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Systematic Review

The Global Prevalence of Conduct Disorder: A Systematic Review and Meta-Analysis

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Abstract

Objective: There has been little effort to conduct systematic reviews or meta-analyses of the available literature to find global prevalence rates of conduct disorder and analyze the sources of heterogeneity.
Method: We searched multiple databases, including Web of Science, PubMed, Scopus, and Google Scholar to identify cross-sectional studies with random or nonrandom sampling to assess the global prevalence of conduct disorder in children and adolescents aged under 18 in the general or school-based populations. Quality assessment and data extraction were independently carried out by two authors. Subgroup analysis was used to find the potential sources of heterogeneity.
Results: We reached 50 studies, incorporating 186,056 children and adolescents from 35 countries. The total prevalence of conduct disorder was 8% (CI: 7-9%; I2: 99.77%), including 7% in females (CI: 4-9%; I2: 99.56%) and 11% in males (CI: 7-15%; I2: 99.74%). The results of subgroup analysis showed that total heterogeneity could be explained by measurement tools. When diagnostic interviews such as the Kiddie Schedule for Affective Disorders and Schizophrenia for School-Age Children—Present and Lifetime Version (K-SADS-PL) and Development and Well-Being Assessment (DAWBA) were employed, the pooled prevalence rates for conduct disorder were 0.4% and 0.7%, respectively, and heterogeneity decreased. However, the use of the screening tools such as the Strengths and Difficulties Questionnaire (SDQ)-parent or teacher report and SDQ-self report increased the pooled prevalence of conduct disorder to 10% and 16% respectively.
Conclusion: The prevalence of conduct disorder in the epidemiological studies should be estimated by employing the diagnostic interviews to reach accurately assessments.

Key words: *Conduct Disorder; Meta-Analysis; Prevalence; Systematic Review*

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The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) defines conduct disorder as groups of repetitive and persistent behaviors, including aggression to people or animals, destruction of property, deceitfulness or theft, and serious violation of rules in children and adolescents aged under 18 (1). Although previous studies showed the role of genetic factors to develop conduct disorder, its multiple environmental risk factors were identified as follows: maternal alcohol use; drug use; smoking; and stress during pregnancy; parental psychopathology; malnutrition; exposure to heavy metals; low IQ; maladaptive parenting; parental maltreatment; deviant peers; low socioeconomic status; poverty; and community violence (2).

The years of healthy life of 5.75 million children and adolescents were lost due to the disability related to conduct disorder (3). Conduct disorder is linked to other psychiatric disorders like substance use disorders, antisocial personality disorder, and attention-deficit/hyperactivity disorder (ADHD). Also, it is related to poor educational outcomes, physical health problems, poor peer relationships, early pregnancy, and higher rates of vehicular accidents and injury (4, 5).

Only 5% of countries have globally estimated the prevalence of conduct disorder (2). In a systematic review, Erskine et al (6) estimated the global epidemiology of conduct disorder for 21 world regions and showed the prevalence rates of 3.6% in males and 1.5% in females in 2010. In a systematic review of studies conducted between 1995 to 2014 years, Salmanian et al (7) indicated that the prevalence of conduct disorder were between 1% to 29.9% for females and 3.3% to 34.6% for males in Middle Eastern countries. Although conduct disorder can be diagnosed in children under the age of five, previous studies typically showed the prevalence of conduct disorder in children aged 5 to 18 years (2).

Prevalence estimates for conduct disorder from the previous literature review vary and globally representative estimates are scarce. Until 2010, Erskine et al (2013) (6) indicated the global epidemiology of conduct disorder. However, they did not perform a meta-analysis and did not quantify the methodological sources of heterogeneity such as different diagnostic criteria or different testing procedures because of the relatively small data sets they had available. Several studies indicated different prevalence rates for conduct disorder using various screening and diagnostic tools. For instance, Salmanian et al (8) found the total lifetime prevalence of 0.78% for conduct disorder in a national study on 29,739 Iranian children and adolescents using K-SADS-PL. Also, Xiaoli et al (9) showed the rate of 0.62% for conduct disorder among Chinese children and adolescents using DAWBA. In another study in the United States, the prevalence rate of 5.44% was reported for conduct disorder among youth using the World Health Organization Composite International Diagnostic Interview (10). Using SDQ-parent report, Kovess-Masfety et al (11) indicated the prevalence rate of 8.4% for conduct disorder across seven European countries. Also, in another study in Kenya, the prevalence of 12.5% was reported using the Youth Self Report (YSR) (12).

Since the majority of studies reported the prevalence of conduct disorder using parent, teacher, or self-report symptom scales rather than diagnostic tools, the true prevalence of conduct disorder may be overestimated. Therefore, the methodological sources of heterogeneity such as different testing procedures should be investigated (7). There is a need for comprehensive global estimates of conduct disorder that perform meta-analysis of data from epidemiological studies and investigate different sources of heterogeneity between study methods. The present systematic review and meta-analysis responded to these gaps in the literature by summarizing the current available literature on the global prevalence of conduct disorder and analyzed the methodological sources of heterogeneity. Therefore, subgroup analysis was undertaken according to quality of study, region of study, study base, living area, type of sampling, measurement tools, age categories, and type of school. Sine violence would be the fifth cause of death in 2030; we supposed that the prevalence rate of conduct disorder has possibly been increasing (7). Overall, the aim of the study was to carry out a systematic review and meta-analysis to estimate the global prevalence of conduct disorder and estimate the sources of heterogeneity by subgroup analysis. It is expected that the need of prevention or early intervention will be facilitated by enhanced understanding of global prevalence of conduct disorder.

Materials and Methods

Search Strategy

We performed a systematic search of the literature in Web of Science, PubMed, Scopus, and Google Scholar to identify studies assessing the global prevalence of conduct disorder. Gray literature, including conference proceedings, was also searched. Published articles from February 1, 2011 until September 30, 2017, were searched. The following search syntax was applied using the PubMed/ MeSh terms: ("conduct disorder" OR "conduct problem") AND (prevalence OR incidence OR amount OR measure OR rate OR frequency OR epidemiolog*).

Eligibility Criteria

Inclusion criteria were all cross-sectional studies with random or nonrandom sampling that used diagnostic or screening instruments to assess the prevalence of conduct disorder in children and adolescents aged under 18 for at least one gender in the general or school-based populations residing in any countries of the world .

The exclusion criteria were as follows: (1) clinical or interventional studies; (2) studies on high-risk groups or specific populations; (3) studies showing the prevalence of conduct disorder with comorbidities; and (4) studies assessing the validity and reliability of the questionnaires. Two of the authors (M.S. and Z.K.) independently investigated the title, abstract, and full-text of each search result; discrepancies were resolved independently by the third author .

Two authors (M.S. and Z.K.) independently searched in the databases and selected the articles based on the eligibility criteria. Any disagreement was resolved by consensus or it was settled by the third author (M.M.).

Quality Assessment and Data Extraction

Using the STROBE checklist, two authors (M.S. and Z.K.) independently evaluated the quality of the included studies (13). Two authors resolved any disagreements in the quality assessment by consensus and the third author (M.M.) settled the case, if needed.

We extracted study characteristics, including the first author name; publication year; continent, country and city where the study was conducted; living area (urban, rural); type of sampling (random, nonrandom); type of study base (general population-based, school population-based); type of school (public, private); response rate; total sample; gender; age; instruments measuring conduct disorder; and outcomes measured.

Statistical Analysis

We used STATA for data analysis (Release 12. STATA Corp). To aggregate prevalence estimates, the graphical methods and random-effects models were used. Heterogeneity across the studies was assessed using the I2 statistic. To assess the source of potential heterogeneity, we used subgroup analysis. We undertook subgroup analysis based on quality of study, region of study, study base, living area, type of sampling, measurement tools, age categories, and type of school .

Begg's funnel plot and Egger's test were used to report the publication bias. Since studies with small sample size or nonsignificant findings are less likely to be published and may be excluded from meta-analyses, publication bias may exist. Thus, trim-and-fill analysis was used to adjust for missing studies. P values < .05 were considered statistically significant (See the published protocol of the study for comprehensive methods) (14).

Results

Study Characteristics

2932 records were identified through database searching; we retrieved 2906 articles after removing duplicate records. Of these articles, 2581 were excluded based on the titles and abstracts; and 325 full-text articles were evaluated (Figure 1). Overall, 50 articles met the eligibility criteria that are presented in Table 1 .

The eligible studies included of 186,056 individuals from 35 countries: Austria (n=1) (15), Brazil (n=2) (16, 17), Canada (n=1) (18), Chile (n=1) (19), China (n=3) (9, 20, 21), Egypt (n=1) (22), Ethiopia (n=1) (23), Finland (n=1) (24), Germany (n=1) (25), Germany, Italy, Netherlands, Lithuania, Romania, Bulgaria, and Turkey (n=1) (11), India (n=3) (26-28), Iran (n=5) (29-33), Ireland (n=2) (34, 35), Kenya (n=2) (12, 36), Korea (n=2) (37, 38), Lebanon (n=2) (39, 40), Malaysia (n=1) (41), Netherlands (n=1) (42), Nigeria (n=1) (43), Norway (n=2) (44, 45), Oman (n=1) (46), Palestine (n=1) (47), Romania (n=1) (48), Spain (n=1) (49), Sri Lanka (n=1) (50), Sudan (n=1) (51), Sweden (n=3) (52-54), Taiwan (n=1) (55), Thailand (n=1) (56), Turkey (n=1) (57), United Kingdom (n=1) (58), United States (n=2) (10, 59), and Vietnam (n=1) (60).

SDQ (n=25) and KSADS (n=6) were the most frequent measurement instruments to screen and diagnose conduct disorder (Table 1).

Meta-analysis

From 50 studies included in qualitative synthesis, five studies only provided the mean and standard deviation of the scores, which were excluded from the meta-analysis (18, 21, 51, 54, 60). One study estimated the prevalence rates using two different measurement tools (SDQ and K-SADS-PL), both of which were entered in the meta-analysis (34). Another study reported the prevalence rates using two different instruments (CBCL and YSR) by two different groups (parents and children), both of which were included in the meta-analysis (53). Also, 1 study evaluated the prevalence rates among 2 different populations in separate times (2006 and 2012), both of which were entered in the meta-analysis (49). In 1 case where the study reported the prevalence rates using 2 different measurement tools (SDQ-parent report and SDQ-self report) among the same population, only the most prevalence rate (SDQ-self report) was entered in the meta-analysis (47). Finally, meta-analysis included 48 studies.

Since we observed a high heterogeneity across the estimates of prevalence, subgroup analysis was undertaken to explore the sources of heterogeneity. Table 2 showed the subgroup analysis according to quality of study, continent, study base, living area, type of sampling, instruments, age categories, and type of school.

Total Prevalence of Conduct Disorder

We estimated the pooled prevalence rates of 8% for conduct disorder in children and adolescents (CI: 7-9%; I2: 99.77%) (Figure 2).

Subgroup analysis showed that total heterogeneity could be explained by measurement tools (Table 2). Studies used diagnostic such tools as KSADS reported statistically lower prevalence rates of conduct disorder than studies that used such screening tools as SDQ (Table 2, Figure 3).

We assessed the publication bias for studies that assessed the total prevalence of conduct disorder. Begg's funnel plot showed asymmetrical distribution of the study results (Figure 4-A). We found the significant

publication bias by Egger's test (P < .001). To adjust the publication bias for studies assessed the total prevalence of conduct disorder, trim-and-fill analysis was used (P = .819).

Prevalence of Conduct Disorder for Each Gender

From the 48 studies entered in the meta-analysis, 22 studies showed the prevalence rates of conduct disorder in females and males separately. We found the pooled prevalence rates of 7% for conduct disorder among females (CI: 4%-9%; I2: 99.56%), and the pooled prevalence rates of 11% for conduct disorder among males (CI: 7%-15%; I2: 99.74%). Due to the high heterogeneity across the estimates of prevalence in females and males, subgroup analysis was assessed (Table 2). Subgroup analysis results showed high heterogeneity in all study subgroups, and we observed no significant differences among each subgroup variables (Table 2).

We evaluated the publication bias for studies that assessed the prevalence of conduct disorder for each gender. Funnel plots indicated asymmetrical distribution of the study results (Figure 4-B, C). The significant publication bias was found by applying Egger's test in studies that assessed the prevalence of conduct disorder among females (P = .004) and males (P = .006). We used trim-and-fill analysis to adjust the publication bias for studies that assessed the prevalence of conduct disorder in females (P = .846) and males (P = .753).

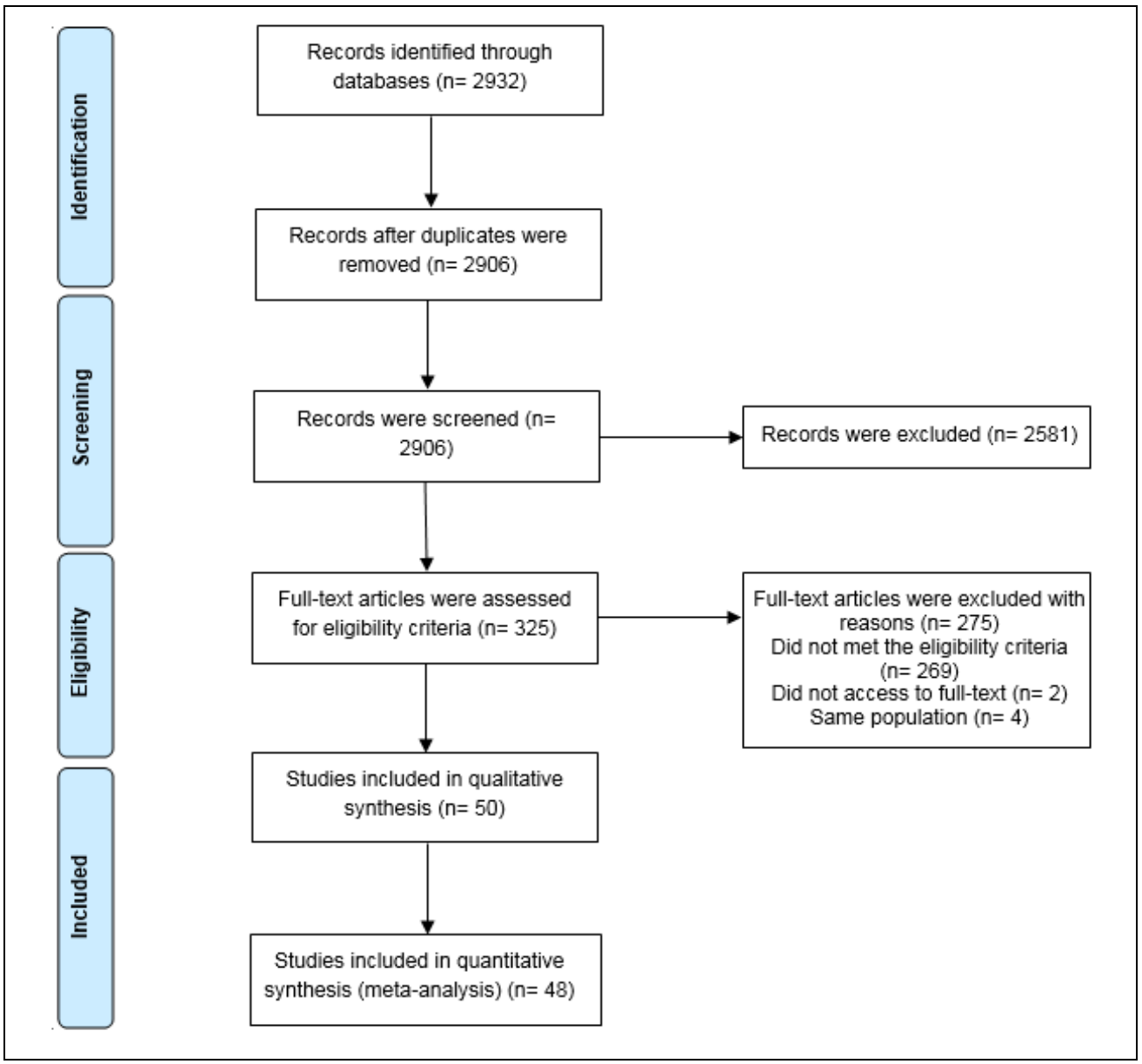

Figure 1. Flow Chart of Literature Search

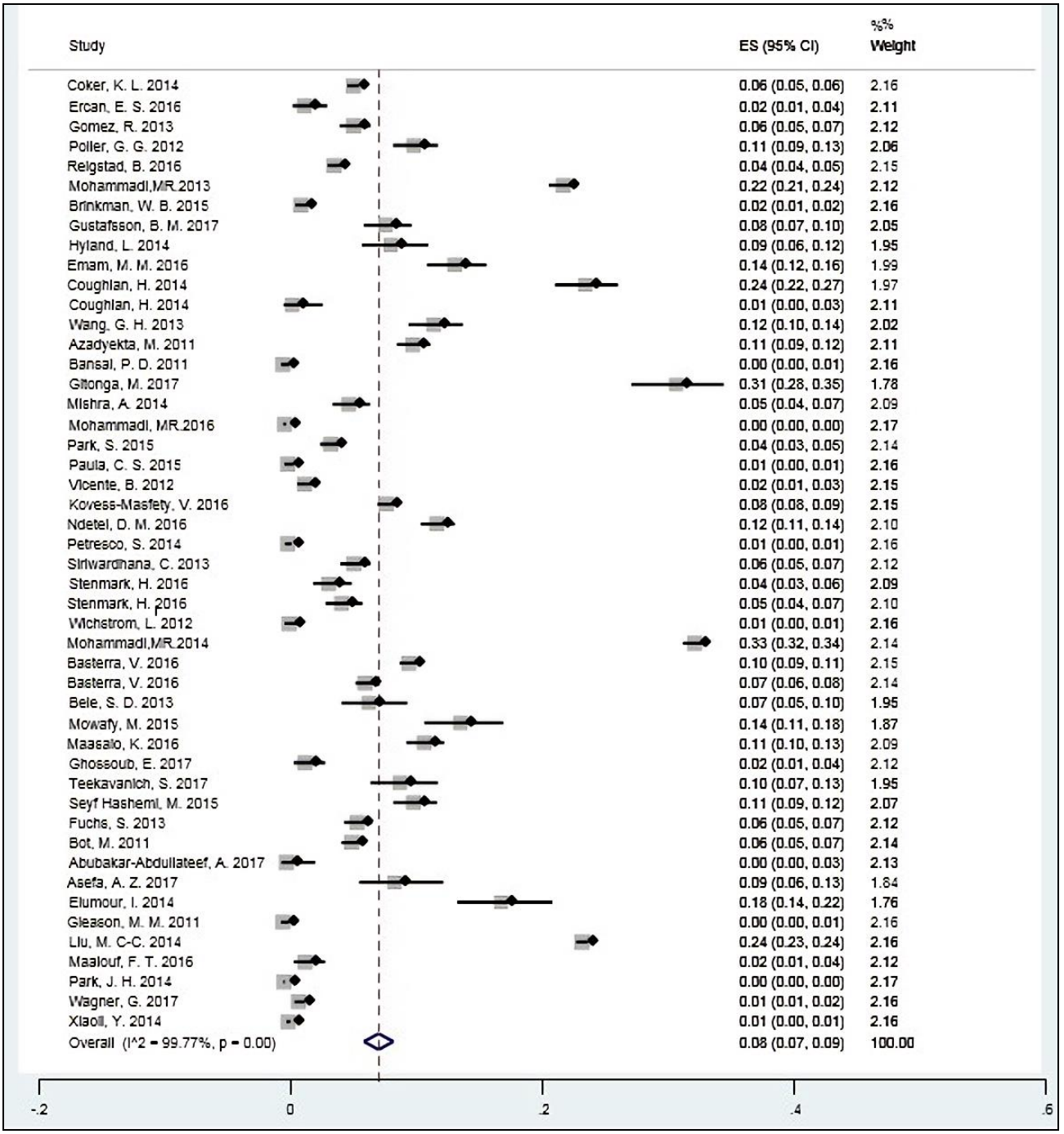

Figure 2. Total Prevalence Rate of Conduct Disorder

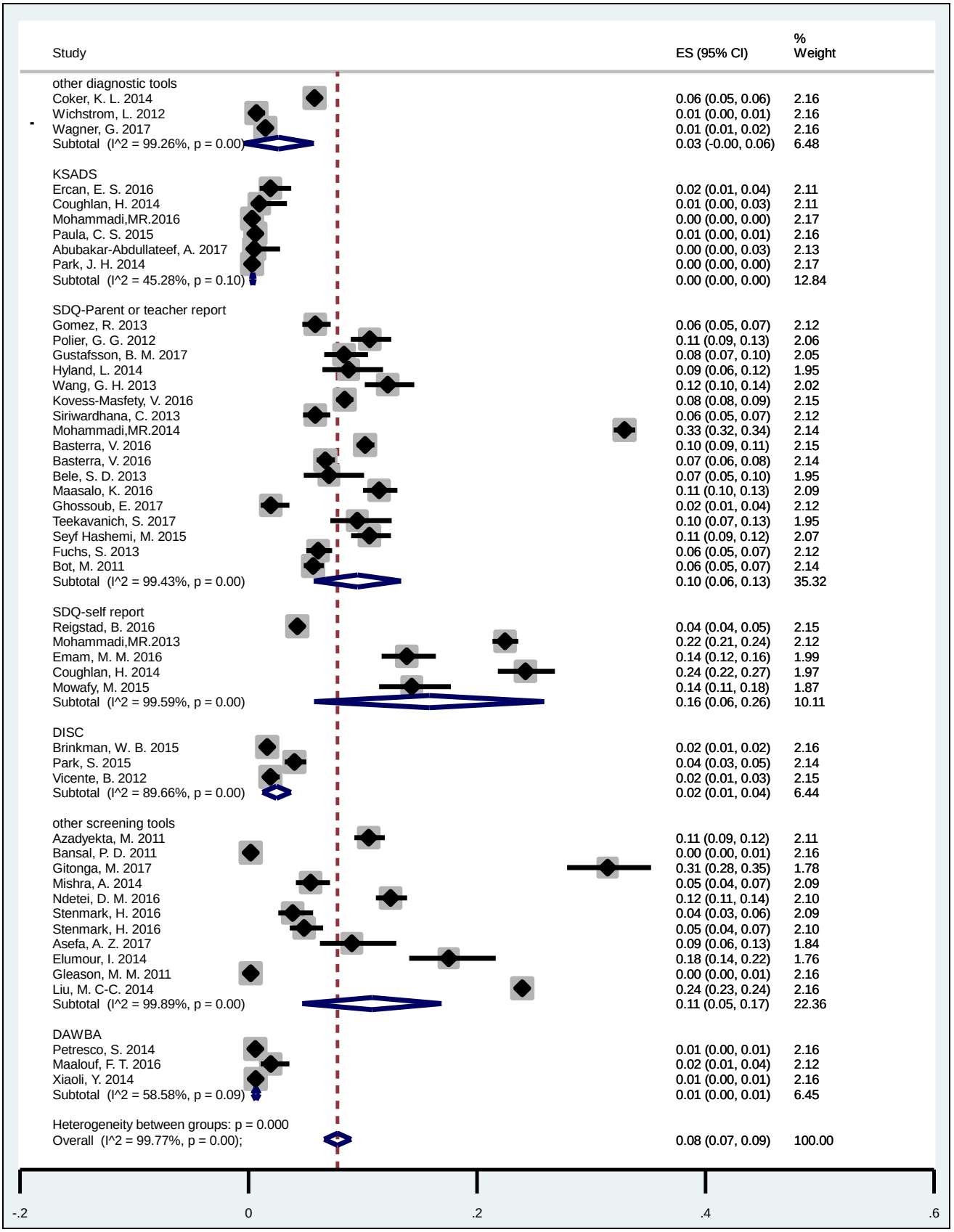

Figure 3. Subgroup Analysis of Data based on the Measurement Tools

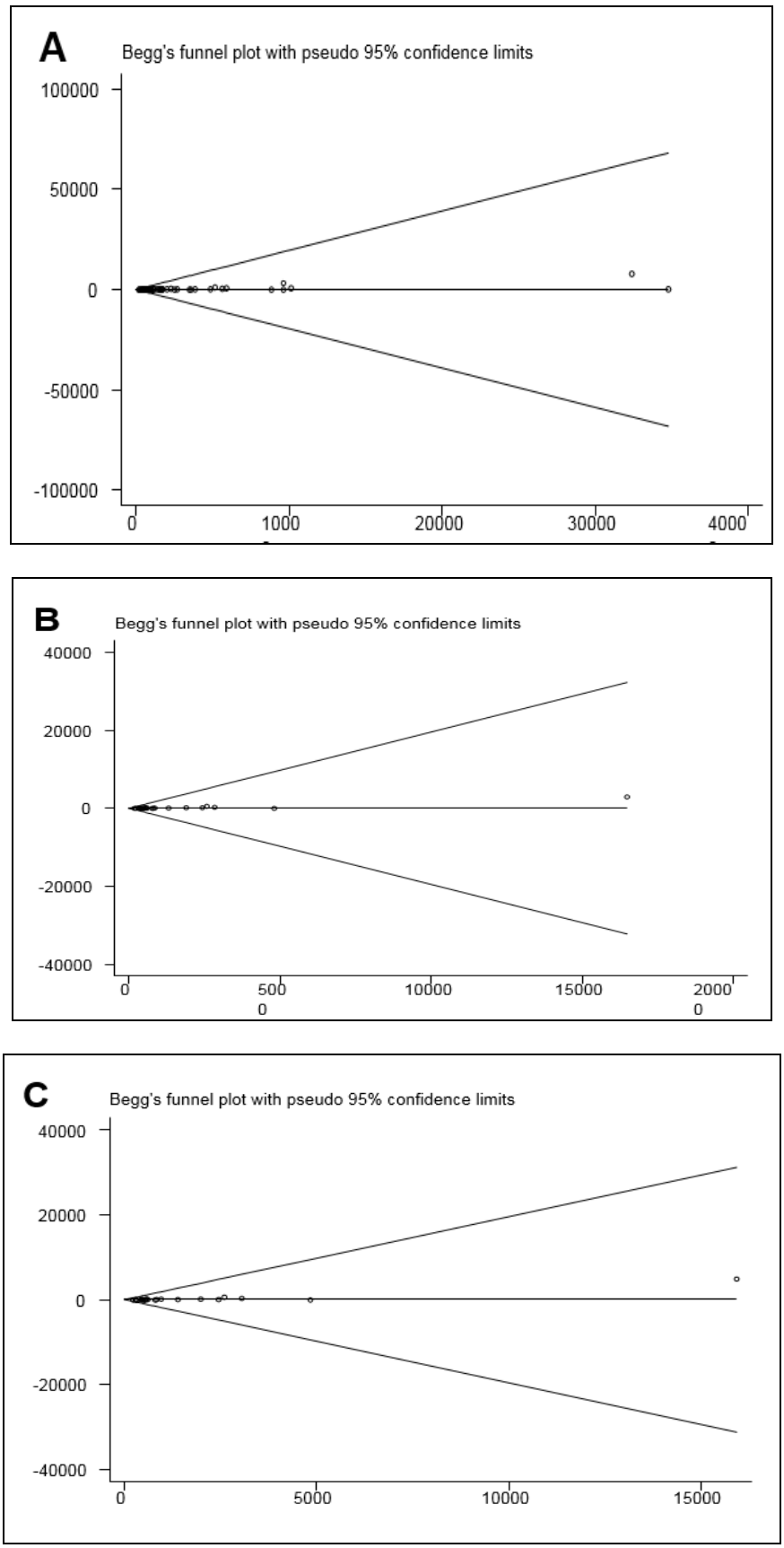

Figure 4. (A) Publication bias for Total Prevalence of Conduct Disorder. (B) Publication bias for Conduct Disorder among Females. (C) Publication bias for Conduct Disorder among Males.

Table 1. Summary of the Included Studies in the Global Prevalence of Conduct Disorder

ID	Quality score	First author. publication year (reference)	Continent (country, city or province)	Living area, urban/rural	Type of sampling (study base)	Type of school, public/ private	Response rate, %	Total, n	Male, n	Female, n	Age	Instrument	Conduct disorder outcome/s			
													Male,%	Female, %	Both, %	Mean (SD)
1	26	Bot, M. 2011 (42)	Europe (Netherlands, Kop van Noord-Holland and West-Friesland)	Rural	Random (general population-based)		67.3	2703	1392	1311	8-12	SDQ- parent report	7.7	3.5	5.7	
2	23	Amstadter, AB. 2011 (60)	Asia (Vietnam, DaNang and Khanh Hoa)		Random (school population-based)		71.5	1368	684	683	11-18	SDQ- parent report				0.71 (1.23)
3	15	Azadyekta, M. 2011 (29)	Asia (Iran, Tehran)		Random (school population-based)			2016	954	850	7-11	Children's symptoms Illness (CSI-4)	13.4	7	10.5	
4	17	Bansal, PD. 2011 (27)	Asia (India, north of India)		Random (school population-based)			982	528	454	10-15	Childhood Psychopathology Measurement Schedule (CPMS)	1.8	0	1	
5	26	Gleason, MM. 2011 (48)	Europe (Romania, Bucharest)		Non-random (general population-based)		78	1003	521	482	18-60 month	Child Behavior Checklist (CBCL)	0	0.2	0.2	
6	22	Polier, GG. 2012 (58)	Europe (United Kingdom, London)		Not mentioned (school population-based)			1160	548	612	8-12	SDQ- parent report	12.6	8.8	10.6	

7	25	Wichstrom, L. 2012 (44)	Europe (Norway, Trondheim)		Not mentioned (general population-based)		79.6	995	489	506	4	the Preschool Age Psychiatric Assessment (PAPA)	1	0.5	0.7	
8	15	Humaida, IAI. 2012 (51)	Africa (Sudan, Khartoum)		Random (school population-based)	Both		384	242	142	5-17	Sutter-Eyberg Student Behavior Inventory				89.5 (24.4)
9	22	Vicente, B. 2012 (19)	South America (Chile; Santiago, Concepcion, Iquique, Cautin)	Both	Random (general population-based)			1558	793	765	4-18	Diagnostic Interview Schedule for Children-IV (DISC-IV)	2.7	1	1.9	
10	23	Andrade, BF. 2013 (18)	North America (Canada, Toronto)	ural and subu	Not mentioned (school population-based)	Public		500	245	255	6-9	SDQ- teacher report				0.82 (1.5)
11	23	Gomez, R. 2013 (41)	Asia (Malaysia, Selangor)		Random (school population-based)		56.3	1407	616	791	5-13	SDQ- parent report			5.8	1.9 (1.5)
12	30	Siriwardhana, C. 2013 (50)	Asia (Sri Lanka, 17 administrative districts)	Both	Random (school population-based)	Public	92.5	1505	729	757	12-17	SDQ- multi-informant			5.8	
13	17	Mohammadi,MR. 2013 (30)	Asia (Iran; Tehran, Isfahan, Fars, Khorasan Razavi, East	Urban	Random (general population-based)		99.4	5171	2593	2578	12-17	SDQ- self report	25.6	22.2	24	

			Azarbaijan)										
14	26	Bele, SD. 2013 (28)	Asia (India, Karimnagar)	Urban slum	Random (general population-based)		370	211	159	5-10	SDQ- parent report	7.02	6.04 (2.08)
16	23	Wang, GH. 2013 (20)	Asia (China, Shenzhen)		Random (school population-based)	93.4	887	495	413	6-14	SDQ- parent report	12.2	1.84 (1.44)
17	20	Coker, KL. 2014 (10)	North America (United States)		Not mentioned (school and general population-based)	83.6	10123	5194	4929	13-17	World Health Organization Composite International Diagnostic Interview	5.44	
18	25	Petresco, S. 2014 (16)	South America (Brazil, Pelotas)	Urban	Not mentioned (general population-based)	84.7	3585	1839	1746	6	Development and Well-Being Assessment (DAWBA)	0.6	
19	20	Plenty, S. 2014 (54)	Europe (Sweden)		Random (school population-based)		3699			15	SDQ- self report		0.25 (0.41)
20	24	Mohammadi,M R. 2014 (32)	Asia (Iran; Tehran, Isfahan, Fars, Khorasan Razavi, East Azarbaijan)	Urban	Random (general population-based)	96.6	9636	4836	4800	6-17	SDQ- parent report	32.9	

21	18	Hyland, L. 2014 (35)	Europe (Ireland, the south west of Irland)	Both	Not mentioned (school population-based)			445	192	253	4-7	SDQ- teacher report			9	1 (1.7)
22a	21	Coughlan, H. 2014 (34)	Europe (Ireland, north Dublin city and county Kildare)		Not mentioned (school population-based)			1131	577	555	11-13	SDQ- self report	27.9	20.4	24.2	
22b	21	Coughlan, H. 2014 (34)	Europe (Ireland, north Dublin city and county Kildare)		Not mentioned (school population-based)			212	102	110	11-13	K-SADS-PL			0.8	
23	23	Wang, JN. 2014 (21)	Asia (China, Liaoning)	Both	Random (school population-based)	Public	84.1	5220	2259	2961	11-18	SDQ- self report				2.31 (1.66)
24a	26	Elumour, I. 2014 (47)	Asia (Palestine; south Gaza Strip, Khan Younis, Rafah area)		Random (school population-based)	Public		388	194	194	12-15	Conduct Disorder Rating Scale (CDRS)-parent report			15.7	
24b	26	Elumour, I. 2014 (47)	Asia (Palestine; south Gaza Strip, Khan Younis, Rafah area)		Random (school population-based)	Public		388	194	194	12-15	Conduct Disorder Rating Scale (CDRS)-self report			17.5	
25	25	Liu, MCC. 2014 (55)	Asia (Taiwan)	Both	Random (school population-based)	Both		32390	15914	16476	13-17	Seven questionnaire items-not specified tool-self report	30.4	17.7	23.9	

26	17	Mishra, A. 2014 (26)	Asia (India, Indore)		Random (school population-based)			900	461	439	6-11	Children's Behavior Questionnaire (CBQ)	7.81	2.96	5.48
27	28	Park, JH. 2014 (37)	Asia (Korea, Busan)		Non-random (school population-based)		79.7	34758			6-16	KSADS			0.3
28	27	Xiaoli, Y. 2014 (9)	Asia (China, Liaoning)	Both	Random (school population-based)	Both	90.2	8848			6-17	DAWBA			0.62
29	22	Brinkman, WB. 2015 (59)	North America (United States)		Random (general population-based)		82.8	2517			12-15	Diagnostic Interview Schedule for Children (DISC)			1.6
30	31	Mowafy, M. 2015 (22)	Africa (Egypt, Nikla rural village)	Rural	Random (school population-based)	Both	93.4	476	260	216	13-17	SDQ- self report			14.3
31	27	Seyf Hashemi, M. 2015 (33)	Asia (Iran, Semnan)	Urban	Random (school population-based)	Both	95.7	1200	616	584	6-12	SDQ- parent report	14.7	6.2	10.6
32	22	Park, S. 2015 (38)	Asia (Korea, Seoul)		Random (school population-based)		66	1645	834	811	6-12	DISC-IV	0.7	0.1	0.4
33	22	Paula, CS. 2015 (17)	South America (Brazil; Caete, Goianira, Itaitinga, Rio Preto da Eva)	Both	Random (school population-based)	Public	81.1	1676			6-16	KSADS			0.6

34	23	Ercan, ES. 2016 (57)	Asia (Turkey, Izmir)		Random (school population-based)	Public	99.5	417	225	192	6-14	KSADS	3.1	0.5	1.9
35	26	Kovess-Masfety, V. 2016 (11)	Europe (Germany, Italy, Netherlands, Lithuania, Romania, Bulgaria, and Turkey)		Random (school population-based)		73.5	5630			6-11	SDQ- parent report	12.7	4.4	8.4
36	28	Ndetei, DM. 2016 (12)	Africa (Kenya; Makindu, Machakos)	Rural and peri-urban	Random (school population-based)	Public	86.5	2267	1099	1177	10-13	Youth Self Report (YSR)			12.5
37	23	Reigstad, B. 2016 (45)	Europe (Norway, northernmost counties)		Not mentioned (school population-based)		83	4881	2446	2435	15-16	SDQ- self report	3.7	5.1	4.4
38a	25	Stenmark, H. 2016 (53)	Europe (Sweden, Umeå)		Not mentioned (school population-based)			623	306	317	9	CBCL	4.6	2.5	4
38b	25	Stenmark, H. 2016 (53)	Europe (Sweden, Umeå)		Not mentioned (school population-based)			842	458	384	12	YSR	6.3	3.1	5
39a	24	Basterra, V. 2016 (49)	Europe (Spain, national-2006)		Not mentioned (general population-based)		96	5894	3047	2847	4-14	SDQ- parent report	10.8	9.6	10.2

39b	24	Basterra, V. 2016 (49)	Europe (Spain, national-2012)		Not mentioned (general population-based)		97.3	3867	1976	1891	4-14	SDQ- parent report	6.2	7.3	6.7	
40	27	Maasalo, K. 2016 (24)	Europe (Finland)	Both	Random (general population-based)		34.3	1714	845	869	4-12	SDQ- parent report			11.4	
41	13	Emam, MM. 2016 (46)	Asia (Oman, two big cities in the Sultanate of Oman)		Random (school population-based)			816	298	336	12-16	SDQ- self report			13.8	2.51 (1.84)
42	28	Maalouf, FT. 2016 (39)	Asia (Lebanon, Beirut)	Urban	Random (general population-based)	Both	50.8	510	286	224	11-17	DAWBA	3.1	0.4	2	
43	20	Mohammadi,MR. 2016 (31)	Asia (Iran; Tehran, Isfahan, Fars, Khorasan Razavi, East Azarbaijan)	Urban	Random (general population-based)		96.6	9636	4836	4800	6-18	KSADS	0.44	0.21	0.34	
44	18	Gustafsson, BM. 2017 (52)	Europe (Sweden)		Random (school population-based)		50.5	815	424	391	1-5	SDQ- teacher report	10.2	6.2	8.3	
45	31	Ghossoub, E. 2017 (40)	Asia (Lebanon, Beirut)	Urban	Random (general population-based)			510	284	226	11-17	SDQ- parent report			1.96	

46	26	Teekavanich, S. 2017 (56)	Asia (Thailand, Bangkok)		Random (school population-based)	Public	53.2	463			4-6	SDQ- parent report			9.5	4.8 (1.1)
47	26	Abubakar-Abdullateef, A. 2017 (43)	Africa (Nigeria, Zaria)		Random (school population-based)	Public	90	200			5-19	KSADS			0.5	
48	28	Asefa, AZ. 2017 (23)	Africa (Ethiopia, Oromia)	Both	Random (school population-based)	Both	74.7	287	170	117	10-16	Disruptive Behavior Disorders (DBD)			9.1	
49	22	Gitonga, M. 2017 (36)	Africa (Kenya, Nairobi)		Random (school population-based)			611	293	318	13-18	conduct disorder scale (CDS)	36.5	26.7	31.4	
50	33	Wagner, G. 2017 (15)	Europe (Austria)		Random (school population-based)	Both	47.3	3477	1554	1923	10-18	The Childrens' Diagnostic Interview for Mental Disorder			1.47	

Table 2. Subgroup Analysis of Included Studies that Reported Prevalence of Conduct Disorder

	Both genders				Female				Male			
Subgroups	Studies, n	Sample	Prevalence, % (95% CI)	I^2, %	Studies, n	Sample	Prevalence, % (95% CI)	I^2, %	Studies, n	Sample	Prevalence, % (95% CI)	I^2, %
Quality of studies												
Below average	21	49006	8 (6-10)	99.42	12	15200	8 (5-11)	99.06	13	15512	11 (8-14)	99.22
Above average	27	125879	8 (6-10)	99.84	10	25022	5 (1-10)	99.68	9	25005	9 (1-18)	99.76
Continent												
Asia	21	114455	9 (7-11)	99.88	9	27408	6 (1-12)	99.80	10	27247	11 (3-18)	99.88

Africa	5	3841	13 (5-22)	99.05	1	318			1	293		
Europe	17	37130	7 (5-9)	99.10	11	11731	6 (4-8)	98.31	10	12184	9 (6-12)	97.78
North America	2	12640	3.9 (3.5-4.2)	100	0	0			0	0		
South America	3	6819	0.9 (0.3-1.5)	85.18	1	765			1	793		
Study base												
General population-based	16	51407	7 (5-9)	99.79	9	15404	5 (3-7)	99.28	8	15933	7 (3-11)	99.45
School population-based	31	113355	8 (7-10)	99.76	13	24818	8 (4-13)	99.38	14	24584	13 (6-20)	99.74
Both	1	10123			0	0			0	0		
Living area												
Urban	8	30618	10 (5-15)	99.89	4	8186	6.9 (0.2-13.7)	99.57	4	8331	11 (2-23)	99.66
Rural	2	3179	6 (5-7)	99.99	1	1311			1	1392		
Both urban and rural	9	50690	8 (2-15)	99.91	2	17241	11 (11-12)	99.86	2	16707	23 (22-23)	99.89
Not mentioned	29	90398	7 (6-8)	99.25	15	13484	6 (4-8)	98.11	15	14087	10 (7-12)	98.38
Sampling type												
Random	33	103628	9 (7-11)	99.81	13	30193	7 (3-11)	99.71	14	30149	12 (6-18)	99.83
Non-random	2	35761	0.3 (0.2-0.4)	99.99	1	482			1	521		
Not mentioned	13	35496	7 (4-9)	99.16	8	9547	7 (4-10)	98.32	8	9847	9 (5-12)	98.17
Instruments												
Screening tools												
SDQ-parent or teacher report	17	39944	10 (6-13)	99.42	6	7636	7 (5-9)	93.03	6	8003	10 (8-13)	92.08
SDQ-self report	5	12475	16 (6-26)	99.58	3	5568	15 (3-28)	99.43	3	5616	18 (2-35)	99.67
Others	11	42309	11 (5-17)	99.88	7	19720	9 (1-16)	99.75	7	19435	14 (1-28)	99.87
Diagnostic tools												
KSADS	6	46899	0.4 (0.2-0.5)	45.28	2	4992	0.2 (0.1-0.3)	99.98	2	5061	0.5 (0.3-0.7)	99.99

DAWBA	3	12943	0.7 (0.4-1)	58.57	1	224			1	286		
DISC	3	5720	2 (1-4)	89.65	2	1576	1 (1-2)	99.71	2	1627	4 (3-5)	99.84
Others	3	14595	2.7 (0.4-5.7)	99.26	1	506			1	489		
Age categories												
Children	17	27005	6 (5-8)	98.83	10	6303	4 (2-5)	95.36	9	6545	9 (5-13)	96.96
Adolescents	15	62083	12 (7-17)	99.79	7	22970	13 (6-20)	99.61	7	22567	19 (7-31)	99.80
Both children and adolescents	16	85797	6 (5-7)	99.75	5	10949	4 (1-7)	99.05	6	11405	4 (1-7)	98.88
Type of school												
Public	7	6916	7 (3-10)	98.59	1	192			1	225		
Both private and public	7	47188	9 (1-17)	99.93	3	17284	8 (5-21)	99.81	3	16816	16 (3-35)	99.71
Not mentioned	19	69884	8 (7-10)	99.33	10	7566	8 (5-11)	96.96	11	7829	12 (8-15)	98.45

Discussion

Our study revealed 50 studies reporting the prevalence of conduct disorder and involving 186,056 children and adolescents from 35 countries. Over 75% of studies were from high-income and upper-middle income countries according to the World Bank classification (61). As Erskine et al (2017) found, high income countries had more level of coverage of prevalence data for mental disorders in children and adolescents (62). Moreover, conduct disorder had the lowest geographical spread of prevalence data as compared to other mental disorders (62). Erskine et al (6, 62) reported the global epidemiology of conduct disorder in 2010 and 2013, while they did not perform a meta-analysis and did not quantify the methodological sources of heterogeneity, such as different testing procedures. Therefore, we carried out a systematic review and meta-analysis to assess the global prevalence of conduct disorder. Also, we assessed the sources of heterogeneity by subgroup analysis and differentiated between screening tools and diagnostic instruments, which have not been done in previous reviews on conduct disorder.

Our findings demonstrated that the overall prevalence rate of conduct disorder was 8%, which was higher than previously published prevalence estimates from Erskine et al studies (6, 62). In 2013, Erskine et al found the prevalence rate of 5% for conduct disorder (62), which was higher than their findings in 2010 (6). Since the global coverage of prevalence data for mental disorders increased between 2010 and 2013 (62), we supposed that more recent publications can be associated with increased conduct disorder prevalence during recent years. Furthermore, the prevalence rate of conduct disorder has possibly been increased among children and adolescents. We found the prevalence rate of 7% and 11% in females and males, respectively. This is in consistent with previous research showing that males had more prevalence rate of conduct disorder than females (6). Although conduct disorder can be diagnosed in children under the age of five, only two studies assessed the prevalence rate of conduct disorder in this age group (25, 48).

Through the subgroup analysis, we found that heterogeneity in prevalence rate could be explained by measurement tools. When diagnostic interviews such as KSADS and DAWBA were employed, the pooled prevalence rates for conduct disorder were 0.4% and 0.7%, respectively, and heterogeneity decreased. However, the use of the screening tools such as SDQ-parent or teacher report and SDQ-self report increased the pooled prevalence of conduct disorder to 10% and 16%, respectively. The majority of included studies estimated conduct disorder using screening tools that measured conduct disorder symptoms rather than diagnostic interviews. Therefore, included studies that used screening tools indicated much more prevalence rates of conduct disorder comparing to studies that used diagnostic tools. For instance, using SDQ-self report, Coughlan, et al (34) showed that 24.2% of adolescents had conduct disorder in Ireland, which was widely different with the rate of 0.8% they found using K-SADS-PL. Also, in other studies in Iran, Mohammadi et al (31, 32) found the prevalence rates of 32.9% and 0.34% for conduct disorder in children and adolescents using SDQ-parent report and K-SADS-PL, respectively. Indeed, screening tools tended to give precedence to sensitivity over specificity and overestimated the prevalence rates (63). In particular, studies that used the self-rating assessments such as SDQ-self report indicated more prevalence rates of conduct disorder than studies that used the parent-rating assessments like SDQ-parent report. It might be due to children and adolescents tendency to consider the minor difficulties and report them, which are less visible for their parents (64). Moreover, the prevalence of conduct disorder varied with different diagnostic instruments in this review, as included studies used K-SADS-PL and DAWBA indicated the rates of below 1% (9, 16, 17, 31, 34, 37, 39, 43, 57), while studies that used DISC showed the pooled prevalence rate of 2% for conduct disorder (19, 38, 59). Overall, the results of this review suggested that diagnostic interviews such as K-SADS-PL should be utilized to accurately estimate the prevalence rate of conduct disorder in the epidemiological studies.

Limitation

There were several limitations that need to be considered in interpretation of the results. First, studies reported the wide variability of the prevalence rates for conduct disorder. This could be due to various conduct disorder measurements. Second, heterogeneity remained after subgroup analysis by quality of study, continent, study base, living area, type of sampling, age categories, and type of school. However, heterogeneity was decreased after subgroup analysis by measurement tools. Third, this review might be affected by publication bias, which may arise from the lack of publications from low-income countries, language restriction, and lack of publications because of providing small sample size or nonsignificant findings.

Conclusion

The global prevalence of conduct disorder was estimated in 186,056 children and adolescents from 35 countries. Results showed the global prevalence rate of 8% for conduct disorder, which included 7% of females and 11% of males. We analyzed the methodological sources of heterogeneity and found the measurement tools as a source of heterogeneity. Thus, studies that used screening tools showed higher prevalence rates of conduct disorder than studies that used diagnostic tools. Consequently, we suggested that the prevalence of conduct disorder in the epidemiological studies should be estimated by employing the diagnostic interviews to reach accurately assessments.

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Conflict of Interest
The authors declare that they have no conflict of interest.

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