not only motor impulsivity (acting without thinking) but also attentional (unable to be concentrate) and non-planning (lack of forethought) is highly related to adolescents' aggression.

In neuroimaging studies, personality traits such as impulsivity and aggressiveness have been associated with variations in the structure and function of brain networks that regulate mood, impulse, and behavior^[26]. The physiological mechanism of impulsivity was generally considered as an excitatory response produced by the nervous system; when stimulated by internal or external factors, it may give rise to an intense emotional state within a short period and this emotion constitutes the basis for impulsive behavior^[16]. On the one hand, an individual can be more decisive and courageous on the spur of impulses in the face of unexpected opportunities or challenges and difficulties. On the other hand, if an individual lacks the cognitive resources necessary to manage impulses, he or she can be driven by desire or anger, which may result in a range of negative outcomes^[27]. According to the GAM model, when an adolescent appraises a certain situation as a possible source of menace and pain, he or she can become negatively aroused^[13]. In such a situation, adolescents with higher impulsivity often show a deficiency in social adaptation and emotional self-control and empathy; therefore, they may face more difficulties to deal with social situations, and their incapacity to adequately managing their emotions may lead them to behave in aggressive ways ^[28].

Comparing our prevalence of aggressive behavior with previous studies implemented in Chinese settings, given the range of reported published estimates from 3.27 % among middle-school students in Hubei Province to 19.80% of middle school students in Henan Province^[29,30], our results suggested a moderate prevalence estimate of aggressive behavior (7.79%). This variation may partially be explained by various social conditions (e.g. economic status, cultural environment, social security) and sample ascertainment methods in different studies. The lack of standardized definition and

1
2
3
4 measurement methods for adolescent aggression may also contribute to the variation.

5
6 The result of the present study indicated that female adolescents were less likely to involved in
7 aggressive behavior toward others than their male counterparts (OR=0.459–0.495), a similar finding
8 was reported elsewhere^[31]. Female students tend to have less physical strength than their male peers
9 and they are always required to be quiet, gentle, and polite under Chinese culture; therefore, these
10 students may less likely to behave in aggressive ways. A previous study has demonstrated that girls
11 were prone to social aggression^[32], while this study mainly focuses on physical aggression, and thus
12 the female aggressive behaviors may be under-estimated.

13
14 The finding that better family care is negatively related to adolescent aggression (OR: 0.558–
15 0.580) is in line with the family coercion theory, which assumes that positive family interactions
16 contribute to decreasing youth problem behaviors^[33]. Poor family care might contribute to adolescent's
17 aggressive behaviors in many ways: such as less monitoring and lack of adults to confide in when
18 anger is triggered because of events and processes in the environment. Further, those adolescents who
19 have grown up with poor family care are more likely to elicit negative responses from their parents as
20 they begin to assert their autonomy and independence. These negative interactions are likely to result
21 in increasingly aversive and coercive processes which could put adolescents at a higher risk of
22 aggression and other behavioral problems^[34].

23
24 The finding of the present study also indicated that adolescents living with their brothers or sisters
25 were more likely to be aggressors (OR: 1.782–1.907). Generally, because the One-Child Policy of
26 China officially ended until only in late 2015, adolescents in our sample were assumed to be only one
27 child if they were from ordinary families. One possible explanation of our result is that students living
28 with siblings might come from immigrant families as the study sites located in the traditional habitat
29 for migrant populations in Shanghai (to confirm our hypothesis we further compared the proportion of
30 “one-child” among migrants and non-migrants, and found that migrants were 6.4 times more likely to
31 have siblings, see appendix 1). Migrant families tend to have more children, lower incomes and worse
32 household conditions, and they were expected to have more difficulties to obtain relevant resources,
33 supports, and treatments, which were historically identified as risk factors for aggression ^[35]. Because
34 of the ill-equipped emotional regulation skills in adolescents, those students from immigrant families
35 are more likely to develop a sense of inferiority ^[36], and thus they might behave in aggressive ways in
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3
4 certain conditions to win the so-called identity and dignity.

5
6 A previous study has demonstrated that social and environmental factors were the principal
7 influences of aggression and that neighborhood support was a significant protective factor against
8 aggression^[37]. Our study also indicated that the neighborhood support of the adolescents may
9 significantly decrease their likelihood of aggressive behaviors (OR₁: 0.665-0.700; OR₂: 0.448-0.465).
10
11 Poor neighborhood environment - characterized by high levels of violence, anger, and disapproval and
12 low warmth and support - has been reported to be associated with an increased risk of behavior
13 problems and delinquency and aggression in adolescents^[38]. In contrast, students were likely to feel
14 more supported – and less aggressive - in a neighborhood that provides adequate resources and
15 assistance for youth healthy growth and development, such as after-school programming and
16 recreational spaces^[39]. These resources may lead to less aggressive behavior by encouraging social
17 networks and bonding within the neighborhood^[37].

18
19 Adolescent aggressors tend to have higher levels of life stress than their counterparts without such
20 behaviors^[40]. Since the school has become the primary arena for an adolescent, stressors caused by
21 discordant school relationships were common such as peer conflicts or bullying^[40]. Consistent with
22 previous research that showed that school-related tensions were significant predictors of aggression^[33],
23 our study also suggested that peer's bullying was associated with a higher risk of aggressive behavior
24 (OR: 9.062–9.358). Adolescents with bullying experience are likely to breed a negative intention of
25 hostility and revenge. If the resulting negative emotions are not handled properly, it would cause
26 aggressive behavior once the victim has an opportunity to retaliate. Further, adolescents tend to have
27 a stronger ability to imitate. The bullying or aggression of their schoolmates may set a bad example,
28 and thus they might behave similarly in certain conditions. This finding implies the efforts to reduce
29 youth aggression by providing appropriate supports and services to those students who have already
30 been bullied by his schoolmates or peers.

31
32 Naturally, there are limitations to this study. Firstly, because of the cross-sectional design, the
33 results cannot provide firm conclusions regarding the causal effects proposed. Secondly, the aggressive
34 behavior in this study is based on self-reports, which may result in the underestimation of aggression
35 (particularly with social aggression). Besides, we did not distinguish the impulsive aggressive
36 behaviors from premeditated aggressive behaviors. Further studies are needed to explore how
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3
4 impulsivity plays differently in these two forms, given their different biological, psychological, and
5 social etiologic factors as well as management strategies. Finally, more than 8% of enrolled students
6 were excluded because of the absence of dependent variable, although the distribution of basic
7 characteristics between enrolled and excluded subjects was not statistically significant, selection bias
8 may be introduced due to this limitation.
9
10
11
12

13
14 None the less, aggression is part of our makeup. It is human nature to occasionally be aggressive
15 towards someone. Teachers, researchers and health promoters need to tell students that there are times
16 and places where aggression is acceptable. They could also teach adolescents to learn how to channel
17 aggression to the places where it is appropriate and useful. The result of our study does not imply that
18 any single individual trait or factor is to be blamed for being the cause of aggressive and violent
19 behaviors. Instead, we believe that learning what combination of factors contributes to it could point
20 to leads for designing the intervention strategies to help young adolescents. That said, it is important
21 to understand that aggressive and violent behaviors continue to be as much a reality in schools as well
22 as in society at large. Helping young adolescents' learn to control their impulsiveness, channeling the
23 anger, and helping those who are at higher risks of being aggressive could be other approaches to
24 improve all adolescents' physical and psychological well-being rather than only taking disciplinary
25 action against aggressors.
26
27
28
29
30
31
32
33
34
35
36
37
38

39 **Conclusions**

40
41 Despite these limitations, the current study provides clear evidence of the role of impulsivity and
42 other factors in aggression in Chinese adolescent students. Consistent with research in other
43 populations, a positive association between impulsivity and aggressive behavior was found.
44
45 Furthermore, results also indicated that aggressive behavior may be affected by multifaceted factors
46 from individual, family, school and community, suggesting a need for comprehensive intervention
47 strategies such as controlling the aggressor's impulsivity, teaching them to channel their anger,
48 creating a supportive and nurturing school and neighborhood environment as well as providing
49 psychological support and services for violence victims.
50
51
52
53
54
55
56

57 **Abbreviations**

1
2
3
4 BIS-11: Barratt Impulsivity Scale; CASI: Computer Assisted Self-Interview; GAM: General
5 Aggression Model; GEAS: The Global Early Adolescent Study; MSI: Mean Score of Impulsivity.
6
7
8

9 **Acknowledgments**

10
11 The Global Early Adolescent Study is a multinational study that aims to understand the development
12 of gender norms in early adolescence, and its impacts on adolescent health across time and geographies.
13 The study operates in conjunction with the World Health Organization (WHO) and the Johns Hopkins
14 Bloomberg School of Public Health (JHBSPH).
15

16
17 We thank all researchers and students who participate in the present study, as well as administrators
18 and teachers in target schools. We thank the technical support from JHBSPH. We thank Dr.
19 Venkatraman Chandra-Mouli from the Department of Reproductive Health Research, WHO for
20 helping review the manuscript.
21
22
23
24
25
26
27
28

29 **Source of funding**

30
31 The present study was funded by the Innovation-oriented Science and Technology Grant from NHC
32 Key Laboratory of Reproduction Regulation [CX2017-05] and the Innovation-oriented Youth Science
33 and Technology Grant [Q2018-1] from Shanghai Institute of Planned Parenthood Research.
34
35
36
37
38

39 **Authors' contributions**

40
41 Chaohua Lou initiated the GEAS in Shanghai as a coordinator and project leader, all authors are
42 contributed to the study design and data collection. Chunyan Yu and Jiashuai Zhang conducted the
43 data analysis and drafted the paper, all authors are involved in the writing of the manuscript and read
44 and approved the final manuscript.
45
46
47
48
49

50 **Declaration of interest**

51
52 The authors report no conflicts of interest.
53
54
55

56 **Reference**

57
58 [1] Stanford MS, Houston RJ, Mathias CW, et al. Characterizing Aggressive behavior. *Assessment*
59
60

1
2
3
4 2003; 10(2): 183-190.

5 [2] Austerman J. Violence and Aggressive Behavior. *Pediatr Rev* 2017; 38 (2): 69-80.

6 [3] MacDonell ET, Willoughby T. Investigating honesty-humility and impulsivity as predictors of
7 aggression in children and youth. *Aggress Behav* 2020; 46(1): 97-106. doi: 10.1002/ab.21874.

8 [4] Estévez E, Jiménez TI, Moreno D. Aggressive behavior in adolescence as a predictor of personal,
9 family, and school adjustment problems. *Psicothema* 2018; 30(1): 66-73.

10 [5] Schmits E, Glowacz F. Delinquency and drug use among adolescents and emerging adults: the role
11 of aggression, impulsivity, empathy, and cognitive distortions. *J Subst Use* 2019; 24(2): 162-169.

12 [6] Obeid S, Saade S, Haddad C, et al. Internet addiction among Lebanese adolescents: the role of self-
13 esteem, anger, depression, anxiety, social anxiety and fear, impulsivity, and aggression - a cross-
14 sectional study. *J Nerv Ment Dis* 2019; 207(10): 838-846.

15 [7] Wang L, He CZ, Yu YM, et al. Associations between impulsivity, aggression, and suicide in
16 Chinese college students. *BMC Public Health* 2014; 14: 551. doi: 10.1186/1471-2458-14-551.

17 [8] Evans SC, Fite PJ, Hendrickson ML, et al. The role of reactive aggression in the link between
18 hyperactive-impulsive behaviors and peer rejection in adolescents. *Child Psychiatry Hum Dev* 2015;
19 46(6): 903-912.

20 [9] Sigurdson JF, Undheim AM, Wallander JL, et al. The long-term effects of being bullied or a bully
21 in adolescence on externalizing and internalizing mental health problems in adulthood. *Child Adolesc*
22 *Psychiatry Ment Health* 2015; 9: 42. doi: 10.1186/s13034-015-0075-2.

23 [10] Ehrenreich SE, Beron KJ, Underwood MK. Social and physical aggression trajectories from
24 childhood through late adolescence: Predictors of psychosocial maladjustment at age 18. *Dev Psychol*
25 2016; 52(3): 457-462.

26 [11] Kokko K, Pulkkinen L, Huesmann LR, et al. Intensity of aggression in childhood as a predictor
27 of different forms of adult aggression: a two-country (Finland and United States) analysis. *J Res*
28 *Adolesc* 2009; 19(1): 9-34.

29 [12] Huesmann LR, Dubow EF, Boxer P. Continuity of aggression from childhood to early adulthood
30 as a predictor of life outcomes: implications for the adolescent-limited and life-course-persistent
31 models. *Aggress Behav* 2009; 35(2):136-149.

32 [13] Anderson CA, Bushman BJ. Human aggression. *Annual Review of Psychology* 2002; 53: 27-51.

- 1
2
3
4 [14] Chapman BP, Huang A, Horner E, et al. High school personality traits and 48-year all-cause
5 mortality risk: results from a national sample of 26 845 baby boomers. *J Epidemiol Community Health*
6 2019;73:106-110.
7
8
9 [15] Barratt ES, Stanford MS, Dowdy L, et al. Impulsive and premeditated aggression: a factor analysis
10 of self-reported acts. *Psychiatry Res* 1999;86:163-173.
11
12 [16] Hamilton KR, Mitchell MR, Wing VC, et al. Choice impulsivity: Definitions, measurement issues,
13 and clinical implications. *Personal Disord* 2015; 6(2): 182-198.
14
15 [17] Azevedo J, Vieira-Coelho M, Castelo-Branco M, et al. Impulsive and premeditated aggression in
16 male offenders with antisocial personality disorder. *PLoS One* 2020; 15(3): e0229876.
17
18 [18] Sarkisiana K, Van Hullea C, Lemery-Chalfant K, et al. Childhood inhibitory control and
19 adolescent impulsivity and novelty seeking as differential predictors of relational and overt aggression.
20 *J Res Pers* 2017; 67: 144-150.
21
22 [19] Urben S, Habersaat S, Pihet S, et al. Specific contributions of age of onset, callous-unemotional
23 traits and impulsivity to reactive and proactive aggression in youths with conduct disorders. *Psychiatr*
24 *Q* 2018; 89(1): 1-10.
25
26 [20] Hahn AM, Simons RM, Simons JS, et al. Prediction of verbal and physical aggression among
27 young adults: A path analysis of alexithymia, impulsivity, and aggression. *Psychiatry Res* 2019; 273:
28 653-656.
29
30 [21] Deng L, Wu Y, Kong R, et al. Interactive influence of impulsiveness and parent-adolescent
31 communication on adolescents' internet addiction. *Psychological Development and Education* 2014;
32 2: 169-176. (In Chinese)
33
34 [22] Zhang W, Liu N, Wang C, et al. Relationship between childhood trauma, impulsivity and suicide
35 ideation in patients with borderline personality disorder. *J Clin Psychiatry* 2017; 27(1): 19-21. (In
36 Chinese)
37
38 [23] Lu X, Zhu F, Liu Y, et al. A comparative study of impulsivity and self-consciousness between
39 depressive adolescents with and without non-suicidal self-injury. *Journal of Psychiatry* 2018; 31(5):
40 325-327. (In Chinese)
41
42 [24] Patton JH, Stanford MS, Barratt ES. Factor structure of the Barratt Impulsiveness scale. *J Clin*
43 *Psychol* 1995; 51: 768 -774.
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

- 1
2
3
4 [25] Wang C, Su L, Li Y, et al. Reliability and validity of Barratt Impulsiveness Scale in Chinese
5 primary school students. *J Appl Clin Pediatr* 2010, 25(17): 1342-1345. (In Chinese)
6
7 [26] Soloffa P, White R, Diwadkar VA. Impulsivity, aggression and brain structure in high and low
8 lethality suicide attempters with borderline personality disorder. *Psychiatry Res* 2014; 222(3): 131–
9 139. doi:10.1016/j.psychres.2014.02.006.
10
11 [27] Pérez Fuentes MDC, Molero Jurado MdM, Carrión Martínez JJ, et al. Sensation-seeking and
12 impulsivity as predictors of reactive and proactive aggression in adolescents. *Front Psychol* 2016; 7:
13 1447. doi: 10.3389/fpsyg.2016.01447.
14
15 [28] Franco C, Amutio A, López-González L, et al. Effect of a mindfulness training program on the
16 impulsivity and aggression levels of adolescents with behavioral problems in the classroom. *Front*
17 *Psychol* 2016; 7: 1385. doi:10.3389/fpsyg.2016.01385.
18
19 [29] Sun L, Heng S, Niu G, et al. Association between childhood psychological abuse and aggressive
20 behavior in adolescents: the mediating role of the security and loneliness. *Chinese Journal of Clinical*
21 *Psychology*. 2017; 25(5): 902-906. (In Chinese)
22
23 [30] Wang J, Yu Y. A case control study on personality character and risk factors of the students with
24 aggressive behavior. *Chin J School Health*, 2006; 27(3): 222-223. (In Chinese)
25
26 [31] Hao W, Wu C, Yu Y. Aggressive behaviors among left-behind and non-left-behind children in
27 rural China: a comparative analysis. *Chin J Public Health* 2019. DOI:10.11847/zgggws1120384. (In
28 Chinese)
29
30 [32] Liu Y, Kuang L, Ai M, et al. Investigation of gender differences of suicidal, impulsive and
31 aggressive behavior among Chongqing college students. *Chin J Sch Health* 2015; 36(3): 333-336. (In
32 Chinese)
33
34 [33] Smokowski PR, Guo S, Cotter KL, et al. Multi-level risk factors and developmental assets
35 associated with aggressive behavior in disadvantaged adolescents. *Aggress Behav* 2016; 42(3): 222-
36 238.
37
38 [34] Hentges RF, Shaw DS, Wang MT. Early childhood parenting and child impulsivity as precursors
39 to aggression, substance use, and risky sexual behavior in adolescence and early adulthood. *Dev*
40 *Psychopathol* 2018; 30(4): 1305-1319.
41
42 [35] Kramer-Kuhn AM, Farrell AD. The promotive and protective effects of family factors in the
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3
4 context of peer and community risks for aggression. *J Youth Adolesc* 2016; 45(4): 793-811.

5 [36] Li H, Wu R, Yao R. Effect of rural family rearing environment on aggressive behavior of children.
6 *Pract Prev Med* 2019; 26(10): 1205-1209. (In Chinese)
7

8 [37] Cotter KL, Smokowski PR. An investigation of relational risk and promotive factors associated
9 with adolescent female aggression. *Child Psychiatry Hum Dev* 2017; 48(5): 754-767.
10
11

12 [38] Musci RJ, Bettencourt AF, Sisto D, et al. Violence exposure in an urban city: A GxE interaction
13 with aggressive and impulsive behaviors. *J Child Psychol Psychiatry* 2019; 60(1): 72-81.
14
15

16 [39] McMahon SD, Todd NR, Martinez A, et al. Aggressive and prosocial behavior: community
17 violence, cognitive, and behavioral predictors among urban African American youth. *Am J Community*
18 *Psychol* 2013; 51(3-4): 407-421.
19
20
21

22 [40] Liu C, Xie B, Lin Z, et al. A pilot study on adolescents' impulsive aggression, stress level and the
23 hypothalamic-pituitary-adrenal axis activity. *Chin J Nerv Ment Dis* 2010; 36(9): 543-546. (In Chinese)
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

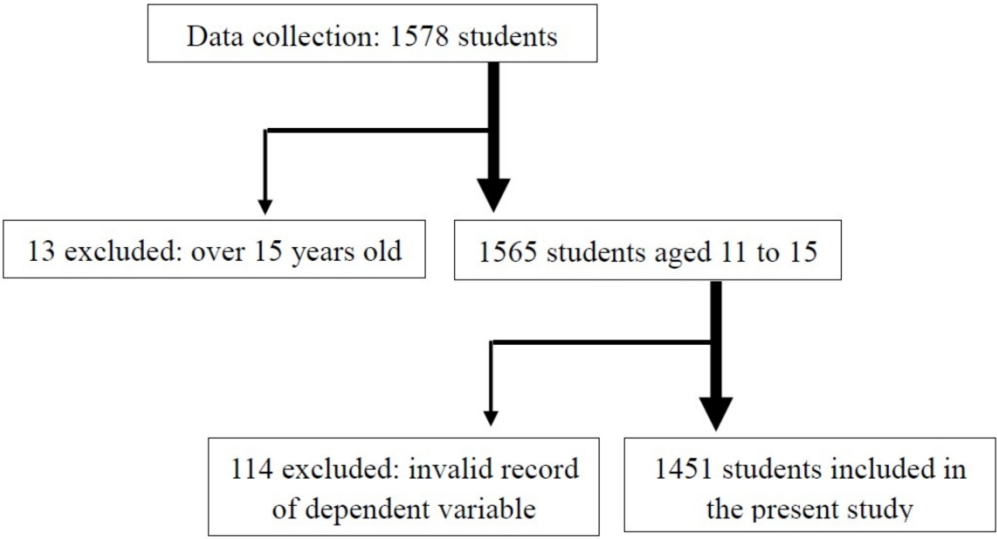


Figure 1: Flow diagram of exclusion and inclusion criteria of participants in data analysis
270x146mm (300 x 300 DPI)

BMJ Open: first published as 10.1136/bmjopen-2020-043785 on 15 July 2021. Downloaded from <http://bmjopen.bmj.com/> on April 19, 2024 by guest. Protected by copyright.

Supplementary file 1:

Table: Differences on distribution of being the only-child between migrant (don't have shanghai Hukou) and non-migrant (have Shanghai Hukou) adolescents

		Only child		χ^2	<i>P</i>	<i>OR</i>	95% <i>CI</i>
		Yes (Exposed)	No (Unexposed)				
Have Shanghai Hukou	Yes (Case)	1028	179	113.2	<0.001	6.38	4.30-9.45
	No (Control)	63	70				

Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

Upload your completed checklist as an extra file when you submit to a journal.

In your methods section, say that you used the STROBE cross sectional reporting guidelines, and cite them as:

von Elm E, Altman DG, Egger M, Pocock SJ, Gotsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies.

		Page
	Reporting Item	Number
Title and abstract		
Title	#1a Indicate the study's design with a commonly used term in the title or the abstract	1

1	Abstract	#1b	Provide in the abstract an informative and balanced summary	2
2			of what was done and what was found	
3				
4				
5				
6	Introduction			
7				
8				
9	Background /	#2	Explain the scientific background and rationale for the	3-4
10	rationale		investigation being reported	
11				
12				
13				
14				
15	Objectives	#3	State specific objectives, including any prespecified	4
16			hypotheses	
17				
18				
19				
20	Methods			
21				
22				
23	Study design	#4	Present key elements of study design early in the paper	4
24				
25				
26	Setting	#5	Describe the setting, locations, and relevant dates, including	4-5
27			periods of recruitment, exposure, follow-up, and data	
28			collection	
29				
30				
31				
32				
33				
34	Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of	4
35			selection of participants.	
36				
37				
38				
39		#7	Clearly define all outcomes, exposures, predictors, potential	5-6
40			confounders, and effect modifiers. Give diagnostic criteria, if	
41			applicable	
42				
43				
44				
45				
46				
47	Data sources /	#8	For each variable of interest give sources of data and details	5
48	measurement		of methods of assessment (measurement). Describe	
49			comparability of assessment methods if there is more than	
50			one group. Give information separately for for exposed and	
51			unexposed groups if applicable.	
52				
53				
54				
55				
56				
57				
58				
59				
60				

1	Bias	#9	Describe any efforts to address potential sources of bias	5-6
2				
3				
4	Study size	#10	Explain how the study size was arrived at	5
5				
6				
7	Quantitative	#11	Explain how quantitative variables were handled in the	6
8	variables		analyses. If applicable, describe which groupings were	
9			chosen, and why	
10				
11				
12				
13				
14				
15	Statistical	#12a	Describe all statistical methods, including those used to	6
16	methods		control for confounding	
17				
18				
19				
20	Statistical	#12b	Describe any methods used to examine subgroups and	6
21	methods		interactions	
22				
23				
24				
25				
26	Statistical	#12c	Explain how missing data were addressed	5-6
27	methods			
28				
29				
30				
31	Statistical	#12d	If applicable, describe analytical methods taking account of	N/A
32	methods		sampling strategy	
33				
34				
35				
36	Statistical	#12e	Describe any sensitivity analyses	N/A
37	methods			
38				
39				
40				
41				
42	Results			
43				
44				
45	Participants	#13a	Report numbers of individuals at each stage of study—eg	4,7
46			numbers potentially eligible, examined for eligibility,	
47			confirmed eligible, included in the study, completing follow-	
48			up, and analysed. Give information separately for for	
49			exposed and unexposed groups if applicable.	
50				
51				
52				
53				
54				
55				
56				
57	Participants	#13b	Give reasons for non-participation at each stage	4
58				
59				
60				

1	Participants	#13c	Consider use of a flow diagram	5
2				
3				
4	Descriptive data	#14a	Give characteristics of study participants (eg demographic,	7
5			clinical, social) and information on exposures and potential	
6			confounders. Give information separately for exposed and	
7			unexposed groups if applicable.	
8				
9				
10				
11				
12				
13				
14	Descriptive data	#14b	Indicate number of participants with missing data for each	7
15			variable of interest	
16				
17				
18				
19	Outcome data	#15	Report numbers of outcome events or summary measures.	7
20			Give information separately for exposed and unexposed	
21			groups if applicable.	
22				
23				
24				
25				
26				
27	Main results	#16a	Give unadjusted estimates and, if applicable, confounder-	8-11
28			adjusted estimates and their precision (eg, 95% confidence	
29			interval). Make clear which confounders were adjusted for	
30			and why they were included	
31				
32				
33				
34				
35				
36				
37	Main results	#16b	Report category boundaries when continuous variables were	8-11
38			categorized	
39				
40				
41				
42	Main results	#16c	If relevant, consider translating estimates of relative risk into	N/A
43			absolute risk for a meaningful time period	
44				
45				
46				
47				
48	Other analyses	#17	Report other analyses done—e.g., analyses of subgroups	21
49			and interactions, and sensitivity analyses	
50				
51				
52				
53	Discussion			
54				
55				
56	Key results	#18	Summarise key results with reference to study objectives	12-15
57				
58				
59				
60				

1	Limitations	#19	Discuss limitations of the study, taking into account sources	14-15
2			of potential bias or imprecision. Discuss both direction and	
3			magnitude of any potential bias.	
4				
5				
6				
7				
8				
9	Interpretation	#20	Give a cautious overall interpretation considering objectives,	12-15
10			limitations, multiplicity of analyses, results from similar	
11			studies, and other relevant evidence.	
12				
13				
14				
15				
16	Generalisability	#21	Discuss the generalisability (external validity) of the study	14
17			results	
18				
19				
20				
21				
22	Other Information			
23				
24				
25	Funding	#22	Give the source of funding and the role of the funders for the	16-17
26			present study and, if applicable, for the original study on	
27			which the present article is based	
28				
29				
30				
31				

32 None The STROBE checklist is distributed under the terms of the Creative Commons Attribution
 33 License CC-BY. This checklist can be completed online using <https://www.goodreports.org/>, a tool
 34 made by the [EQUATOR Network](#) in collaboration with [Penelope.ai](#)

BMJ Open

Correlations of impulsivity and aggressive behaviors among adolescents in Shanghai, China: cross-sectional data from Global Early Adolescent Study

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2020-043785.R1
Article Type:	Original research
Date Submitted by the Author:	13-Feb-2021
Complete List of Authors:	Yu, Chunyan; Shanghai Institute of Planned Parenthood Research, Department of Epidemiology & Social Science Zhang, Jiashuai; Shanghai Institute of Planned Parenthood Research, Department of Epidemiology & Social Science; Fudan University School of Public Health Zuo, Xiayun; Shanghai Institute of Planned Parenthood Research Lian, Qiguo; Shanghai Institute of Planned Parenthood Research Tu, Xiaowen; Shanghai Institute of Planned Parenthood Research, Dep. of epidemiology & social science Lou, Chaohua; Shanghai Institute of Planned Parenthood Research, Department of Epidemiology & Social Science
Primary Subject Heading:	Mental health
Secondary Subject Heading:	Public health
Keywords:	Child & adolescent psychiatry < PSYCHIATRY, PUBLIC HEALTH, Impulse control disorders < PSYCHIATRY

SCHOLARONE™
Manuscripts



I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

1
2
3 1 **Correlations of impulsivity and aggressive behaviors among adolescents in Shanghai, China:**
4
5 2 **cross-sectional data from Global Early Adolescent Study**

6
7 3 Chunyan Yu ^{1†}, Jiashuai Zhang ^{2†}, Xiayun Zuo¹, Qiguo Lian¹, Xiaowen Tu¹, Chaohua Lou^{1*}
8

- 9
10 4 1. NHC Key Lab. of Reproduction Regulation (Shanghai Institute of Planned Parenthood
11 5 Research), Fudan University, Shanghai, PR China.
12
13 6 2. NHC Key Lab. of Reproduction Regulation (Shanghai Institute of Planned Parenthood
14 7 Research), School of Public Health, Fudan University, Shanghai, PR China.
15
16 8

17
18 9 †: Contributed equally.

19
20 10 *: Correspondence to Professor Lou C, Department of Epidemiology and Social Science,
21 11 Shanghai Institute of Planned Parenthood Research. *Postal Address: 779 Old Hu Min Road,*
22 12 *Shanghai 200237, PR China. Email: louchaohua60@163.com. TEL:86 21 64771589.*
23
24
25

26 13
27
28 14 **Keywords:** Adolescent; Impulsivity; Aggressive behaviors; Neighborhood supports.

29
30 15 **Word counts:** 4019 words

31
32 16 **Total Pages:** 22

33
34 17 **Tables:** 5

35
36 18 **Supplementary files:** 2 tables
37
38
39
40
41 20
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1 ABSTRACT

2 **Objective:** To examine the correlations between impulsivity and aggressive behaviors among
3 Chinese adolescents.

4 **Design:** A school-based cross-sectional study.

5 **Setting:** Three primary middle schools located in less-developed communities of Shanghai.

6 **Participants:** 1524 adolescents aged 11 to 16 years.

7 **Measures:** The impulsivity was measured by Barratt Impulsivity Scale (BIS-11), and the aggressive
8 behaviors were determined by self-reports. Data were collected through Computer-Assisted Self-
9 Interview using tablets. Multivariate Firth logistic regression model was conducted to examine
10 correlations between total, attentional, motor, and non-planning impulsivity and aggressive
11 behaviors, respectively

12 **Results:** Totally 7.48% of participants reported aggressive behaviors toward others during the past 6
13 months. The proportion of aggressors among boys and girls was 10.60% and 4.18%, respectively.
14 Results of the multivariate regression suggested the risk of aggressive behaviors was significantly
15 increased among those with the highest tertile of total impulsivity (aOR_{boys}=3.14, 95%CI: 1.48-6.65;
16 aOR_{girls}=3.74, 95%CI: 1.10-12.76) and motor impulsivity (aOR_{boys}=2.91, 95%CI: 1.46-5.82;
17 aOR_{girls}=3.57, 95%CI: 1.25-10.20.), comparing with those with the lowest tertile, for boys and girls,
18 respectively. Besides, younger age, lower social cohesion, and being bullied within 6 months were
19 associated with a higher risk of aggressive behaviors among girls. Less family caring and being
20 bullied within 6 months were associated with the risk among boys.

21 **Conclusions:** The present study indicates a positive association between impulsivity and aggressive
22 behaviors, with a more salient correlation between motor impulsivity sub-trait and aggressive
23 behavior among both boys and girls. Furthermore, adolescents' aggressive behaviors were affected
24 by multiple factors from individual, family, peers, and community. Comprehensive intervention
25 strategies such as controlling the aggressor's impulsivity, helping them better channel their anger,
26 creating a better family, school, and neighborhood environment, and providing support and services
27 for violence victims are needed.

28 **Keywords:** Adolescent; Impulsivity; Aggressive behaviors; Neighborhood supports.

29 **Strengths and limitations of this study :**

- 30 1. The study used a reliable and validated scale to access impulsivity among the participants.
- 31 2. The findings warrant further exploration of the impulsiveness subscales to the understanding of
32 aggressive behaviors critically.

- 1
2
3 1 3. The simplified measurement of aggressive behavior prevents the further distinction of the
4
5 2 impulsive aggressive behavior from premeditated aggressive behavior. Further studies are needed
6
7 3 to explore how different facets of impulsivity plays differently in these two forms.
8
9 4
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

For peer review only

1. Introduction

Aggression is a complex concept. It has traditionally been classified into two distinct subtypes, impulsive (also known as reactive or hostile) or premeditated (also known as proactive or instrumental). The former is characterized by uncontrolled and exaggerated responses to the stimuli, while the latter is defined as planned or conscious aggressive acts, not spontaneous or related to an agitated state^[1]. Though the division is not without meaningfulness to guide the prevention and intervention due to the potential harm it could cause, there were some criticism of the dichotomous method of characterizing aggressive behavior as the distinction of the two is not that clear and it is the harm that should be concerned regardless the typology of the actions ^[2].

Previous studies have indicated that aggressive behavior was associated with a range of adverse outcomes in adolescence, such as the increased risk of depressive symptoms, delinquency, internet addiction, and suicide attempts^[3-6]. In the school setting, aggressive behavior was related to low academic performance scores and higher peer rejection^[3, 7]. At the family level, significant relationships were observed between aggressive behavior on the one hand and family conflict and low family cohesion on the other^[3]. More importantly, if aggressive behaviors become prevalent during this developmental stage, they can be escalated and persist^[8]. Evidence from longitudinal research has demonstrated that adolescents with higher aggression levels are at greater risk of criminal activity and violence, peer victimization, rule-breaking behaviors, internalizing symptoms, and narcissistic and borderline personality features in the future^[9, 10]. Furthermore, adolescents with higher aggressiveness tend to have difficulties in controlling waves of anger in adulthood and have consistently poorer outcomes across life success domains ^[11, 12]. Also, research has shown that high levels of aggression may result in high social costs because a range of services and resources are needed for the delinquency, incarceration, and unemployment^[5, 9].

As a personality trait with a strong biological foundation, impulsivity was defined as a quick and unplanned response for internal or external stimuli regardless of the negative consequences for an individual or others^[13]. The definition of impulsivity does have overlaps with aggressiveness. It is also one of the main precursors of a set of antisocial behaviors and the basis for several pathological disorders such as attention-deficit/hyperactive disorder, borderline personality disorder and antisocial personality disorder^[14-16]. A great number of studies in western countries have demonstrated a positive association between impulsivity and aggression^[7, 17-19], both concurrently and longitudinally. However, such correlations were majorly explored among the forensic population or clinical sample, or taking the impulsivity as a whole (using the total impulsive score in the analysis) instead of considering it as a multi-facet construct.

1
2
3 1 Among adolescents, studies showed that impulsivity might not be a direct risk for aggression.
4
5 2 Youth often cannot adequately manage their emotions when facing difficulties, leading them to behave
6
7 3 in aggressive ways [20]. Existing research also argues that behaviors resulting from motor impulsiveness
8
9 4 are by nature unplanned or reactive[21]. In contrast, behaviors resulting from attentional (cognitive)
10
11 5 impulsiveness are more likely to be planned or proactive. The latter should be taken more attention
12
13 6 and in consideration of targeted intervention or treatment[14]. Other researches showed that impulsivity
14
15 7 was present in any type of aggressive act and did not distinguish between acts of premeditated or
16
17 8 impulsive aggression[16, 22, 23]. Given the mixed results and their relevance to both healthy and harmful
18
19 9 facets of the behaviors, the role of impulsivity still attracts numerous attentions. The question of
20
21 10 whether a person is capable of modulating their cognition and behavior to fit the demands of a given
22
23 11 environment is imperative[14], which makes understanding the role of impulsiveness in the forming of
24
25 12 aggression among healthy/ordinary population, especially among young adolescents who are at the
26
27 13 critical developing stage urgent.

28
29 14 The present study is guided by Bronfenbrenner's ecological model and Blum's conceptual
30
31 15 framework for research targeting early adolescence[24], including family-, school- and neighborhood-
32
33 16 factors in the process of shaping youth's aggressive behavior despite individual biological
34
35 17 characteristics and personal traits[25]. At the family level, family structure and parental connectedness
36
37 18 would help buffer the anger, while school and peer interactions exert significant influences on the
38
39 19 conducting of aggressive havior[25, 26]. Neighborhood environment is another important but always
40
41 20 neglected factor for shaping aggressive behavior as it provides the scenario for multiple health risk
42
43 21 behaviors[27]. For adolescence, specifically, it is a critical period for curtailing aggressive behaviors as
44
45 22 both impulsivity and sensation seeking (both relate to risk-taking behaviors)are at their peak during
46
47 23 this developmental window according to the Dual System Model[21]. The changes, stresses, and
48
49 24 disparities could arouse anger easily[8]. According to Blum's framework[24], adolescence is also a
50
51 25 dynamic developmental period of learning and adaptation, which creates both vulnerabilities and
52
53 26 unique opportunities for early intervention and prevention. Thus, the identification of risk factors is
54
55 27 critical to the understanding of aggressive behaviors among adolescents.

56
57 28 There are also culturally bounded limits on acceptable levels of aggression or violent behaviors.
58
59 29 Aggressive behaviors over the boundaries of acceptable levels are often considered harmful[28]. Such
60
30 cultural differences were noted by researchers both in the level of aggression and their correlations,
31
32 31 reflected through the social environment and individual differences, including personality and
33
34 32 cognition [23]. In China, researches on adolescents' impulsiveness were mainly focused on its impacts
35
36 33 on internet addiction and self-injury or suicidal behavior[29-31], while researches on the association

1
2
3 1 between impulsivity and aggressive behaviors were scant. We used the wave 2 cross-sectional data
4 2 from the Global Early Adolescent Study (GEAS) in Shanghai to examine the correlations of
5 3 impulsivity and aggressive behaviors with the consideration of covariates in the individual, family,
6 4 school and neighborhood level according to the ecological model. GEAS a multinational longitudinal
7 5 study that focused on early adolescents in disadvantaged urban environments with a gender lens. For
8 6 the present study, we hypothesized that (1) impulsivity would be positively correlated with young
9 7 adolescents' aggressive behavior while the correlation would be strong among motor or non-planning
10 8 impulsiveness and aggression; (2) Ecological factors like family interactions, peer interactions and
11 9 community environment would be influential to the forming of adolescents' aggressive behaviors.
12
13
14
15
16
17
18
19
20

21 2. Methods

22 2.1. Study design and participants

23 12
24 13 Data for this study were drawn from wave 2 of the GEAS investigation. A stratified cluster
25 14 sampling procedure was adopted for the selection of participants in GEAS Shanghai site. Three
26 15 primary public middle schools in two less-developed sub-districts of the Jing'an district in Shanghai
27 16 were selected, and the fieldwork was implemented with the coordination of key informants from the
28 17 local teacher's organization. All eligible students in grades 7th to 9th (the baseline investigation of
29 18 GEAS was conducted in grades 6th to 8th) were invited to participate in the study after obtaining their
30 19 assent and the consent of their parents or guardians.
31
32
33
34
35
36

37 20 A total of 1611 adolescents participated in the wave 2 investigation. Of them, 87 (5.40%) were
38 21 excluded because of missing information on impulsivity (16) or aggressive behaviors (71), respectively.
39 22 Finally, 1524 eligible students were included in the data analysis.
40
41

42 2.2. Procedure

43 24 Data were collected through tablets using the Computer-Assisted Self-Interview (CASI) method
44 25 during November and December in 2018. The students were organized by their teachers in the class
45 26 units to fill in the electronic questionnaire independently during the lunch break or psychological class.
46 27 In each class, 1-2 trained investigators were present in case the participants need assistance with the
47 28 tablet using. Communication or discussion among participants during the process was dissuaded, while
48 29 questions regarding the survey could be raised to the available investigators. The questionnaire took
49 30 approximately 25 to 40 minutes to finish. The tablets were returned after the process and checked by
50 31 the investigators to ensure that all necessary questions were answered before submission. Each student
51 32 was compensated for their participation with a small gift valued at 20-30 CNY after the process.
52
53
54
55
56
57
58

59 33 The GEAS in Shanghai was approved by the Medical Ethical Committee of the Shanghai Institute
60

of Planned Parenthood Research (No. PJ2017-27); a deemed exempt for secondary data analysis was approved by the Johns Hopkins Bloomberg School of Public Health Institutional Review Board.

2.3. Measures

2.3.1. Aggressive behavior

Aggressive behavior was assessed by two items: 1) During the past 6 months, have you bullied or threatened another boy or girl for any reason? 2) During the past 6 months, have you slapped, hit, or otherwise physically hurt another boy or girl in any way that they did not want? Each item comprised six options: 1) no; 2) yes, both for girls and boys; 3) yes, for boys; 4) yes, for girls; 5) don't know; 6) refuse to answer. Options 5 and 6 were treated as missing values in data analysis. A student was classified into an aggressor if both or one of the two behaviors listed above exists.

2.3.2. Impulsivity

The impulsivity was measured by BIS-11, a valid and reliable instrument developed by Barratt in 1959 and revised by Patton in 1995^[32]. The scale composed of 30 items and grouped into three subscales: attentional impulsivity (AI, 8 items) describes the tendency to inattention or to make a quick decision; motor impulsivity (MI, 11 items) is about the propensity to act solely on the spur of the moment despite the consequences; non-planning impulsivity (NPI, 11 items) indicates the lack of a plan for daily or long-term actions^[32]. The items were rated by a 4-point Likert-type option from 1 (rarely/ never) to 4 (almost always/ always), and mean scores ranged from 1 to 4 of the scales were calculated after partly items were scored transpose, with a higher score indicating greater impulsiveness. We split the continuous mean scores into tertiles in the multivariate regression model due to skewed distributions of mean scores and the absence of generalized cut-off values across researches. The model compared the highest and middle to the lowest tertiles. Previous studies demonstrated the reliability and validity of BIS-11 when used in Chinese children and adolescents, and the polychoric ordinal alpha value in the present study was 0.62 for AI, 0.81 for NPI, and 0.74 for MI, and 0.89 for the total BIS.

2.3.3 Covariates

Covariates include adolescents' age, binary indicators of gender at the individual level, binary indicators of family structure (only child vs. other), perceived care from the primary caregiver that reflecting family caring at the family level, number of close friends, experiences of being bullied within 6 months at the school level, as well as perceived supports from the neighborhood.

2.4. Data analysis

The data analysis began with describing and comparing aggressive behavior, impulsivity, and covariates between boys and girls. Secondly, the differences of the mean scores of BIS-11 and its

1 subscales between aggressors and non-aggressors were compared using either *t*-test or *Wilcoxon* test.
 2 Thirdly, due to the lower prevalence of aggressors in the present study, the multivariate firth logistic
 3 regression model^[33] was conducted to assess the association between impulsivity and aggressive
 4 behavior among the total sample, as well as boys' and girls', respectively. Four models were explored
 5 for each group using total BIS-11 mean core and the mean score of each subscale (AI, MI, and NPI,
 6 respectively. In each model, the demographic characteristics, as well as personal and ecological factors
 7 listed above were controlled. Before modeling, we first examined the cluster effects on the level of
 8 school (level-3) and class (level-2) through multilevel zero-models to determine if the hierarchical
 9 structure statistically exists in our data given the cluster obtained by cluster sampling. We found,
 10 however, the effects were statistically insignificant both for boys or girls, and thus the general logistic
 11 regression model was chosen for data analysis. The statistical analyses were conducted by Stata SE
 12 version 15. The level of significance was set $\alpha=0.05$ at two-tailed.

2.5. Patient and public involvement

14 Young adolescents were invited to test the face validity of the questionnaire in the designing
 15 stage. During the survey, all participants were provided with an information sheet about psychosocial
 16 resources available to them and an option within the study to indicate interest in supported referrals to
 17 services. Adolescents will be invited to join the interpretations of the findings and dissemination stages
 18 of the research as well.

3. Results

3.1 Sample characteristics

22 The eligible participants in this study were aged 11 to 16 years old, with a mean age of $13.32 \pm$
 23 0.96 . Boys included in the analysis were slightly more than girls (51.38% vs. 48.62%). Table 1 exhibits
 24 the variables used in this study by gender. Compared to boys, girls reported fewer experiences of being
 25 bullied within 6 months and fewer close friends. Boys scored higher on attentional impulsivity, and
 26 lower on non-planning impulsivity. Additionally, gender differences in the proportion of only child,
 27 family caring, social cohesion, total impulsivity, and motor impulsivity are statistically insignificant
 28 ($P > 0.05$), while the prevalence of aggressive behaviors is higher among boys than among girls (P
 29 < 0.05).

Table 1 Description of demographic variables, aggressive behaviors, impulsivity, and covariates

Variables	Total (N=1524)	Boys (n=783)	Girls (n=741)
Aggressors (%)	7.48	10.60	4.18 *
Only child (%)	78.74	80.20	77.19

Bulled within 6 month (%)	35.24	39.59	30.23 *
No. of close friends (%)			
0-3	36.35	31.03	41.97 *
4-6	30.71	31.16	20.23
7-	32.94	37.08	27.80
Neighbors caring for each other (%)			
Never or seldom	19.95	20.82	19.03
Sometimes	34.58	33.46	35.76
Always	39.57	39.46	39.68
Perceived care from the primary caregiver (%)			
Lower	48.56	49.04	48.04
Higher	49.51	48.28	50.20
Age (Mean ± SD)	13.32 (0.96)	13.35 (0.98)	13.28 (0.94)
Total impulsivity (Mean ± SD)	2.04 (0.34)	2.05 (0.34)	2.04 (0.33)
Attentional impulsivity (Mean ± SD)	2.00 (0.39)	2.04 (0.41)	1.96 (0.37) &
Motor impulsivity (Mean ± SD)	2.01 (0.42)	2.01 (0.43)	2.00 (0.42)
Non-planning impulsivity (Mean ± SD)	2.11 (0.47)	2.08 (0.47)	2.15 (0.46) ^s

Note: percentages may not add to 100% due to missing data

*: $p < 0.05$, chi-square test; &: $p < 0.05$, Wilcoxon test; ^s: $p < 0.05$, two-independent t-test.

3.2 Score of impulsivity between aggressors and non-aggressors

Table 2 shows the comparison of impulsivity between aggressors and non-aggressors by gender. The mean score of BIS-11 in aggressors was 2.27 and 2.32 among boys and girls, respectively, which were significantly higher than their counterparts ($P < 0.001$). Moreover, the scores of AI, MI, and NPI in aggressors were significantly higher than those of non-aggressors for both boys and girls ($P < 0.001$).

Table 2 The score (mean ± SD) of impulsivity, grouping by gender and aggressive behavior

	Boys			Girls		
	Aggressors	Non-aggressors	<i>P</i>	Aggressors	Non-aggressors	<i>P</i>
Total impulsivity	2.27 (0.36)	2.02 (0.33)	<0.001*	2.32 (0.40)	2.03 (0.33)	<0.001&
AI	2.27 (0.45)	2.02 (0.39)	<0.001*	2.20 (0.46)	1.95(0.36)	0.002&
MI	2.28 (0.51)	1.98 (0.41)	<0.001&	2.33 (0.52)	1.99 (0.40)	<0.001&
NPI	2.26 (0.44)	2.06 (0.46)	<0.001*	2.41 (0.52)	2.14 (0.46)	0.001*

*: two-independent t-test; &: Wilcoxon test

3.3 Factors associated with aggressive behavior

For the total sample, the multivariate logistic regression model results indicated the risk of aggressive behaviors was significantly increased among those with the highest tertile of total impulsivity, AI, MI, and NPI when compared with those among the lowest tertile (Table 3, OR:

1
2
3 1 1.99~3.23). However, a statistically significant difference was not found among the middle tertile
4 2 group and the lowest tertile group. Table 4 and Table 5 exhibits the results of gender-stratified data
5 3 analysis for boys and girls, respectively. Similarly, for total impulsivity and MI(model 1 and model 3),
6 4 the risk of conducting aggressive behaviors significantly increased in the highest tertile group
7 5 compared to those in the lowest tertile group. However, for AI and NPI (model 2 and model 4), the
8 6 risk of conducting aggressive behaviors in the highest or middle tertile group was not statistically
9 7 increased versus the lowest tertile group.

10 8 The results suggested that female adolescents were less likely to be an aggressor (Table 3, OR:
11 9 0.43~0.48). For boys, those who reported a higher level of family caring were less likely to be an
12 10 aggressor (Table 4), whereas such an effect was not significant among girls. On the contrary, older age
13 11 and higher social cohesion were associated with a lower risk of aggressive behaviors among girls
14 12 (Table 5), while these effects were not significant among boys. Being bullied within 6 months may
15 13 significantly increase the risk of aggressive behaviors for both boys and girls. However, the number
16 14 of close friends, family structure (only child) showed no significant associations with aggressive
17 15 behaviors in this study (Table 4 and 5).

Table 3 Factors associated with aggressive behaviors among all samples: results of a multivariable binary Firth logistic regression model

Variables	Model 1	Model 2	Model 3	Model 4
	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)
Age (years)				
11~13	ref	ref	ref	ref
14~16	0.54 (0.34-0.88)	0.54 (0.33-0.87)	0.51 (0.31-0.83)	0.54 (0.34-0.88)
Gender				
Boys	ref	ref	ref	ref
Girls	0.43 (0.27-0.70)	0.48 (0.29-0.77)	0.45 (0.28-0.73)	0.43 (0.27-0.70)
No. of close friends				
0~3	ref	ref	ref	ref
4~6	1.09 (0.62-1.90)	1.08 (0.62-1.90)	1.10 (0.63-1.94)	1.12 (0.64-1.95)
≥7	1.56 (0.90-2.68)	1.42 (0.83-2.44)	1.46 (0.85-2.52)	1.57 (0.91-2.71)
Perceived care from the primary caregiver				
Lower	ref	ref	ref	ref
Higher	0.58 (0.35-0.94)	0.57 (0.35-0.93)	0.58 (0.35-0.95)	0.56 (0.35-0.92)
Only child				
Yes	ref	ref	ref	ref
No	1.62 (0.99-2.68)	1.62 (0.98-2.65)	1.66 (1.01-2.75)	1.56 (0.95-2.57)
Neighbors caring for each other				
Never or seldom	ref	ref	ref	ref
Sometimes	0.65 (0.38-1.11)	0.69 (0.41-1.18)	0.66 (0.39-1.12)	0.66 (0.39-1.12)
Always	0.46 (0.25-0.83)	0.45 (0.25-0.82)	0.43 (0.23-0.78)	0.45 (0.25-0.82)
Being bullied within 6 months				
No	ref	ref	ref	ref
Yes	7.83 (4.44-13.80)	8.23 (4.67-14.50)	8.15 (4.62-14.39)	8.46 (4.81-14.88)

Impulsivity				
Lowest tertile	ref	ref	ref	ref
Middle tertile	2.02 (0.99-4.11)	1.04 (0.55-1.99)	1.26 (0.67-2.37)	1.29 (0.68-2.45)
Highest tertile	3.23 (1.70-6.16)	1.99 (1.12-3.54)	3.07 (1.72-5.50)	2.04 (1.11-3.72)

Note: the impulsivity in the model 1, 2, 3, and 4 refers to the total, attentional, motor, and non-planning impulsivity, respectively.

Table 4 Factors associated with aggressive behaviors among boys: results of a multivariate binary logistic regression model

Variables	Model 1	Model 2	Model 3	Model 4
	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)
Age (years)				
11~13	ref	ref	ref	ref
14~16	0.69 (0.39-1.20)	0.67 (0.38-1.16)	0.65 (0.37-1.11)	0.70 (0.40-1.21)
No. of close friends				
0~3	ref	ref	ref	ref
4~6	1.25 (0.64-2.46)	1.19 (0.60-2.33)	1.25 (0.63-2.46)	1.26 (0.64-2.46)
≥7	1.68 (0.86-3.27)	1.48 (0.77-2.87)	1.54 (0.79-3.01)	1.65 (0.84-3.21)
Perceived care from the primary caregiver				
Lower	ref	ref	ref	ref
Higher	0.49 (0.27-0.88)	0.47 (0.26-0.84)	0.49 (0.27-0.89)	0.48 (0.27-0.87)
Only child				
Yes	ref	ref	ref	ref
No	1.35 (0.72-2.53)	1.40 (0.75-2.62)	1.35 (0.72-2.54)	1.30 (0.69-2.43)
Neighbors caring for each other				
Never or seldom	ref	ref	ref	ref

Sometimes	0.81 (0.42-1.55)	0.87 (0.46-1.67)	0.85 (0.44-1.64)	0.82 (0.43-1.56)
Always	0.59 (0.28-1.21)	0.58 (0.28-1.20)	0.55 (0.27-1.13)	0.55 (0.27-1.13)
Being bullied within 6 months				
No	ref	ref	ref	ref
Yes	6.93 (3.56-13.50)	7.20 (3.70-13.99)	7.17 (3.67-14.07)	7.49 (3.86-14.53)
Impulsivity				
Lowest tertile	ref	ref	ref	ref
Middle tertile	1.86 (0.82-4.22)	0.84 (0.38-1.88)	1.20 (0.57-2.54)	1.41 (0.68-2.91)
Highest tertile	3.14 (1.48-6.65)	1.96 (0.99-3.89)	2.91 (1.46-5.82)	1.82 (0.89-3.72)

Note: the impulsivity in models 1, 2, 3, and 4 refers to the total, attentional, motor, and non-planning impulsivity, respectively.

Table 5 Factors associated with aggressive behavior among girls: results of a multivariate binary logistic regression model

Variables	Model 1	Model 2	Model 3	Model 4
	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)
Age (years)				
11~13	ref	ref	Ref	ref
14~16	0.33 (0.12-0.89)	0.34 (0.13-0.89)	0.32 (0.12-0.86)	0.34 (0.13-0.90)
No. of close friends				
0~3	ref	ref	Ref	ref
4~6	0.80 (0.29-2.18)	0.87 (0.32-2.34)	0.92 (0.34-2.50)	0.91 (0.33-2.48)
≥7	1.27 (0.50-3.23)	1.26 (0.50-3.17)	1.26 (0.49-3.24)	1.33 (0.52-3.40)
Perceived care from the primary caregiver				
Lower	ref	ref	Ref	ref
Higher	0.93 (0.39-2.21)	0.93 (0.38-2.26)	0.90 (0.38-2.13)	0.86 (0.37-2.03)
Only child				

1					
2					
3	Yes	ref	ref	Ref	ref
4	No	2.15 (0.94-4.92)	2.08 (0.91-4.77)	2.20 (0.94-5.15)	2.00 (0.87-4.58)
5					
6	Neighbors caring for each other				
7	Never or seldom	ref	ref	Ref	ref
8	Sometimes	0.47 (0.19-1.17)	0.47 (0.19-1.16)	0.43 (0.17-1.09)	0.46 (0.19-1.16)
9	Always	0.30 (0.10-0.86)	0.31 (0.11-0.88)	0.28 (0.10-0.81)	0.32 (0.11-0.92)
10					
11	Being bullied within 6 months				
12	No	ref	ref	Ref	ref
13	Yes	9.65 (3.38-27.55)	10.24 (3.61-29.06)	10.08 (3.53-28.70)	10.09 (3.55-28.65)
14					
15	Impulsivity				
16	Lowest tertile	ref	ref	Ref	ref
17	Middle tertile	2.67 (0.69-10.37)	1.64 (0.56-4.83)	1.38 (0.44-4.32)	1.15 (0.31-4.34)
18	Highest tertile	3.74 (1.10-12.76)	2.13 (0.73-6.19)	3.57 (1.25-10.20)	2.75 (0.91-8.36)
19					
20	Note: the impulsivity in the model 1, 2, 3, and 4 refers to the total, attentional, motor, and non-planning impulsivity, respectively.				
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					

4. Discussion

The present study sought to add to our knowledge about the relationship between impulsivity and aggression among adolescents by exploring this relationship in a sample of Chinese primary/middle school students. Positive associations were found between the higher levels of total impulsivity and aggressive behaviors, demonstrating the consistent relationship of impulsivity and aggression [7, 8, 34, 35]. The physiological mechanism of impulsivity was generally considered as an excitatory response produced by the nervous system; when stimulated by internal or external factors, it may give rise to an intense emotional state within a short period. This emotion constitutes the basis for aggressive behavior^[13]. On the one hand, an individual with high motor impulsivity can be more decisive and courageous on the spur of impulses in the face of unexpected opportunities or challenges and difficulties. On the other hand, if an individual lacks the cognitive resources necessary to manage impulses (of high attentional impulsivity), they can be driven by desire or anger to conduct aggressive behaviors, resulting in a range of adverse outcomes^[36].

Studies among forensic and clinical samples found high impulsiveness in both types of aggression, with no significant difference in total scores measured by BIS^[1 22]. Studies in ordinary western people indicated that the non-planning sub-trait of impulsivity was related to impulsive aggression^[37]. In our sample, however, the correlation of non-planning impulsivity and aggression is not clearly supported. In the multivariate model of our study, a higher level of motor impulsivity was the only sub-trait that significantly contributed to aggressive behaviors among both boys and girls, suggesting that the aggressive behaviors among Chinese youth are conducted in adolescence majorly because of the act without thinking. Though the effects of attentional and non-planning impulsiveness were not statistically significant, there was a consistent trend in the multivariate model that the risk of conducting aggressive behaviors rose when the impulsive level increased. Our result indicated that it might be the critical window for early intervention during the adolescence period before the sub-trait and related cognitive deficit triggered the harmful behavior.

The finding that better family care is negatively related to adolescent boys' aggression (OR: 0.47~0.49) is in line with the family coercion theory, which assumes that positive family interactions decrease boys' problem behaviors^[33]. Insufficient family care might contribute to adolescents' aggressive behaviors in many ways: less monitoring and lack of adults to confide in when anger is

1
2
3
4 1 triggered because of events and processes in the environment. Further, those adolescents who have
5
6 2 grown up with less family care are more likely to elicit negative responses from their parents as they
7
8 3 begin to assert their autonomy and independence. These negative interactions are likely to result in
9
10 4 increasingly aversive and coercive processes, putting adolescents at a higher risk of aggression and
11
12 5 other behavioral problems^[34]. Interestingly, such a finding was only positive among boys. It might be
13
14 6 because female students are less likely to behave in aggressive ways physically and are always required
15
16 7 to be quiet, gentle, and polite under Chinese culture, which does not distinguish between aggressors
17
18 8 and non-aggressors.

19 9 A previous study has demonstrated that social and environmental factors were the principal
20
21 10 influences of aggression and that neighborhood support was a significant protective factor against
22
23 11 attack ^[37]. Our study also indicated that adolescent girls' neighborhood support may significantly
24
25 12 decrease their likelihood of aggressive behaviors (OR:0.28~0.32). Poor neighborhood environment -
26
27 13 characterized by high levels of violence, anger, and disapproval and low warmth and support - has
28
29 14 been reported to be associated with an increased risk of behavior problems and delinquency and
30
31 15 aggression in adolescents^[38]. In contrast, students were likely to feel more supported – and less
32
33 16 aggressive - in a neighborhood that provides adequate resources and assistance for youth healthy
34
35 17 growth and development, such as after-school programming and recreational spaces^[39]. These
36
37 18 resources may lead to less aggressive behavior by encouraging social networks and bonding within the
38
39 19 neighborhood^[37].

40
41 20 Adolescent aggressors tend to have higher levels of life stress than their counterparts without such
42
43 21 behaviors^[40]. Since the school has become the primary arena for an adolescent, stressors caused by
44
45 22 discordant school relationships were expected, such as peer conflicts or bullying^[40]. Consistent with
46
47 23 previous research that school-related tensions were significant predictors of aggression^[33], our study
48
49 24 also suggested that peer bullying was associated with a higher risk of aggressive behavior (OR:
50
51 25 7.83~8.46). Adolescents with bullying experience are likely to breed a negative intention of hostility
52
53 26 and revenge. If the resulting negative emotions are not handled properly, it will cause aggressive
54
55 27 behavior once the victim has an opportunity to retaliate. Furthermore, adolescents tend to have a strong
56
57 28 ability to imitate. The bullying or aggression of their schoolmates may set a bad example, and thus
58
59 29 they might behave similarly in certain conditions. This finding implies the efforts to reduce youth
60

1
2
3
4 1 aggression by providing appropriate support and services to those students who have already been
5
6 2 bullied by their schoolmates or peers.

7
8 3 The result of the present study indicated that female adolescents were less likely to be involved
9
10 4 in aggressive behavior toward others than their male counterparts (OR: 0.45–0.48). Females tend to
11
12 5 have less physical strength than males, thus, they are less likely to resort to violence to solve problems.
13
14 6 Previous studies has demonstrated that girls were prone to social aggression^[38]. Though this study
15
16 7 included verbal and social aggression in the outcome related to bully (see supplement table S1 and S2
17
18 8 for multivariate analysis using bully, and physical attack as outcomes separately), the main focus was
19
20 9 still on physical aggression. Thus, the girls' aggressive behaviors may be under-estimated.

21
22 10 We compared the prevalence of aggressive behavior in our study with previous studies
23
24 11 implemented in Chinese settings. Given the range of reported published estimates from 3.27 % among
25
26 12 middle-school students in Hubei Province to 19.80% of middle school students in Henan Province^{[39}
27
28 13 ^{40]}, our results suggested a moderate prevalence estimate of aggressive behavior (7.48%). This
29
30 14 variation may partially be explained by various social conditions (e.g. economic status, cultural
31
32 15 environment, social security) and sample ascertainment methods in different studies. The lack of
33
34 16 standardized definition and measurement methods for adolescent aggression may also contribute to
35
36 17 the variation. The prevalence of aggressive behavior in our sample is significantly lower than that
37
38 18 among either Asian Americans or any other racial/ethnic group (White, Black, Hispanic) in the U.S.,
39
40 19 according to the result from the Youth Risk Behavior Surveillance System. Suggesting that cultural
41
42 20 factors might work as the modifiers between impulsivity and aggression^[41]. A study among Chinese
43
44 21 and Canadian adolescents suggested that in Eastern cultures, individuals tend to define themselves in
45
46 22 the context of social relationships and group membership. Thus the expression of self-focused
47
48 23 emotions is discouraged, and peacefulness is highly valued^[42]. However, such a trend might decrease
49
50 24 as the age increases or the living environment changes, indicating the necessity to employ a
51
52 25 developmental view of behavioral changes when considering the cultural influences.

53
54 26 Naturally, there are limitations to this study. Firstly, the results cannot provide firm conclusions
55
56 27 regarding the causal effects proposed because of the cross-sectional design. Secondly, this study's
57
58 28 aggressive behaviors were assessed by two self-reported items, which may result in the
59
60 29 underestimation of aggression. Besides, we did not distinguish the impulsive aggressive behaviors

1
2
3
4 1 from premediated aggressive behaviors. Further studies are needed to explore how each facet of
5
6 2 impulsivity plays the role differently in these two forms, given their different biological, psychological,
7
8 3 social etiologic factors and management strategies. Lastly, our findings may be affected by selection
9
10 4 bias due to missing data. However, given the proportion of the enrolled students excluded in the present
11
12 5 study was less than 6%, and we use more robust analytical strategies, the bias was adequately
13
14 6 controlled.

15 7 Aggression is one of the basic human traits aiding in the mechanism of survival. As part of our
16
17 8 makeup, it is human nature to be aggressive towards someone occasionally. Teachers, researchers and
18
19 9 health promoters need to tell students that there are times and places where aggression is acceptable.
20
21 10 They could also teach adolescents to learn how to channel aggression to the areas where it is
22
23 11 appropriate and useful. Our study's result does not imply that any individual trait or factor is to be
24
25 12 blamed for being the cause of aggressive and violent behaviors. It is always debatable whether
26
27 13 impulsivity signal healthy or unhealthy trends in the evolutionarily adaptive. Instead, we believe that
28
29 14 learning what combination of factors contributes to it could point to leads for designing the intervention
30
31 15 strategies to help young adolescents. That said, it is essential to understand that aggressive and violent
32
33 16 behaviors continue to be as much a reality in schools and society at large. Helping young adolescents
34
35 17 learn to control their impulsiveness, channeling the anger, and helping those at higher risks of being
36
37 18 aggressive could be approached to improving all adolescents' physical and psychological well-being
38
39 19 rather than only taking disciplinary action against aggressors.

40 41 20 42 43 21 **Conclusions**

44
45 22 Despite the limitations, this study contributes to the growing body of research that tries to delve
46
47 23 into the relation between three sub-traits of impulsivity and aggressive behaviors through a sample of
48
49 24 Chinese middle school adolescent students. Consistent with research in other populations, a positive
50
51 25 association between impulsivity and aggressive behaviors were found. Specifically, such correlation
52
53 26 was more salient between motor impulsiveness sub-trait and aggressive behavior among boys and
54
55 27 girls. Furthermore, results also indicated that aggressive behaviors were affected by several factors
56
57 28 within the ecological model. Comprehensive intervention strategies such as controlling the
58
59 29 aggressor's impulsivity, teaching them to channel their anger, creating a supportive and nurturing
60

1
2
3
4 1 school and neighborhood environment as well as providing psychological support and services for
5
6 2 violence victims are needed.
7
8 3

9 4 **Abbreviations**

10 5 BIS-11: Barratt Impulsivity Scale; CASI: Computer Assisted Self-Interview; AI: attentional
11 6 impulsivity; MI: motor impulsivity; NPI: non-planning impulsivity; GEAS: The Global Early
12
13 7 Adolescent Study.
14
15
16
17 8

18 9 **Acknowledgments**

20 10 The GEAS is a multinational study that aims to understand the development of gender norms in early
21 11 adolescence and its impacts on adolescent health across time and geographies. The study operates in
22 12 conjunction with the World Health Organization and the Johns Hopkins Bloomberg School of Public
23 13 Health. Support for the study is made possible in part by the United States Agency for International
24 14 Development (USAID), the World Health Organization, the David and Lucile Packard Foundation,
25 15 the Bill and Melinda Gates Foundation, the Oak Foundation, and the United Nations Children's Fund.
26 16 We wish to acknowledge all partners and funders for their supports. We would also thank all
27 17 researchers and students who participate in the study, as well as administrators and teachers in target
28 18 schools.
29
30
31
32
33
34
35
36
37
38
39

40 20 **Source of funding**

41 21 The present study was funded by the Innovation-oriented Science and Technology Grant from NHC
42 22 Key Laboratory of Reproduction Regulation (CX2017-05), and the Innovation-oriented Youth Science
43 23 and Technology Grant (Q2018-1) from Shanghai Institute of Planned Parenthood Research.
44
45
46
47
48 24
49

50 25 **Authors' contributions**

51 26 Chaohua Lou initiated the GEAS in Shanghai as a coordinator and project leader. All authors
52 27 contributed to the study design and data collection. Chunyan Yu and Jiashuai Zhang conducted the
53 28 data analysis and drafted the paper. All authors are involved in the writing of the manuscript and read
54 29 and approved the final manuscript.
55
56
57
58
59
60

2 Declaration of interest

3 The authors report no conflicts of interest.

5 Data sharing statement

6 Data are available upon reasonable request but the approval of institutional review board will be
7 necessary. Please contact the corresponding author for detail.

9 Reference

- 11 [1] Stanford MS, Houston RJ, Mathias CW, et al. Characterizing aggressive behavior. *Assessment*
12 2003;10(2):183-90. doi: 10.1177/1073191103010002009 [published Online First: 2003/06/13]
- 13 [2] Bushman BJ, Anderson CA. Is it time to pull the plug on the hostile versus instrumental aggression
14 dichotomy? *Psychol Rev* 2001;108(1):273-9. doi: 10.1037/0033-295x.108.1.273 [published Online First:
15 2001/02/24]
- 16 [3] Estévez E, Jiménez TI, Moreno D. Aggressive behavior in adolescence as a predictor of personal, family,
17 and school adjustment problems. *Psicothema* 2018;30(1):66-73. doi: 10.7334/psicothema2016.294
18 [published Online First: 2018/01/25]
- 19 [4] Obeid S, Saade S, Haddad C, et al. Internet Addiction Among Lebanese Adolescents: The Role of Self-
20 Esteem, Anger, Depression, Anxiety, Social Anxiety and Fear, Impulsivity, and Aggression-A Cross-
21 Sectional Study. *J Nerv Ment Dis* 2019;207(10):838-46. doi: 10.1097/nmd.0000000000001034 [published
22 Online First: 2019/09/11]
- 23 [5] Schmits E, Glowacz F. Delinquency and drug use among adolescents and emerging adults: The role of
24 aggression, impulsivity, empathy, and cognitive distortions. *Journal of Substance Use* 2019;24(2):162-69.

- 1
2
3
4 1 doi: 10.1080/14659891.2018.1531945
5
6
7 2 [6] Wang L, He CZ, Yu YM, et al. Associations between impulsivity, aggression, and suicide in Chinese college
8
9 3 students (in Chinese). *BMC Public Health* 2014;14:551. doi: 10.1186/1471-2458-14-551 [published Online
10
11 4 First: 2014/06/05]
12
13
14 5 [7] Evans SC, Fite PJ, Hendrickson ML, et al. The Role of Reactive Aggression in the Link Between
15
16 6 Hyperactive-Impulsive Behaviors and Peer Rejection in Adolescents. *Child Psychiatry Hum Dev*
17
18 7 2015;46(6):903-12. doi: 10.1007/s10578-014-0530-y [published Online First: 2015/01/02]
19
20
21
22 8 [8] MacDonell ET, Willoughby T. Investigating honesty-humility and impulsivity as predictors of aggression in
23
24 9 children and youth. *Aggress Behav* 2020;46(1):97-106. doi: 10.1002/ab.21874 [published Online First:
25
26 10 2019/11/14]
27
28
29
30 11 [9] Ehrenreich SE, Beron KJ, Underwood MK. Social and physical aggression trajectories from childhood
31
32 12 through late adolescence: Predictors of psychosocial maladjustment at age 18. *Dev Psychol* 2016;52(3):457-
33
34 13 62. doi: 10.1037/dev0000094 [published Online First: 2016/02/20]
35
36
37
38 14 [10] Sigurdson JF, Undheim AM, Wallander JL, et al. The long-term effects of being bullied or a bully in
39
40 15 adolescence on externalizing and internalizing mental health problems in adulthood. *Child Adolesc*
41
42 16 *Psychiatry Ment Health* 2015;9:42. doi: 10.1186/s13034-015-0075-2 [published Online First: 2015/08/25]
43
44
45
46 17 [11] Huesmann LR, Dubow EF, Boxer P. Continuity of aggression from childhood to early adulthood as a
47
48 18 predictor of life outcomes: implications for the adolescent-limited and life-course-persistent models. *Aggress*
49
50 19 *Behav* 2009;35(2):136-49. doi: 10.1002/ab.20300 [published Online First: 2009/02/04]
51
52
53
54 20 [12] Kokko K, Pulkkinen L, Huesmann LR, et al. Intensity of Aggression in Childhood as a Predictor of Different
55
56 21 Forms of Adult Aggression: A Two-Country (Finland and United States) Analysis. *J Res Adolesc*
57
58 22 2009;19(1):9-34. doi: 10.1111/j.1532-7795.2009.00579.x [published Online First: 2009/11/06]
59
60

- 1
2
3
4 1 [13] Hamilton KR, Mitchell MR, Wing VC, et al. Choice impulsivity: Definitions, measurement issues, and
5
6
7 2 clinical implications. *Personal Disord* 2015;6(2):182-98. doi: 10.1037/per0000099 [published Online First:
8
9 3 2015/04/14]
- 10
11
12 4 [14] Stanford MS, Mathias CW, Dougherty DM, et al. Fifty years of the Barratt Impulsiveness Scale: An
13
14 5 update and review. *Personality and Individual Differences* 2009;47(5):385-95. doi:
15
16
17 6 <https://doi.org/10.1016/j.paid.2009.04.008>
- 18
19
20 7 [15] Mahon K, Burdick KE, Wu J, et al. Relationship between suicidality and impulsivity in bipolar I disorder: a
21
22 8 diffusion tensor imaging study. *Bipolar Disord* 2012;14(1):80-9. doi: 10.1111/j.1399-5618.2012.00984.x
23
24
25 9 [published Online First: 2012/02/15]
- 26
27 10 [16] Azevedo J, Vieira-Coelho M, Castelo-Branco M, et al. Impulsive and premeditated aggression in male
28
29
30 11 offenders with antisocial personality disorder. *PLoS One* 2020;15(3):e0229876. doi:
31
32
33 12 10.1371/journal.pone.0229876 [published Online First: 2020/03/07]
- 34
35 13 [17] Urben S, Habersaat S, Pihet S, et al. Specific Contributions of Age of Onset, Callous-Unemotional Traits
36
37
38 14 and Impulsivity to Reactive and Proactive Aggression in Youths with Conduct Disorders. *Psychiatr Q*
39
40 15 2018;89(1):1-10. doi: 10.1007/s11126-017-9506-y [published Online First: 2017/03/28]
- 41
42
43 16 [18] Martin S, Zabala C, Del-Monte J, et al. Examining the relationships between impulsivity, aggression, and
44
45
46 17 recidivism for prisoners with antisocial personality disorder. *Aggression and Violent Behavior*
47
48 18 2019;49:101314. doi: <https://doi.org/10.1016/j.avb.2019.07.009>
- 49
50
51 19 [19] Soloff P, White R, Diwadkar VA. Impulsivity, aggression and brain structure in high and low lethality
52
53 20 suicide attempters with borderline personality disorder. *Psychiatry Res* 2014;222(3):131-9. doi:
54
55
56 21 10.1016/j.psychres.2014.02.006 [published Online First: 2014/03/25]
- 57
58
59 22 [20] Franco C, Amutio A, López-González L, et al. Effect of a Mindfulness Training Program on the Impulsivity
60

- 1
2
3
4 1 and Aggression Levels of Adolescents with Behavioral Problems in the Classroom. *Front Psychol*
5
6 2016;7:1385. doi: 10.3389/fpsyg.2016.01385 [published Online First: 2016/10/08]
7 2
8
9 3 [21] Wasserman AM, Mathias CW, Hill-Kapturczak N, et al. The Development of Impulsivity and Sensation
10
11 Seeking: Associations with Substance Use among At-Risk Adolescents. *J Res Adolesc* 2020;30(4):1051-
12 4
13 66. doi: 10.1111/jora.12579 [published Online First: 2020/09/21]
14 5
15
16
17 6 [22] Barratt ES, Stanford MS, Dowdy L, et al. Impulsive and premeditated aggression: a factor analysis of self-
18
19 reported acts. *Psychiatry Res* 1999;86(2):163-73. doi: 10.1016/s0165-1781(99)00024-4 [published Online
20 7
21 First: 1999/07/09]
22 8
23
24
25 9 [23] Maneiro L, Cutrín O, Gómez-Fraguela XA. Gender Differences in the Personality Correlates of Reactive
26
27 and Proactive Aggression in a Spanish Sample of Young Adults. *J Interpers Violence*
28 10
29 2020;886260520957697. doi: 10.1177/0886260520957697 [published Online First: 2020/09/15]
30 11
31
32
33 12 [24] Blum RW, Astone NM, Decker MR, et al. A conceptual framework for early adolescence: a platform for
34
35 research. *International journal of adolescent medicine and health* 2014;26(3):321-31. doi: 10.1515/ijamh-
36
37 2013-0327 [published Online First: 2014/02/04]
38 14
39
40 15 [25] Austerman J. Violence and Aggressive Behavior. *Pediatrics in Review* 2017;38(2):69-80. doi:
41
42 10.1542/pir.2016-0062
43 16
44
45
46 17 [26] Kramer-Kuhn AM, Farrell AD. The Promotive and Protective Effects of Family Factors in the Context of
47
48 Peer and Community Risks for Aggression. *J Youth Adolesc* 2016;45(4):793-811. doi: 10.1007/s10964-016-
49
50 0438-x [published Online First: 2016/02/18]
51 19
52
53
54 20 [27] Browning CR, Burrington LA, Leventhal T, et al. Neighborhood structural inequality, collective efficacy,
55
56 and sexual risk behavior among urban youth. *Journal of health and social behavior* 2008;49(3):269-85. doi:
57
58 10.1177/002214650804900303
59 22
60

- 1
2
3
4 1 [28] Austerman J. Violence and Aggressive Behavior. *Pediatr Rev* 2017;38(2):69-80. doi: 10.1542/pir.2016-
5
6 0062 [published Online First: 2017/02/06]
7 2
8
9 3 [29] Deng L, Wu Y, Kong R, et al. Interactive Influence of Impulsiveness and Parent-Adolescent
10
11 Communication on Adolescents' Internet Addiction (in Chinese). *Psychological Development and Education*
12 4
13 2014;30(02):169-76.
14 5
15
16
17 6 [30] Lu X, Zhu F, Liu Y, et al. A comparative study of impulsivity and self-consciousness between depressive
18
19 adolescents with and without nonsuicidal self-injury (in Chinese). *Journal of Psychiatry* 2018;31(05):325-27.
20 7
21
22 8 [31] Zhang W, Liu N, Wang C, et al. Relationship between childhood trauma, impulsivity and suicide ideation
23
24 in patients with borderline per-sonality disorder(in Chinese). *Journal of Clinical Psychiatry* 2017;27(01):19-
25 9
26 21.
27 10
28
29
30 11 [32] Patton JH, Stanford MS, Barratt ES. Factor structure of the Barratt impulsiveness scale. *J Clin Psychol*
31
32 1995;51(6):768-74. doi: 10.1002/1097-4679(199511)51:6<768::aid-jclp2270510607>3.0.co;2-1 [published
33 12
34 Online First: 1995/11/01]
35 13
36
37
38 14 [33] Heinze G, Schemper M. A solution to the problem of separation in logistic regression. *Statistics in*
39
40 *Medicine* 2002;21(16):2409-19. doi: <https://doi.org/10.1002/sim.1047>
41 15
42
43 16 [34] Hahn AM, Simons RM, Simons JS, et al. Prediction of verbal and physical aggression among young adults:
44
45 A path analysis of alexithymia, impulsivity, and aggression. *Psychiatry Res* 2019;273:653-56. doi:
46 17
47 10.1016/j.psychres.2019.01.099 [published Online First: 2019/06/19]
48 18
49
50
51 19 [35] Sarkisian K, Van Hulle C, Lemery-Chalfant K, et al. Childhood inhibitory control and adolescent impulsivity
52
53 and novelty seeking as differential predictors of relational and overt aggression. *J Res Pers* 2017;67:144-
54 20
55 50. doi: 10.1016/j.jrp.2016.07.011 [published Online First: 2017/10/07]
56 21
57
58
59 22 [36] Pérez Fuentes MD, Molero Jurado MD, Carrión Martínez JJ, et al. Sensation-Seeking and Impulsivity as
60

- 1
2
3
4 1 Predictors of Reactive and Proactive Aggression in Adolescents. *Front Psychol* 2016;7:1447. doi:
5
6 10.3389/fpsyg.2016.01447 [published Online First: 2016/10/13]
7 2
8
9 3 [37] Ramírez JM, Andreu JM. Aggression, and some related psychological constructs (anger, hostility, and
10
11 impulsivity); some comments from a research project. *Neurosci Biobehav Rev* 2006;30(3):276-91. doi:
12 4
13 10.1016/j.neubiorev.2005.04.015 [published Online First: 2005/08/06]
14 5
15
16
17 6 [38] Liu Y, Kuang L, Ai M, et al. Investigation of gender differences of suicidal, impulsive and aggressive
18
19 behavior among Chongqing college students. (in Chinese). *Chin J Sch Health* 2015;36(03):333-36.
20 7
21
22 8 [39] Wang J, Yu Y. A Case Control Study on Personality Character and Risk Factors of the Students with
23
24 Aggressive Behavior (in Chinese). *Chin J Sch Health* 2006(03):222-23.
25 9
26
27 10 [40] Sun L, Heng S, Niu G, et al. Association between childhood psychological abuse and aggressive behavior
28
29 in adolescents: the mediating role of the security and loneliness (in Chinese). . *Chin J Clinical Psychol*
30 11
31 2017;25(05):902-06.
32 12
33
34
35 13 [41] Lowry R, Eaton DK, Brener ND, et al. prevalence of health-risk behaviors among Asian American and
36
37 Pacific Islander high school students in the U.S., 2001-2007. *Public Health Rep* 2011;126(1):39-49. doi:
38 14
39 10.1177/003335491112600108 [published Online First: 2011/02/23]
40 15
41
42
43 16 [42] Jia F, Li L, Krettenauer T. Self- and other-evaluative moral emotions in prosocial contexts: A comparison
44
45 of Chinese and Canadian adolescents. *Psych J* 2019;8(2):203-11. doi: 10.1002/pchj.261 [published Online
46 17
47 First: 2019/01/12]
48 18
49
50
51 19
52
53
54
55
56
57
58
59
60

Supplements:**Table S1** Factors associated with bullying among all samples: results of a multivariable binary logistic regression model

Variables	Model 1	Model 2	Model 3	Model 4
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Age (years)				
11~13	ref	ref	ref	ref
14~16	0.58 (0.33-1.02)	0.59 (0.34-1.02)	0.52 (0.29-0.92)	0.59 (0.34-1.02)
Gender				
Boys	ref	ref	ref	ref
Girls	0.42 (0.23-0.74)	0.46 (0.26-0.82)	0.43 (0.24-0.77)	0.42 (0.23-0.74)
No. of close friends				
0~3	ref	ref	ref	ref
4~6	0.90 (0.47-1.74)	0.90 (0.47-1.74)	0.92 (0.47-1.78)	0.94 (0.49-1.81)
≥7	1.39 (0.74-2.59)	1.26 (0.68-2.33)	1.31 (0.70-2.46)	1.39 (0.75-2.61)
Perceived care from the primary caregiver				
Lower	ref	ref	ref	ref
Higher	0.56 (0.31-1.00)	0.55 (0.31-0.98)	0.57 (0.31-1.03)	0.55 (0.31-0.97)
Only child				
Yes	ref	ref	ref	ref
No	1.59 (0.89-2.84)	1.58 (0.89-2.82)	1.64 (0.91-2.95)	1.52 (0.85-2.71)
Neighbors caring for each other				
Never or seldom	ref	ref	ref	ref
Sometimes	0.53 (0.28-0.99)	0.57 (0.30-1.06)	0.54 (0.28-1.02)	0.54 (0.29-1.02)
Always	0.55 (0.28-1.07)	0.54 (0.28-1.05)	0.51 (0.26-1.00)	0.54 (0.28-1.07)

Variables	Model 1	Model 2	Model 3	Model 4
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Being bullied within 6 months				
No	ref	ref	ref	ref
Yes	7.25 (3.67-14.31)	7.73 (3.91-15.26)	7.58 (3.83-15.01)	7.97 (4.04-15.71)
Impulsivity				
Lowest tertile	ref	ref	ref	ref
Middle tertile	2.30 (0.97-5.44)	1.00 (0.47-2.16)	0.98 (0.44-2.16)	1.06 (0.49-2.27)
Highest tertile	3.62 (1.65-7.94)	1.94 (0.99-3.79)	3.51 (1.78-6.92)	2.04 (1.02-4.08)

Note: the impulsivity in the model 1, 2, 3, and 4 refers to the total, attentional, motor, and non-planning impulsivity, respectively.

Table S2 Factors associated with physical violence among all samples: results of a multivariable binary logistic regression model

Variables	Model 1	Model 2	Model 3	Model 4
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Age (years)				
11~13	ref	ref	ref	ref
14~16	0.72 (0.41-1.24)	0.71 (0.41-1.23)	0.69 (0.39-1.20)	0.72 (0.42-1.24)
Gender				
Boys	ref	ref	ref	ref
Girls	0.40 (0.22-0.71)	0.45 (0.25-0.80)	0.42 (0.23-0.75)	0.40 (0.23-0.72)
No. of close friends				
0~3	ref	ref	ref	ref
4~6	1.26 (0.65-2.45)	1.25 (0.65-2.44)	1.26 (0.65-2.44)	1.28 (0.66-2.47)
≥7	1.60 (0.84-3.05)	1.46 (0.77-2.78)	1.48 (0.78-2.83)	1.58 (0.83-3.01)
Perceived care from the primary caregiver				
Lower	ref	ref	ref	ref
Higher	0.68 (0.38-1.19)	0.68 (0.38-1.20)	0.67 (0.38-1.19)	0.66 (0.37-1.15)
Only child				
Yes	ref	ref	ref	ref
No	1.33 (0.72-2.44)	1.32 (0.72-2.42)	1.34 (0.73-2.47)	1.29 (0.71-2.37)
Neighbors caring for each other				
Never or seldom	ref	ref	ref	ref
Sometimes	0.64 (0.34-1.21)	0.68 (0.36-1.28)	0.66 (0.35-1.24)	0.66 (0.35-1.23)
Always	0.57 (0.28-1.13)	0.57 (0.29-1.13)	0.53 (0.27-1.05)	0.54 (0.27-1.08)
Being bullied within 6 months				

Variables	Model 1	Model 2	Model 3	Model 4
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
No	ref	ref	ref	ref
Yes	7.40 (3.74-14.64)	7.77 (3.92-15.36)	7.65 (3.87-15.12)	8.18 (4.15-16.16)
Impulsivity				
Lowest tertile	ref	ref	ref	ref
Middle tertile	2.28 (0.97-5.37)	1.20 (0.54-2.65)	1.51 (0.70-3.24)	1.31 (0.63-2.73)
Highest tertile	3.57 (1.62-7.83)	2.41 (1.19-4.88)	3.13 (1.54-6.34)	1.84 (0.91-3.70)

Note: the impulsivity in the model 1, 2, 3, and 4 refers to the total, attentional, motor, and non-planning impulsivity, respectively.

For peer review only

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46

Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

Upload your completed checklist as an extra file when you submit to a journal.

In your methods section, say that you used the STROBE cross sectional reporting guidelines, and cite them as:

von Elm E, Altman DG, Egger M, Pocock SJ, Gotsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies.

		Page
	Reporting Item	Number
Title and abstract		
Title	#1a Indicate the study's design with a commonly used term in the title or the abstract	1

1	Abstract	#1b	Provide in the abstract an informative and balanced summary	2
2			of what was done and what was found	
3				
4				
5				
6	Introduction			
7				
8				
9	Background /	#2	Explain the scientific background and rationale for the	3-4
10	rationale		investigation being reported	
11				
12				
13				
14	Objectives	#3	State specific objectives, including any prespecified	4
15			hypotheses	
16				
17				
18				
19	Methods			
20				
21				
22				
23	Study design	#4	Present key elements of study design early in the paper	4
24				
25				
26	Setting	#5	Describe the setting, locations, and relevant dates, including	4-5
27			periods of recruitment, exposure, follow-up, and data	
28			collection	
29				
30				
31	Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of	4
32			selection of participants.	
33				
34				
35		#7	Clearly define all outcomes, exposures, predictors, potential	5-6
36			confounders, and effect modifiers. Give diagnostic criteria, if	
37			applicable	
38				
39				
40				
41				
42				
43				
44				
45				
46				
47	Data sources /	#8	For each variable of interest give sources of data and details	5
48	measurement		of methods of assessment (measurement). Describe	
49			comparability of assessment methods if there is more than	
50			one group. Give information separately for for exposed and	
51			unexposed groups if applicable.	
52				
53				
54				
55				
56				
57				
58				
59				
60				

1	Bias	#9	Describe any efforts to address potential sources of bias	5-6
2				
3				
4	Study size	#10	Explain how the study size was arrived at	5
5				
6				
7	Quantitative	#11	Explain how quantitative variables were handled in the	6
8	variables		analyses. If applicable, describe which groupings were	
9			chosen, and why	
10				
11				
12				
13				
14				
15	Statistical	#12a	Describe all statistical methods, including those used to	6
16	methods		control for confounding	
17				
18				
19				
20	Statistical	#12b	Describe any methods used to examine subgroups and	6
21	methods		interactions	
22				
23				
24				
25				
26	Statistical	#12c	Explain how missing data were addressed	5-6
27	methods			
28				
29				
30				
31	Statistical	#12d	If applicable, describe analytical methods taking account of	N/A
32	methods		sampling strategy	
33				
34				
35				
36	Statistical	#12e	Describe any sensitivity analyses	N/A
37	methods			
38				
39				
40				
41				
42	Results			
43				
44				
45	Participants	#13a	Report numbers of individuals at each stage of study—eg	4,7
46			numbers potentially eligible, examined for eligibility,	
47			confirmed eligible, included in the study, completing follow-	
48			up, and analysed. Give information separately for for	
49			exposed and unexposed groups if applicable.	
50				
51				
52				
53				
54				
55				
56				
57	Participants	#13b	Give reasons for non-participation at each stage	4
58				
59				
60				

1	Participants	#13c	Consider use of a flow diagram	5
2				
3				
4	Descriptive data	#14a	Give characteristics of study participants (eg demographic,	7
5			clinical, social) and information on exposures and potential	
6			confounders. Give information separately for exposed and	
7			unexposed groups if applicable.	
8				
9				
10				
11				
12				
13				
14	Descriptive data	#14b	Indicate number of participants with missing data for each	7
15			variable of interest	
16				
17				
18				
19	Outcome data	#15	Report numbers of outcome events or summary measures.	7
20			Give information separately for exposed and unexposed	
21			groups if applicable.	
22				
23				
24				
25				
26				
27	Main results	#16a	Give unadjusted estimates and, if applicable, confounder-	8-11
28			adjusted estimates and their precision (eg, 95% confidence	
29			interval). Make clear which confounders were adjusted for	
30			and why they were included	
31				
32				
33				
34				
35				
36				
37	Main results	#16b	Report category boundaries when continuous variables were	8-11
38			categorized	
39				
40				
41				
42	Main results	#16c	If relevant, consider translating estimates of relative risk into	N/A
43			absolute risk for a meaningful time period	
44				
45				
46				
47				
48	Other analyses	#17	Report other analyses done—e.g., analyses of subgroups	21
49			and interactions, and sensitivity analyses	
50				
51				
52				
53	Discussion			
54				
55				
56	Key results	#18	Summarise key results with reference to study objectives	12-15
57				
58				
59				
60				

1	Limitations	#19	Discuss limitations of the study, taking into account sources	14-15
2			of potential bias or imprecision. Discuss both direction and	
3			magnitude of any potential bias.	
4				
5				
6				
7				
8				
9	Interpretation	#20	Give a cautious overall interpretation considering objectives,	12-15
10			limitations, multiplicity of analyses, results from similar	
11			studies, and other relevant evidence.	
12				
13				
14				
15				
16	Generalisability	#21	Discuss the generalisability (external validity) of the study	14
17			results.	
18				
19				
20				
21				
22	Other Information			
23				
24				
25	Funding	#22	Give the source of funding and the role of the funders for the	16-17
26			present study and, if applicable, for the original study on	
27			which the present article is based	
28				
29				
30				
31				

32 None The STROBE checklist is distributed under the terms of the Creative Commons Attribution
 33 License CC-BY. This checklist can be completed online using <https://www.goodreports.org/>, a tool
 34 made by the [EQUATOR Network](#) in collaboration with [Penelope.ai](#)

BMJ Open

Correlations of impulsivity and aggressive behaviors among adolescents in Shanghai, China using bioecological model: cross-sectional data from Global Early Adolescent Study

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2020-043785.R2
Article Type:	Original research
Date Submitted by the Author:	26-May-2021
Complete List of Authors:	Yu, Chunyan; Shanghai Institute of Planned Parenthood Research, Department of Epidemiology & Social Science Zhang, Jiashuai; Fudan University School of Public Health Zuo, Xiayun; Shanghai Institute of Planned Parenthood Research, Dep. of epidemiology & social science Lian, Qiguo; Shanghai Institute of Planned Parenthood Research, Dep. of epidemiology & social science Tu, Xiaowen; Shanghai Institute of Planned Parenthood Research, Dep. of epidemiology & social science Lou, Chaohua; Shanghai Institute of Planned Parenthood Research, Department of Epidemiology & Social Science
Primary Subject Heading:	Mental health
Secondary Subject Heading:	Public health
Keywords:	Child & adolescent psychiatry < PSYCHIATRY, PUBLIC HEALTH, Impulse control disorders < PSYCHIATRY

SCHOLARONE™
Manuscripts



I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

1
2
3 1 **Correlations of impulsivity and aggressive behaviors among adolescents in Shanghai, China**
4
5 2 **using bioecological model: cross-sectional data from Global Early Adolescent Study**

6
7 3 Chunyan Yu ^{1†}, Jiashuai Zhang ^{2†}, Xiayun Zuo¹, Qiguo Lian¹, Xiaowen Tu¹, Chaohua Lou^{1*}
8

- 9
10 4 1. NHC Key Lab. of Reproduction Regulation (Shanghai Institute for Biomedical and
11 5 Pharmaceutical Technologies), Fudan University, Shanghai, PR China.
12
13 6 2. NHC Key Lab. of Reproduction Regulation (Shanghai Institute for Biomedical and
14 7 Pharmaceutical Technologies), School of Public Health, Fudan University, Shanghai, PR China.
15 7
16 8

17
18 9 †: Contributed equally.

19
20 10 *: Correspondence to Professor Lou C, Department of Epidemiology and Social Science, NHC
21 11 Key Lab. of Reproduction Regulation (Shanghai Institute for Biomedical and Pharmaceutical
22 12 Technologies). *Postal Address: 779 Old Hu Min Road, Shanghai 200237, PR China. Email:*
23
24 12 *louchaohua60@163.com. TEL:86 21 64771589.*
25 13
26 13
27
28 14
29
30

31 15 **Keywords:** Adolescent; Impulsivity; Aggressive behaviors; Neighborhood supports.

32
33 16 **Word counts:** 4143 words

34
35 17 **Total Pages:** 23

36
37 18 **Tables:** 5

38
39
40 19 **Supplementary files:** 4 tables
41 20
42
43 21
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1 ABSTRACT

2 **Objective:** To examine the correlations between impulsivity and aggressive behaviors among
3 Chinese adolescents.

4 **Design:** A school-based cross-sectional study.

5 **Setting:** Three primary middle schools located in less-developed communities of Shanghai.

6 **Participants:** 1524 adolescents aged 11 to 16 years.

7 **Measures:** The impulsivity was measured by Barratt Impulsivity Scale (BIS-11), and the aggressive
8 behaviors were determined by self-reports. Data were collected through Computer-Assisted Self-
9 Interview using tablets. Multivariate Firth logistic regression model was conducted to examine
10 correlations between total, attentional, motor, and non-planning impulsivity and aggressive
11 behaviors, respectively

12 **Results:** Totally 7.48% of participants reported aggressive behaviors toward others during the past 6
13 months. The proportion of aggressors among boys and girls was 10.60% and 4.18%, respectively.
14 Results of the multivariate regression suggested the risk of aggressive behaviors was significantly
15 increased among those with the highest tertile of total impulsivity (aOR_{boys}=3.14, 95%CI: 1.48-6.65;
16 aOR_{girls}=3.74, 95%CI: 1.10-12.76) and motor impulsivity (aOR_{boys}=2.91, 95%CI: 1.46-5.82;
17 aOR_{girls}=3.57, 95%CI: 1.25-10.20.), comparing with those with the lowest tertile, for boys and girls,
18 respectively. Besides, younger age, lower social cohesion, and being bullied within 6 months were
19 associated with a higher risk of aggressive behaviors among girls. Less family caring and being
20 bullied within 6 months were associated with the risk among boys.

21 **Conclusions:** The present study indicates a positive association between impulsivity and aggressive
22 behaviors, with a more salient correlation between motor impulsivity sub-trait and aggressive
23 behavior among both boys and girls. Furthermore, adolescents' aggressive behaviors were affected
24 by multiple factors from individuals, family, peers, and community. Comprehensive intervention
25 strategies such as controlling the aggressor's impulsivity, helping them better channel their anger,
26 creating a better family, school, and neighborhood environment, and providing support and services
27 for violence victims are needed.

28 **Keywords:** Adolescent; Impulsivity; Aggressive behaviors; Neighborhood supports.

29 **Strengths and limitations of this study :**

- 30 1. The study used a reliable and validated scale to access impulsivity among the participants.
- 31 2. The findings warrant further exploration of the impulsiveness subscales to the understanding of
32 aggressive behaviors critically.

- 1
2
3 1 3. The simplified measurement of aggressive behavior prevents the further distinction of impulsive
4 2 aggressive behavior from premeditated aggressive behavior. Further studies are needed to explore
5 3 how different facets of impulsivity play the role differently in these two forms.
6 4
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

For peer review only

1. Introduction

Aggression is a complex concept. It has traditionally been classified into two distinct subtypes, impulsive (also known as reactive or hostile) or premeditated (also known as proactive or instrumental). The former is characterized by uncontrolled and exaggerated responses to the stimuli, while the latter is defined as planned or conscious aggressive acts, not spontaneous or related to an agitated state^[1]. Though the division is not without meaningfulness to guide the prevention and intervention due to the potential harm it could cause, there were some criticism of the dichotomous method of characterizing aggressive behavior as the distinction of the two is not that clear and it is the harm that should be concerned regardless the typology of the actions ^[2].

Previous studies have indicated that aggressive behavior was associated with a range of adverse outcomes in adolescence, such as the increased risk of depressive symptoms, delinquency, internet addiction, and suicide attempts^[3-6]. In the school setting, aggressive behavior was related to low academic performance scores and higher peer rejection^[3, 7]. At the family level, significant relationships were observed between aggressive behavior on the one hand and family conflict and low family cohesion on the other^[3]. More importantly, if aggressive behaviors become prevalent during this developmental stage, they can be escalated and persist^[8]. Evidence from longitudinal research has demonstrated that adolescents with higher aggression levels are at greater risk of criminal activity and violence, peer victimization, rule-breaking behaviors, internalizing symptoms, and narcissistic and borderline personality features in the future^[9, 10]. Furthermore, adolescents with higher aggressiveness tend to have difficulties in controlling waves of anger in adulthood and have consistently poorer outcomes across life success domains ^[11, 12]. Also, research has shown that high levels of aggression may result in high social costs because a range of services and resources are needed for the delinquency, incarceration, and unemployment^[5, 9].

As a personality trait with a strong biological foundation, impulsivity was defined as a quick and unplanned response for internal or external stimuli regardless of the negative consequences for an individual or others^[13]. The definition of impulsivity does have overlaps with aggressiveness. It is also one of the main precursors of a set of antisocial behaviors and the basis for several pathological disorders such as attention-deficit/hyperactive disorder, borderline personality disorder and antisocial personality disorder^[14-16]. A great number of studies in western countries have demonstrated a positive association between impulsivity and aggression^[7, 17-19], both concurrently and longitudinally. However, such correlations were majorly explored among the forensic population or clinical sample, or taking the impulsivity as a whole (using the total impulsive score in the analysis)) instead of considering it as a multi-facet construct.

1
2
3 1 Among adolescents, studies showed that impulsivity might not be a direct risk for aggression.
4
5 2 Youth often cannot adequately manage their emotions when facing difficulties, leading them to behave
6
7 3 in aggressive ways [20]. Existing research also argues that behaviors resulting from motor impulsiveness
8
9 4 are by nature unplanned or reactive[21]. In contrast, behaviors resulting from attentional (cognitive)
10
11 5 impulsiveness are more likely to be planned or proactive. The latter should be taken more attention
12
13 6 and in consideration of targeted intervention or treatment[14]. Other research showed that impulsivity
14
15 7 was present in any type of aggressive act and did not distinguish between acts of premeditated or
16
17 8 impulsive aggression[16, 22, 23]. Given the mixed results and their relevance to both healthy and harmful
18
19 9 facets of the behaviors, the role of impulsivity still attracts numerous attentions. The question of
20
21 10 whether a person is capable of modulating their cognition and behavior to fit the demands of a given
22
23 11 environment is imperative[14], which makes understanding the role of impulsiveness in the forming of
24
25 12 aggression among healthy/ordinary population, especially among young adolescents who are at the
26
27 13 critical developing stage urgent.

28
29 14 The present study is guided by Bronfenbrenner's bioecological model and Blum's conceptual
30
31 15 framework for research targeting early adolescence[24], including family-, school- and neighborhood-
32
33 16 factors in the process of shaping youth's aggressive behavior despite individual biological
34
35 17 characteristics and personal traits[25]. At the family level, family structure and parental connectedness
36
37 18 would help buffer the anger. While in school, peer interactions exert significant influences on the
38
39 19 conducting of aggressive behavior[25, 26]. Neighborhood environment is another important but always
40
41 20 neglected factor for shaping aggressive behavior as it provides the scenario for multiple health risk
42
43 21 behaviors[27]. For adolescence, specifically, it is a critical period for curtailing aggressive behaviors as
44
45 22 both impulsivity and sensation seeking (both relate to risk-taking behaviors)are at their peak during
46
47 23 this developmental window according to the Dual System Model[21]. The changes, stresses, and
48
49 24 disparities could arouse anger easily[8]. According to Blum's framework[24], adolescence is also a
50
51 25 dynamic developmental period of learning and adaptation, which creates both vulnerabilities and
52
53 26 unique opportunities for early intervention and prevention. Thus, the identification of risk factors is
54
55 27 critical to the understanding of aggressive behaviors among adolescents.

56
57 28 There are also culturally bounded limits on acceptable levels of aggression or violent behaviors.
58
59 29 Aggressive behaviors over the boundaries of acceptable levels are often considered harmful[28]. Such
60
30 cultural differences were noted by researchers both in the level of aggression and their correlations,
31
32 31 reflected through the social environment and individual differences, including personality and
33
34 32 cognition [23]. In China, research on adolescents' impulsiveness were mainly focused on its impacts on
35
36 33 internet addiction and self-injury or suicidal behavior[29-31], while research on the association between
37
38 34 impulsivity and aggressive behaviors were scant. We used the wave 2 cross-sectional data from the

1
2
3 1 Global Early Adolescent Study (GEAS) in Shanghai to examine the correlations of impulsivity and
4 2 aggressive behaviors with the consideration of covariates in the individual, family, school and
5 3 neighborhood level according to the bioecological model. GEAS is a multinational longitudinal study
6 4 that focused on early adolescents in disadvantaged urban environments with a gender lens. For the
7 5 present study, we hypothesized that (1) impulsivity would be positively correlated with young
8 6 adolescents' aggressive behavior while the correlation would be strong among motor or non-planning
9 7 impulsiveness and aggression; (2) ecological factors like family interactions, peer interactions and
10 8 community environment would be influential to the forming of adolescents' aggressive behaviors.
11 9
12 10

11 2. Methods

12 2.1. Study design and participants

13 12 Data for this study were drawn from wave 2 of the GEAS investigation. A stratified cluster
14 13 sampling procedure was adopted for the selection of participants in GEAS Shanghai site. Three
15 14 primary public middle schools in two less-developed sub-districts of the Jing'an district in Shanghai
16 15 were selected, and the fieldwork was implemented with the coordination of key informants from the
17 16 local teacher's organization. All eligible students in grades 7th to 9th (the baseline investigation of
18 17 GEAS was conducted in grades 6th to 8th) were invited to participate in the study after obtaining their
19 18 assent and the consent of their parents or guardians.
20 19

21 20 A total of 1611 adolescents participated in the wave 2 investigation. Of them, 87 (5.40%) were
22 21 excluded because of missing information on impulsivity (16) or aggressive behaviors (71), respectively.
23 22 Finally, 1524 eligible students were included in the data analysis.
24 23

25 2.2. Procedure

26 24 Data were collected through tablets using the Computer-Assisted Self-Interview (CASI) method
27 25 during November and December in 2018. The students were organized by their teachers in the class
28 26 units to fill in the electronic questionnaire independently during the lunch break or psychological class.
29 27 In each class, 1-2 trained investigators were present in case the participants need assistance with the
30 28 tablet using. Communication or discussion among participants during the process was dissuaded, while
31 29 questions regarding the survey could be raised to the available investigators. The questionnaire took
32 30 approximately 25 to 40 minutes to finish. The tablets were returned after the process and checked by
33 31 the investigators to ensure that all necessary questions were answered before submission. Each student
34 32 was compensated for their participation with a small gift valued at 20-30 CNY after the process.
35 33

36 34 The GEAS in Shanghai was approved by the Medical Ethical Committee of the Shanghai Institute
37 35 for Biomedical and Pharmaceutical Technologies (Formerly named Shanghai Institute of Planned
38 36
39 37
40 38
41 39
42 40
43 41
44 42
45 43
46 44
47 45
48 46
49 47
50 48
51 49
52 50
53 51
54 52
55 53
56 54
57 55
58 56
59 57
60 58

1
2
3 1 Parenthood Research, No. PJ2017-27); a deemed exempt for secondary data analysis was approved by
4 2 the Johns Hopkins Bloomberg School of Public Health Institutional Review Board.

6 3 **2.3. Measures**

8 4 **2.3.1. Aggressive behavior**

10 5 Aggressive behavior was assessed by two items: 1): During the past 6 months, have you bullied
11 6 or threatened another boy or girl for any reason? 2): During the past 6 months, have you slapped, hit,
12 7 or otherwise physically hurt another boy or girl in any way that they did not want? Each item comprised
13 8 six options: 1) no; 2) yes, both for girls and boys; 3) yes, for boys; 4) yes, for girls; 5) don't know; 6)
14 9 refuse to answer. Options 5 and 6 were treated as missing values in data analysis. A student was
15 10 classified into an aggressor if both or one of the two behaviors listed above exists.

20 11 **2.3.2. Impulsivity**

22 12 Impulsivity was measured by BIS-11, a valid and reliable instrument developed by Barratt in
23 13 1959 and revised by Patton in 1995^[32]. The scale composed of 30 items and grouped into three
24 14 subscales: attentional impulsivity (AI, 8 items) describes the tendency to inattention or to make a quick
25 15 decision; motor impulsivity (MI, 11 items) is about the propensity to act solely on the spur of the
26 16 moment despite the consequences; non-planning impulsivity (NPI, 11 items) indicates the lack of a
27 17 plan for daily or long-term actions^[32]. The items were rated by a 4-point Likert-type option from 1
28 18 (rarely/ never) to 4 (almost always/ always). After reversely coded the negatively worded items, we
29 19 calculated the mean scores of the scales. Higher scores indicated greater impulsiveness. Because of
30 20 the absence of generalized cut-off values among youth across research, and the interest of us to see the
31 21 changes of aggressive behaviors with increased levels of impulsivity, we split the continuous mean
32 22 scores into tertiles in the multivariate regression model (The mean BIS cores of total- and sub- scale
33 23 for each tertile among boys and girls were exhibited in the supplementary table S1) . The model
34 24 compared the highest and middle to the lowest tertiles. Previous studies demonstrated the reliability
35 25 and validity of BIS-11 when used in Chinese children and adolescents, and the polychoric ordinal
36 26 alpha value in the present study was 0.62 for AI, 0.81 for NPI, and 0.74 for MI, and 0.89 for the total
37 27 BIS.

50 28 **2.3.3 Covariates**

51 29 Covariates include adolescents' age, binary indicators of gender at the individual level, binary
52 30 indicators of family structure (only child vs. other), perceived care from the primary caregiver that
53 31 reflecting family caring at the family level, number of close friends, experiences of being bullied within
54 32 6 months at the school level, as well as perceived supports from the neighborhood.

58 33 **2.4. Data analysis**

60 34 The data analysis began with describing and comparing aggressive behavior, impulsivity, and

1 covariates between boys and girls. Secondly, the differences of the mean scores of BIS-11 and its
 2 subscales between aggressors and non-aggressors were compared using either *t*-test or *Wilcoxon* test.
 3 Thirdly, due to the lower prevalence of aggressors in the present study, the multivariate firth logistic
 4 regression model^[33] was conducted to assess the association between impulsivity and aggressive
 5 behavior among the total sample, as well as boys' and girls', respectively. Four models were explored
 6 for each group using total BIS-11 mean core and the mean score of each subscale (AI, MI, and NPI,
 7 respectively). In each model, the demographic characteristics, as well as personal and bioecological
 8 factors listed above were controlled. Before modeling, we first examined the cluster effects on the
 9 level of school (level-3) and class (level-2) through multilevel zero-models to determine if the
 10 hierarchical structure statistically exists in our data given the cluster obtained by cluster sampling. We
 11 found, however, the effects were statistically insignificant both for boys or girls, and thus the general
 12 logistic regression model was chosen for data analysis. The statistical analyses were conducted by
 13 Stata SE version 15. The level of significance was set $\alpha=0.05$ at two-tailed.

2.5. Patient and public involvement

15 Young adolescents were invited to test the face validity of the questionnaire in the designing
 16 stage. During the survey, all participants were provided with an information sheet about psychosocial
 17 resources available to them and an option within the study to indicate interest in supported referrals to
 18 services. Adolescents will be invited to join the interpretations of the findings and dissemination stages
 19 of the research as well.

3. Results

3.1 Sample characteristics

23 The eligible participants in this study were aged 11 to 16 years old, with a mean age of $13.32 \pm$
 24 0.96 . Boys included in the analysis were slightly more than girls (51.38% vs. 48.62%). Table 1 exhibits
 25 the variables used in this study by gender. Compared to boys, girls reported fewer experiences of being
 26 bullied within 6 months and fewer close friends. Boys scored higher on attentional impulsivity and
 27 lower on non-planning impulsivity. Additionally, gender differences in the proportion of only child,
 28 family caring, social cohesion, total impulsivity, and motor impulsivity are statistically insignificant
 29 ($P > 0.05$), while the prevalence of aggressive behaviors is higher among boys than among girls (P
 30 < 0.05).

Table 1. Description of demographic variables, aggressive behaviors, impulsivity, and covariates

Variables	Total (N=1524)	Boys (n=783)	Girls (n=741)
-----------	-------------------	-----------------	------------------

Aggressors (%)	7.48	10.60	4.18 *
Only child (%)	78.74	80.20	77.19
Bullied within 6 month (%)	35.24	39.59	30.23 *
No. of close friends (%)			
0-3	36.35	31.03	41.97 *
4-6	30.71	31.16	20.23
7-	32.94	37.08	27.80
Neighbors caring for each other (%)			
Never or seldom	19.95	20.82	19.03
Sometimes	34.58	33.46	35.76
Always	39.57	39.46	39.68
Perceived care from the primary caregiver (%)			
Lower	48.56	49.04	48.04
Higher	49.51	48.28	50.20
Age (Mean ± SD)	13.32 (0.96)	13.35 (0.98)	13.28 (0.94)
Total impulsivity (Mean ± SD)	2.04 (0.34)	2.05 (0.34)	2.04 (0.33)
Attentional impulsivity (Mean ± SD)	2.00 (0.39)	2.04 (0.41)	1.96 (0.37) &
Motor impulsivity (Mean ± SD)	2.01 (0.42)	2.01 (0.43)	2.00 (0.42)
Non-planning impulsivity (Mean ± SD)	2.11 (0.47)	2.08 (0.47)	2.15 (0.46) ^s

Note: percentages may not add to 100% due to missing data

*: $p < 0.05$, chi-square test; &: $p < 0.05$, Wilcoxon test; ^s: $p < 0.05$, two-independent t-test.

3.2 Score of impulsivity between aggressors and non-aggressors

Table 2 shows the comparison of impulsivity between aggressors and non-aggressors by gender. The mean score of BIS-11 in aggressors was 2.27 and 2.32 among boys and girls, respectively, significantly higher than their counterparts ($P < 0.001$). Moreover, the scores of AI, MI, and NPI in aggressors were significantly higher than non-aggressors for both boys and girls ($P < 0.001$).

Table 2. The score (mean ± SD) of impulsivity, grouping by gender and aggressive behavior

	Boys			Girls		
	Aggressors	Non-aggressors	<i>P</i>	Aggressors	Non-aggressors	<i>P</i>
Total impulsivity	2.27 (0.36)	2.02 (0.33)	<0.001*	2.32 (0.40)	2.03 (0.33)	<0.001&
AI	2.27 (0.45)	2.02 (0.39)	<0.001*	2.20 (0.46)	1.95(0.36)	0.002&
MI	2.28 (0.51)	1.98 (0.41)	<0.001&	2.33 (0.52)	1.99 (0.40)	<0.001&
NPI	2.26 (0.44)	2.06 (0.46)	<0.001*	2.41 (0.52)	2.14 (0.46)	0.001*

*: two-independent t-test; &: Wilcoxon test

3.3 Factors associated with aggressive behavior

For the total sample, the multivariate logistic regression model results indicated the risk of aggressive behaviors was significantly increased among those with the highest tertile of total impulsivity, AI, MI, and NPI compared with those among the lowest tertile (Table 3). However, a

1
2
3 1 statistically significant difference was not found among the middle tertile group and the lowest tertile
4 2 group. Table 4 and Table 5 exhibits the results of gender-stratified data analysis for boys and girls,
5 3 respectively. Similarly, for total impulsivity and MI(model 1 and model 3), the risk of conducting
6 4 aggressive behaviors significantly increased in the highest tertile group compared to those in the lowest
7 5 tertile group. However, for AI and NPI (model 2 and model 4), the risk of conducting aggressive
8 6 behaviors in the highest or middle tertile group was not statistically increased versus the lowest tertile
9 7 group.

10 8 The results suggested that female adolescents were less likely to be an aggressor (Table 3). For
11 9 boys, those who reported a higher level of family caring were less likely to be an aggressor (Table 4),
12 10 whereas such an effect was not significant among girls. On the contrary, older age and higher social
13 11 cohesion were associated with a lower risk of aggressive behaviors among girls (Table 5), while these
14 12 effects were not significant among boys. Being bullied within 6 months may significantly increase the
15 13 risk of aggressive behaviors for both boys and girls. However, the number of close friends, family
16 14 structure (only child) showed no significant associations with aggressive behaviors in this study (Table
17 15 4 and 5).

Table 3. Factors associated with aggressive behaviors among all samples: results of a multivariable binary Firth logistic regression model

Variables	Model 1	Model 2	Model 3	Model 4
	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)
Age (years)				
11-13	ref	ref	ref	ref
14-16	0.54 (0.34-0.88)	0.54 (0.33-0.87)	0.51 (0.31-0.83)	0.54 (0.34-0.88)
Gender				
Boys	ref	ref	ref	ref
Girls	0.43 (0.27-0.70)	0.48 (0.29-0.77)	0.45 (0.28-0.73)	0.43 (0.27-0.70)
No. of close friends				
0-3	ref	ref	ref	ref
4-6	1.09 (0.62-1.90)	1.08 (0.62-1.90)	1.10 (0.63-1.94)	1.12 (0.64-1.95)
≥7	1.56 (0.90-2.68)	1.42 (0.83-2.44)	1.46 (0.85-2.52)	1.57 (0.91-2.71)
Perceived care from the primary caregiver				
Lower	ref	ref	ref	ref
Higher	0.58 (0.35-0.94)	0.57 (0.35-0.93)	0.58 (0.35-0.95)	0.56 (0.35-0.92)
Only child				
Yes	ref	ref	ref	ref
No	1.62 (0.99-2.68)	1.62 (0.98-2.65)	1.66 (1.01-2.75)	1.56 (0.95-2.57)
Neighbors caring for each other				
Never or seldom	ref	ref	ref	ref
Sometimes	0.65 (0.38-1.11)	0.69 (0.41-1.18)	0.66 (0.39-1.12)	0.66 (0.39-1.12)
Always	0.46 (0.25-0.83)	0.45 (0.25-0.82)	0.43 (0.25-0.78)	0.45 (0.25-0.82)
Being bullied within 6 months				
No	ref	ref	ref	ref
Yes	7.83 (4.44-13.80)	8.23 (4.67-14.50)	8.15 (4.62-14.39)	8.46 (4.81-14.88)
Impulsivity				
Lowest tertile	ref	ref	ref	ref

Middle tertile	2.02 (0.99-4.11)	1.04 (0.55-1.99)	1.26 (0.67-2.37)	1.29 (0.68-2.45)
Highest tertile	3.23 (1.70-6.16)	1.99 (1.12-3.54)	3.07 (1.72-5.50)	2.04 (1.11-3.72)

Note: the impulsivity in the model 1, 2, 3, and 4 refers to the total, attentional, motor, and non-planning impulsivity, respectively.

Table 4 Factors associated with aggressive behaviors among boys: results of a multivariate binary Firth logistic regression model

Variables	Model 1	Model 2	Model 3	Model 4
	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)
Age (years)				
11-13	ref	ref	ref	ref
14-16	0.69 (0.39-1.20)	0.67 (0.38-1.16)	0.65 (0.37-1.13)	0.70 (0.40-1.21)
No. of close friends				
0-3	ref	ref	ref	ref
4-6	1.25 (0.64-2.46)	1.19 (0.60-2.33)	1.25 (0.63-2.46)	1.26 (0.64-2.46)
≥7	1.68 (0.86-3.27)	1.48 (0.77-2.87)	1.54 (0.79-3.01)	1.65 (0.84-3.21)
Perceived care from the primary caregiver				
Lower	ref	ref	ref	ref
Higher	0.49 (0.27-0.88)	0.47 (0.26-0.84)	0.49 (0.27-0.89)	0.48 (0.27-0.87)
Only child				
Yes	ref	ref	ref	ref
No	1.35 (0.72-2.53)	1.40 (0.75-2.62)	1.35 (0.72-2.54)	1.30 (0.69-2.43)
Neighbors caring for each other				
Never or seldom	ref	ref	ref	ref
Sometimes	0.81 (0.42-1.55)	0.87 (0.46-1.67)	0.85 (0.44-1.64)	0.82 (0.43-1.56)
Always	0.59 (0.28-1.21)	0.58 (0.28-1.20)	0.55 (0.27-1.13)	0.55 (0.27-1.13)
Being bullied within 6 months				
No	ref	ref	ref	ref
Yes	6.93 (3.56-13.50)	7.20 (3.70-13.99)	7.17 (3.67-14.01)	7.49 (3.86-14.53)

Impulsivity				
Lowest tertile	ref	ref	ref	ref
Middle tertile	1.86 (0.82-4.22)	0.84 (0.38-1.88)	1.20 (0.57-2.74)	1.41 (0.68-2.91)
Highest tertile	3.14 (1.48-6.65)	1.96 (0.99-3.89)	2.91 (1.46-5.82)	1.82 (0.89-3.72)

Note: the impulsivity in models 1, 2, 3, and 4 refers to the total, attentional, motor, and non-planning impulsivity, respectively.

Table 5. Factors associated with aggressive behavior among girls: results of a multivariate binary Firth logistic regression model

Variables	Model 1	Model 2	Model 3	Model 4
	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)
Age (years)				
11-13	ref	ref	Ref	ref
14-16	0.33 (0.12-0.89)	0.34 (0.13-0.89)	0.32 (0.12-0.86)	0.34 (0.13-0.90)
No. of close friends				
0-3	ref	ref	Ref	ref
4-6	0.80 (0.29-2.18)	0.87 (0.32-2.34)	0.92 (0.34-2.53)	0.91 (0.33-2.48)
≥7	1.27 (0.50-3.23)	1.26 (0.50-3.17)	1.26 (0.49-3.27)	1.33 (0.52-3.40)
Perceived care from the primary caregiver				
Lower	ref	ref	Ref	ref
Higher	0.93 (0.39-2.21)	0.93 (0.38-2.26)	0.90 (0.38-2.19)	0.86 (0.37-2.03)
Only child				
Yes	ref	ref	Ref	ref
No	2.15 (0.94-4.92)	2.08 (0.91-4.77)	2.20 (0.94-5.10)	2.00 (0.87-4.58)
Neighbors caring for each other				
Never or seldom	ref	ref	Ref	ref
Sometimes	0.47 (0.19-1.17)	0.47 (0.19-1.16)	0.43 (0.17-1.06)	0.46 (0.19-1.16)
Always	0.30 (0.10-0.86)	0.31 (0.11-0.88)	0.28 (0.10-0.81)	0.32 (0.11-0.92)
Being bullied within 6 months				

1					
2					
3	No	ref	ref	Ref	ref
4	Yes	9.65 (3.38-27.55)	10.24 (3.61-29.06)	10.08 (3.53-28.86)	10.09 (3.55-28.65)
5					
6	Impulsivity				
7	Lowest tertile	ref	ref	Ref	ref
8	Middle tertile	2.67 (0.69-10.37)	1.64 (0.56-4.83)	1.38 (0.44-4.32)	1.15 (0.31-4.34)
9	Highest tertile	3.74 (1.10-12.76)	2.13 (0.73-6.19)	3.57 (1.25-10.20)	2.75 (0.91-8.36)
10					

Note: the impulsivity in the model 1, 2, 3, and 4 refers to the total, attentional, motor, and non-planning impulsivity, respectively.

For peer review only

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46

4. Discussion

The present study sought to add to our knowledge about the relationship between impulsivity and aggression among adolescents by exploring this relationship in a sample of Chinese primary/middle school students. Positive associations were found between the higher levels of total impulsivity and aggressive behaviors, demonstrating the consistent relationship between impulsivity and aggression [7, 8, 34, 35]. The physiological mechanism of impulsivity was generally considered as an excitatory response produced by the nervous system; when stimulated by internal or external factors, it may give rise to an intense emotional state within a short period. This emotion constitutes the basis for aggressive behavior^[13]. On the one hand, an individual with high motor impulsivity can be more decisive and courageous on the spur of impulses in the face of unexpected opportunities or challenges and difficulties. On the other hand, if an individual lacks the cognitive resources necessary to manage impulses (of high attentional impulsivity), they can be driven by desire or anger to conduct aggressive behaviors, resulting in a range of adverse outcomes^[36].

Studies among forensic and clinical samples found high impulsiveness in both types of aggression, with no significant difference in total scores measured by BIS^[1 22]. Studies in ordinary western people indicated that the non-planning sub-trait of impulsivity was related to impulsive aggression^[37]. In our sample, however, the correlation of non-planning impulsivity and aggression is not clearly supported. In the multivariate model of our study, a higher level of motor impulsivity was the only sub-trait that significantly contributed to aggressive behaviors among both boys and girls, suggesting that the aggressive behaviors among Chinese youth are conducted in adolescence majorly because of the act without thinking. Though the effects of attentional and non-planning impulsiveness were not statistically significant, there was a consistent trend in the multivariate model that the risk of conducting aggressive behaviors rose when the impulsive level increased. Our result indicated that it might be the critical window for early intervention during the adolescence period before the sub-trait and related cognitive deficit triggered the harmful behavior.

Bronfenbrenner's bioecological model supports the finding in our study that better family care was negatively related to adolescent boys' aggression. The result is also in line with the family coercion theory, which assumes that positive family interactions decrease boys' problem behaviors^[33]. Insufficient family care might contribute to adolescents' aggressive behaviors in many ways: less

1
2
3
4 1 monitoring and lack of adults to confide in when anger is triggered because of events and processes in
5
6 2 the environment. Further, those adolescents who have grown up with less family care are more likely
7
8 3 to elicit negative responses from their parents as they begin to assert their autonomy and independence.
9
10 4 These negative interactions are likely to result in increasingly aversive and coercive processes, putting
11
12 5 adolescents at a higher risk of aggression and other behavioral problems^[34]. Interestingly, such a
13
14 6 finding was only positive among boys. It might be because female students are less likely to behave in
15
16 7 aggressive ways physically and are always required to be quiet, gentle, and polite under Chinese culture,
17
18 8 which does not distinguish between aggressors and non-aggressors.

19 9 A previous study has demonstrated that social and environmental factors were the principal
20
21 10 influences of aggression and that neighborhood support was a significant protective factor against
22
23 11 attack ^[37]. Our study also indicated that adolescent girls' neighborhood support might significantly
24
25 12 decrease their likelihood of aggressive behaviors. Poor neighborhood environment - characterized by
26
27 13 high levels of violence, anger, and disapproval and low warmth and support - has been reported to be
28
29 14 associated with an increased risk of behavior problems and delinquency and aggression in
30
31 15 adolescents^[38]. In contrast, students were likely to feel more supported – and less aggressive - in a
32
33 16 neighborhood that provides adequate resources and assistance for youth healthy growth and
34
35 17 development, such as after-school programming and recreational spaces^[39]. These resources may lead
36
37 18 to less aggressive behavior by encouraging social networks and bonding within the neighborhood^[37].

38
39 19 Adolescent aggressors tend to have higher levels of life stress than their counterparts without such
40
41 20 behaviors^[40]. Since the school has become the primary arena for an adolescent, stressors caused by
42
43 21 discordant school relationships were expected, such as peer conflicts or bullying^[40]. Consistent with
44
45 22 the bioecological model as well as the previous research that school-related tensions were significant
46
47 23 predictors of aggression^[33], our study also suggested that peer bullying was associated with a higher
48
49 24 risk of aggressive behavior. Adolescents with bullying experience are likely to breed a negative
50
51 25 intention of hostility and revenge. If the resulting negative emotions are not handled properly, it will
52
53 26 cause aggressive behavior once the victim has an opportunity to retaliate. Furthermore, adolescents
54
55 27 tend to have a strong ability to imitate. The bullying or aggression of their schoolmates may set a bad
56
57 28 example, and thus they might behave similarly in certain conditions. This finding implies the efforts
58
59 29 to reduce youth aggression by providing appropriate support and services to those students who have
60
30 already been bullied by their schoolmates or peers.

1
2
3
4 1 The result of the present study indicated that female adolescents were less likely to be involved
5
6 2 in aggressive behavior toward others than their male counterparts. Females tend to have less physical
7
8 3 strength than males; thus, they are less likely to resort to violence to solve problems. Previous studies
9
10 4 have demonstrated that girls were prone to social aggression^[38]. Though this study included verbal and
11
12 5 social aggression in the outcome related to bully (see supplement table S2 and S3 for multivariate
13
14 6 analysis using bully and physical attack as outcomes separately), the main focus was still on physical
15
16 7 aggression. Thus, the girls' aggressive behaviors may be under-estimated.

17
18 8 We compared the prevalence of aggressive behavior in our study with previous studies
19
20 9 implemented in Chinese settings. Given the range of reported published estimates from 3.27 % among
21
22 10 middle-school students in Hubei Province to 19.80% of middle school students in Henan Province^[39]
23
24 11 ^[40], our results suggested a moderate prevalence estimate of aggressive behavior. This variation may
25
26 12 partially be explained by various social conditions (e.g., economic status, cultural environment, social
27
28 13 security) and sample ascertainment methods in different studies. The lack of standardized definition
29
30 14 and measurement methods for adolescent aggression may also contribute to the variation. The
31
32 15 prevalence of aggressive behavior in our sample is significantly lower than that among either Asian
33
34 16 Americans or any other racial/ethnic group (White, Black, Hispanic) in the U.S., according to the result
35
36 17 from the Youth Risk Behavior Surveillance System, suggesting that cultural factors might work as the
37
38 18 modifiers between impulsivity and aggression^[41]. A study among Chinese and Canadian adolescents
39
40 19 suggested that in Eastern cultures, individuals tend to define themselves in the context of social
41
42 20 relationships and group membership. Thus the expression of self-focused emotions is discouraged, and
43
44 21 peacefulness is highly valued^[42]. However, such a trend might decrease as the age increases or the
45
46 22 living environment changes, indicating the necessity to employ a developmental view of behavioral
47
48 23 changes when considering the cultural influences.

49
50 24 Naturally, there are limitations to this study. Firstly, the results cannot provide firm conclusions
51
52 25 regarding the causal effects proposed because of the cross-sectional design. Secondly, this study's
53
54 26 aggressive behaviors were assessed by two self-reported items, which may result in the
55
56 27 underestimation of aggression. Third, instead of using sum-up scores, we used the tertile to categorize
57
58 28 the BIS score in the interest of making better use of existing data. Statistically, it would assume an
59
60 29 underlying qualitative difference between the groups, although such assumption may not exist or be
30
31 30 replicated by other studies. However, we did calculate the summary score of impulsivities, grouping

1
2
3
4 1 by gender and aggressive behavior (supplementary table S4); the result is consistent with what we
5
6 2 presented using tertile splits. Besides, we did not distinguish impulsive aggressive behaviors from
7
8 3 premediated aggressive behaviors. Further studies are needed to explore how each facet of impulsivity
9
10 4 plays the role in these two forms of aggressive behaviors. To better understand their different biological,
11
12 5 psychological, social etiologic factors would help with making management strategies. Lastly, our
13
14 6 findings may be affected by selection bias due to missing data. However, given the proportion of the
15
16 7 enrolled students excluded in the present study was less than 6%, and we use more robust analytical
17
18 8 strategies, the bias was adequately controlled.

19 9 Aggression is one of the basic human traits aiding in the mechanism of survival. As part of our
20
21 10 makeup, it is human nature to be aggressive towards someone occasionally. Teachers, researchers and
22
23 11 health promoters need to tell students that there are times and places where aggression is acceptable.
24
25 12 They could also teach adolescents to learn how to channel aggression to the areas where it is
26
27 13 appropriate and useful. Our study's result does not imply that any individual trait or factor is to be
28
29 14 blamed for being the cause of aggressive and violent behaviors. It is always debatable whether
30
31 15 impulsivity signal healthy or unhealthy trends in the evolutionarily adaptive. Instead, we believe that
32
33 16 learning what combination of factors contributes to it could point to leads for designing the intervention
34
35 17 strategies to help young adolescents. That said, it is essential to understand that aggressive and violent
36
37 18 behaviors continue to be as much a reality in schools and society at large. Helping young adolescents
38
39 19 learn to control their impulsiveness, channeling the anger, and helping those at higher risks of being
40
41 20 aggressive could be approached to improving all adolescents' physical and psychological well-being
42
43 21 rather than only taking disciplinary action against aggressors.

44 45 22 46 23 **Conclusions**

47
48 24 Despite the limitations, this study contributes to the growing body of research that tries to delve
49
50 25 into the relation between three sub-traits of impulsivity and aggressive behaviors through a sample of
51
52 26 Chinese middle school adolescent students. Consistent with research in other populations, a positive
53
54 27 association between impulsivity and aggressive behaviors were found. Specifically, such correlation
55
56 28 was more salient between motor impulsiveness sub-trait and aggressive behavior among boys and
57
58 29 girls. Furthermore, results also indicated that aggressive behaviors were affected by several factors
59
60 30 within the bioecological model. Comprehensive intervention strategies such as controlling the

1
2
3
4 1 aggressor's impulsivity, teaching them to channel their anger, creating a supportive and nurturing
5
6 2 school and neighborhood environment as well as providing psychological support and services for
7
8 3 violence victims are needed.
9
10 4

11 5 **Abbreviations**

12
13 6 BIS-11: Barratt Impulsivity Scale; CASI: Computer Assisted Self-Interview; AI: attentional
14
15 7 impulsivity; MI: motor impulsivity; NPI: non-planning impulsivity; GEAS: The Global Early
16
17 8 Adolescent Study.
18
19 9

20 10 **Acknowledgments**

21
22 11 The GEAS is a multinational study that aims to understand the development of gender norms in early
23
24 12 adolescence and its impacts on adolescent health across time and geographies. The study operates in
25
26 13 conjunction with the World Health Organization and the Johns Hopkins Bloomberg School of Public
27
28 14 Health. Support for the study is made possible in part by the United States Agency for International
29
30 15 Development (USAID), the World Health Organization, the David and Lucile Packard Foundation,
31
32 16 the Bill and Melinda Gates Foundation, the Oak Foundation, and the United Nations Children's Fund.
33
34 17 We wish to acknowledge all partners and funders for their supports. We would also thank all
35
36 18 researchers and students who participate in the study, as well as administrators and teachers in target
37
38 19 schools.
39
40 20
41

42 21 **Source of funding**

43
44 22 The present study was funded by the Innovation-oriented Science and Technology Grant from NHC
45
46 23 Key Laboratory of Reproduction Regulation (CX2017-05), and the Innovation-oriented Youth Science
47
48 24 and Technology Grant (Q2018-1) from Shanghai Institute for Biomedical and Pharmaceutical
49
50 25 Technologies.
51
52 26

53 27 **Authors' contributions**

54
55 28 Chaohua Lou initiated the GEAS in Shanghai as a coordinator and project leader. Chaohua Lou and
56
57 29 Xiayun Zuo contributed to the study design. Chunyan Yu, Xiayun Zuo, Qiguo Lian, Xiaowen Tu and
58
59 30 Chaohua Lou contributed to data collection. Chunyan Yu and Jiashuai Zhang conducted the data

1
2
3
4 1 analysis and drafted the paper. All authors are involved in the revising of the manuscript and read and
5
6 2 approved the final manuscript.

9 4 **Declaration of interest**

11 5 The authors report no conflicts of interest.

15 7 **Data sharing statement**

17 8 Data are available upon reasonable request but the approval of institutional review board will be
18
19 9 necessary. Please contact the corresponding author for detail.

23 11 **Reference**

- 25 12
- 26 13 [1] Stanford MS, Houston RJ, Mathias CW, et al. Characterizing aggressive behavior. *Assessment*
27
28
29 14 2003;10(2):183-90. doi: 10.1177/1073191103010002009 [published Online First: 2003/06/13]
- 30
31
32 15 [2] Bushman BJ, Anderson CA. Is it time to pull the plug on the hostile versus instrumental aggression
33
34
35 16 dichotomy? *Psychol Rev* 2001;108(1):273-9. doi: 10.1037/0033-295x.108.1.273 [published Online First:
36
37 17 2001/02/24]
- 38
39
40 18 [3] Estévez E, Jiménez TI, Moreno D. Aggressive behavior in adolescence as a predictor of personal, family,
41
42
43 19 and school adjustment problems. *Psicothema* 2018;30(1):66-73. doi: 10.7334/psicothema2016.294
44
45 20 [published Online First: 2018/01/25]
- 46
47
48 21 [4] Obeid S, Saade S, Haddad C, et al. Internet Addiction Among Lebanese Adolescents: The Role of Self-
49
50 22 Esteem, Anger, Depression, Anxiety, Social Anxiety and Fear, Impulsivity, and Aggression-A Cross-
51
52
53 23 Sectional Study. *J Nerv Ment Dis* 2019;207(10):838-46. doi: 10.1097/nmd.0000000000001034 [published
54
55 24 Online First: 2019/09/11]
- 56
57
58 25 [5] Schmits E, Glowacz F. Delinquency and drug use among adolescents and emerging adults: The role of
59
60

- 1
2
3
4 1 aggression, impulsivity, empathy, and cognitive distortions. *Journal of Substance Use* 2019;24(2):162-69.
5
6 2 doi: 10.1080/14659891.2018.1531945
7
8
9 3 [6] Wang L, He CZ, Yu YM, et al. Associations between impulsivity, aggression, and suicide in Chinese college
10
11 students (in Chinese). *BMC Public Health* 2014;14:551. doi: 10.1186/1471-2458-14-551 [published Online
12 4
13 First: 2014/06/05]
14 5
15
16
17 6 [7] Evans SC, Fite PJ, Hendrickson ML, et al. The Role of Reactive Aggression in the Link Between
18
19 Hyperactive-Impulsive Behaviors and Peer Rejection in Adolescents. *Child Psychiatry Hum Dev*
20 7
21 2015;46(6):903-12. doi: 10.1007/s10578-014-0530-y [published Online First: 2015/01/02]
22 8
23
24
25 9 [8] MacDonell ET, Willoughby T. Investigating honesty-humility and impulsivity as predictors of aggression in
26
27 children and youth. *Aggress Behav* 2020;46(1):97-106. doi: 10.1002/ab.21874 [published Online First:
28 10
29 2019/11/14]
30 11
31
32
33 12 [9] Ehrenreich SE, Beron KJ, Underwood MK. Social and physical aggression trajectories from childhood
34
35 through late adolescence: Predictors of psychosocial maladjustment at age 18. *Dev Psychol* 2016;52(3):457-
36 13
37 62. doi: 10.1037/dev0000094 [published Online First: 2016/02/20]
38 14
39
40
41 15 [10] Sigurdson JF, Undheim AM, Wallander JL, et al. The long-term effects of being bullied or a bully in
42
43 adolescence on externalizing and internalizing mental health problems in adulthood. *Child Adolesc*
44 16
45 *Psychiatry Ment Health* 2015;9:42. doi: 10.1186/s13034-015-0075-2 [published Online First: 2015/08/25]
46 17
47
48 18 [11] Huesmann LR, Dubow EF, Boxer P. Continuity of aggression from childhood to early adulthood as a
49
50 predictor of life outcomes: implications for the adolescent-limited and life-course-persistent models. *Aggress*
51 19
52 *Behav* 2009;35(2):136-49. doi: 10.1002/ab.20300 [published Online First: 2009/02/04]
53 20
54
55
56 21 [12] Kokko K, Pulkkinen L, Huesmann LR, et al. Intensity of Aggression in Childhood as a Predictor of Different
57
58 Forms of Adult Aggression: A Two-Country (Finland and United States) Analysis. *J Res Adolesc*
59 22
60

- 1
2
3
4 1 2009;19(1):9-34. doi: 10.1111/j.1532-7795.2009.00579.x [published Online First: 2009/11/06]
5
6
7 2 [13] Hamilton KR, Mitchell MR, Wing VC, et al. Choice impulsivity: Definitions, measurement issues, and
8
9 3 clinical implications. *Personal Disord* 2015;6(2):182-98. doi: 10.1037/per0000099 [published Online First:
10
11 4 2015/04/14]
12
13
14 5 [14] Stanford MS, Mathias CW, Dougherty DM, et al. Fifty years of the Barratt Impulsiveness Scale: An
15
16 6 update and review. *Personality and Individual Differences* 2009;47(5):385-95. doi:
17
18 7 <https://doi.org/10.1016/j.paid.2009.04.008>
19
20
21
22 8 [15] Mahon K, Burdick KE, Wu J, et al. Relationship between suicidality and impulsivity in bipolar I disorder: a
23
24 9 diffusion tensor imaging study. *Bipolar Disord* 2012;14(1):80-9. doi: 10.1111/j.1399-5618.2012.00984.x
25
26 10 [published Online First: 2012/02/15]
27
28
29
30 11 [16] Azevedo J, Vieira-Coelho M, Castelo-Branco M, et al. Impulsive and premeditated aggression in male
31
32 12 offenders with antisocial personality disorder. *PLoS One* 2020;15(3):e0229876. doi:
33
34 13 10.1371/journal.pone.0229876 [published Online First: 2020/03/07]
35
36
37
38 14 [17] Urben S, Habersaat S, Pihet S, et al. Specific Contributions of Age of Onset, Callous-Unemotional Traits
39
40 15 and Impulsivity to Reactive and Proactive Aggression in Youths with Conduct Disorders. *Psychiatr Q*
41
42 16 2018;89(1):1-10. doi: 10.1007/s11126-017-9506-y [published Online First: 2017/03/28]
43
44
45
46 17 [18] Martin S, Zabala C, Del-Monte J, et al. Examining the relationships between impulsivity, aggression, and
47
48 18 recidivism for prisoners with antisocial personality disorder. *Aggression and Violent Behavior*
49
50 19 2019;49:101314. doi: <https://doi.org/10.1016/j.avb.2019.07.009>
51
52
53
54 20 [19] Soloff P, White R, Diwadkar VA. Impulsivity, aggression and brain structure in high and low lethality
55
56 21 suicide attempters with borderline personality disorder. *Psychiatry Res* 2014;222(3):131-9. doi:
57
58 22 10.1016/j.psychres.2014.02.006 [published Online First: 2014/03/25]
59
60

- 1
2
3
4 1 [20] Franco C, Amutio A, López-González L, et al. Effect of a Mindfulness Training Program on the Impulsivity
5
6 2 and Aggression Levels of Adolescents with Behavioral Problems in the Classroom. *Front Psychol*
7
8
9 3 2016;7:1385. doi: 10.3389/fpsyg.2016.01385 [published Online First: 2016/10/08]
10
11
12 4 [21] Wasserman AM, Mathias CW, Hill-Kapturczak N, et al. The Development of Impulsivity and Sensation
13
14 5 Seeking: Associations with Substance Use among At-Risk Adolescents. *J Res Adolesc* 2020;30(4):1051-
15
16 6 66. doi: 10.1111/jora.12579 [published Online First: 2020/09/21]
17
18
19 7 [22] Barratt ES, Stanford MS, Dowdy L, et al. Impulsive and premeditated aggression: a factor analysis of self-
20
21 8 reported acts. *Psychiatry Res* 1999;86(2):163-73. doi: 10.1016/s0165-1781(99)00024-4 [published Online
22
23 9 First: 1999/07/09]
24
25
26
27 10 [23] Maneiro L, Cutrín O, Gómez-Fraguela XA. Gender Differences in the Personality Correlates of Reactive
28
29 11 and Proactive Aggression in a Spanish Sample of Young Adults. *J Interpers Violence*
30
31 12 2020;886260520957697. doi: 10.1177/0886260520957697 [published Online First: 2020/09/15]
32
33
34
35 13 [24] Blum RW, Astone NM, Decker MR, et al. A conceptual framework for early adolescence: a platform for
36
37 14 research. *International journal of adolescent medicine and health* 2014;26(3):321-31. doi: 10.1515/ijamh-
38
39 15 2013-0327 [published Online First: 2014/02/04]
40
41
42
43 16 [25] Austerman J. Violence and Aggressive Behavior. *Pediatrics in Review* 2017;38(2):69-80. doi:
44
45 17 10.1542/pir.2016-0062
46
47
48 18 [26] Kramer-Kuhn AM, Farrell AD. The Promotive and Protective Effects of Family Factors in the Context of
49
50 19 Peer and Community Risks for Aggression. *J Youth Adolesc* 2016;45(4):793-811. doi: 10.1007/s10964-016-
51
52 20 0438-x [published Online First: 2016/02/18]
53
54
55
56 21 [27] Browning CR, Burrington LA, Leventhal T, et al. Neighborhood structural inequality, collective efficacy,
57
58 22 and sexual risk behavior among urban youth. *Journal of health and social behavior* 2008;49(3):269-85. doi:
59
60

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

10.1177/002214650804900303

- [28] Austerman J. Violence and Aggressive Behavior. *Pediatr Rev* 2017;38(2):69-80. doi: 10.1542/pir.2016-0062 [published Online First: 2017/02/06]
- [29] Deng L, Wu Y, Kong R, et al. Interactive Influence of Impulsiveness and Parent-Adolescent Communication on Adolescents' Internet Addiction (in Chinese). *Psychological Development and Education* 2014;30(02):169-76.
- [30] Lu X, Zhu F, Liu Y, et al. A comparative study of impulsivity and self-consciousness between depressive adolescents with and without nonsuicidal self-injury (in Chinese). *Journal of Psychiatry* 2018;31(05):325-27.
- [31] Zhang W, Liu N, Wang C, et al. Relationship between childhood trauma, impulsivity and suicide ideation in patients with borderline per-sonality disorder(in Chinese). *Journal of Clinical Psychiatry* 2017;27(01):19-21.
- [32] Patton JH, Stanford MS, Barratt ES. Factor structure of the Barratt impulsiveness scale. *J Clin Psychol* 1995;51(6):768-74. doi: 10.1002/1097-4679(199511)51:6<768::aid-jclp2270510607>3.0.co;2-1 [published Online First: 1995/11/01]
- [33] Heinze G, Schemper M. A solution to the problem of separation in logistic regression. *Statistics in Medicine* 2002;21(16):2409-19. doi: <https://doi.org/10.1002/sim.1047>
- [34] Hahn AM, Simons RM, Simons JS, et al. Prediction of verbal and physical aggression among young adults: A path analysis of alexithymia, impulsivity, and aggression. *Psychiatry Res* 2019;273:653-56. doi: 10.1016/j.psychres.2019.01.099 [published Online First: 2019/06/19]
- [35] Sarkisian K, Van Hulle C, Lemery-Chalfant K, et al. Childhood inhibitory control and adolescent impulsivity and novelty seeking as differential predictors of relational and overt aggression. *J Res Pers* 2017;67:144-50. doi: 10.1016/j.jrp.2016.07.011 [published Online First: 2017/10/07]

- 1
2
3
4 1 [36] Pérez Fuentes MD, Molero Jurado MD, Carrión Martínez JJ, et al. Sensation-Seeking and Impulsivity as
5
6 2 Predictors of Reactive and Proactive Aggression in Adolescents. *Front Psychol* 2016;7:1447. doi:
7
8
9 3 10.3389/fpsyg.2016.01447 [published Online First: 2016/10/13]
10
11
12 4 [37] Ramírez JM, Andreu JM. Aggression, and some related psychological constructs (anger, hostility, and
13
14 5 impulsivity); some comments from a research project. *Neurosci Biobehav Rev* 2006;30(3):276-91. doi:
15
16 6 10.1016/j.neubiorev.2005.04.015 [published Online First: 2005/08/06]
17
18
19 7 [38] Liu Y, Kuang L, Ai M, et al. Investigation of gender differences of suicidal, impulsive and aggressive
20
21 8 behavior among Chongqing college students. (in Chinese). *Chin J Sch Health* 2015;36(03):333-36.
22
23
24 9 [39] Wang J, Yu Y. A Case Control Study on Personality Character and Risk Factors of the Students with
25
26 10 Aggressive Behavior (in Chinese). *Chin J Sch Health* 2006(03):222-23.
27
28
29 11 [40] Sun L, Heng S, Niu G, et al. Association between childhood psychological abuse and aggressive behavior
30
31 12 in adolescents: the mediating role of the security and loneliness (in Chinese). . *Chin J Clinical Psychol*
32
33 13 2017;25(05):902-06.
34
35
36 14 [41] Lowry R, Eaton DK, Brener ND, et al. prevalence of health-risk behaviors among Asian American and
37
38 15 Pacific Islander high school students in the U.S., 2001-2007. *Public Health Rep* 2011;126(1):39-49. doi:
39
40 16 10.1177/003335491112600108 [published Online First: 2011/02/23]
41
42
43 17 [42] Jia F, Li L, Krettenauer T. Self- and other-evaluative moral emotions in prosocial contexts: A comparison
44
45 18 of Chinese and Canadian adolescents. *Psych J* 2019;8(2):203-11. doi: 10.1002/pchj.261 [published Online
46
47 19 First: 2019/01/12]
48
49
50
51
52
53 20
54
55
56
57
58
59
60

Supplementary Tables:**Table S1.** Mean scores of impulsivity for each tertile, grouping by gender

	Total impulsivity		AI		MI		NPI	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Lowest tertile	1.71 (0.16)	1.70 (0.17)	1.61 (0.16)	1.60 (0.16)	1.63 (0.17)	1.63 (0.17)	1.61 (0.25)	1.61 (0.25)
Middle tertile	2.05 (0.08)	2.05 (0.08)	2.00 (0.10)	2.01 (0.10)	2.03 (0.10)	2.05 (0.10)	2.14 (0.10)	2.14 (0.10)
Highest tertile	2.43 (0.19)	2.40 (0.20)	2.49 (0.26)	2.44 (0.24)	2.58 (0.30)	2.54 (0.29)	2.61 (0.25)	2.62 (0.24)
Skewness	0.24	0.24	0.45	0.48	0.76	0.64	0.05	-0.05

Table S2. Factors associated with bullying among all samples: results of a multivariable binary logistic regression model

Variables	Model 1	Model 2	Model 3	Model 4
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Age (years)				
11~13	ref	ref	ref	ref
14~16	0.58 (0.33-1.02)	0.59 (0.34-1.02)	0.52 (0.29-0.92)	0.59 (0.34-1.02)
Gender				
Boys	ref	ref	ref	ref
Girls	0.42 (0.23-0.74)	0.46 (0.26-0.82)	0.43 (0.24-0.77)	0.42 (0.23-0.74)
No. of close friends				
0~3	ref	ref	ref	ref
4~6	0.90 (0.47-1.74)	0.90 (0.47-1.74)	0.92 (0.47-1.78)	0.94 (0.49-1.81)
≥7	1.39 (0.74-2.59)	1.26 (0.68-2.33)	1.31 (0.70-2.46)	1.39 (0.75-2.61)
Perceived care from the primary caregiver				
Lower	ref	ref	ref	ref
Higher	0.56 (0.31-1.00)	0.55 (0.31-0.98)	0.57 (0.31-1.03)	0.55 (0.31-0.97)

Variables	Model 1	Model 2	Model 3	Model 4
	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)
Only child				
Yes	ref	ref	ref	ref
No	1.59 (0.89-2.84)	1.58 (0.89-2.82)	1.64 (0.91-2.95)	1.52 (0.85-2.71)
Neighbors caring for each other				
Never or seldom	ref	ref	ref	ref
Sometimes	0.53 (0.28-0.99)	0.57 (0.30-1.06)	0.54 (0.28-1.02)	0.54 (0.29-1.02)
Always	0.55 (0.28-1.07)	0.54 (0.28-1.05)	0.51 (0.26-1.00)	0.54 (0.28-1.07)
Being bullied within 6 months				
No	ref	ref	ref	ref
Yes	7.25 (3.67-14.31)	7.73 (3.91-15.26)	7.58 (3.63-15.01)	7.97 (4.04-15.71)
Impulsivity				
Lowest tertile	ref	ref	ref	ref
Middle tertile	2.30 (0.97-5.44)	1.00 (0.47-2.16)	0.98 (0.44-2.16)	1.06 (0.49-2.27)
Highest tertile	3.62 (1.65-7.94)	1.94 (0.99-3.79)	3.51 (1.78-6.92)	2.04 (1.02-4.08)

Note: the impulsivity in the model 1, 2, 3, and 4 refers to the total, attentional, motor, and non-planning impulsivity, respectively.

Table S3. Factors associated with physical violence among all samples: results of a multivariable binary logistic regression model

Variables	Model 1	Model 2	Model 3	Model 4
	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)
Age (years)				
11~13	ref	ref	ref	ref
14~16	0.72 (0.41-1.24)	0.71 (0.41-1.23)	0.69 (0.39-1.20)	0.72 (0.42-1.24)
Gender				

Variables	Model 1	Model 2	Model 3	Model 4
	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)
Boys	ref	ref	ref	ref
Girls	0.40 (0.22-0.71)	0.45 (0.25-0.80)	0.42 (0.22-0.75)	0.40 (0.23-0.72)
No. of close friends				
0~3	ref	ref	ref	ref
4~6	1.26 (0.65-2.45)	1.25 (0.65-2.44)	1.26 (0.65-2.46)	1.28 (0.66-2.47)
≥7	1.60 (0.84-3.05)	1.46 (0.77-2.78)	1.48 (0.77-2.83)	1.58 (0.83-3.01)
Perceived care from the primary caregiver				
Lower	ref	ref	ref	ref
Higher	0.68 (0.38-1.19)	0.68 (0.38-1.20)	0.67 (0.38-1.19)	0.66 (0.37-1.15)
Only child				
Yes	ref	ref	ref	ref
No	1.33 (0.72-2.44)	1.32 (0.72-2.42)	1.34 (0.72-2.47)	1.29 (0.71-2.37)
Neighbors caring for each other				
Never or seldom	ref	ref	ref	ref
Sometimes	0.64 (0.34-1.21)	0.68 (0.36-1.28)	0.66 (0.36-1.24)	0.66 (0.35-1.23)
Always	0.57 (0.28-1.13)	0.57 (0.29-1.13)	0.53 (0.27-1.05)	0.54 (0.27-1.08)
Being bullied within 6 months				
No	ref	ref	ref	ref
Yes	7.40 (3.74-14.64)	7.77 (3.92-15.36)	7.65 (3.84-15.15)	8.18 (4.15-16.16)
Impulsivity				
Lowest tertile	ref	ref	ref	ref
Middle tertile	2.28 (0.97-5.37)	1.20 (0.54-2.65)	1.51 (0.74-3.24)	1.31 (0.63-2.73)
Highest tertile	3.57 (1.62-7.83)	2.41 (1.19-4.88)	3.13 (1.51-6.34)	1.84 (0.91-3.70)

Note: the impulsivity in the model 1, 2, 3, and 4 refers to the total, attentional, motor, and non-planning impulsivity, respectively.

Table S4. Summary score (mean \pm SD) of impulsivity, grouping by gender and aggressive behavior

	Boys			Girls		
	Aggressors	Non-aggressors	<i>P</i>	Aggressors	Non-aggressors	<i>P</i>
Total impulsivity	68.07 (11.12)	60.46 (9.77)	<0.001*	69.79 (12.34)	60.84 (9.70)	<0.001 ^{&}
AI	18.14 (3.65)	16.12 (3.12)	<0.001 ^{&}	17.76 (3.70)	15.56 (2.88)	0.001 ^{&}
MI	25.04 (5.46)	21.81 (4.44)	<0.001 ^{&}	25.70 (5.78)	21.86 (4.45)	<0.001 ^{&}
NPI	24.99 (4.90)	22.63 (5.14)	<0.001*	26.48 (5.77)	23.49 (5.03)	0.001*

*: two-independent t-test; &: Wilcoxon test

Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

Upload your completed checklist as an extra file when you submit to a journal.

In your methods section, say that you used the STROBE cross sectional reporting guidelines, and cite them as:

von Elm E, Altman DG, Egger M, Pocock SJ, Gotsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies.

		Page
	Reporting Item	Number
Title and abstract		
Title	#1a Indicate the study's design with a commonly used term in the title or the abstract	1

1	Abstract	#1b	Provide in the abstract an informative and balanced summary	2
2			of what was done and what was found	
3				
4				
5				
6	Introduction			
7				
8				
9	Background /	#2	Explain the scientific background and rationale for the	3-4
10	rationale		investigation being reported	
11				
12				
13				
14	Objectives	#3	State specific objectives, including any prespecified	4
15			hypotheses	
16				
17				
18				
19				
20	Methods			
21				
22				
23	Study design	#4	Present key elements of study design early in the paper	4
24				
25				
26	Setting	#5	Describe the setting, locations, and relevant dates, including	4-5
27			periods of recruitment, exposure, follow-up, and data	
28			collection	
29				
30				
31	Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of	4
32			selection of participants.	
33				
34				
35		#7	Clearly define all outcomes, exposures, predictors, potential	5-6
36			confounders, and effect modifiers. Give diagnostic criteria, if	
37			applicable	
38				
39				
40	Data sources /	#8	For each variable of interest give sources of data and details	5
41	measurement		of methods of assessment (measurement). Describe	
42			comparability of assessment methods if there is more than	
43			one group. Give information separately for for exposed and	
44			unexposed groups if applicable.	
45				
46				
47				
48				
49				
50				
51				
52				
53				
54				
55				
56				
57				
58				
59				
60				

1	Bias	#9	Describe any efforts to address potential sources of bias	5-6
2				
3				
4	Study size	#10	Explain how the study size was arrived at	5
5				
6				
7	Quantitative	#11	Explain how quantitative variables were handled in the	6
8	variables		analyses. If applicable, describe which groupings were	
9			chosen, and why	
10				
11				
12				
13				
14				
15	Statistical	#12a	Describe all statistical methods, including those used to	6
16	methods		control for confounding	
17				
18				
19				
20	Statistical	#12b	Describe any methods used to examine subgroups and	6
21	methods		interactions	
22				
23				
24				
25				
26	Statistical	#12c	Explain how missing data were addressed	5-6
27	methods			
28				
29				
30				
31	Statistical	#12d	If applicable, describe analytical methods taking account of	N/A
32	methods		sampling strategy	
33				
34				
35				
36	Statistical	#12e	Describe any sensitivity analyses	N/A
37	methods			
38				
39				
40				
41				
42	Results			
43				
44				
45	Participants	#13a	Report numbers of individuals at each stage of study—eg	4,7
46			numbers potentially eligible, examined for eligibility,	
47			confirmed eligible, included in the study, completing follow-	
48			up, and analysed. Give information separately for for	
49			exposed and unexposed groups if applicable.	
50				
51				
52				
53				
54				
55				
56				
57	Participants	#13b	Give reasons for non-participation at each stage	4
58				
59				
60				

1	Participants	#13c	Consider use of a flow diagram	5
2				
3				
4	Descriptive data	#14a	Give characteristics of study participants (eg demographic,	7
5			clinical, social) and information on exposures and potential	
6			confounders. Give information separately for exposed and	
7			unexposed groups if applicable.	
8				
9				
10				
11				
12				
13				
14	Descriptive data	#14b	Indicate number of participants with missing data for each	7
15			variable of interest	
16				
17				
18				
19	Outcome data	#15	Report numbers of outcome events or summary measures.	7
20			Give information separately for exposed and unexposed	
21			groups if applicable.	
22				
23				
24				
25				
26				
27	Main results	#16a	Give unadjusted estimates and, if applicable, confounder-	8-11
28			adjusted estimates and their precision (eg, 95% confidence	
29			interval). Make clear which confounders were adjusted for	
30			and why they were included	
31				
32				
33				
34				
35				
36				
37	Main results	#16b	Report category boundaries when continuous variables were	8-11
38			categorized	
39				
40				
41				
42	Main results	#16c	If relevant, consider translating estimates of relative risk into	N/A
43			absolute risk for a meaningful time period	
44				
45				
46				
47				
48	Other analyses	#17	Report other analyses done—e.g., analyses of subgroups	21
49			and interactions, and sensitivity analyses	
50				
51				
52				
53	Discussion			
54				
55				
56	Key results	#18	Summarise key results with reference to study objectives	12-15
57				
58				
59				
60				

1	Limitations	#19	Discuss limitations of the study, taking into account sources	14-15
2			of potential bias or imprecision. Discuss both direction and	
3			magnitude of any potential bias.	
4				
5				
6				
7				
8				
9	Interpretation	#20	Give a cautious overall interpretation considering objectives,	12-15
10			limitations, multiplicity of analyses, results from similar	
11			studies, and other relevant evidence.	
12				
13				
14				
15				
16	Generalisability	#21	Discuss the generalisability (external validity) of the study	14
17			results.	
18				
19				
20				
21				
22	Other Information			
23				
24				
25	Funding	#22	Give the source of funding and the role of the funders for the	16-17
26			present study and, if applicable, for the original study on	
27			which the present article is based	
28				
29				
30				
31				

32 None The STROBE checklist is distributed under the terms of the Creative Commons Attribution
 33 License CC-BY. This checklist can be completed online using <https://www.goodreports.org/>, a tool
 34 made by the [EQUATOR Network](#) in collaboration with [Penelope.ai](#)