Abstract

**Aims:** The inclusion of “Internet gaming disorder (IGD)” in the fifth edition of Diagnostic and Statistical Manual of Mental Disorders (DSM-5) creates a possible line of research. Despite the fact that adolescents are vulnerable to IGD, studies had reported wide array of prevalence estimates in this population. The aim of this paper is to review the published studies on prevalence of IGD among adolescents. **Methods:** Relevant studies prior to March 2017 were identified through databases. A total of 16 studies met the inclusion criteria. **Results:** Thepooled prevalence of IGD among adolescents was 4.6% (95% CI = 3.4%-6.0%). Male adolescents generally reported higher prevalence rate (6.8%, 95% CI= 4.3%-9.7%) than female adolescents (1.3%, 95% CI = 0.6%-2.2%). Subgroup analyses revealed that prevalence estimates were highest when studies were conducted in: (i) 1990s, (ii) use DSM criteria for pathological gambling, (iii) examine gaming disorder, (iv) Asia, and (v) small samples (<1000). **Conclusion:** This study confirms the alarming prevalence of IGD among adolescents, especially among males. Given the methodological deficits in past decades (such as reliance on DSM criteria for “pathological gambling”, inclusion of the word “Internet”, and small sample sizes), it is critical for researchers to apply a common methodology for assess this disorder.

*Keywords*: Internet Gaming Disorder, prevalence, adolescent, DSM-5, meta-analysis

Prevalence of Internet Gaming Disorder in Adolescents

A Meta-Analysis across 3 Decades

Internet Gaming Disorder (IGD) has received much research attentions since the release of the first commercial video game in early 1970s, especially after the incident of several high profile cases of violence due to gaming issues (such as the Colorado movie theatre massacre conducted by James Holmes in 2012). Various studies had been conducted to investigate different aspects of IGD, which include validation of assessment tools (Lemmens, Valkenburg, & Peter, 2009; Tejeiro & Bersabé, 2002; Wölfling, Müller, & Beutel, 2011), identification of potential impacts of IGD (Kim, Namkoong, Ku, & Kim, 2008; Männikkö, Billieux, & Kääriäinen, 2015; Vollmer, Randler, Horzum, & Ayas, 2014), and examination of comorbidity with other addictions (Griffiths, 2008; King, Delfabbro, & Griffiths, 2010).

The fifth edition of Diagnostic and Statistical Manual of Mental Disorders (DSM-5) proposes Internet gaming disorder (IGD) as a potential psychiatric condition that requires further scientific research before it can be officially recognized as formal disorder (American Psychiatric Association, 2013). The proposed IGD contains nine criteria: (i) preoccupation with Internet games, (ii) withdrawal symptoms when Internet gaming is taken away, (iii) the need to spend increasing amounts of time engaged in Internet games, (iv) unsuccessful attempts to control the participation in Internet games, (v) loss of interests in previous hobbies and entertainment, (vi) continued excessive use of Internet games despite knowledge of psychosocial problems, (vii) has deceived family members, therapists, or others regarding the amount of Internet gaming, (viii) use of Internet games to escape or relieve a negative mood, and (ix) has jeopardized or lost a significant relationship, job, or educational or career opportunity because of participation in Internet games. With the newly updated DSM-5, experts from multiple nations had collaborated to propose a common method for assessing internet gaming disorder (Petry et al., 2014), in the hope to create an international consensus to assess this disorder.

However, the inclusion of this new diagnosis in DSM-5, as well as the introduction of international consensus for IGD, have led to a number of issues and concerns (Griffiths et al., 2016; Kuss, Griffiths, & Pontes, 2017b; Starcevic, 2017). Specifically, the inclusion of the word “Internet” in IGD has been challenged in various studies (Griffiths & Pontes, 2014; King & Delfabbro, 2013; Király, Griffiths, & Demetrovics, 2015; Kuss, Griffiths, & Pontes, 2017a). This concern is not unexpected, given the DSM-5’s ambiguous description of IGD as “most often involves specific Internet games, but it could involve non-Internet computerized games as well, although these have been less researched” (American Psychiatric Association, 2013, p796). Indeed, there are researchers which argue that IGD should be viewed as a subtype of video gaming addiction, whereby Internet is merely a medium to play games (King & Delfabbro, 2013; Király et al., 2015; Starcevic, 2013). This argument can be further supported by the works of Griffiths and Pontes, which has consistently claimed that individuals are not addicted to the Internet itself, but use Internet as medium to assess other addictions (Griffiths, 1999; Griffiths & Pontes, 2014; Griffiths & Szabo, 2013). Hence, it is plausible that the word “Internet” will cause confusion and underestimate the impacts of this disorder.

Another issue of IGD worth noting is the approach and method to assess IGD. Traditionally, researchers rely heavily on the DSM-IV’s diagnosis of “pathological gambling” and “substance dependence” to assess IGD (Ahmadi et al., 2014; Festl, Scharkow, & Quandt, 2013; Fisher, 1994; Gupta & Derevensky, 1996). Indeed, there are studies which merely substitute the term “gambling” for “gaming” to assess IGD. This practice has received much criticisms due to distinctive differences between both addictive behaviours (Charlton & Danforth, 2007). In accordance to DSM-5 (American Psychiatric Association, 2013), the main concern of IGD is placed on cognitive and behavioural impairment, whereby “this condition is separate from gambling disorder involving the Internet because money is not at risk” (p797). For instance, the direct translation of “needs to gamble with increasing amounts of money in order to achieve the desired excitement” to “needs to play games with increasing amounts of money in order to achieve the desired excitement” may not represents the addictive gaming behaviour among gamers. Thus, early research which utilized DSM-IV’s diagnosis of “pathological gambling” to assess IGD may have over-identified non-problematic individuals.

Having considered the ambiguous definition and erroneous methodology in relation to IGD, the next challenge is to scientifically determine the prevalence of IGD in different settings. In search of the existing literature, it is noted that quite a number of studies have examined the epidemiology of IGD across various populations, ranging from eight year-old child (Han et al., 2009) to older adults aged 40 years and above (Festl et al., 2013). Of the numerous studies been conducted, adolescence is often being labelled as vulnerable group for IGD (Vollmer et al., 2014). For instance, research found higher prevalence of IGD in younger age groups (16-21 years old) than in older age groups (34-40 years old) (Mentzoni et al., 2011). Undeniably there are diverse set of benefits of gaming activities towards adolescents (Granic, Lobel, & Engels, 2014), but excessive gameplay can cost adolescents on their psychological, social, and physical health (Männikkö et al., 2015; Mills, Mettler, Sornberger, & Heath, 2016). However, despite the various investigations into the prevalence of IGD among adolescents, the yielded prevalence estimates tend to differ widely from study to study (Griffiths, Kuss, & King, 2012). It is stated in DSM-5 that “the prevalence of Internet gaming disorder is unclear because of the varying questionnaires, criteria and thresholds employed” (American Psychiatric Association, 2013, p797)

In light of this consideration, there is a need synthesized the overall prevalence, which accounted the two issues noted before. Therefore, it is the purpose of this study to: (i) synthesize the overall prevalence of IGD among adolescents, (ii) examine gender difference in prevalence of IGD, and (iii) investigate how study characteristics can influence the prevalence estimates, where the study characteristics include study year, measures, recorded disorder, study location, and sample size.

**METHODS**

**Search strategy and inclusion criteria**

Three online databases were searched for articles published before March 2017 (Academic Search Complete, PubMed, and ERIC) with combinations of keywords, namely *prevalence* AND (“*internet gaming disorder*” OR “*game addiction*” OR “*gaming disorder*” OR “*pathological gaming*”) AND (*adolescent* OR *student*). The search identified 458 publications (Figure 1), which were then screened through the following inclusion criteria: (i) written in English; (ii) focused on adolescents aged between 10 to 19 years (all studies which fall within this age range were included in this study); (iii) reported prevalence of IGD, game addiction, gaming disorder, or pathological gaming; and (iv) reported module used to diagnose symptoms of addiction. Of the 282 unique articles, 15 articles met all inclusion criteria. One additional article was identified through reference lists of the eligible studies. Hence, a total of 16 studies were included in the current study.

**Data extraction**

The following information was extracted from the eligible studies: study year, instrument, recorded disorder, sample size, percentage of male participants, study location, and prevalence of IGD. Further, prevalence of IGD by gender was extracted when separate results were reported.

**Statistical analyses**

The degree of heterogeneity of estimates across studies is examined using *I*2 index, with *I*2 value above 50% and 75% signals the existence of heterogeneity and high heterogeneity respectively (Higgins & Thompson, 2002). While the current study did not limit the geographical location of the eligible studies, it seems reasonable that the studies do not share a common effect size. Hence, the current study utilized random-effects model to determine the pooled prevalence of problematic gaming.

Further, previous study suggested increasing problems arise when the prevalence estimates approach to extreme end of 0% and 100%, where the weight of the extreme study tend to be overestimated (Barendregt, Doi, Lee, Norman, & Vos, 2013). To deal with this issue, the present study employed double arcsine to transform the prevalence estimates.

Subgroup analyses was performed to identified the potential influences of prevalence estimates. Five study characteristics were considered as potential influences, namely study year (categorized into “1990s”, “2000s”, and “2010s”), recorded disorder (categorized into “Internet gaming disorder” and “gaming disorder”), measures (categorized into “DSM criteria” and “other validated measures”), study location (categorized into “Asia”, “Australia”, “Europe” and “North America”), and sample size (“<1000”, “1000 to 5000”, and “>5000”). All analyses were conducted using MetaXL, a freely available add-in for Microsoft Excel (downloadable from www.epigear.com).

**RESULTS**

**Overall Prevalence of Internet Gaming Disorder among Adolescents**

 The prevalence of IGD among adolescents had been examined since 1990s (Table 1). Twenty-eight prevalence estimates were included in this study, which involved over 61,737 respondents. The prevalence estimates of IGD ranged from 0.6% in a sample of Spanish secondary school students (Müller et al., 2015) to 19.9% among adolescents in Exeter, England (Griffiths & Hunt, 1998). Low prevalence estimates (6% and below) were reported in most studies (Ahmadi et al., 2014; Fisher, 1994; King & Delfabbro, 2016; King, Delfabbro, Zwaans, & Kaptsis, 2013; Müller et al., 2015; Pápay et al., 2013; Rehbein, Kliem, Baier, Mößle, & Petry, 2015; Rehbein, Psych, Kleimann, Mediasci, & Mößle, 2010; Vadlin, Åslund, Rehn, & Nilsson, 2015), while only three studies (Griffiths & Hunt, 1998; Lopez-Fernandez, Honrubia-Serrano, Baguley, & Griffiths, 2014; Wang et al., 2014) reported high prevalence estimates of IGD (above 10 %). However, two of the high estimate studies were conducted in small samples (Griffiths & Hunt, 1998; Wang et al., 2014), whereby the prevalence estimates might be overestimated.

The pooled prevalence was graphically presented as forest plot in Figure 2. Overall, the pooled prevalence of IGD was 4.6% (95% CI = 3.4% - 6.0%) with high heterogeneity between the studies (*I*2 = 98%).

**Gender Difference in Prevalence of Internet Gaming Disorder**

 Eight studies reported separate prevalence estimates by gender (Table 2). The prevalence estimates were higher for males in all studies. The pooled prevalence indicates higher prevalence of IGD in males (6.8%, 95% CI= 4.3%-9.7%) compared to females (1.3%, 95% CI = 0.6%-2.2%). High heterogeneity was found in both subgroups (*I*2 = 98% for both gender).

**Prevalence of Internet Gaming Disorder by Study Characteristics**

 Four subgroup analyses were performed separately for study year, measures, study location, and sample size (Table 3). The results revealed pooled prevalence declined gradually across three decades (from 12.1% in 1990s to 3.8% in 2010s). Further analysis revealed that studies which utilized the DSM criteria for pathological gambling are likely to yield higher prevalence (9.5%, 95% CI = 2.4%-18.2%) than studies who implemented other validated measures (4.1%, 95% CI = 2.9%-5.4%). The result also revealed lower prevalence among studies of IGD (1.6%, 95% CI = 1.3%-2.1%) than studies of gaming disorder (7.6%, 95% CI = 5.1%-10.4%). This is also the case event when the three studies which utilized diagnosis of pathological gambling were excluded (prevalence of gaming disorder = 7.2%, 95% CI = 4.5%-10.2%, not presented in table). Besides, high prevalence estimates of IGD were found in Asia (9.9%, 95% CI = 1.0%-21.5%) and North America (9.4%, 95% CI = 8.3%-10.5%), whereby low prevalence estimates were found in Australia (4.4%, 95% CI = 1.9%-7.4%) and Europe (3.9%, 95% CI = 2.8%-5.3%). In three sample size groups (<1000, 1000 to 5000, and >5000), the pooled prevalence was highest in studies with sample size <1000 (8.6%, 95% CI = 5.8%-11.7%) and lowest in studies with large samples (2.2%, 95% CI = 0.8%-4.0%). High heterogeneity was found between the studies (*I*2 ranged from 93% to 99%).

**DISCUSSION**

 The aim of this study was to provide a comprehensive picture of the prevalence of IGD among adolescents. The results display wide variation of prevalence estimates from 0.6% (Müller et al., 2015) to 19.9% (Griffiths & Hunt, 1998). Overall, the pooled prevalence of IGD among adolescents was 4.6% (95% CI = 3.4% - 6.0%). This finding is similar to the previous review which reported prevalence range of 1.7% to 10.0% (Griffiths et al., 2012). Additionally, this finding is slightly higher than the prevalence rate in child samples (4.2%) but comparatively lower than adult samples (8.9%) reported in previous meta-analysis (Ferguson, Coulson, & Barnett, 2011). This may reflect the onset of IGD during early age. With almost one in twenty adolescents will engage in IGD, this percentage is alerting because many adolescents are unaware of the risks associated with IGD (Wong & Lam, 2016), such as depression and declined academic achievement (Brunborg, Mentzoni, & Frøyland, 2014).

This finding is consistent with previous studies which found gender difference in patterns of gaming (Griffiths et al., 2012; Hartmann & Klimmt, 2006; Vollmer et al., 2014), whereby all separate prevalence estimates in this study documented comparatively higher prevalence rate of IGD among male adolescents than female adolescents. The results show that male adolescents (7.1%) are about four times more likely to engage in IGD than female adolescents (1.7%). Indeed, previous studies have documented more IGD behaviour among males compared to females, such as longer gaming sessions and experienced irresistible urge to play (Desai, Krishnan-Sarin, Cavallo, & Potenza, 2010). The disparity between gender may be attributable to the gender-specific game preference (Greenberg, Sherry, Lachlan, Lucas, & Holmstrom, 2010; Hartmann & Klimmt, 2006; Homer, Hayward, Frye, & Plass, 2012). For instance, Phan, Jardina, and Hoyle (2012) demonstrated that male gamers generally prefer strategy, role playing, action, and fighting genres; while female gamers prefer social, puzzle/card, music/dance, educational/edutainment, and simulation genres. However, most articles included in this study evaluate prevalence of IGD without consideration on game genres. Hence, it is recommended for future studies to evaluate prevalence of IGD across various game genres, especially for those more female-oriented games which are currently under-researched, such as simulation (e.g. The Sims 4) and puzzle games (e.g. Candy Crush Saga).

 Although the current findings found a declining trend of IGD across 3 decades, interpretations of these findings should proceed with care due to two reasons. First, the subgroup sizes are highly imbalanced. In fact, the number of studies in each subgroup can have great impacts on the margin of error (Liu, 2015). While there are 20 prevalence estimates across multiple research designs in 2010s, only two small-scale studies were conducted in 1990s. Thus, the lack of studies conducted in 1990s elongates the width of confidence interval of the subgroup (ranged from 0.5% to 27.8%), which can potentially leads to imprecise measure of prevalence estimate (Liu, 2015).

Second, there are methodological differences between the subgroups. More precisely, the two studies from 1990s examined IGD among adolescents with DSM criteria for pathological gambling, while studies conducted in 2010s generally utilized other validated instrument as measurement of IGD, such as Problem Video Game Playing (PVP) scale (Tejeiro & Bersabé, 2002) and Game Addiction Scale (GAS) (Lemmens et al., 2009). As mentioned, the usage of DSM criteria for pathological gambling to assess IGD has received much criticisms (Wood, 2008). As suggested by Ferguson and colleagues (Ferguson et al., 2011), the direct translation of pathological gambling into IGD may over-identify non-problematic individuals, which will inflate the prevalence estimates. Needless to say, the current findings also demonstrated that the application of DSM criteria for pathological gambling tend to produce higher prevalence with wider confidence interval (ranged between 2.4% and 18.2%), while application of other validated measures of IGD are likely to produce lower prevalence and narrower confidence interval (ranged between 2.9% and 5.4%). In light of these considerations, it is plausible that early findings in 1990s might have erroneously overestimated the prevalence of IGD among adolescents. It is recommended for future study to adapt validated measures to assess IGD, which can later facilitate for more meaningful comparisons of patterns and trends.

On the other hand, the current findings further confirmed the problem arise due to the inclusion of the word “Internet” in IGD. More precisely, studies which specifically examine IGD (1.6%) tend to report lower prevalence than studies which examine gaming disorder (7.2%). This finding echo the Starcevic’s (2013) argument, which suggest IGD as a subtype of gaming disorder. Due to the inclusion of the word “Internet”, the respondents will easily presume and limit IGD as online gaming behaviours only. Hence, the instruments are unable to capture the addictive gaming behaviours among the offline gamers, such as those who play games using game consoles, handheld game devices, and smartphones. For this reason, it is recommended for American Psychiatric Association and future research to revise the term “IGD” in order to explicitly underscore the potential offline gaming disorders.

The current study also shed light on the cultural difference in IGD among adolescents. Echoing the depiction in DSM-5 (American Psychiatric Association, 2013), Asian estimates of prevalence in this study were highest among four continents (9.9%), which are slightly above those from North America (9.4%). By the way of contrast, studies from Australia and Europe reported comparatively lower prevalence estimates of 4.4% and 4.2% respectively. The inflating IGD in Asian countries is not unexpected, given that many of the top game developers come from Asian countries (such as Nintendo, Capcom, Konami, and Square Enix). In fact, the 2017 Global Games Market Report (Newzoo, 2017) estimate highest total global game revenues in Asia-Pacific region (47%, $51.2 billion), which followed by North America (25%, $27.0 billion) and Latin America (4%, $4.4 billion). With the great demands of games in Asian countries, it seems reasonable to see more addictive gamers in this region. However, similar issue occurred when the prevalence estimates were compared by study location. It is noteworthy that huge proportion of the included studies were conducted in European countries (20 studies), while few studies were conducted in North America (one studies), Asia (two studies), and Australia (four studies). Therefore, more research on IGD in these countries is needed.

Last but not least, the prevalence estimates of IGD vary according to study sample size. In particular, the pooled prevalence was highest among studies with less than 1000 respondents (8.6%), whereas studies with moderate (1000 to 5000) and large sample size (>5000) reported similar pooled prevalence (3.1% and 2.2% respectively). This finding is not unexpected as a higher sample size is needed in order to precisely detect a small effect size, whereby small sample size will often result in imprecise prevalence estimates with wide confidence intervals (Corty & Corty, 2011; Hajian-Tilaki, 2011; Jones, Carley, & Harrison, 2003). In according to the calculation by Hajian-Tilaki (2011), the minimum sample size for detecting a small prevalence rate of 5% is around 1168 respondents, and the required sample size goes higher for more uncommon outcomes. For this reason, it is possible that studies with less than 1000 respondents are underpowered.

**Study Limitation**

Findings of this study should be interpreted with consideration of several limitations. First, no effort was made to request raw data from author(s). Most 95% CI reported in this study are calculated with sample size and prevalence estimates. Second, the diversity of measures was not accounted in this study. The prevalence estimates for IGD were assessed with varying measures. Due to the limited number of studies for each measure, comparison of this methodological difference is difficult. Third, there are only two studies with nationwide data, where the sample sizes range widely from 112 to 15168 respondents. As mentioned, sample size plays a significant role in detecting small prevalence estimates. The lack of nationwide data can yield imprecise prevalence estimates. Fourth, the current study did not restrict the study location for article inclusion. Consequently, high heterogeneity was found in almost all estimates. Lastly, this study did not account for the potential age differences in prevalence of IGD. Although the age ranges were recorded in this study, however, comparison of the age groups is almost impossible due to inconsistent age range. For instance, while Müller et al. (2015) provided separate prevalence estimates for adolescents aged “14-15 years” and “16-17 years”, Ustinavičienė et al. (2016) provided separate prevalence estimates for adolescents aged “13-15 years” and “16-18 years”.

**CONCLUSION**

 In conclusion, the prevalence of IGD among adolescents is about 4.1% (after excluding the two studies which utilized pathological gambling), occurred by around one in twenty adolescents, with higher prevalent among males. The lack of studies and methodological deficits during 1990s limited the understanding of trend and patterns in IGD. At present, the cultural variation in IGD required for further investigation, preferably large-scale epidemiological studies. The inclusion of the word “Internet” in IGD deserves for more investigations.

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Table 1

Summary of studies on prevalence of Internet Gaming Disorder among adolescents

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Study** | **Study Year** | **Instrument** | **Outcome** | **Sample size** | **Study location** | **Prevalence % (95% CI)** |
| Ahmadi et al. (2014) | 2008/2009 | DSM-IV | Computer games dependent | 1020 | Iran | 5.3 (4.0-6.8)\* |
| Festl et al. (2013) | 2011 | GAS | Problematic game use | 562 | Germany | 7.6 (5.6-10.1) |
| Fisher (1994) | 1990 | DSM-IV | Video game addiction | 467 | England | 6.0 (4.0-8.3)\* |
| Griffiths and Hunt (1998) | 1995 | DSM-III | Computer games dependent | 387 | England | 19.9 (16.1-24.0)\* |
| King et al. (2013) | 2012 | PTU | Pathological video gaming | 1214 | Australia | 1.8 (1.1-2.6)\* |
| King and Delfabbro (2016) | 2014 | IGD Checklist | Internet gaming disorder | 824 | Australia | 3.1 (2.1-4.5)\* |
| Lopez-Fernandez et al. (2014) – Spain | 2014 | PVP | Pathological video gaming | 1132 | Spain | 7.7 (6.2-9.3)\* |
| Lopez-Fernandez et al. (2014) – Great Britain | 2014 | PVP | Pathological video gaming | 1224 | Great Britain | 14.6 (12.7-16.7)\* |
| Müller et al. (2015) – Germany | 2011/2012 | AICA-S | Internet gaming disorder | 2315 | Germany | 1.6 (1.1-2.2)\* |
| Müller et al. (2015) – Greece  | 2011/2012 | AICA-S | Internet gaming disorder | 1897 | Greece | 2.5 (1.9-3.3)\* |
| Müller et al. (2015) – Iceland (Müller et al., 2015) | 2011/2012 | AICA-S | Internet gaming disorder | 1924 | Iceland | 1.8 (1.2-2.4)\* |
| Müller et al. (2015) – Netherlands  | 2011/2012 | AICA-S | Internet gaming disorder | 1188 | Netherlands | 1.0 (0.6-1.8)\* |
| Müller et al. (2015) – Poland  | 2011/2012 | AICA-S | Internet gaming disorder | 1892 | Poland | 2.0 (1.5-2.8)\* |
| Müller et al. (2015) – Romania (Müller et al., 2015) | 2011/2012 | AICA-S | Internet gaming disorder | 1790 | Romania | 1.3 (0.9-1.9)\* |
| Müller et al. (2015) – Spain  | 2011/2012 | AICA-S | Internet gaming disorder | 1931 | Spain | 0.6 (0.3-1.0)\* |
| Pápay et al. (2013) | 2011 | POGQ-SF | Problematic online gaming | 5045 | Hungary | 4.6 (4.0-5.2)\* |
| Rehbein et al. (2010) | 2007/2008 | KFN-CSAS-II | Video games dependent | 15,168 | Germany | 1.7 (1.5-1.9)\* |
| Rehbein et al. (2015) | 2013 | CSAS | Internet gaming disorder | 11,003 | Germany | 1.2 (1.0-1.4) |
| Scharkow, Festl, and Quandt (2014) – Time 1 | 2011 | GAS | Problematic game use | 112 | Germany  | 8.9 (4.3-15.0)\* |
| Scharkow et al. (2014) – Time 2 | 2012 | GAS | Problematic game use | 112 | Germany  | 7.1 (3.0-12.8)\* |
| Scharkow et al. (2014) – Time 3 | 2013 | GAS | Problematic game use | 112 | Germany  | 7.1 (3.0-12.8)\* |
| Thomas and Martin (2010) – Computer game | 2004/2005 | YDQ | Computer game addiction | 990 | Australia | 7.0 (5.5-8.6)\* |
| Thomas and Martin (2010) – Video-arcade game | 2004/2005 | YDQ | Video-arcade game addiction | 990 | Australia | 7.0 (5.5-8.6)\* |
| Turner et al. (2012) | 2007 | PVP | Problematic video gaming | 2832 | Canada | 9.4 (8.2-10.8) |
| Vadlin et al. (2015) – GAIT | 2012 | GAIT | Internet gaming disorder | 1783 | Sweden | 1.3 (0.8-1.8)\* |
| Vadlin et al. (2015) – GAIT-P | 2012 | GAIT-P | Internet gaming disorder | 1814 | Sweden | 2.4 (1.8-3.2)\* |
| Wang et al. (2014) | 2013 | GAS – Chinese | Probable gaming addiction | 503 | Hong Kong | 15.7 (12.7-19.0)\* |

\* Estimated 95% CI from sample size and prevalence estimates.

Table 2

Prevalence of Internet Gaming Disorder by gender

|  |  |  |
| --- | --- | --- |
| **Study** | **Male Percent (%)** | **Prevalence %** |
| **Male** | **Female** |
| Müller et al. (2015) | 47.1  | 3.1 (2.6-3.5) | 0.3 (0.2-0.5) |
| Rehbein et al. (2010) | 51.3  | 3.0 (2.6-3.4)\* | 0.3 (0.2-0.4)\* |
| Rehbein et al. (2015) | 51.1  | 2.0 (1.7-2.4) | 0.3 (0.1-0.4) |
| Thomas and Martin (2010) |  |  |  |
| Computer game addiction | 52.4  | 9.9 (7.4-12.5)\* | 3.5 (1.9-5.2)\* |
| Video-arcade game addiction | 52.4  | 9.0 (6.7-11.7)\* | 4.0 (2.4-6.0)\* |
| Turner et al. (2012) | 52.7  | 15.1 (13.2-17.0)\* | 3.1 (2.3-4.1)\* |
| Vadlin et al. (2015) |  |  |  |
| GAIT | 45.2 | 2.9 (1.8-4.1)\* | 0.0 (0.0-0.2)\* |
| GAIT-P | 45.0 | 5.0 (3.6-6.6)\* | 0.4 (0.1-0.9)\* |
| Wang et al. (2014) | 49.5  | 22.7 (17.9-28.3)\* | 8.7 (5.5-12.5)\* |

\* Estimated 95% CI from sample size and prevalence estimates.

Table 3

Subgroup analysis on prevalence of Internet Gaming Disorder by study year, measures, study location, and sample size

|  |  |  |  |
| --- | --- | --- | --- |
| Category | Number of prevalence estimates, k | Prevalence % (95% CI) | *I*2, % |
| Study year |  |  |  |
| 1990s | 2 | 12.1 (0.5-27.8) | 97 |
| 2000s | 5 | 5.7 (1.9-10.4) | 99 |
| 2010s | 20 | 3.8 (2.5-5.2) | 98 |
| Measures |  |  |  |
| DSM pathological gambling | 3 | 9.5 (2.4-18.2) | 97 |
| Other validated measures | 24 | 4.1 (2.9-5.4) | 98 |
| Disorder |  |  |  |
| Internet gaming disorder | 11 | 1.6 (1.3-2.1) | 84 |
| Gaming disorder | 16 | 7.6 (5.1-10.4) | 98 |
| Gaming disorder (exclude DSM pathological gambling) | 13 | 7.2 (4.5-10.2) | 99 |
| Study location |  |  |  |
| Asia | 2 | 9.9 (1.0-21.5) | 98 |
| Australia | 4 | 4.4 (1.9-7.4) | 95 |
| Europe | 20 | 3.9 (2.8-5.3) | 98 |
| North America | 1 | 9.4 (8.3-10.5) | 98 |
| Sample size |  |  |  |
| <1000 | 10 | 8.6 (5.8-11.7) | 93 |
| 1000 to 5000 | 14 | 3.1 (1.6-4.9) | 98 |
| >5000 | 3 | 2.2 (0.8-4.0) | 99 |

*Figure 1*. Flow chart of article inclusion.



*Figure 2*. Forest plot of prevalence of Internet gaming disorder among adolescents.