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Treatment of Internet gaming disorder:

An international systematic review and CONSORT evaluation

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ABSTRACT

Treatment services for Internet gaming disorder are becoming increasingly prevalent worldwide, particularly in East Asia. This international systematic review was designed to appraise the quality standards of the gaming disorder treatment literature, a task previously undertaken by King et al. (2011) prior to the inclusion of Internet gaming disorder in Section III of the DSM-5 and 'Gaming disorder' in the draft ICD-11. The reporting quality of 30 treatment studies conducted from 2007 to 2016 was assessed. Reporting quality was defined according to the 2010 Consolidating Standards of Reporting Trials (CONSORT) statement. The results reaffirmed previous criticisms of these trials, namely: (a) inconsistencies in the definition, diagnosis, and measurement of disordered use; (b) lack of randomization and blinding; (c) lack of controls; and (d) insufficient information on recruitment dates, sample characteristics, and effect sizes. Although cognitive-behavioral therapy has a larger evidence base than other therapies, it remains difficult to make definitive statements on its benefits. Study design quality has not improved over the last decade, indicating a need for greater consistency and standardization in this area. Continuing international efforts to understand the core psychopathology of gaming disorder are vital to developing a model of best practice in treatment.

Keywords:

Internet gaming disorder; Internet addiction; treatment; CONSORT; DSM-5; ICD-11

1. Introduction

Excessive and disordered types of gaming and Internet use are recognized as issues of relevance to clinical psychology due to their negative impact on various areas of functioning (Ferguson, Coulson, & Barnett, 2011; Kuss & Griffiths, 2012; Mentzoni et al., 2010; Weinstein, Feder, Rosenberg, & Dannon, 2014), as well as their association with other mental disorders (King, Delfabbro, Zwaans, & Kaptsis, 2013; van Rooij et al., 2010). In some regions, such as South Korea and China, the broad term 'Internet addiction' (IA) is often used to refer to a class of problematic activities, typically with a focus on gaming-related activities, stemming from overuse of online-enabled devices, including computers, smartphones, and gaming devices. However, this classification has been criticized for being too broad and failing to distinguish the problematic activity from the medium in which the activity occurs (Blaszczynski, 2006; King & Delfabbro, 2013). To enable focus on a specific problematic behavior that occurs exclusively online or on a digital platform, one significant development was the inclusion of Internet Gaming Disorder (IGD) in Section III of the DSM-5 as a condition for further study. More recently, the beta draft ICD-11 listed 'Gaming disorder' as referring to "persistent or recurrent gaming behaviour characterised by an impaired control over gaming, increasing priority given to gaming over other activities to the extent that gaming takes precedence over other interests and daily activities and continuation of gaming despite the occurrence of negative consequences." Despite the emphasis on gaming in clinical nomenclature, the term 'Internet addiction' remains commonly used in the literature to refer broadly to problems related to excessive use of electronic devices, including gaming devices. To review the literature on disordered gaming, it is therefore necessary to employ a broad scope that includes studies of 'Internet addiction'.

Although research into gaming and Internet-related disorders has grown rapidly, the field has been plagued by inconsistent conceptualization and approaches to screening and 'diagnosis' (King & Delfabbro, 2012a; Lortie & Guitton, 2013; Sim et al., 2012). These inconsistencies stem from the lack of accepted criteria for Internet-related pathologies, even post-DSM-5, and the tendency of researchers to adapt the criteria of other disorders (e.g., pathological gambling in the DSM-IV-TR) on the assumption of conceptual overlap or similarity (Winkler et al., 2013). The literature is characterized by multiple formulations and assessment tools, often with insufficient justification for

their use and/or modification of other approaches (Griffiths et al., 2014; Starcevic, 2013). For example, a systematic review of 18 assessment tools employed in 63 studies of problematic gaming reported that no two measures were alike in their ability to 'map out' diagnostic features (King et al., 2013). It has therefore been hoped that the advent of the DSM-5 classification, as well as the upcoming ICD-11, would lead to improved studies to build a greater consensus on how best to define and treat a gaming disorder (Petry et al., 2014).

Conceptual difficulties in this area are problematic for clinicians who have a practical need for a reliable evidence base on which to base treatments for gaming disorders. Such evidence was reviewed, for example, by Winkler et al. (2013) who conducted the most recent meta-analysis, including 16 studies of psychological and pharmacological treatment studies of IA (including gaming disorder) conducted worldwide. They reported that treatment effect size estimates indicated that existing interventions were "highly effective" (p.317) for reducing IA symptoms, time spent using the Internet, and co-morbid depression and anxiety. They concluded that effect sizes were "high, robust, unrelated to study quality or design, and maintained over follow-up" (p.317). These views are, however, tempered by the findings from a systematic review by King et al. (2011) who reported that follow up was rarely conducted, and studies had not assessed formative change in diagnostic status at post-treatment or follow-up phases.

This systematic review is intended as a five-year update on the work by King et al. (2011) who reviewed the Internet and gaming addiction literature and its overall compliance with the Consolidating Standards of Reporting Trials (CONSORT) statement. A major limitation of their review was the non-inclusion of non-English literature, thereby excluding a large body of work conducted in East Asia, a region that has committed significant government resources to epidemiological research, prevention, and treatment in this area (Koh, 2015; Zhan & Chan, 2012). It was reasoned that the 2011 review should be updated given that information is most useful when it is current and includes evidence that may inform a new consensus on a topic, particularly in a rapidly evolving field. The Cochrane Collaboration, for example, recommends that systematic reviews are updated every two years (Moher et al., 2008).

1.1. The present review

The primary aim of this review was to summarize and critique peer-reviewed treatment studies of 'Internet gaming disorder' or 'gaming disorder' (i.e., the current draft classifications in the DSM-5 and ICD-11 systems). The broader term "Internet addiction" was also included in the scope of this review given its common usage in relation to gaming activities. The term IA is used at times in this paper, referring to those studies relating the term to gaming problems. It is recognized that the only Internet-related disorder described in the DSM-5 is the tentative 'Internet Gaming Disorder' (IGD), and the ICD-11 draft recognizes 'Gaming disorder' (online and offline subtypes). IGD is not an established diagnosis and therefore the term 'diagnosis' (among other clinical terms) employed throughout this review is a shorthand in full acknowledgement of its tentative status, and not with an assumption or endorsement of its legitimacy. A secondary aim of this review was to evaluate the extent to which studies employed follow up to assess remission and relapse. A useful indicator of whether a treatment is effective is the extent to which patients report improvements on relevant outcome measures at follow up (e.g., reduction in Internet gaming activity, remission of symptoms).

2. Methods

2.1. Identification and selection of studies

A computer database search of *Academic Search Complete, PubMed, PsychINFO, ScienceDirect, Scopus* and *Web of Science* was conducted, using the following search terms and logic: (treat* OR intervention) AND (gam* OR Internet). All searches were limited to full text peer-reviewed papers published from 2007 to 2016. These database search parameters yielded a total of 3,348 hits, which included the following results in each database: *Academic Search Premier* (603 results), *PsychInfo* (194 results), *PubMed* (602 results), *Scopus* (684 results), *ScienceDirect* (638 results), and *Web of Science* (591 results). A search using Google Scholar yielded 17,100 results which were all systematically checked for relevance, but did not identify any additional unique results. The reference lists of recent systematic reviews were consulted (i.e., King & Delfabbro, 2014a; Kuss & Lopez-Fernandez, 2016; Przepiorka et al., 2014; Winkler et al., 2013), as well as the reference lists of the included studies.

Exclusion criteria were case report studies, interventions that did not target gaming-related issues, and studies without outcome data. Studies that reported a non-psychological or non-pharmacological intervention (e.g., 'art therapy', 'forest therapy', 'psychodrama', 'fitness program', 'joining the army') were also excluded (*N*=11). Articles published in a non-English language were translated by Google Translate software and verified by the author in the team fluent in the relevant language (German [DJK], Chinese [AW], Japanese [HS], and Korean [YY]). A total of 30 studies were identified.

2.2. Quality assessment

Following the approach taken in King et al.'s (2011) systematic review, the quality of the included studies was assessed by the 25-item version of the CONSORT (Consolidating Standards of Reporting Trials) statement (Schulz, Altman, & Moher, 2010). The CONSORT statement is primarily utilized to assess randomized controlled trials (RCTs), but it has been extended to cover many other designs (Boutron et al., 2008). The checklist, published in 1996 and revised in 2001, 2008, and 2010, comprises a set of guidelines that may be used to identify the strengths and weaknesses of clinical trials for both pharmacological and non-pharmacological treatments (Jarlais, Lyles, & Crepaz, 2004; Schulz, Altman, & Moher, 2010). The checklist can be used, for example, to assess whether a study has adequately reported the eligibility criteria for participants, has provided the precise details of the interventions intended for each group, and has provided justification (e.g., power analysis) for the obtained sample size. Failure to report such information will result in a lower level of CONSORT compliance indicating lower reporting quality of the study.

All included studies were assessed for compliance with the 2010 guidelines of the CONSORT statement, in consultation of the additional explanation and elaboration provided by Boutron et al. (2008). To measure compliance, a two-point grading system was devised for each CONSORT criterion, where the reviewers (DLK and DJK) gave a score of '0' if the item was not present at all, '1' if the feature was partially present (i.e., some aspects of the CONSORT item were missing or unclear), and '2' if the CONSORT item was present and clear. To demonstrate this scoring method, the CONSORT item 3 states: *"Eligibility criteria for participants and the settings and locations*

where the data were collected". A score of 0 would be given if the researchers noted that eligibility criteria were used, but did not explain what these criteria were, and did not report the settings and locations where the data were collected; a score of '1' would be given if the researchers provided complete details of the eligibility criteria (inclusion and exclusion criteria), but did not report the settings and locations where the data were collected (or vice versa); and a score of '2' would be given if the researchers provided clear descriptions of both the eligibility criteria used in the study and the setting and locations where the data were collected. In instances where the CONSORT item was not present due to inherent limitations of the study design, a score of '0' on that item was given. A detailed Excel spreadsheet of the CONSORT evaluation of all 30 studies is available by request.

An additional checking method involved keyword searches in Acrobat Reader for CONSORT items including 'blind*', 'power*' and 'random*. The inter-rater reliability of the CONSORT evaluation was .90. Discrepancies in evaluation were primarily related to ratings of the 'sample' (i.e., how sample size was determined, and details on clustering), 'interventions' (i.e., details of the treatment), and 'recruitment' (i.e., dates of recruitment and follow up), and discrepant ratings were resolved by discussion and consultation of guidelines by Boutron et al. (2008).

3. Results

Table 1 presents a summary of the key characteristics of the 30 included studies. For parsimony, reviewed studies are referenced according to a numerical system corresponding to values assigned in Table 1 (e.g., 'Ref 1' indicating Cao et al. [2007]) when referring to five or more studies.

[INSERT TABLE 1]

3.1. Study context

The majority of the studies were conducted in South Korea (*n*=11) and China or Hong Kong (*n*=10), and the remaining studies were carried out in the U.S. (*n*=3), Germany (*n*=2), Japan (*n*=1), India (*n*=1), Switzerland (*n*=1), and Brazil (*n*=1). A total of 19 studies were conducted in public hospitals or outpatient clinics, or clinics within university schools of medicine or psychiatry (i.e.,

Refs: 2, 4, 5, 7, 10-12, 14-17, 19, 20, 23, 24, 26, 28-30); seven studies were school-based or independent counseling programs (i.e., Refs: 1, 6, 8, 9, 18, 22, 25); three studies involved online interventions (i.e., Su et al., 2011; Young, 2007; 2013), and one study was home-based (Lee et al., 2016). Only three studies conducted in outpatient clinics and medical settings were based in non-Western countries (i.e., Dell'Osso et al., 2008; Thorens et al., 2013; Wölfling et al., 2014).

3.2. Definition and diagnosis

All 30 studies referred to the harms or functional impairment associated with excessive Internet use and/or gaming in their introductory sections, but the actual operational definitions of disorders in each study varied. In Han et al.'s (2010) study, for example, IA was defined as the *"inability of individuals to control their Internet use, resulting in marked distress and functional impairment of general life"* (p.297). In Ge et al.'s (2011) study, IA was "*characterized by obsessive cravings that lead to seeking and addiction behaviors*" (p.2037). There were multiple references to these problems being an impulse control disorder as defined in the DSM-IV-TR (Young, 2007; Kim, 2008; Lee & Son, 2008; Su et al., 2011), or as a variant of pathological gambling with similar criteria (Du et al., 2010). Some studies referred simply to 'problematic' or 'excessive' Internet or gaming activity (Han & Renshaw, 2011; Kim et al., 2012; Jeong, 2012), and some studies did not introduce a definition of the concept (Han et al., 2009; Shek et al., 2009; Jing et al., 2010). There were nine treatment studies with manuscript submission dates post-announcement of the DSM-5 Internet gaming disorder (IGD) classification (i.e., dates from May 2013 onwards), with one study (Young, 2013) that referred to the APA Working Group's intermediary proposal of 'Internet use disorder'. Two post-2014 studies did not make reference to the IGD classification or the DSM-5 (Liu et al., 2015; Shin et al., 2015).

The choice of diagnostic instrument varied between the studies. The most commonly employed measure was Young's (1996) Internet Addiction Test (IAT) or Young's Diagnostic Questionnaire (YDQ: a shorter variant of the IAT), which was used in 17 studies (Refs: 1-3, 6-8, 10-15, 20, 21, 24, 28, 29). The cut-off scores on Young's measures were inconsistently applied, with cut-offs on the most frequently used IAT including '50+' (Refs: 7, 10, 15, 28, 29) and '70+' (Lee & Son, 2008; Thorens et al., 2013). The second most frequently used measure was the YDQ (Refs: 1, 2, 11-13, 24),

which had a consistent cut-off score of '5'. The third most common (*n*=3) scale was the Korean Internet Addiction Scale (K-IAS), which was used exclusively in South Korea, but it was not the only test used in this region. Only six out of the 30 studies (i.e., Refs: 10, 13, 14, 15, 19, 28) included a pre-intervention measure of gaming activity (e.g., hours of weekly use), with five studies specifying excessive use as 30+ hours per week, and one study (Su et al., 2011) specifying 14 hours per week. All nine post-DSM-5 studies employed a different diagnostic tool, with only one study using the DSM-5 IGD criteria for assessment purposes (i.e., Sakuma et al., 2016).

3.3. Intervention types

The majority of studies (*n*=24) utilized diverse psychological or counseling interventions, with three studies also including a pharmacological or electro-acupuncture treatment (i.e., Kim et al., 2012; Santos et al., 2016; Zhu et al., 2012). These 24 studies employed cognitive-behavioral therapy (CBT), motivational interviewing (MI), reality training, or a combination of psychological and/or counseling therapies within a broader treatment program. Interventions were delivered in both individual (*n*=14) and group (*n*=10) formats. Group studies were more likely to include control groups (90%; 9/10 studies) as compared to individual therapy studies (57% controlled, 8/14 studies). Only two studies included psychological and non-psychological treatment as separate conditions (Kim et al., 2012; Zhu et al., 2012). Psychological therapy and counseling regimes ranged from a single therapy session to programs that involved participation for up to 19 months. However, the most common interventions were based on 6-session (Refs: 16, 18, 19, 25, 26) and 8-session (Refs: 1, 9, 11, 15, 22) care plans.

Pharmacological interventions predominantly employed antidepressants (i.e., bupropion and escitalopram; Refs: 4, 7, 14, 15, 29), with one study (Han et al., 2009) using a psychostimulant for a sample with co-morbid attention deficit problems. An initial 150mg dose of bupropion subsequently increased to 300mg was the most common pharmacological intervention (i.e., Han et al., 2010; Han & Renshaw; 2011; Kim et al., 2012). Only one randomized drug trial was conducted outside of South Korea (i.e., Dell'Osso et al., 2008).

3.4. Sample characteristics

A total of 1,880 participants were involved in the 30 studies, of whom 1,064 received a psychological or counseling treatment, 263 received a pharmacological treatment, and 553 were allocated to a control group. Seventeen out of 30 studies reported to exclude potential participants with co-morbid symptoms, including concurrent mood disorders (*n*=14; Refs: 3, 4, 7, 9, 10-12, 15, 17, 19, 23-25, 28) and substance use or dependence (*n*=9; Refs: 4, 7, 10-12, 15, 24, 25, 28). Only one study (Su et al., 2011) reported to exclude participants already receiving some form of IA treatment. The number of participants in each study ranged from 14 to 335 (*M*=60.6, *SD*=61.9). Eight studies (Refs: 10, 14-16, 19, 23, 28, 30) employed males only. Overall, 1,281 participants were male (68%) and 599 were female (32%), with studies including both sexes having an average male representation of 58%. A total of 11 studies (Refs: 1, 7-9, 15, 16, 19, 22, 25, 27, 30) recruited adolescents only; however, a further five studies (Refs: 2, 4, 10, 14, 20) included both adults and adolescents. The specific age of participants was not clearly reported (e.g., mean age only) in seven studies (Refs: 3, 5, 6, 11, 13, 18, 26). Only four studies provided a flow diagram (i.e., Shek et al., 2009; Su et al., 2011; Lui et al., 2015; Lee et al., 2016).

3.5. Outcomes and follow-up

All studies except Ge et al. (2011) employed a survey measure of Internet addiction (see 3.2) to assess treatment outcome. However, eight studies employed different IA measures at baseline and post-intervention stage. Notably, only 14 studies (Refs: 2, 4, 7, 9, 10, 13-15, 18, 22, 23, 25, 26, 30) reported changes in gaming behavior at the post-intervention stage. Of those studies (*n*=18) that did not exclude potential participants with pre-existing Axis I psychopathology, there were 5 studies (Refs: 1, 6, 8, 14, 29) that assessed changes in depression and/or anxiety symptomatology as an outcome of treatment. Four studies (i.e., Han et al. 2010; Ge et al., 2011; Zhu et al., 2013; Park et al., 2016) assessed post-treatment changes in brain activity (e.g., dopamine and norepinephrine levels, orbitofrontal cortex activity) using fMRI procedures. There were no neuroimaging studies conducted in Western countries. The majority of studies (*n*=19; Refs: 1, 2, 4, 5, 7, 8, 10-12, 17-20, 22, 23, 26-29) included post-test assessment only, whereas two studies (i.e., Su et al., 2011; Bipeta et al., 2015)

included one follow-up but no post-test assessment. In terms of adverse outcomes, the four pharmacological intervention studies (i.e., Dell'Osso et al., 2008; Han et al., 2009; 2010; Kim et al., 2012) and the electro-acupuncture study (Zhu et al. 2012) documented nausea, fainting, headaches, insomnia, fatigue, libido changes, and abdominal pain or discomfort. Adverse events were not reported in psychological intervention studies.

[INSERT TABLE 2]

3.7. CONSORT evaluation

Table 2 presents a summary of the CONSORT evaluation of the 30 studies. A comprehensive evaluation of all individual studies was beyond the scope of this review, therefore, a selective overview of the studies' main limitations is presented. In general, the studies provided adequate research background and definitions, overviews of interventions, research objectives, and baseline data; however, there were common weaknesses in areas of abstract reporting, sample size calculations, recruitment dates, randomization, blinding, and participant flow.

3.7.1. Randomization and blinding

Eleven studies reported using randomization (Refs: 2, 4, 5, 11, 13-15, 17, 19, 25, 28), however actual details of the random allocation sequence were often missing or unclear. Only two RCTs have been published in the last three years (i.e., Park et al., 2016; Lui et al., 2015). The sequence of RCT publication dates (i.e., 2007, 2008, 2008, 2010, 2011, 2012, 2012, 2015, and 2016) did not appear to indicate an increasing proportion of RCT to non-RCT studies over time. Two double blind placebo-controlled pharmacotherapy trials (Dell'Osso et al., 2008; Han & Renshaw, 2012) were identified. A trial of electro-acupuncture and psychotherapy by Zhu et al. (2012) involved a blind data analyst. As Boutron et al. (2008) and Berger (2015) note, it is usually not possible to mask a non-pharmacological intervention, but it may be feasible to blind post-treatment assessors to the study condition (i.e., intervention vs. control group), unless treatment is administered and assessed by a single researcher (e.g., Young, 2007; 2013). In Du et al. (2010) and Li and Wang's (2013) studies, post-intervention

assessments were conducted by staff blinded to the participant's group status. Bipeta et al. (2015) stated explicitly that their study did not employ blinding. Blinding procedures were not reported in other studies.

3.7.2. Sampling issues

A common study limitation related to sample size justification. Only Du et al. (2010) and Han and Renshaw's (2011) studies presented a power analysis to determine the necessary sample size to observe a significant effect of treatment. Several studies (e.g., Ge et al., 2011; Li & Wang, 2013; Shek et al., 2009; Su et al., 2011) reported that limited sample size may have been a potential threat. Another concern was the lack of reported information about the flow of participants through each stage of the treatment protocol, including the number of care providers or centers performing the intervention. For example, Kim's (2008) study involved group therapy, but group numbers and number of service care providers was unclear. Only four studies included a participant flow diagram (i.e., Lee et al., 2016; Liu et al., 2013; Shek et al., 2009; Su et al., 2011).

3.7.3. Eligibility and recruitment

Participant eligibility criteria, including co-morbidity issues, were reported adequately in 17 out of 30 studies. A common shortcoming was the lack of dates defining the periods of recruitment and follow-up, with the exception of four studies (i.e., Dell'Osso et al., 2008; Thorens et al., 2013; Wartberg et al., 2014; Sakuma et al., 2016). The full name and physical location of services or treatment centers was often unclear, which is necessary for establishing the historical context for the data (Boutron et al., 2008).

3.7.4. Statistical analyses

Effect sizes were reported in five studies only (Du et al., 2010; Li & Wang, 2013; Sakuma et al., 2016; Su et al., 2011; Wölfling et al., 2014), although there was adequate information (i.e., means and standard deviations) to manually calculate effect size in the majority of studies. The most commonly used statistical approach was repeated-measures ANOVA (e.g., Refs: 4, 14-16, 19, 24, 25), a test which is less capable of handling missing data (Gueorguieva & Krystal, 2004). The method for

handling missing data was reported in four studies only, which involved excluding these cases (Refs: 19, 20, 23) or using the last observation carried forward (Han & Renshaw, 2012). There was some inconsistency between studies regarding the appropriateness of some analyses, for example, the use of an analysis of covariance (ANCOVA) when the comparison groups were not equivalent at baseline. Where applicable, studies did not provide details regarding the clustering of participants with care providers or centers, and whether they could have influenced the analysis.

3.7.5. Interpretation of results

All 30 studies provided an interpretation of their results in terms of the overall efficacy of the trialed intervention. The CONSORT statement requires that interpretation is consistent with the weight of the evidence, balancing the benefits and harms of treatment, and any potential threats to the study's validity (Schulz, Altman, & Moher, 2010). None of the 30 studies reported total null findings, although there was some evidence of weaker than expected results. For example, Dell'Osso et al. (2008) reported significant treatment gains in the open-label trial phase, but no significant differences in outcome measures between placebo and treatment conditions in the double-blind phase. Du et al. (2010) reported moderate to large treatment effect sizes, but noted that the control group also reported significantly lower Internet overuse. Sakuma et al. (2016) noted that, despite significant gains in other areas of functioning, the participants "were still gaming almost daily" (p.359).

Many studies referred to the trialed intervention as being beneficial, including as examples: (i) *"effective at ameliorating the common symptoms"* (Young, 2007, p.677); (ii) *"very effective to improve Internet addiction level"* (Kim, 2008, p.10); (iii) *"clearly suggest that the program is effective"* (Shek et al., 2009, p.376); (iv) "*Internet addiction behaviour has the potential to change and improve"* (Du et al., 2010, p.132), (v)*"improving the maladaptive behaviors"* (Han et al., 2010, p.302); (vi) *"significant intervention effects"* (Su et al., 2011, p.5); (vii)*" significant clinical benefit"* (Kim et al., 2012; p.1959); (viii) "*effective at ameliorating the common symptoms of online addiction"* (Young, 2013, p.214); (ix) "*effectively treated by psychotherapeutic strategies—at least when referring to the immediate therapy effects"* (Wölfling et al., 2014, p.7); (x) "*helpful to keeping children away from Internet addiction"* (Liu et al., 2015, p.6); and (xi) "*may be able to prevent habitual, emotionless game use by facilitating limbic-regulated responses to rewarding stimuli"* (Park

et al., 2016, p.107). However, as noted in 3.7.4., the estimated effect sizes and their precision (e.g., at a 95% confidence interval) were rarely reported (e.g., Du et al. [2010]: Cohen's d=1.08 for main treatment effect; Su et al. [2011]: Cohen's d=0.75-0.98 for main treatment effects).

3.7.6. Other information

The CONSORT item on 'other information' refers to the registration number and name of the trial registry, the trial protocol, and sources of funding. Most studies acknowledged funding support, if applicable, and provided some details of the trial protocol in the appendices (e.g., Kim, 2008) or a reference for this information (e.g., Shek et al., 2008). However, only one study (Dell'Osso et al., 2008) provided a registration number with the name of the trial registry. Industry funding was declared by two studies, including a pharmaceuticals company (Dell'Osso et al., 2008) and a telecommunications provider (Han et al., 2009). Competitive research funding (i.e., equivalent to Category 1 grant funding in Australia) for gaming disorder or Internet addiction treatment research was not evident outside of South Korea, China, and Japan.

[INSERT TABLE 3]

3.8. Recovery and relapse indicators

Table 3 presents a summary of the follow-up treatment outcomes reported in reviewed studies. Eleven out of 30 studies (Refs: 3, 6, 9, 13-15, 16, 21, 24, 25, 30) included a follow-up, as compared to 3 out of 8 studies in King et al.'s (2011) review. Follow-up periods included one month (Han & Renshaw, 2011; Kim et al., 2012; Su et al., 2011), two months (Lee & Son, 2008; Jeong, 2012), three months (Liu et al., 2015; Sakuma et al., 2016), six months (Du et al., 2010; Young, 2007, 2013), and 12 months (Bipeta et al., 2013). Most of the studies with follow-up phases involved non-pharmacological interventions.

Measurement of recovery and relapse was examined at post-test and follow-up. The following indicators were considered: (1) a qualitative change in diagnostic status at follow-up indicative of improved mental health (i.e., change from 'disordered' status to 'normal' or low-risk category); (2) a

reliable reduction in severity of symptoms, irrespective of risk classification, and (3) a meaningful reduction in gaming or Internet use. Only two out of 11 studies (i.e., Bipeta et al., 2013; Liu et al., 2015) reported diagnostic change in participants at post-test. These two studies were also the only two studies to report diagnostic change at follow-up. Liu et al. (2015), for example, reported that the "*Internet addiction rate dropped from 100% at the baseline assessment to 4.8% at the end of the intervention and remained at 11.1% at the three-month follow-up assessment*" (p.6). As Bipeta et al.'s (2013) study was concerned with IA in presentations of obsessive-compulsive disorder, they reported: "*at 12 months, out of the 11 IA OCD subjects, only two (18.18%) IA OCD subjects still met the criteria for IA*." (p.20).

A strength of the majority of studies with follow-up was reporting on change in symptoms (*n*=10 studies), however five different measures were used across these studies. It was not clear how many participants exited therapy no longer meeting the criteria for a gaming or Internet-related disorder. The use of tools that measure different core psychopathology, such as tolerance and withdrawal (see Kaptsis et al., 2016; King et al., 2013), creates complexity for considerations of treatment effectiveness. On a positive note, it appears possible to conduct secondary analysis to identify changes in diagnostic status at follow-up, by selecting symptom variables that align with the DSM-5 criteria. Only four of the 11 studies (i.e., Han & Renshaw, 2011; Liu et al., 2015; Sakuma et al., 2016; Su et al., 2011) reported on changes in gaming or Internet use (e.g., hours of use per week) at follow-up.

4. Discussion

This systematic review was designed to update our knowledge of quality standards in the international Internet gaming disorder treatment literature. This task was previously undertaken by King et al. (2011) examining 'Internet addiction', prior to the Internet gaming disorder listing in Section III of the DSM-5. A noteworthy feature of this updated review was its inclusion of studies published in non-English languages. Most of the studies in this review originated from China and South Korea, reinforcing the need for an international approach in this field. Although the literature base has grown considerably in the last decade, the rate of compliance with the CONSORT statement was comparable to that reported in King et al. (2011). Many studies employed only pre-test/post-test

designs and lacked randomization or blinding techniques. These findings therefore reaffirm many of King et al.'s (2011) observations, including: (1) one third of the studies did not employ a comparator for between-group comparison; (2) most studies failed to provide adequate justification for their sample size and did not provide calendar dates of recruitment and intervention; and (3) there are multiple inconsistencies in assessment of treatment outcome and a lack of follow-up. While a larger base of quality studies has developed over the last decade, there are nevertheless many areas for future improvement. It remains difficult to make definitive statements on the effectiveness of psychological and pharmacological treatments for Internet gaming disorder.

The majority of studies have employed psychological interventions with a focus on cognitive-behavioral therapy (CBT), but the content of CBT sessions is often described ambiguously. Nevertheless, there appears to be a stronger consensus on the benefits of CBT as compared to other approaches, and particularly in contrast to pharmacological treatment. There are unresolved questions of the optimal length of treatment (e.g., number of sessions), short and longer term gains (i.e., durability of treatment response), and differences between individual- versus group-based delivery. Future work should endeavour to critically evaluate the nature and structure of CBT programs for gaming disorder. A follow-up review could identify modules (e.g., psychoeducation, thought-challenging) that tend to be used and whether they vary across studies, or are modified for diverse populations. Identifying effective techniques may inform future clinical trials, including studies involving treatment-matching, as well as universal prevention strategies, such as educational campaigns on healthy gaming use. With regard to pharmacological treatment, bupropion (150-300mg) is the most commonly studied medication. However, no pharmacological agent (including bupropion) has been investigated in at least two independent double-blind studies.

An assumption that the evidence base has improved in quality over the last decade was not supported by this review, with only two RCTs published in the past three years. A total of 19 studies in this review did not employ randomization, including 10 out of 13 studies published in the last 3 years. Only five studies in the same period have employed comparators. The 9 most recently published studies have employed a different diagnostic tool, including the IAT, YDQ and K-IAS, with only one study using the DSM-5 IGD criteria (Sakuma et al., 2016). It may be unreasonable to expect

that the DSM-5 at this early stage would have influenced assessment in trials, but it is surprising that the DSM-5 in general has not been referenced in the scientific background of recent studies. It is noteworthy that funding opportunities for high quality clinical research appear to be limited, particularly outside of East Asia, suggesting that gaming disorder may be a low priority for competitive grant schemes.

Studies with follow up tended to measure changes in disordered gaming symptoms. However, only two studies assessed diagnostic change, and most studies did not assess changes in gaming behaviour after treatment. Future studies should include a basic measure of gaming or Internet activity use. It may also be useful to examine whether treatment produced any changes in motives for gaming (e.g., escape, excitement, socializing) or modifications to gaming schedules and game preferences (e.g., genres, online vs offline play). Clear demarcations of gaming versus other online activity, with consistent measurement of associated problems, is essential for applying the evidence base to the DSM-5 and ICD-11 systems. Finally, future studies could supplement study outcome data with normative data from local epidemiological studies to contextualize the benefits.

4.1 Improving methodology

There remains a need for more precise statements of treatment benefits by including estimates of effect size and confidence intervals. Improved descriptions of treatment techniques used (e.g., exposure therapy, psychoeducation, and cognitive restructuring), level of participant adherence (e.g., attending, completion of homework), and qualifications and competence of therapists would be beneficial. Other practical recommendations include: (1) extending follow-up to at least 3 to 6 months; (2) including measurement of diagnostic change; (3) broader assessment of treatment outcomes, including quality of life, and measuring cognition in CBT studies (see King & Delfabbro, 2014b); and (4) examining post-treatment adjustment, including social and environmental changes. Clinical trials should be registered to define outcome measures a priori and reduce outcome reporting biases. Once the evidence base becomes more established, it may be useful to include populations with comorbidities and administering treatment that targets comorbidities in conjunction with gaming problems. Online treatments are relatively understudied compared to other modes of delivery. Although online treatment could be considered counterproductive to the goal of reducing Internet use,

such services are already prevalent and may be the first avenue for many help-seekers, particularly in Western countries where public services for gaming problems may not be available.

4.2 Limitations of the review

The review was based on King et al. (2011) and thus many of its limitations also apply to this work. First, the prescribed method for evaluating each study using the CONSORT statement, including the two-point scoring method, may have been limited given the lack of randomized controlled trials (RCTs). Second, much of the reviewed literature predates the DSM-5 classification, and therefore discrepancies in diagnostic parameters should be expected. Third, this review was more inclusive than the 2011 review by including non-English studies, but excluded case report studies (e.g., Allison et al., 2006), gray literature, and studies published before 2007. The focus was on design and reporting standards, and therefore this review did not assess weight of evidence (e.g., effect sizes) (see Winkler et al., 2013 for a review). Finally, inadequate reporting does not necessarily indicate that certain methodological procedures were not applied, only that this information was not reported.

4.3 Conclusions

The tentative inclusion of Internet gaming disorder in clinical nomenclature has been a signpost of the need for evidence-based treatment. Treatment and prevention services for gaming problems are becoming increasingly prevalent worldwide, particularly in East Asia, amid continuing debate on their conceptual definition and assessment. In the meantime, researchers, clinicians, and policymakers are guided by the best available information about interventions. This five-year update on King et al.'s (2011) systematic review suggests that CBT has the support of a larger base of empirical studies than other interventions. However, this evaluation has identified many areas of study design and reporting in need of improvement. It remains difficult to make definitive statements on the effectiveness of gaming disorder treatment, given methodological inconsistencies and lack of follow-up. It is hoped that this information will serve future reviews and studies, including meta-analyses, as well as inform funding agendas and policy responses. As a final thought, evaluating the standards of past studies can only tell us so much. To advance the field, there remains a need for studies that provide greater insight into the core psychopathology of Internet gaming disorder, providing the foundation for developing

interventions equipped to deliver optimal outcomes to clients. International consensus and collaboration will be vital to developing a model for best practice in Internet gaming disorder treatment.

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Contributors

Author A designed the review and wrote the protocol, with approval of all authors. Author A conducted literature searches, with language translation assistance from Authors C, D, and H. The CONSORT evaluation was performed by Authors A and E. Author A wrote the first draft of the manuscript and all authors contributed to and have approved the final manuscript.

Conflict of Interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

Table 3

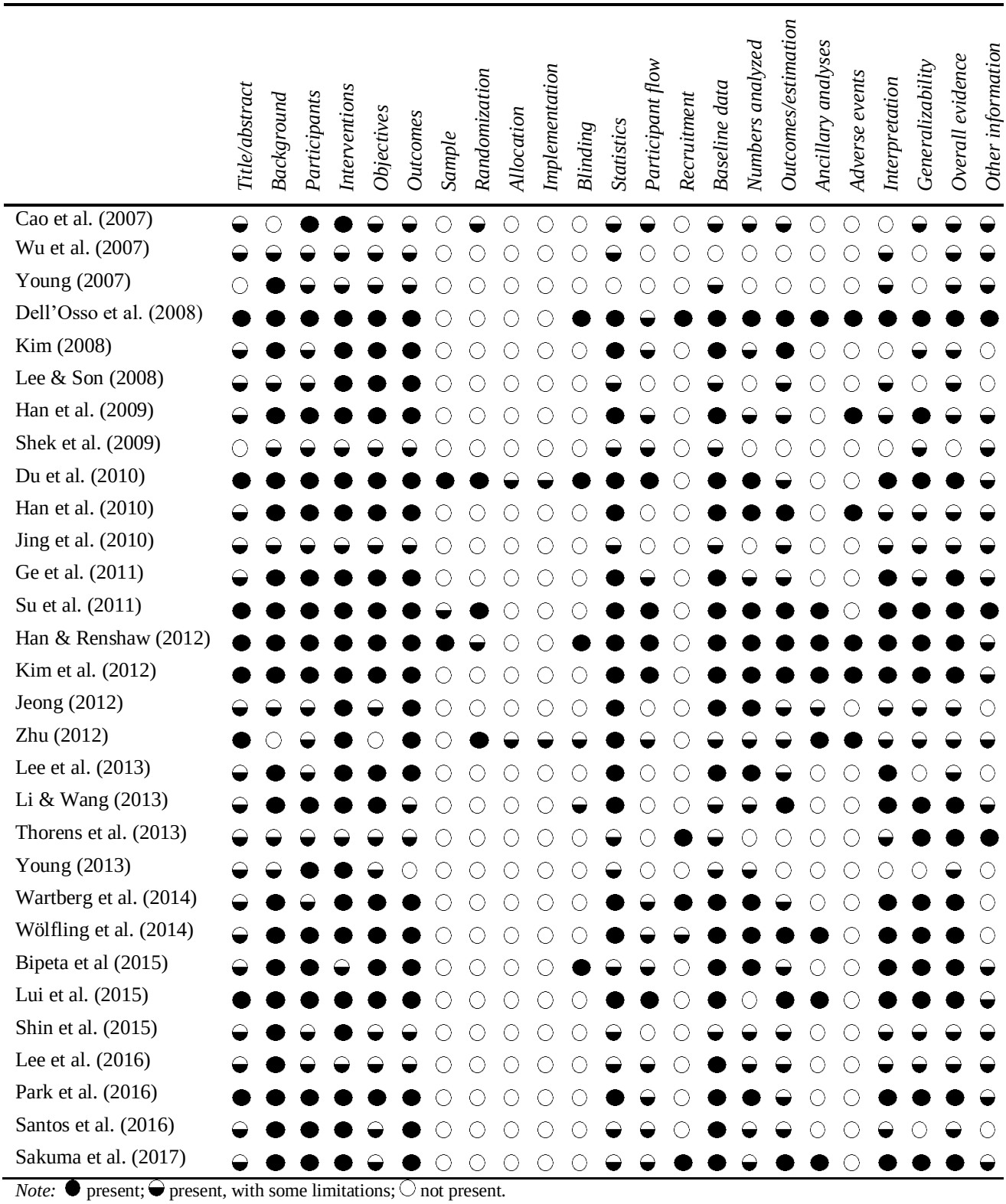
Definitions of treatment outcome in treatment studies: Remission and relapse indicators

		Post-test			Follow-up		
Study	FU period	Diagnosis	Symptoms	Activity	Diagnosis	Symptoms	Activity
Young (2007)	6 months	-	-	-	-	-	-
Lee & Son (2008)	2 months	-	IGAT score	-	-	IGAT score	-
Du et al. (2010)	6 months	-	IOSRC score	-	-	IOSRC score	-
Su et al. (2011)	1 month	-	YDQ score	Weekly use	-	YDQ score	Weekly use
Han & Renshaw (2012)	1 month	-	YIAS score	Weekly use	-	YIAS score	Weekly use
Kim et al. (2012)	1 month	-	YIAS score	Weekly use	-	-	-
Jeong (2012)	2 months	-	K-IAS score	-	-	K-IAS score	-
Young (2013)	1,3,6 months	-	IADQ items	-	-	IADQ items	-
Bipeta et al. (2013)	12 months	IAT	IAT score	-	IAT	IAT score	-
Lui et al. (2015)	3 months	APIUS	APIUS	Weekly use	APIUS	APIUS	Weekly use
Sakuma et al. (2016)	3 months	-	-	Daily, weekly use, days of use	-	-	Daily, weekly use, days of

FU: Follow up. See Table 1 for other acronyms.

Table 2

A CONSORT evaluation of treatment studies in chronological order of publication date



Note: ● present; ◒ present, with some limitations; ○ not present.

Table 1
Characteristics of treatment studies for disordered gaming

Study	Assessment of Internet addiction or related disorder	Excluded morbidity	Interventions	N	Age range (years)	Outcome measures	Follow-up	Country
1. Cao et al. (2007)	YDQ (score 5+)	NR	1. Group CBT (8 modules) 2. NT control	64	12-18	YDQ; CIAS; SDQ; SCARED	Post-test	CH
2. Wu et al. (2007)	YDQ (score 5+)	NR	1. Transcutaneous electrical stimulation (HANS) 2. Placebo HANS treatment	27	16-27	Self-devised IA scale; Internet use	Post-test, 3-day follow-up	CH
3. Young (2007)	IAT (score not specified)	History of psychological trauma, sexual abuse, or Axis II pathology	1. CBT (12 sessions)	114	NR	COQ (self-devised)	Post-test; 6-month follow-up	US
4. Dell'Osso et al. (2008)	IC-IUD-YBOCS (4 criteria)	Comorbid organic or psychotic mental disorders, mental retardation, substance use or dependence, personality disorders, SI.	1. Escitalopram 10-20mg (10-weeks) and placebo 2. Escitalopram 10-20mg (19-weeks)	14	18-51+	CGI-I; BIS; YBOCS;IC-IUD-YBOCS; Internet use	Post-test	US
5. Kim (2008)	K-IAS (score not specified)	NR	1. R/T group (5 weeks) 2. NT control	25	NR	K-IAS; CSEI	Post-test	SK
6. Lee & Son (2008)	IGAT (translated IAT) (score 70+)	NR	1. Group CBT (12 modules) 2. Sport program	27	NR	IGAT; BDI; SCRS	Post-test; 8-week follow-up	SK
7. Han et al. (2009)	YIAS-K (50+)	Prior history of psychiatric treatment; IQ<70; substance use; mood/anxiety disorders; developmental disorders	1. Methylphenidate (8 weeks)	62	8-12	YIAS-K, K-ARS-PT; VCPT; Internet use	Post-test	SK
8. Shek et al. (2009)	YIAS-10 score of 4; YIAS-8 score of 5; YIAS-7 score of 3; CIAS score of 3	NR	1. Multi-modal counselling (15 to 19 months)	59	11-18	YIAS-10;YIAS-8;YIAS-7; CIAS; BDI	Post-test	HK
9. Du et al. (2010)	Beard's Diagnostic Questionnaire	Pre-existing psychiatric disorder; co-morbid medical disorder; currently taking psychoactive medication	1. CBT (8 sessions) 2. NT control	56	12-17	IOSRS, SDQ, SCARED; Internet use	Post-test; 6 month follow-up	CH
10. Han et al. (2010)	YIAS score of 50 or higher; >4 hr per day/30 hr per week; DSM-IV criteria for substance abuse	History or current episode of Axis I psychiatric disorder; substance abuse not including tobacco and alcohol; neurological or medical disorders	1. Bupropion (6 weeks, 15-300 mg) 2. Case-control	19	16-29	YIAS; fMRI (brain activity); Internet use	Post-test	SK
11. Jing et al. (2010)	YDQ (score 5+)	Severe depression	1. Group CBT (8 sessions) 2. NT control	81	NR	CIAS; ESLI; SES; Coping scale	Post-test	CH
12. Ge et al. (2011)	YDQ (score 5+); SCID	Pregnancy; medical conditions; SI; Psychosis; Mania; Substance use or dependence	1. Group CBT (3 months) 2. Case-control	96	28-35	P300 waveform	Post-test	CH
13. Su et al. (2011)	YDQ (score 5+); Internet use of 14 hours or more per week	Currently taking psychotropic medicine or receiving other treatment for Internet addiction	1. HOSC-NE (one session) 2. HOSC-LE (one session) 3. HOSC-NI (one session) 4. NT control	65	NR	YDQ; Internet use	1-month follow-up only	CH
14. Han & Renshaw (2012)	YIAS (score 50+); gaming 30 hours per	NR	1. Bupropion (150-300mg) + Education (8 weeks)	50	13-45	YIAS; BDI; CGI-S; Internet video game	Post-test; 4-week follow-up	SK

	week; impaired control and distress		2. Placebo + Education			use		
15. Kim et al. (2012)	YIAS (score 50+); gaming 30 hours per week; impaired control and distress	History of psychiatric disorders; substance abuse history; neurological or medical disorders	1. CBT (8 sessions) + Bupropion (150-300mg) 2. Bupropion (150-300mg)	65	13-18	YIAS; BAI: BDI; M-SPBS; Total time of Internet game play	Post-test; 4-week follow-up	SK
16. Jeong (2012)	K-IAS (score 94+)	NR	1. Group counselling (6 sessions) 2. NT control	21	11	K-IAS; CBS; SIS; SES	Post-test; 2-month follow up	SK
17. Zhu et al. (2012)	Criteria from American Association of Psychology (1997)	Non-IA mental disorder; cardiovascular disease; pregnancy; hypersensitivity to acupuncture	1. Electro-acupuncture 2. Psycho-intervention 3. Both	120	18-24	YIAS; P300 Waveform; WMS	Post-test	CH
18. Lee et al. (2013)	IUHDS	NR	1. Group counselling (6 sessions) 2. Control	46	NR	IUHDS; Internet use	Post-test	SK
19. Li & Wang (2013)	OGCAS (score 35+); IAS-CR (3+); gaming 30 hours per week	ADD; Major depression, anxiety; Schizophrenia	1. Group CBT (6 weeks) 2. NT control	28	12-19	IAS; OGCAS; Cognition scale	Post-test	CH
20. Thorens et al. (2013)	IAT (score 70+)	NR	1. Psychotherapy	57	13-67	IAT; CGI	Post-test	SW
21. Young (2013)	IAT (score 4+)	Trauma history; personality disorders	1. CBT (12 weeks)	128	22-56	IAT; COQ	Post-test; 1-month; 3-month; 6-month follow up	US
22. Wartberg et al. (2014)	CIUS	None	1. Group CBT (8 modules)	18	12-17	CIUS; RAAI; Internet use	Post-test	DE
23. Wölfling et al. (2014)	AICA-S (score 7+)	Comorbid disorders; severe IA	1. CBT (24 sessions)	42	18-47	AICA-S; SCL-90R; GSE; Internet use	Post-test	DE
24. Bipeta et al. (2015)	YDQ (score 5+)	Psychiatric disorders; BIS (55+); Substance dependence history; personality disorder	1. Various pharm	72	25-30	IAT; YBOCS; BIS	12-month follow up only	IN
25. Lui et al. (2015)	APIUS (score 3.15+)	Physical disabilities; Other addictive behaviors; Other mental disorders	1. MFGT (6 sessions) 2. Waitlist control	96	12-18	APIUS; P-CCS; Internet use	Post-test; 3-month follow up	CH
26. Shin et al. (2015)	KIAS	NR	1. MI group (6 sessions) 2. Waitlist control	20	NR	KIAS; SOCRATES-I; Internet use	Post-test	SK
27. Lee et al. (2016)	KSAPS	NR	1. HDJ-S (2 weeks)	335	12-14	KSAPS; Parental concern; Motivation	Post-test	SK
28. Park et al. (2016)	YIAS (score 50+); Internet use >30 hours	Axis I disorders; alcohol and other substance dependence; history of head trauma or other neurologic disease	1. CBT (4 weeks) 2. VRT (4 weeks) 3. NT control	24	18	YIAS; BDI; BAI; ASRS-K; fMRI assessment	Post-test	SK
29. Santos et al. (2016)	IAT (Score 50+)	Illiterate; Axis II disorders	1. CBT + pharm (10 weeks)	39	18-65	YIAS; CGI; Depression/Anxiety	Post-test	BR
30. Sakuma et al. (2016)	DSM-5 criteria	NR	1. SDiC (CBT, counselling, medical lecture, outdoor program) (9 days)	10	15-17	SOCRATES; Self-efficacy; Internet use	Post-test; 3-month follow-up	JP

Abbreviations: AICA-S: Scale for the Assessment of Internet and Computer Game Addiction; APIUS: Adolescent Pathological Internet Use Scale; ASRS-K; Korean version of the WHO adult ADHD self-report scale; BAI: Beck Anxiety Inventory; BASIS-32: Behavioral and Symptom Identification Scale; BDI: Beck Depression Inventory; BIS: Barratt Impulsiveness Scale; BR: Brazil; CBT: Cognitive Behavior Therapy; CGI: Clinical Global Impressions Scale; CH: China; CHI-I: Clinical Global Impressions-Improvement; CIAS: Chinese Internet Addiction Scale; CBS: Cyber Behavior Scale; COQ: Client Outcome Questionnaire; CSEI: Coopersmith's Self-Esteem Inventory; DE: Germany; DSM-IV: Diagnostic and Statistical Manual of Mental Disorders (4th Edition); ESLI: Social Loneliness Scale; fMRI: Functional Magnetic Resonance Imaging; GSE; General Self-efficacy Scale; HDJ-S: Home-based Daily Journal-Smartphone; HK: Hong Kong; HOSC: Healthy Online Self-Helping Center [NE: Natural Environment; IAT: Internet Addiction Test; IC-IUD-YBOCS: YBOCS for Internet Use Disorder; IGAT: Internet Game Addiction Test; IN: India; IOSRS: Internet Overuse Self-Rating Scale; IUHDS: Internet Use Habit Diagnosis Scale; JP: Japan; K-ARS-PT: Korean version of Du Paul's ADHD Rating Scale; K-BDI: Beck Depression Inventory-Korean Version; K-IAS: Korean Internet Addiction Scale; KSAPS: Korean Smartphone Addiction Scale; LE: Learning Environment; MFGT: Multi-Family Group Therapy; MI: Motivational Interviewing; M-SPBS: Modified-School Problematic Behavior Scale; NI: Non-Interactive; NT: No treatment; NR: Not reported; OGCAS: Online Cognitive Addiction Scale; OTIS: Orzack Time Intensity Scale; P-CCS: Parent-Child Communication Scale; RAAI; Reynolds Adolescent Adjustment Inventory; R/T: Reality Training; RtC: Readiness to Change therapy; SCARED: Screen for Child Anxiety Related Emotional Disorders; SCRS; Self-Control Rating Scale; SDiC: Self-Discovery Camp; SDQ: Strengths and Difficulties Questionnaire; SES: Self-esteem Scale; SI: Suicidal Ideation; SIS: Social Interest Scale; SK: South Korea; SW: Switzerland; US: United States; VCPT: Visual Continuous Performance Test; SES: Self Encouragement Scale; SOCRATES-I: Stages of Change Readiness and Treatment Eagerness Scale; VRT: Virtual Reality Therapy; WMS: Wechsler Memory Scale; YDQ: Young's Diagnostic Questionnaire; YIAS: Young Internet Addiction Scale; YBOCS: Yale-Brown Obsessive Compulsive Scale; YIAS-K: Young Internet Addiction Scale – Korean Version.