

# The effectiveness of prevention programs for Problematic Usage of Internet in adolescents and youths: A systematic review and meta-analysis



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## Introduction



The expansion of Internet availability and its extended use through smartphones has given rise to concerns about the effects of internet use on well-being. Adolescents (12-17 years) and emerging adults (18-29 years), who access the internet more than other age groups<sup>1</sup>, are particularly vulnerable to ill effects. Excessive, uncontrolled, or compulsive use of internet can lead to depression, anxiety, stress and loneliness<sup>2,3</sup>, as well as impaired academic and working performance, sleep deprivation, family problems, and reduced social activities<sup>4</sup>. All of these consequences result in high public health and societal costs<sup>5</sup>.

Maladaptive use of internet is often conceptualized as a behavioral addiction. It is referred to by a variety of terms, including: internet addiction, compulsive internet use, internet dependence, and pathological internet use<sup>6,7</sup>. This conceptualization remains controversial<sup>8,9,10</sup> since it over-pathologizes such conditions by applying the criteria for substance use without distinguishing a broader spectrum of behavior (e.g., high involvement vs dysfunctional involvement). As an alternative, the term **Problematic Usage of Internet** (PUI)<sup>11</sup> is proposed as an umbrella term describing maladaptive patterns of internet use involving: an apparent loss of control over the behavior, the occurrence of psychological, social or professional negative consequences and worries and obsessive thoughts when it is not possible to use the internet<sup>8</sup>. PUI includes, but is not limited to, gaming, gambling, buying, pornography viewing, social networking and cyberbullying<sup>11</sup>.

Previous systematic reviews on the matter agree that the literature on prevention of internet addiction and PUI is scarce, and that there is a need to introduce and implement interventions for at risk populations as well as to assess their effectiveness using well designed studies<sup>12,13</sup>.

## Aims and objective



This systematic review aimed to investigate the state of the art of published research on PUI prevention efforts and their effectiveness. Specifically, it aimed to synthesize how authors conceptualize PUI, which PUI behaviors are being targeted by primary prevention programs, which risk and protective factors are addressed, which strategies used, and what evidence is available regarding their effectiveness.

## Method



Multiple databases were searched using both general and specific terms targeting the different behaviors that are comprised by PUI. The protocol for this review was registered in the PROSPERO database of prospectively registered systematic reviews (CRD42019135887).

## Eligibility criteria

Studies had to (a) cover either primary prevention programs for Problematic Internet Use or Internet Addiction, or programs for specific behaviors such as: problematic smartphone use, problematic social networking, gaming disorder, cybersex addiction, online gambling and online buying; (b) target adolescents and youths aged 12-29; (c) use proper outcome measures (either validated questionnaires or ad hoc measures of problematic internet use); (d) use experimental and quasi-experimental study designs including randomized controlled trials and before and after studies with or without a control group.

## Search strategy and information sources

The search was performed by two researchers using PubMed, PsycINFO, Cochrane Register of Controlled Trials and Scopus, using the following keywords for the targeted behaviors:

"problematic internet us\*", "compulsive internet us\*", "pathological internet us\*", "excessive computer us\*", "internet addiction", "smartphone addiction", "cellphone addiction", "excessive mobile phone us\*", "problematic smartphone us\*", "problematic mobile phone us\*", "problematic online gaming", "internet gaming", "Online gaming", "gaming addiction", "internet gaming addiction", "internet gaming disorder", "gaming disorder", "problematic social media us\*", "problematic social networking us\*", "social network addiction", "facebook addict\*", "instagram addiction", "problematic social networking", "internet sex addiction", "cybersex", "online sex addiction", "online pornography", "compulsive online pornography viewing", "online gambling", "problematic online gambling", "problematic internet gambling", "problematic online shopping", "compulsive online shopping". These were combined with the targeted intervention key words: "prevention", "prevent", "prevention program", "psychoeducation", "online program" and with the targeted population: "adolesc\*", "youth\*", "teen\*", "university student\*", "undergraduate student", "college student\*\*".

The search strategy was adapted for each database to account for differences in terminology and indexing. Articles in English, French and Spanish were included. No date limits were imposed. The reference list of all studies selected was examined to seek for additional studies.

## Study selection and data collection

### Quality assessment

The quality of the selected studies was assessed using Downs and Black<sup>14</sup> checklist, setting the cut-off at 60% of the criteria fulfilled to ensure that enough quality studies could be retained for further analysis.

### Data extraction and analysis

A **narrative synthesis** was performed considering the year, country, program name, targeted behavior, participant and intervention characteristics, measures used, and main findings.

A **meta-analysis** was performed in R, pooling the quantitative data across studies and using a random effects model for the analysis, correcting cluster-randomized data before inclusion. Effect size estimates and 95% confidence intervals were calculated for between group post-test differences between the pooled intervention and control samples. Hedges' *g* was used as an index of the treatment effect, and the DerSimonian-Laird estimator and Hartung-Knapp-Sidik-Jonkman (HKSJ) methods to estimate the variance of the distribution of true effect sizes,  $\tau^2$ .

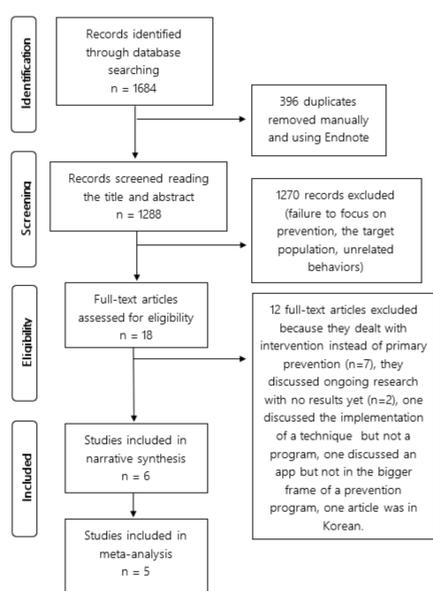


Figure 1. PRISMA flow chart portraying the selection process

## Results



### Study Quality

The six remaining studies obtained the minimum score of 60% that was required to assure quality, resulting in good scores for **general quality** (M=21 out of 27 items, 75% positive answers). The score for **reporting quality** was high (M=8,5 out of 10 items, with 85% positive answers) as well as for **internal validity bias** (M=4,7 out of 7 items, with 67% positive answers). Average scores were obtained for **external validity** (M=2 out of 3 items, with 78% of positive answers) and **internal validity confounding** (M= 4 out of 6 items, with 67% positive answers). Finally, 4 out of 6 studies reported information regarding sample size calculation for **power estimations**.

No published studies were found documenting primary prevention programs for problematic use of social networks, cybersex addiction, online gambling or online buying. Out of the six studies that met the criteria<sup>15-20</sup>, one was concerned with problematic gaming and the other five aimed at preventing Internet Addiction or PUI.

### Meta-analysis

Five studies met the criteria to be included in the meta-analysis. All of them were concerned with the implementation of a theory-based primary prevention program targeting either adolescents or youths without imposing exclusion criteria, used an experimental or quasi-experimental design, and used a validated Internet Addiction measure to account for the outcome.

Pooling the samples of the five studies resulted in a total sample of 965 students in the intervention group and 1201 in the control group. Figure 2 shows the forest plot and statistics for the random effects model testing for post-test differences between the groups, showing a significant overall effect of the interventions. Two studies showed moderate effect sizes, and three high effect sizes<sup>21</sup>. These findings can be considered as robust since the confidence intervals did not include zero. However, heterogeneity was also high ( $I^2 = 98\%$ ), and subgroup analysis to identify sources of variation could not be performed due to the small number of studies.

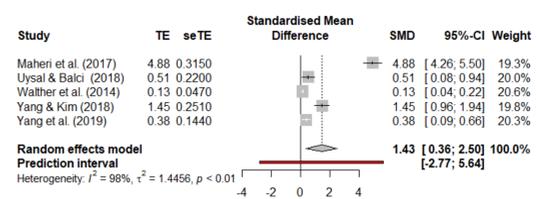


Figure 2. Forest plot and statistics for REM with 5 studies

While the DerSimonian-Laird estimator is known to produce false positives when the number of studies is low and there is high heterogeneity<sup>22</sup>, an analysis with the Hartung-Knapp-Sidik-Jonkman (HKSJ) method gave more conservative results, showing no combined significant effect (95% CI: -0.98; 3.89) and high levels of heterogeneity. The latter is mainly due to one of the studies<sup>15</sup>, showing a disproportionate Hedges *g* value. A sensitivity analysis confirmed that this study contributes largely to the heterogeneity found in the meta-analysis (Figure 3).

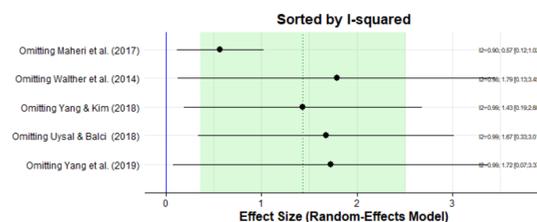


Figure 3. Leve-one-out analysis sorted by I<sup>2</sup>

A re-analysis including only the four other studies ( $n_{EG} = 885$ ,  $n_{CG} = 1121$ ) gave an overall non-significant effect (95% CI: -0.31; 1.48) with a prediction interval at a 95% confidence Interval of -2.00; 3.17 (Figure 4). The number of studies was too small to perform an Egger's test, but the funnel plot suggests asymmetry, and therefore, publication bias.

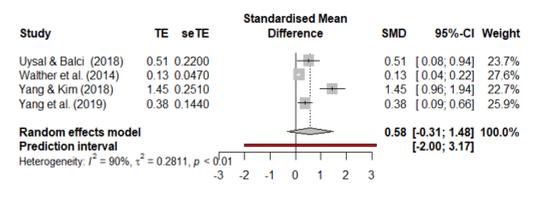


Figure 4. Forest plot and statistics for REM with 4 studies

## Discussion

Although problematic usage of internet is a popular topic, little is known about the strategies to prevent it or about the effectiveness of existing prevention programs. The main focus of the literature seems to be on treatment rather than prevention, even if the debate regarding the nature of PUI is still ongoing. It is noted that the studies included in this review sought to prevent PUI in general rather than a specific behavior, and that the proposed prevention programs drew on different theoretical approaches, ranging between education on media literacy and including usage of internet as a health behavior to be addressed alongside eating habits, sleep, and exercise to increase quality of life and well-being among students.

While the studies included in this review are of high quality and reported medium to large effect sizes for short-term efficacy on their own, they are too few in number to warrant robust conclusions regarding a pooled effect. As some studies may have been omitted because of language restrictions and publication bias, future research should include studies published in more languages as well as grey literature. Moreover, moderator analysis could be considered to account for the effects of potential moderators such as study design, type of program depending on the underlying theory, culture (specially if including Asian studies), age, and gender.

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