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
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 epidemiol)*).

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 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
### The Global Prevalence of Conduct Disorder

#### Figure 2. Total Prevalence Rate of Conduct Disorder

| Study                          | ES (95% CI)    | Weight |
|-------------------------------|---------------|--------|
| Coker, K. L. 2014             | 0.06 (0.05, 0.06) | 2.16   |
| Erkan, E. S. 2016             | 0.02 (0.01, 0.04) | 2.11   |
| Gomez, R. 2013                | 0.06 (0.05, 0.07) | 2.12   |
| Poller, G. G. 2012            | 0.11 (0.09, 0.13) | 2.06   |
| Rieglard, B. 2016             | 0.04 (0.04, 0.06) | 2.15   |
| Mohammadi, M.R. 2013          | 0.22 (0.21, 0.24) | 2.12   |
| Brinkman, W. B. 2016          | 0.02 (0.01, 0.02) | 2.16   |
| Gustafsson, B. M. 2017        | 0.05 (0.07, 0.10) | 2.05   |
| Hyland, L. 2014               | 0.09 (0.06, 0.12) | 1.95   |
| Enam, M. M. 2016              | 0.14 (0.12, 0.16) | 1.99   |
| Coughlan, H. 2014             | 0.24 (0.22, 0.27) | 1.97   |
| Coughlan, H. 2014             | 0.01 (0.00, 0.03) | 2.11   |
| Wang, G. H. 2013              | 0.12 (0.10, 0.14) | 2.02   |
| Azad-Yekta, M. 2011           | 0.11 (0.09, 0.12) | 2.11   |
| Bansil, P. D. 2011            | 0.00 (0.00, 0.01) | 2.16   |
| Ghotoga, M. 2017              | 0.34 (0.28, 0.35) | 1.78   |
| Mishra, A. 2014               | 0.05 (0.04, 0.07) | 2.09   |
| Mohammadi, M.R. 2016          | 0.00 (0.00, 0.00) | 2.17   |
| Park, S. 2015                 | 0.04 (0.03, 0.06) | 2.14   |
| Pauls, C. S. 2015             | 0.01 (0.00, 0.01) | 2.16   |
| Vicente, B. 2012              | 0.02 (0.01, 0.03) | 2.15   |
| Kovesi-Maslouy, V. 2016       | 0.09 (0.08, 0.09) | 2.15   |
| Nettel, D. M. 2016            | 0.12 (0.11, 0.14) | 2.10   |
| Petrescu, S. 2014             | 0.01 (0.00, 0.01) | 2.16   |
| Strlwardhana, C. 2013         | 0.06 (0.05, 0.07) | 2.12   |
| Steinman, H. 2016             | 0.04 (0.03, 0.06) | 2.09   |
| Steinman, H. 2016             | 0.05 (0.04, 0.07) | 2.10   |
| Wohstrom, L. 2012             | 0.01 (0.00, 0.01) | 2.16   |
| Mohammadi, M.R. 2014          | 0.33 (0.32, 0.34) | 2.14   |
| Basterra, V. 2016             | 0.10 (0.09, 0.11) | 2.15   |
| Basterra, V. 2016             | 0.07 (0.06, 0.08) | 2.14   |
| Bele, S. D. 2013              | 0.07 (0.05, 0.10) | 1.95   |
| Movafy, M. 2015               | 0.14 (0.11, 0.18) | 1.87   |
| Maesato, K. 2016              | 0.11 (0.10, 0.13) | 2.09   |
| Ghosseous, E. 2017            | 0.02 (0.01, 0.04) | 2.12   |
| Teekkania, S. 2017            | 0.10 (0.07, 0.13) | 1.95   |
| Seyf Hashemi, M. 2015         | 0.11 (0.09, 0.12) | 2.07   |
| Fuchs, S. 2013                | 0.06 (0.05, 0.07) | 2.12   |
| Bot, M. 2011                  | 0.06 (0.05, 0.07) | 2.14   |
| Abubakar-Abdullateef, A. 2017 | 0.00 (0.00, 0.03) | 2.13   |
| Asafe, A. Z. 2017             | 0.09 (0.06, 0.13) | 1.64   |
| Elمور, I. 2014               | 0.16 (0.14, 0.22) | 1.76   |
| Gkayoua, M. 2011              | 0.00 (0.00, 0.01) | 2.16   |
| Liu, M. C-C. 2014             | 0.24 (0.23, 0.24) | 2.16   |
| Maalouf, F. T. 2016           | 0.02 (0.01, 0.04) | 2.12   |
| Park, J. H. 2014              | 0.00 (0.00, 0.00) | 2.17   |
| Wagner, G. 2017               | 0.01 (0.01, 0.02) | 2.16   |
| Xiao, Y. 2014                 | 0.01 (0.00, 0.01) | 2.16   |
| Overall (I² = 99.77%, p = 0.00) | 0.00 (0.07, 0.09) | 100.00 |
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.
| 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 | Mean (SD) |
|----|----------------|------------------------------------------|---------------------------------------|--------------------------|-------------------------------|-------------------------------|-----------------|----------|--------|----------|-----|------------|----------------------------|----------|
| 1  | 26             | Bot, M. 2011 (42)                       | Europe (Netherland s, Kop van Noord- Holland and West- Friesland) | Rural                    | Random (general population based) |                           | 67.3           | 2703    | 1392   | 1311    | 8-12 | SDQ- parent report | Male,% Female,% Both, % | 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     | 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    | 7-11    | 546 | 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   | 10-15   | 552 | 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     | 482     | 18-60 month | Child Behavior Checklist (CBCL) | 0.2 0.2 0.2 |
| 6  | 22             | Polier, GG. 2012 (58)                  | Europe (United Kingdom, London)       | Not mentioned (school population based) |                           | 1160                         | 548            | 612     | 8-12    | 8-12    | 580 | SDQ- parent report |                          | 12.6 8.8 10.6 |
| No. | Authors | Year | Region | Type | Sample Size | Age Range | Diagnosis | Assessment | Prevalence | Confidence Interval |
|-----|---------|------|--------|------|-------------|-----------|-----------|------------|-------------|---------------------|
| 7   | Wichstrom, L. | 2012 | Europe (Norway, Trondheim) | Not mentioned (general population-based) | 79.6 | 995 | 489 | 506 | 4 | 1 0.5 0.7 |
| 8   | Humaida, IAi. | 2012 | Africa (Sudan, Khartoum) | Random (school population-based) | Both | 384 | 242 | 142 | 5-17 | Sutter-Eyberg Student Behavior Inventory | 89.5 (24.4) |
| 9   | Vicente, B. | 2012 | South America (Chile; Santiago, Concepcion, Iquique, Cautin) | Rando m (general population-based) | 1558 | 793 | 765 | 4-18 | Diagnostic Interview Schedule for Children-IV (DISC-IV) | 2.7 1 1.9 |
| 10  | Andrade, BF. | 2013 | North America (Canada, Toronto) | Not mentioned (school population-based) | Public | 500 | 245 | 255 | 6-9 | SDQ- teacher report | 0.82 (1.5) |
| 11  | Gomez, R. | 2013 | Asia (Malaysia, Selangor) | Rando m (school population-based) | 56.3 | 1407 | 616 | 791 | 5-13 | SDQ- parent report | 5.8 |
| 12  | Siriwardhana, C. | 2013 | Asia (Sri Lanka, 17 administrative districts) | Rando m (school population-based) | Public | 92.5 | 1505 | 729 | 757 | 12-17 | SDQ- multi-informant | 5.8 |
| 13  | Mohammadi, M R. | 2013 | Asia (Iran; Tehran, Isfahan, Fars, Khorasan Razavi, East) | Random (general population-based) | Urban | 99.4 | 5171 | 2593 | 2578 | 12-17 | SDQ- self report | 25.6 22.2 24 |
| #  | Authors               | Year       | Region                              | Study Type                  | Sample Size | SDQ Score | SE  |
|----|-----------------------|------------|-------------------------------------|-----------------------------|-------------|-----------|-----|
| 14 | Bele, SD.             | 2013 (28)  | Asia (India, Karimnagar) Urban slum | Random (general population-based) | 370         | 211       | 159 | 5-10 |
| 16 | Wang, GH.             | 2013 (20)  | Asia (China, Shenzhen)              | Random (school population-based) | 93.4        | 887       | 495 | 413  | 6-14 |
| 17 | Coker, KL.            | 2014 (10)  | North America (United States)       | Not mentioned (school and general population-based) | 83.6        | 10123     | 5194 | 4929 | 13-17 |
| 18 | Petresco, S.          | 2014 (16)  | South America (Brazil, Pelotas)     | Not mentioned (general population-based) | 84.7        | 3585      | 1839 | 1746 | 6    |
| 19 | Plenty, S.            | 2014 (54)  | Europe (Sweden)                     | Random (school population-based) | 3699        |           |     |      |      |
| 20 | Mohammadi, M R.      | 2014 (32)  | Asia (Tehran, Isfahan, Fars, Khorasan Razavi, East Azarbaijan) | Random (general population-based) | 96.6        | 9636      | 4836 | 4800 | 6-17 |

**Note:** SDQ = Strengths and Difficulties Questionnaire
| Reference | Region | Sample Size | Methodology | SDQ Score |
|-----------|--------|-------------|-------------|-----------|
| Hyland, L. 2014 (35) | Europe (Ireland, the south west of Ireland) | 192 | Both (school population-based) | 11.31 |
| Coughlan, H. 2014 (34) | Europe (Ireland, north Dublin city and county, Kildare) | 577 | Not mentioned (school population-based) | 11.13 |
| Coughlan, H. 2014 (34) | Europe (Ireland, north Dublin city and county, Kildare) | 212 | Not mentioned (school population-based) | 10.2 |
| Elumour, I. 2014 (47) | Asia (Palestine; south Gaza Strip, Khan Younis, Rafah area) | 194 | Both (school population-based) | 12.15 |
| Wang, JN. 2014 (21) | Asia (China, Liaoning) | 32390 | Both (school population-based) | 13.0 |
| Liu, MCC. 2014 (55) | Asia (Taiwan) | 388 | Not mentioned (school population-based) | 12.15 |
| Li, Y. 2014 (55) | Asia (Taiwan) | 194 | Not mentioned (school population-based) | 12.15 |
| Wang, Y. 2014 (21) | Asia (China, Liaoning) | 32390 | Both (school population-based) | 13.0 |
| Wang, JN. 2014 (21) | Asia (China, Liaoning) | 32390 | Both (school population-based) | 13.0 |
| Liu, MCC. 2014 (55) | Asia (Taiwan) | 388 | Not mentioned (school population-based) | 12.15 |
| Li, Y. 2014 (55) | Asia (Taiwan) | 194 | Not mentioned (school population-based) | 12.15 |
| Wang, Y. 2014 (21) | Asia (China, Liaoning) | 32390 | Both (school population-based) | 13.0 |
| Wang, JN. 2014 (21) | Asia (China, Liaoning) | 32390 | Both (school population-based) | 13.0 |
| Liu, MCC. 2014 (55) | Asia (Taiwan) | 388 | Not mentioned (school population-based) | 12.15 |
| Li, Y. 2014 (55) | Asia (Taiwan) | 194 | Not mentioned (school population-based) | 12.15 |
| Wang, Y. 2014 (21) | Asia (China, Liaoning) | 32390 | Both (school population-based) | 13.0 |
| Wang, JN. 2014 (21) | Asia (China, Liaoning) | 32390 | Both (school population-based) | 13.0 |
| Liu, MCC. 2014 (55) | Asia (Taiwan) | 388 | Not mentioned (school population-based) | 12.15 |
| Li, Y. 2014 (55) | Asia (Taiwan) | 194 | Not mentioned (school population-based) | 12.15 |
| Wang, Y. 2014 (21) | Asia (China, Liaoning) | 32390 | Both (school population-based) | 13.0 |
| Wang, JN. 2014 (21) | Asia (China, Liaoning) | 32390 | Both (school population-based) | 13.0 |
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| Li, Y. 2014 (55) | Asia (Taiwan) | 194 | Not mentioned (school population-based) | 12.15 |
| Wang, Y. 2014 (21) | Asia (China, Liaoning) | 32390 | Both (school population-based) | 13.0 |
| Wang, JN. 2014 (21) | Asia (China, Liaoning) | 32390 | Both (school population-based) | 13.0 |
| Liu, MCC. 2014 (55) | Asia (Taiwan) | 388 | Not mentioned (school population-based) | 12.15 |
| Li, Y. 2014 (55) | Asia (Taiwan) | 194 | Not mentioned (school population-based) | 12.15 |
| Wang, Y. 2014 (21) | Asia (China, Liaoning) | 32390 | Both (school population-based) | 13.0 |
| Wang, JN. 2014 (21) | Asia (China, Liaoning) | 32390 | Both (school population-based) | 13.0 |
| Liu, MCC. 2014 (55) | Asia (Taiwan) | 388 | Not mentioned (school population-based) | 12.15 |
| Li, Y. 2014 (55) | Asia (Taiwan) | 194 | Not mentioned (school population-based) | 12.15 |
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| Wang, Y. 2014 (21) | Asia (China, Liaoning) | 32390 | Both (school population-based) | 13.0 |
| Wang, JN. 2014 (21) | Asia (China, Liaoning) | 32390 | Both (school population-based) | 13.0 |
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| Li, Y. 2014 (55) | Asia (Taiwan) | 194 | Not mentioned (school population-based) | 12.15 |
| Wang, Y. 2014 (21) | Asia (China, Liaoning) | 32390 | Both (school population-based) | 13.0 |
| Wang, JN. 2014 (21) | Asia (China, Liaoning) | 32390 | Both (school population-based) | 13.0 |
| Liu, MCC. 2014 (55) | Asia (Taiwan) | 388 | Not mentioned (school population-based) | 12.15 |
| Li, Y. 2014 (55) | Asia (Taiwan) | 194 | Not mentioned (school population-based) | 12.15 |
| Wang, Y. 2014 (21) | Asia (China, Liaoning) | 32390 | Both (school population-based) | 13.0 |
| Wang, JN. 2014 (21) | Asia (China, Liaoning) | 32390 | Both (school population-based) | 13.0 |
| Liu, MCC. 2014 (55) | Asia (Taiwan) | 388 | Not mentioned (school population-based) | 12.15 |
| Li, Y. 2014 (55) | Asia (Taiwan) | 194 | Not mentioned (school population-based) | 12.15 |
| Wang, Y. 2014 (21) | Asia (China, Liaoning) | 32390 | Both (school population-based) | 13.0 |
| Wang, JN. 2014 (21) | Asia (China, Liaoning) | 32390 | Both (school population-based) | 13.0 |
| No. | Author(s) | Year | Region | Sample Size | Sampling Method | Instrument | Prevalence (95% CI) |
|-----|-----------|------|--------|-------------|----------------|------------|---------------------|
| 26  | Mishra, A. | 2014 | Asia (India, Indore) | Rando (school population-based) | Children's Behavior Questionnaire (CBQ) | 900 461 439 6-11 | 7.81 2.96 5.48 |
| 27  | Park, JH. | 2014 | Asia (Korea, Busan) | Non-random (school population-based) | KSADS | 79.7 34758 6-16 | 0.3 |
| 28  | Xiaoli, Y. | 2014 | Asia (China, Liaoning) | Rando (school population-based) | DAWBA | Both 90.2 8848 6-17 | 0.62 |
| 29  | Brinkman, WB. | 2015 | North America (United States) | Rando (general population-based) | Diagnostic Interview Schedule for Children (DISC) | 82.8 2517 12-15 | 1.6 |
| 30  | Mowafy, M. | 2015 | Africa (Egypt, Nikla rural village) | Rural | SDQ- self report | Both 93.4 476 260 216 13-17 | 14.3 |
| 31  | Seyf Hashemi, M. | 2015 | Asia (Iran, Semnan) | Urban | SDQ- parent report | Both 95.7 1200 616 584 6-12 | 14.7 6.2 10.6 |
| 32  | Park, S. | 2015 | Asia (Korea, Seoul) | Rando (school population-based) | DISC-IV | 66 1645 834 811 6-12 | 0.7 0.1 0.4 |
| 33  | Paula, CS. | 2015 | South America (Brazil; Caite, Goianira, Itaitinga, Rio Preto da Eva) | Rando (school population-based) | KSADS | Both 81.1 1676 6-16 | 0.6 |
| Page | Study Code | Author | Year | Region | Sample Size | Methodology | Age Range | Conduct Disorder | Validity Measures |
|------|------------|--------|------|--------|-------------|-------------|------------|----------------|-----------------|
| 34   | 23         | Ercan, ES. | 2016 (57) | Asia (Turkey, Izmir) | Random (school population-based) | Public | 99.5 | 417 | 225 | 192 | 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-report | 12.7 | 4.4 | 8.4 |
| 36   | 28         | Ndetei, DM. | 2016 (12) | Africa (Kenya: Makindu, Machakos) | 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  |            |         |      |        | Not mentioned (school population-based) | | | | | | | |
| 25   | 25         | Stenmark, H. | 2016 (53) | Europe (Sweden, Umeå) | Not mentioned (school population-based) | | 842 | 458 | 384 | 12 | YSR | 6.3 | 3.1 | 5 |
| 24   |            |         |      |        | Not mentioned | | | | | | SDQ-parent report | |
| 39a  | 25         | Basterra, V. | 2016 (49) | Europe (Spain, national-2006) | Not mentioned (general population-based) | | 96 | 5894 | 3047 | 2847 | 4-14 | 10.8 | 9.6 | 10.2 |
| Study ID | Year | Region | Sample Characteristics | Prevalence (SD) | Methodology 1 | Prevalence (SD) | Methodology 2 | Prevalence (SD) | Methodology 3 |
|----------|------|--------|------------------------|-----------------|---------------|----------------|---------------|----------------|---------------|
| 39b      | 24   | Europe | Spain, national-based  | 97.3 (3867)     | SDQ- parent   report | 6.2 (7.3)      | SDQ- self     report | 11.4          |             |
| 40       | 27   | Europe | Finland                | 34.3 (1714)     | SDQ- parent   report | 6.2 (7.3)      | SDQ- self     report | 13.8 (2.5)    |             |
| 41       | 13   | Asia   | Oman, two big cities   | 816 (298)       | SDQ- self     report | 13.8 (2.5)    | SDQ- self     report | 13.8 (2.5)    |             |
|          |      |        | in the Sultanate of    |                 |               |                |               |                |               |
|          |      |        | Oman)                  |                 |               |                |               |                |               |
| 42       | 28   | Asia   | Lebanon, Beirut        | 50.8 (510)      | SDQ- parent   report | 3.1 (0.4)      | SDQ- parent   report | 3.1 (0.4)     |             |
| 43       | 20   | Asia   | Iran; Tehran, Isfahan,| 96.6 (9636)     | SDQ- parent   report | 0.44 (0.21)    | SDQ- parent   report | 0.34          |             |
|          |      |        | Fars, Khorasan, Razavi,|                |               |                |               |                |               |
|          |      |        | East Azarbaijan)       |                |               |                |               |                |               |
| 44       | 18   | Europe | Sweden                 | 50.5 (815)      | SDQ- teacher  report | 10.2 (6.2)     | SDQ- parent   report | 1.96          |             |
| 45       |      |        |                        |                 |               |                |               |                |               |
| 31       | 31   | Asia   | Lebanon, Beirut        | 510 (284)       | SDQ- parent   report | 1.96          | SDQ- parent   report | 1.96          |             |
| No. | Males | Females | Both genders |
|-----|-------|---------|--------------|
| 46  | 26    | Asia (Thailand, Bangkok) | Random (school population-based) | Public | 53.2 | 463 | 4-6 | SDQ-parent report | 9.5 | 4.8 (1.1) |
| 47  | 26    | Africa (Nigeria, Zaria) | Random (school population-based) | Public | 90 | 200 | 5-19 | KSADS | 0.5 |
| 48  | 28    | Africa (Ethiopia, Oromia) | Both | Both | 74.7 | 287 | 170 | 117 | 10-16 | Disruptive Behavior Disorders (DBD) | 9.1 |
| 49  | 22    | Africa (Kenya, Nairobi) | Random (school population-based) | Random (school population-based) | 611 | 293 | 318 | 13-18 | Conduct disorder scale (CDS) | 36.5 | 26.7 | 31.4 |
| 50  | 33    | Europe (Austria) | Both | Both | 47.3 | 3477 | 1554 | 1923 | 10-18 | The Children's Diagnostic Interview for Mental Disorder | 1.47 |

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

| Subgroups            | Studies, n | Sample | Prevalence, % (95% CI) | I², % | Studies, n | Sample | Prevalence, % (95% CI) | I², % | Studies, n | Sample | Prevalence, % (95% CI) | I², % |
|----------------------|------------|--------|------------------------|------|------------|--------|------------------------|------|------------|--------|------------------------|------|
| 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          | 25025  | 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|

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| Region                  | Total | Prevalence | Total | Prevalence | Total | Prevalence | Total | Prevalence | Total | Prevalence |
|------------------------|-------|------------|-------|------------|-------|------------|-------|------------|-------|------------|
| 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          | 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      |
| Type of School          | DAWBA | DISC      | Others   |
|------------------------|-------|-----------|----------|
|                        | 3     | 3         | 3        |
|                        | 12943 | 5720      | 14595    |
|                        | 0.7 (0.4-1) | 2 (1-4) | 2.7 (0.4-5.7) |
|                        | 58.57 | 89.65     | 99.26    |
|                        | 1     | 2         | 1        |
|                        | 224   | 1576      | 506      |
|                        | 1     | 1         | 1        |
|                        | 286   | 1627      | 489      |

| Age Categories         | DAWBA | DISC      | Others   |
|------------------------|-------|-----------|----------|
|                        | 3     | 3         | 3        |
|                        | 17    | 15        | 16       |
|                        | 27005 | 62083     | 85797    |
|                        | 6 (5-8) | 12 (7-17) | 6 (5-7)  |
|                        | 98.83 | 99.79     | 99.75    |
|                        | 10    | 7         | 5        |
|                        | 6303  | 22970     | 10949    |
|                        | 4 (2-5) | 13 (6-20) | 4 (1-7)  |
|                        | 95.36 | 99.61     | 99.05    |
|                        | 9     | 7         | 6        |
|                        | 6545  | 22567     | 11405    |
|                        | 9 (5-13) | 19 (7-31) | 4 (1-7)  |
|                        | 96.96 | 99.80     | 98.88    |

| Type of school          | DAWBA | DISC      | Others   |
|------------------------|-------|-----------|----------|
|                        | 3     | 3         | 3        |
|                        | 7     | 7         | 7        |
|                        | 6916  | 47188     | 69884    |
|                        | 7 (3-10) | 9 (1-17) | 8 (7-10) |
|                        | 98.59 | 99.93     | 99.33    |
|                        | 1     | 3         | 10       |
|                        | 192   | 17284     | 7566     |
|                        | 1     | 7         | 11       |
|                        | 225   | 17284     | 7829     |
|                        |       | 19        | 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 K-SADS 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.
Acknowledgment
This study was funded and supported by Tehran University of Medical Sciences (Grant No. 34795).

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

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