





# Problematic Internet uses and depression in adolescents: A meta-analysis

Usos problemáticos de Internet y depresión en adolescentes: Meta-análisis

 Raquel Lozano-Blasco is Predoctoral Researcher (FPU) in the School of Education at the University of Zaragoza (Spain) (rlozano@unizar.es) (<https://orcid.org/0000-0002-0100-1449>)

 Dr. Alejandra Cortés-Pascual is Associate Professor of Education at the University of Zaragoza (Spain) (alcortes@unizar.es) (<https://orcid.org/0000-0002-2839-7041>)

## ABSTRACT

Widespread use of the Internet in 21st century society is not risk-free. This paper studies the comorbidity of some problematic uses of Internet with depression in order to assess their correlation. With that aim, a meta-analysis of 19 samples obtained from 13 different studies ( $n=33,458$ ) was carried out. The subjects of these studies are adolescents between the ages of 12 and 18 years ( $\mu=15.68$ ) from different cultures and continents (Europe, Euro-Asia, America and Asia). The effect size obtained from the use of a random-effects model ( $r=0.3$ ,  $p<0.000$ ) is significant, moderate and positive, thus confirming the relation between pathologic uses of the Internet and depression. Moreover, meta-regression test results showed that 9% of the variance ( $R^2=0.09$ ) is associated with the male gender, while age and culture are not significant variables. The variability rate of the studies is high ( $I^2=87.085\%$ ), as a consequence of heterogeneity rather than publication bias, as Egger's regression test shows (1-tailed  $p$ -value=0.25; 2-tailed  $p$ -value=0.50, and  $\sigma=1.57$ ). Therefore, the need for specific interventions in secondary education dealing with this issue is evident to ensure that it does not extend into adult life.

## RESUMEN

El uso extendido de Internet en la sociedad del siglo XXI no está exento de riesgos. El presente trabajo estudia la comorbilidad entre los usos problemáticos de Internet y la depresión con la finalidad de determinar la existencia de relación entre ambas. Para ello se ha llevado a cabo un meta-análisis, que cuenta con 19 muestras recogidas en 13 investigaciones ( $n=33.748$ ), con adolescentes de entre 12 y 18 años ( $\mu=15,68$ ) de diferentes culturas y continentes (Europa, Euro-Asia, América y Asia). El tamaño del efecto obtenido a partir de un modelo de efectos aleatorios ( $r=0,3$ ,  $p<0,000$ ) es significativo, positivo y moderado confirmando la existencia de relación entre usos patológicos de Internet y depresión. Por otra parte, la meta-regresión mostró que el 9% ( $R^2=0,09$ ) de la varianza es explicada por el sexo masculino, mientras que la edad y la cultura no son variables significativas. La variabilidad de los estudios es elevada ( $I^2=87,085\%$ ) siendo fruto de la heterogeneidad y no del sesgo de publicación, tal y como indicó la prueba de regresión de Egger ( $p$ -value 1 tailed=0,25;  $p$ -value 2 tailed=0,50 y  $\sigma=1,57$ ). Se advierte la necesidad de comenzar a generar proyectos de intervención en Educación Secundaria que traten esta problemática con el objetivo de que no se extienda a la vida adulta.

## KEYWORDS | PALABRAS CLAVE

Meta-analysis, adolescence, Internet, pathological use, depression, comorbidity, correlation, moderating effect.  
Meta-análisis, adolescencia, Internet, uso patológico, depresión, comorbilidad, correlación, efecto moderador.

## 1. Introduction

In recent years, a spread of Internet use in different cultures has been observed. In the case of Europe, research conducted in several countries shows continuous growth in the frequency of use of new technologies. A clear example is the study by Tsitsika et al. (2014) of European adolescents, which found that 70% of their sample regularly used social networks and that 40% used them for an average of two hours a day. In the case of the United Kingdom (UK), 83% of adolescents aged 12 to 15 years have cellphones and spend 21 hours per week on them (Ofcom, 2017).

In the United States (USA), the Pew Research Center (2015) states that approximately 24% of adolescents are almost constantly connected to social networks. However, this increase does not only occur in Europe and the Americas, Asian teenagers also spend more time on the Internet for different purposes. The case of South Korea is paradigmatic. According to surveys performed in that country, 29.2% of South Korean adolescents are potentially addicted users, a larger proportion than observed for the older population (Israelashvili & Romano, 2016).

According to Jun (2016), this problem is observed in adolescents and young people in industrialized countries. Even so, Zhang et al. (2013) report that Internet addiction (IA) is not unique to first-world countries but is also present in developing countries. That is, the pervasiveness of the Internet has led to pathological uses, which in turn has promoted possible pandemics. The meta-analysis conducted by Cheng and Li (2014) shows that 6% of the adult population suffers from IA.

As Király et al. indicate (2015), the Internet is a portal through which numerous online activities are accessed: social networks, video games, video downloads, etc. Regarding social networks such as Facebook and Instagram, Oberst et al. (2016) state that these platforms allow adolescents to create profiles that reflect their desired self-representation, thus making these platforms very attractive spaces. According to King et al. (2013), the increase in new technological spaces implies changes in our behavior. In the words of Lu et al. (2018), the excessive Internet use can lead to health problems.

The nature of adolescence should be considered in light of potential excessive Internet use, as indicated by Underwood and Ehrenreich (2017). At this stage, human beings are especially susceptible to suffering the negative effects of social networks. In particular, adolescents may face situations that lead to feelings of exclusion or victimization (Underwood & Ehrenreich, 2017).

IA is defined by Young (1998) as an excessive concern with the activities carried out on this platform that creates discomfort in the daily lives of users at the personal, social or professional level. As El-Asam et al. (2019) state, in recent years, several terms have come into use, such as excessive Internet use, problematic Internet use (PIU) and Internet addiction disorder (IAD). Other authors, such as Müller et al. (2016), use the term "Internet addiction" (IA), which they define as the excessive and uncontrolled use of online applications accessible through the Internet (social networks, online games, pornography sites, etc.).

Although these terms are frequently used, only Internet gaming disorder (IGD) is a recognized disorder. In fact, IGD is included in the latest edition of the *Diagnostic and Statistical Manual of Mental Disorders (DSM-5)*, American Psychiatric Association, 2013). Analyses carried out in different countries and cultures show that the persistent use of the Internet (for social networking, online gaming or other activities related to surfing the web) increases the risk of developing addictive behaviors (Müller et al., 2016; Tsitsika et al., 2014).

There are numerous studies that relate the addictive use of the Internet to various health problems that affect the individual and his or her way of relating to the world. The relationship between IA and depression or depressive symptoms is especially alarming. Kaess et al. (2014), in their sample of European adolescents with an average age of 15, found that the pathological use of the Internet is related to different mental problems, including suicidal ideation and depression.

Gámez-Guadix et al. (2014) verified the correlation between depressive disorder and the components of PIU in a population of Spanish adolescents aged 13 to 17. Banjanin et al. (2015) claim that the level of IA is correlated with depressive symptoms in adolescent Serbs aged between 12 and 18. Even so, the relationship between IA or pathological use is not only an endemic problem in Europe. Adolescents from Asia, and North and South America also suffer from these psychological illnesses.

According to several studies, the relationship between addiction and depression is mixed. In this sense, we find several authors who show that addiction affects depressive symptoms (Chou & Edge, 2012; Bickhan et al., 2015). The reverse also occurs: depressive symptoms predict addiction (Bonetti et al., 2010; Kim et al., 2015).

In the first case, the idealization of personal and professional qualities—that is, hiding one's own defects—could affect one's mood (Chou & Edge, 2012). Likewise, the lack of family rules regarding the use of new technologies seems to lead to the onset of depressive symptoms (Bickhan et al., 2015). In this sense, it is noteworthy to mention the research of Mehdizadeh (2010), according to which, Facebook users with higher rates of narcissism and lower self-esteem had greater online activity; that is, they were more active.

In the second case, people with depression used their mobile devices to reduce negative feelings (Kim et al., 2015). Likewise, solitary adolescents could have greater difficulty relating face to face, which would increase their interest in relating online (Bonetti et al., 2007). Thus, it is understood that there is no consensus regarding which factor constitutes the dependent variable and which the independent variable is.

Access to the Internet could become a health problem for young people. McLaughlin and King (2015), among others, argue that adolescence continues to be an evolutionary stage of great vulnerability in terms of low self-esteem and the onset of depressive and anxiety disorders. Underwood and Ehrenreich (2017) report that social networks can lead to situations of exclusion and victimization. Therefore, Woods and Scott (2016) support the need to understand the relationship between pathologies and social networks.

Given the evidence of the pathological use of new technologies and the psychological problems that these entail, it should be noted that there are protective factors for their prevention. Authors such as Wu et al. (2015) note that it is essential to guide adolescents in the proper use of the Internet and to rely on tools offered by both the school and the family.

## 2. Methodology

### 2.1. Research question

In recent years there has been increasing interest in how adolescents use new technologies and how it is beginning to impact their health. That is, the comorbidity between problematic-addictive use of the Internet and depression in adolescents.

### 2.2. Criteria for inclusion and exclusion

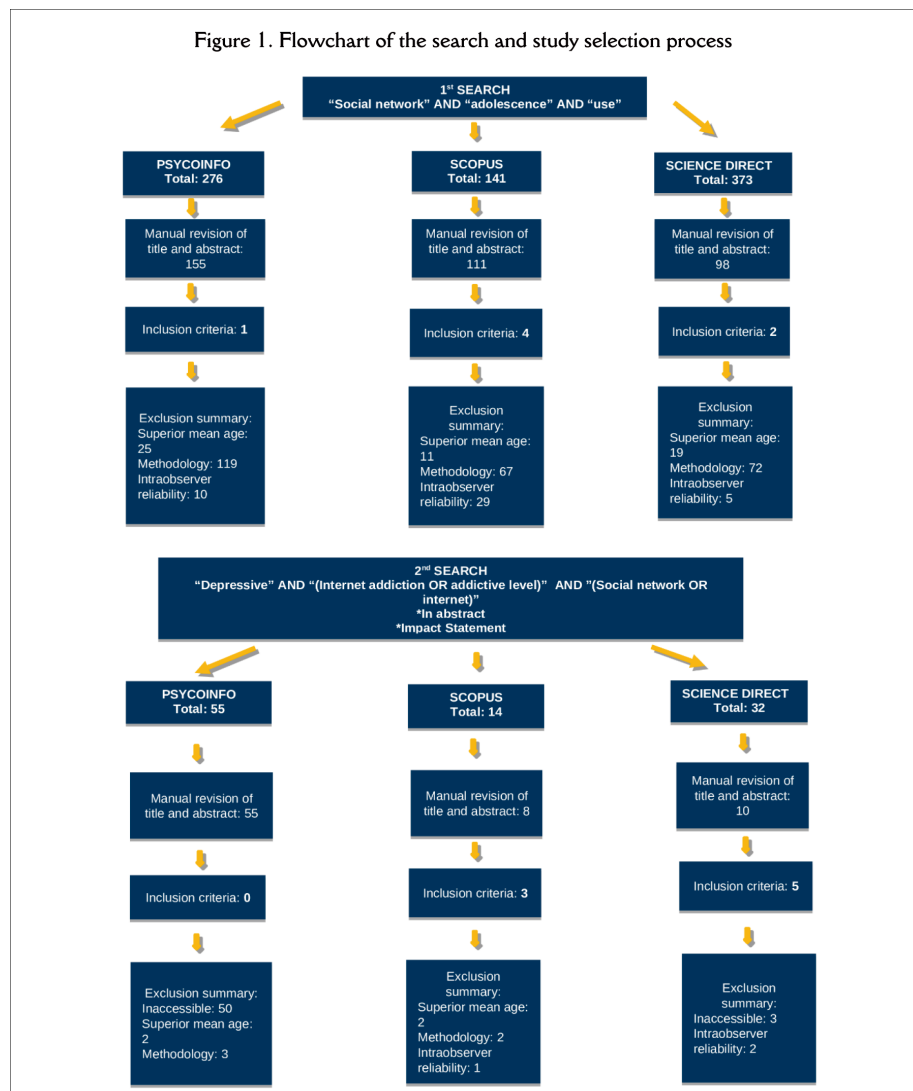
A series of inclusion criteria are stipulated to develop the search:

- Age of the sample. The study population corresponds to adolescents with a mean age between 12 and 18 (including up to 18.9 years to represent high school and professional education students).
- Methodological nature of the articles. Studies should be experimental and quantitative.
- Date of publication. A range was established from 2013 to 2019.
- Intraobserver reliability. It was decided to select only journals of recognized prestige positioned in the 1<sup>st</sup> quartile (Q1) in the Scimago Journal & Country Rank.
- The exclusion criteria stipulated are as follows:
- Biomedical nature. Studies that evaluated addiction and depression using instruments other than psychometric tests were discarded.
- Adolescent population with special educational needs (SEN) as a main feature. However, it was stipulated that research in which students with SEN were a standard measure according to the normal curve would be accepted.
- Research studies without clear and accurate quantitative data. Scientific studies that did not present numerical data or that did not clearly state the statistics in question were excluded. Similarly, those for which the CMA software detected any statistical error were also left out of the sample.

### 2.3. Search strategy

The search strategy followed the requirements of Botella and Sánchez (2015). Searches of three databases -Psycinfo, Scopus and Science Direct – were performed. Two Boolean searches were carried out with different keywords (see Figure 1). The first search was performed using the Boolean search actions “Social network AND adolescence AND use”. All of the articles obtained were manually screened by reading their title and abstract (Figure 1).

Next, other types of keywords were introduced for the second search, such as “depressive AND (Internet addiction OR addictive level) AND (social network OR Internet)”. The reference lists of the different articles were reviewed, but none met the inclusion criteria. In total, the meta-analysis comprised 13 studies, with  $k=9$  samples from Europe, Asia and the Americas. The search lasted 4 months (October, November and December 2018 and January 2019).



### 2.4. Coding procedure

The study followed the guidelines provided by the Cochrane Manual of Systematic Reviews in Higgins and Green (2011), which stipulates clear objectives as well as terms related to the criteria for the selection of eligible studies. The studies were coded manually because most of them did not refer explicitly to

addiction related to, or excessive use of new technologies and depression. First, it was necessary to code terms in the same category: “addiction”, “excessive use”, “Internet addiction”, “average and high use”, “problematic Internet use”, “negative consequence of mobile device use (CERM)” and “problematic Facebook use” were coded as problematic use.

As explained by El-Asam et al. (2019), in recent years, various terms have been used, such as “excessive Internet use”, “problematic Internet use (PIU)” or “Internet addiction disorder (IAD)”. On the other hand, only studies that addressed depression were selected; thus, studies were excluded if they contained terms such as “suicidal ideation,” “loss of interest,” “preoccupation,” “shyness,” “loneliness” and “alexithymia,” among others, although they could be symptoms of depressive disorder.

The effect size was calculated from data and expressed as Pearson correlations, odds ratio and sample sizes with p values. These data were entered into the statistical software CMA and returned an effect size of  $r=0.3$ , which according to Cohen (1998) establishes a significant positive and moderate correlation between the variables.

## 2.5. Instruments

For the instruments used to measure both problematic Internet use and depression, see Table 1.

<b>Author</b>	<b>Problematic use instrument</b>	<b>Depression instrument</b>
El-Asam et al.	Problematic Internet Use (PIUQ)	Patient Health Questionnaire 9 (PHQ)
Woods & Scott	Social Integration and Emotional Connection subscale of the Social Media Use Integration Scale	Hospital Anxiety and Depression Scale
Walburg et al.	Internet Addiction Test (AIT)	Center for Epidemiologic Studies Depression Scale (CES-D)
Sami et al.	Internet Addiction Test (AIT)	Center for Epidemiologic Studies Depression Scale (CES-D)
Colder-Carras et al.	Video Game Addiction Test (VAT)	Depressive Mood List
Banjanin et al.	Young Internet Addiction Test, designed by the authors	Center for Epidemiologic Studies of Depression Scale for Children (CES-DC)
Kircaburun et al.	Ten-item Internet gaming disorder test (IGDT-10)	UCLA Loneliness Scale-Short form (ULS-4)
Jun	KCYPS	Korean Manual of Symptom Checklist
Chang et al.	Chen Internet Addiction Scale (CIAS)	Center for Epidemiologic Studies Depression Scale (CES-D)
Lin and others	Chen Internet Addiction Scale (CIAS)	Ko's Depression Inventory
Zhang et al.	Beard's Diagnostic Questionnaire for Internet Addiction	Self-Rating Depression Scale (SDS)
Gámez-Guadix et al.	Generalized Problematic Internet Use Scale 2	Brief Symptom Inventory
Oberst et al.	Questionnaire of experiences related to mobile phone use (CERM)	Self-report Hospital Anxiety and Depression Scale (HADS)

## 3. Results and analysis

### 3.1. Sample description

The literature searches for studies related to pathological use and depressive symptoms in recent years (2013-2019) yielded interesting results. The 19 samples ( $K = 19$ ) in the 13 selected studies comprised a total of 33,748 individuals. The smallest sample was 20 individuals, and the largest was 9,733 individuals. Regarding the cultures examined in the research, 46.15% of the studies included European populations (France, Serbia, UK, Holland, Spain). The European population represented 42.81% of the total sample. A total of 30.76% of the studies were conducted in Asia (China and North Korea), accounting for 50.18% of the total sample. A total of 15.31% of the studies were carried out in Eurasian countries (Israel and Turkey), representing 2.60% of the total sample. Regarding the Americas (represented by Spanish-speaking countries), 7.69% of the studies were conducted in South America and represented 4.38% of the sample. The presence of various countries allowed an examination of differences among cultures. However, it

should be noted that no studies conducted in Africa, North America or Oceania were included. It would have been interesting to have a greater representation of Indo-European and Asian countries because the latter are only represented by China and South Korea, and Southeast Asia and the Middle East were ignored. Regarding sex, it is worth indicating that two studies did not provide data related to this variable. Of the total sample, 38.15% were men and 41.02% were women. Three studies did not provide a mean age but instead present a range of years, while the rest reported the mean age of their participants. In sum, the mean age of the sample was 14.75 years.

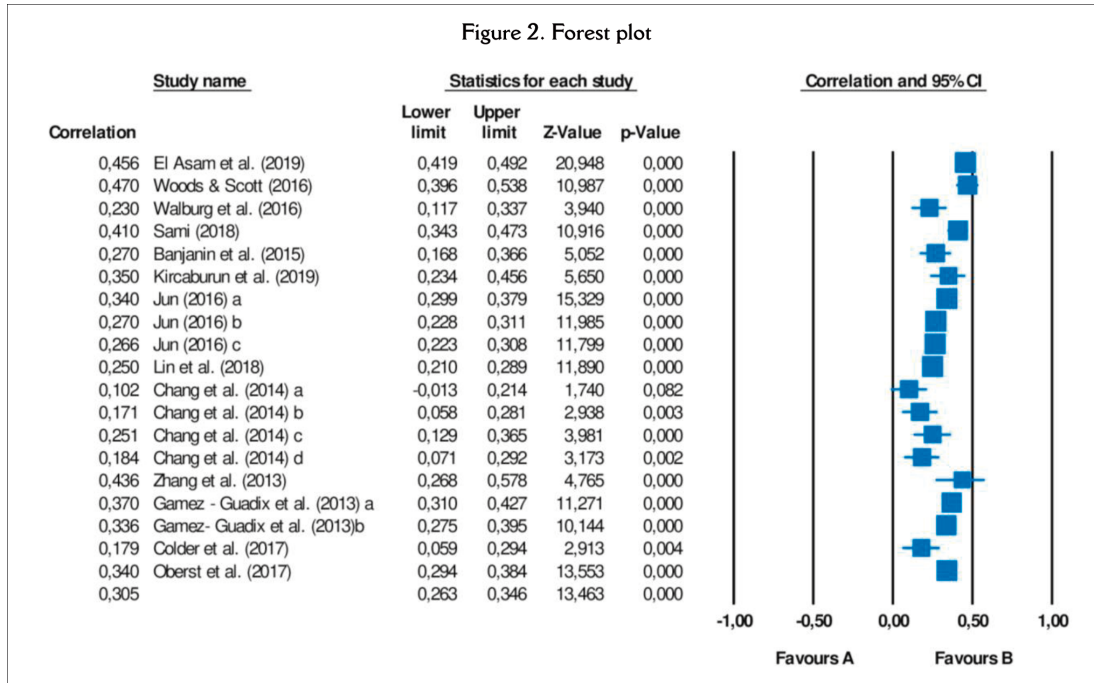
Author	Country	Year	Population	Sex % males	Sex % women	Mean age
El-Asam et al.	UK	2019	1.814	53	47	12.6
Woods & Scott	UK	2016	467	-	-	14
Walburg et al.	France	2016	286	40.2	59.8	16.5
Sami et al.	Israel	2018	631	43.5	56.6	14.95
Colder-Carras et al.	The Netherlands	2017	9733	48.83	51.17	14.5
Banjanin et al.	Serbia	2015	336	34.52	65.48	18
Kircaburun et al.	Turkey	2019	242	93	7	18.78
Jun (x3)	South Korea	2016	1877	49.77	50.23	15.98 14.89 13.89
Chang et al. (x4)	Taiwan	2014	2.315	52	48	15.5
Lin et al.	Taiwan	2018	2.170	-	-	15.83
Zhang et al.	China	2013	20	90	10	16.8
Gómez-Guadix et al. (x2)	Spain	2013	845	41.07	58.93	15.2
Oberst et al.	Latin America	2017	1.468	25.59	74.31	16.59

### 3.2. Statistical analysis

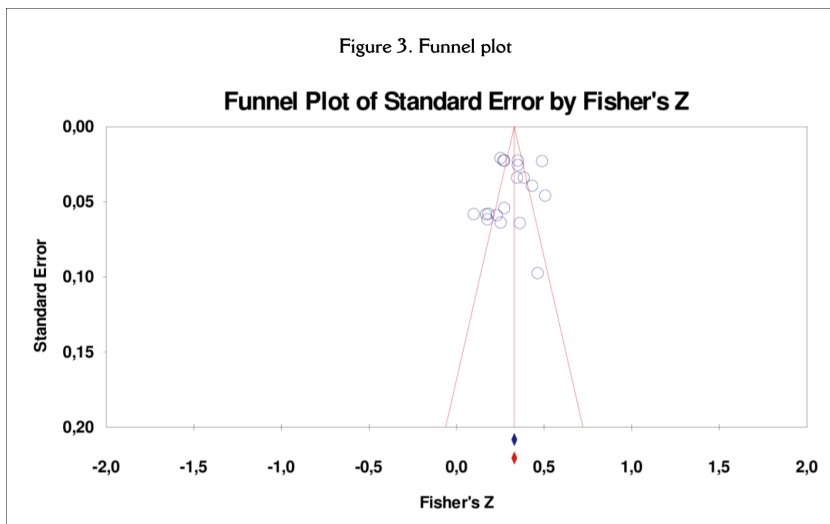
This study aimed to research the relationship between the variables “problematic Internet use” and “depression” using the CMA software. Based on the sample of correlation coefficients, a decision was made to transform these values to Fisher’s Z scores (Martin-Andrés & Luna-del-Castillo, 2004). Figure 2 (forest plot graph) shows the sample size and 95% confidence interval (0.263, 0.346) for the studies that reported both variables. The size effect was moderate ( $d = 0.30$ ) according to Cohen (1988) and was significant ( $p=0.000$ ). Although 95% of the data were within the confidence interval, we must highlight that Banjanin et al. (2015), Walburg et al. (2016), Chang et al. (2014) and Colder-Carras et al. (2017) had limits below the mean confidence interval and that El-Asam et al. (2019), Woods and Scott (2016), Sami et al. (2018) and Kircaburun et al. (2019) presented values above the upper mean limit. This finding implies that the confidence interval was wide, which implies greater variability in the data of these articles and suggests a strong likelihood of the presence of extreme data that increased the standard deviation. On the other hand, it is necessary to note that the  $p$  value must be less than 0.05 to accept that the correlations are significant. In this regard, the “ $a$ ” value of Chang et al. (2014) was nonsignificant ( $p=0.082$ ) as it was greater than  $p=0.005$ , unlike the rest of the sample. The weight of each study was assumed through the random or random-effects model. This decision-making process is explained below.

Per Cochrane in Higgins and Green (2011), the heterogeneity of the sample was studied. The  $Q$  statistic of Der-Simonian and Laird (1986) ( $Q=139.368$ ,  $df=8$ ,  $p<0.000$ ) showed that there was variability in the studies; therefore, the hypothesis of homogeneity was rejected. For its part, the  $I^2$  statistic, which describes the percentage of variability resulting from heterogeneity and not from chance, had a high value (87.085%), indicating that there was a high degree of heterogeneity in the studies. According to Higgins et al. (2003), these findings indicate that the variability of this meta-analysis was high. For this reason, the random model or random-effects model was applied (Martin-Andrés & Luna-del-Castillo, 2004). However, following the indications of Botella and Sánchez (2015), Egger’s regression intercept was applied to verify the nonexistence of publication bias. This allows an estimation of the asymmetry of the funnel plot data, which determines the publication bias. In this study, we observed that there was no

significance in either tail (1-tailed p-value=0.25, 2-tailed p-value=0.50), which implies the absence of bias (Eggers et al., 1997). In addition, the value of the standard error was small (1.57); therefore, it was quite close to the regression line, which reaffirms the lack of publication bias (Jin et al., 2014; Martin-Andrés & Luna-del-Castillo, 2004).



On the other hand, the funnel plot (Figure 3) reflected the variability that had been previously found, reaffirming that the source of this variability is the diverse nature of the studies (Sterne et al., 2011), as indicated by Egger's test. As the cone progresses, it implies that the standard error increases; therefore, it is possible to allow some studies that are below but always within the structure. We must note that 3 studies clearly depart from the figure. These studies present more extreme data, although it is noteworthy that during the transformation from a normal curve to the Fisher curve, values greater than 0.5 undergo some deformation and become even more distant from the mean.



The studies that move away from the figure on the right are El-Asam et al. (2019) and Wood and Scott (2016), which worked with an Anglo-Saxon sample (UK) and had confidence intervals greater than the mean (see Figure 2). On the left side, we find Chang et al. (2014) “a”, which presents a value for the lower limit of the confidence interval that is significantly lower than the mean (Figure 2).

### 3.3. Moderating variables and meta-regression analysis

Moderating variables were established to study the variability of the investigations (Botella & Sánchez, 2015). Three such variables were determined: sex, mean age and culture (Europe, Eurasia, Americas and Asia), since it was considered necessary to determine whether these were variables that affected the variability of the results. Once the meta-regression was performed (see Table 3), five models were generated: 1) simple, 2) female sex, 3) male sex, 4) age, and 5) culture. The first model, in which no moderating variable was introduced, did not explain any percentage of the variance, unlike the rest of the models. Models 2 and 3 (sex) explained 9% of the variance ( $R^2 = 0.09$ ), but only model 3 (male sex) had high significance ( $p < 0.05$ ). This finding implies that sex was a moderating variable but was only significant in the case of men; therefore, there were differences between sex in terms of PIU and depression. Model 4 (age) explained 4% of the variance, a value that was not significant ( $p = 0.383$ ); in comparison, model 5 (culture) explained 14% of the variance, although that value was not significant either ( $p = 0.1761$ ) (Martin-Andrés & Luna-del-Castillo, 2004). These findings indicate that the variability of the data presented originated from differences in sex, and not age or culture.

**Table 3. Meta-regression of model 3 and model comparison test with a random effect (MM). Distribution Z and Z of Fisher**

Meta-regression M.3						
Covariance	Coefficient	Standard error	95% lower	95% upper	Z value	2-tailed p-value
Intersection	0.3497	0.0315	0.2880	0.4114	11.11	0,0000
Man	-0.0000	0.0000	-0.0001	-0.0000	-1.97	0,0491
Comparison of models						
Model name	TauSq	R <sup>2</sup>	Q	df	p value	
Model 1	0.0079	0	0	0	1	
Model 2	0.0071	0.09	3.28	1	0.07	
Model 3	0.0072	0.09	3.87	1	0.04	
Model 4	0.0076	0.04	0.76	1	0.383	
Model 5	0.0068	0.14	4.94	3	0.1761	

### 3.4. Extreme values

The study, which initially consisted of 21 samples and 15 studies, was reduced by two factors. In addition, the studies of Lu et al. (2018) and Wartberg et al. (2016) presented extreme Fisher’s Z values (0.016 and 0.019, respectively), which were very far from the values of the other studies. However, it is necessary to keep these three studies in mind in the discussion.

## 4. Discussion and conclusions

There was a consensus among most of the studies (Banjanin et al., 2015; Colder et al., 2017; El-Asam et al., 2019; Gámez-Guadix et al., 2013; Kircaburun et al., 2019; Lin et al., 2018; Sami et al., 2018; Walburg et al., 2016; Lu et al., 2018; Wartberg et al., 2016; Woods et al., 2016; Zhang et al., 2013), indicating that there was a significant and positive correlation between PIU and depression in adolescents. This is consistent with the results presented in Figure 2, which shows a moderate effect size ( $r = 0.30$ ) according to Cohen (1988). However, Banjanin et al. (2015) reaffirmed that multiple regressions showed that the time spent on social networks was unrelated to IA and to depressive symptoms. Therefore, the number of hours should not be equated with Internet use as harmful to health. The influence of sex as a moderating variable was discussed in some of the studies that make up the sample. Consistent with the results obtained, El-Asam et al. (2019) showed that 26.2% of the variance in the general score on the “Problematic Internet Use Questionnaire” (PIUQ) was significantly predictive of depression ( $p < 0.001$ ).



and male sex ( $p < 0.001$ ). Walburg et al. (2016), meanwhile, found that adolescents (male sex,  $r = 0.37$ ,  $p < 0.001$ ) who engage in problematic use of Facebook were significantly more vulnerable to depression than other adolescents (female sex,  $r = 0.10$ ,  $p > 0.05$ ). Lu et al. (2018), in their multiple logistic regression analysis, revealed that male sex, religious beliefs and the most severe depressive symptoms were associated with IA. The present study is in line with the findings of these first authors; the meta-regression showed that men were more likely to present both pathologies ( $R^2 = 0.09$ ,  $p < 0.05$ ). Other researchers, such as Banjanin et al. (2015), Wartberg et al. (2016) and Oberts et al. (2017), showed no differences between sexes.

The longitudinal studies of Jun (2016) and Chang et al. (2014) allow an analysis of how depression increases as problematic use grows. Jun (2016), in a longitudinal three-tailed study with a multiage population, found that mobile addiction and depression had a bidirectional relationship. Each measure of addiction to the cellphone at T1 and T2 positively influenced depressive symptoms at T2 and T3, and depressive symptoms at T1 and T2 affected cellphone addiction at T2 and T3, respectively. Chang et al. (2014) showed the longitudinal influence of IA on depression (among other mental health problems) and demonstrated that depression is a variable that predicts the initiation and persistence of IA in youth. Colder et al. (2017) compared the population with PIU with the population at risk of suffering from depressive symptoms, observing how depression grows as the problematic use increases. Lin et al. (2018) also compared two populations, one with IA and another without Internet access, and found clear differences. The diagnosis of IA was positively and significantly correlated with various variables, including alexithymia, impulsivity, disapproval of third parties regarding the use of the Internet, etc. On the other hand, IA was negatively correlated with variables such as self-esteem, subjective well-being, and social support. These findings indicate that psychological distress is related to IA, while well-being reduces the risk of IA; in other words, individual psychological variables are determining factors in the appearance of IA.

The results of the meta-regression showed that age was not a significant moderating variable (see Table 3); that is, IA is not an evolutionary problem. However, time does seem to play a fundamental role. Problematic use of the Internet and depressive symptoms appear to have a feedback loop, so that one problem promotes the other. This shows the urgent need to intervene via education. Because age and culture were not moderating variables, there is a risk of IA and depression being maintained in adulthood. We should not forget that Cheng and Li (2014) demonstrated that 6% of the world's adult population suffers from IA, and 15-20% suffer from depression (Sotelo-Alonso et al., 2012). Considering the positive correlation between both pathologies, it is necessary to begin providing intervention programs in secondary education to avoid future public health problems. On the other hand, Gámez-Guadix et al. (2013) show that being a victim of cyberbullying increases the incidence of depression and problematic Internet use.

In conclusion, there is evidence of a relationship between PIU and depression in adolescents, with sex as the moderating variable that significantly influences depression. There are other variables that should be studied and analyzed and that show comorbidity with pathological Internet use, such as behavioral problems, hyperactivity, emotional problems, and physical health, according to El-Asam et al. (2019). Likewise, there is a significant positive correlation between IGD and emotional traumas, social anxiety or self-esteem (Kircaburun et al., 2019) and Sami et al. (2018) note that IA has a direct effect on sleep disorders. In any case, age is not a moderating variable, and research showing a correlation between IA and depression in adulthood presents an alarming situation. It is necessary to intervene in secondary education to prevent these pathologies from continuing into adult life.

It is necessary to state that there are certain limitations to this study, the first being the inclusion of a limited sample from specific areas; most notably, there was a lack of subjects from Africa, Oceania, North America and Southeast Asia. Furthermore, most studies did not present data differentiated by sex, nor did they address PIU and depressive symptoms as the main topic. As a result, it is necessary to continue studying other variables that may be related to problematic Internet use, such as anxiety, stress, sleep problems, low self-esteem, and to develop intervention projects for institutes.

### Funding Agency

This research is supported by the Educaviva Research Group, the Collective Intelligence Department of the University of Zaragoza and University Faculty Education (Formación de Profesorado Universitario – FPU) contract coverage of the Ministry of Science, Innovation and Universities of Spain.

## References

- American Psychiatric Association (Ed.) (2013). *Diagnostic and statistical manual of mental disorders*. <https://doi.org/10.1176/appi.books.9780890425596>
- Banjanin, N., Banjanin, N., Dimitrijevic, I., & Pantic, I. (2015). Relationship between internet use and depression: Focus on physiological mood oscillations, social networking and online addictive behavior. *Computers in Human Behavior, 43*, 308-312. <https://doi.org/10.1016/j.chb.2014.11.013>
- Bickham, D.S., Hswen, Y., & Rich, M. (2015). Media use and depression: exposure, household rules, and symptoms among young adolescents in the USA. *International Journal of Public Health, 60*(2), 147-155. <https://doi.org/10.1007/s00038-014-0647-6>
- Bonetti, L., Campbell, M.A., & Gilmore, L. (2010). The relationship of loneliness and social anxiety with children's and adolescents' online communication. *Cyberpsychology, Behavior, and Social Networking, 13*(3), 279-285. <https://doi.org/10.1089/cyber.2009.0215>
- Botella, J., & Sánchez, J. (2015). *Meta-análisis en ciencias sociales y de la salud*. Síntesis.
- Chang, F.C., Chiu, C.H., Lee, C.M., Chen, P.H., & Miao, N.F. (2014). Predictors of the initiation and persistence of Internet addiction among adolescents in Taiwan. *Addictive Behaviors, 39*(10), 1434-1440. <https://doi.org/10.1016/j.addbeh.2014.05.010>
- Cheng, C., & Li, A.Y. (2014). Internet addiction prevalence and quality of (real) life: A metaanalysis of 31 nations across seven world regions. *Cyberpsychology, Behavior, and Social Networking, 17*, 755-760. <https://doi.org/10.1089/cyber.2014.0317>
- Cho, C.M. (2017). Self-rating smart phone addiction scale for adolescents. In Israelashvili, M., & Romano, J. (Eds.), *The Cambridge Handbook of International Prevention Science* (pp. 571-573). Cambridge University Press.
- Chou, H.T.G., & Edge, N. (2012). They are happier and having better lives than I am: The impact of using Facebook on perceptions of others' lives. *Cyberpsychology, Behavior, and Social Networking, 15*, 117-121. <https://doi.org/10.1089/cyber.2011.0324>
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Erlbaum. <https://doi.org/10.4324/9780203771587>
- Colder-Carras, M., Van-Rooij, A., de Mheen, D.V., Musci, R., Xue, Q.L., & Mendelson, T. (2017). Video gaming in a hyperconnected world: A cross-sectional study of heavy gaming, problematic gaming symptoms, and online socializing in adolescents. *Computers in Human Behavior, 68*, 472-479. <https://doi.org/10.1016/j.chb.2016.11.060>
- Der-Simonian, R., & Laird, N. (1986). Meta-analysis in clinical trials. *Medline, 7*, 177-188. <https://doi.org/10.1016/j.cct.2015.09.002>
- Egger, M., Smith, G.D., Schneider, M., & Minder, C. (1997). Bias in meta-analysis detected by a simple, graphical test. *BMJ*, (pp. 315). <https://doi.org/10.1136/bmj.315.7109.629>
- El-Asam, A., Samara, M., & Terry, P. (2019). Problematic internet use and mental health among British children and adolescents. *Addictive Behaviors, 90*, 428-436. <https://doi.org/10.1016/j.addbeh.2018.09.007>
- Gámez-Guadix, M. (2014). Depressive symptoms and problematic Internet use among adolescents: Analysis of the longitudinal relationships from the cognitive behavioral model. *Cyberpsychology, Behavior, and Social Networking, 17*(11), 714-719. <https://doi.org/10.1089/cyber.2014.0226>
- Higgins, J., Thompson, S., Deeks, J., & Altman, D. (2003). Measuring inconsistency in meta-analyses. *BMJ, 327*, 557-560. <https://doi.org/10.1136/bmj.327.7414.557>
- Higgins, J.P.T., & Green, S. (2011). *Cochrane handbook for systematic reviews of interventions*. The Cochrane Collaboration.
- Israelashvili, M., & Romano, J. (2016). *The Cambridge handbook of international prevention science*. Cambridge University Press. <https://doi.org/10.1017/9781316104453.024>
- Jin, Z.C., Wu, C., Zhou, X.H., & He, J. (2014). A modified regression method to test publication bias in meta-analysis with binary outcomes. *BMJ, 7*(109), 629-634. <https://doi.org/10.1186/1471-2288-14-132>
- Jun, S. (2016). The reciprocal longitudinal relationships between mobile phone addiction and depressive symptoms among Korean adolescents. *Computers in Human Behavior, 58*, 179-186. <https://doi.org/10.1016/j.chb.2015.12.061>
- Kaess, M., Durkee, T., Brunner, R., Carli, V., Parzer, P., Wasserman, C., Sarchiapone, M., Hoven, C., Apter, A., Balazs, J., Balint, M., Bobes, J., Cohen, R., Cosman, D., Cotter, P., Fischer, G., Floderus, B., Iosue, M., Haring, C., ... Ziberna, J. (2014). Pathological Internet use among European adolescents: Psychopathology and self destructive behaviors. *European Child & Adolescent Psychiatry, 23*(1), 1093-1102. [https://doi.org/10.1016/s0924-9338\(13\)76661-6](https://doi.org/10.1016/s0924-9338(13)76661-6)
- Kim, J.H., Seo, M., & David, P. (2015). Alleviating depression only to become problematic mobile phone users: Can face-to-face communication be the antidote? *Computers in Human Behavior, 51*, 440-447. <https://doi.org/10.1016/j.chb.2015.05.030>
- King, A.L.S., Valença, A.M., Silva, A.C.O., Baczynski, T., Carvalho, M.R., & Nardi, A.E. (2013). Nomophobia: Dependency on virtual environments or social phobia? *Computers in Human Behavior, 29*(1), 140-144. <https://doi.org/10.1016/j.chb.2012.07.025>
- Király, O., Nagygörgy, K., Koronczai, B., Griffiths, M.D., & Demetrovics, Z. (2015). Assessment of problematic Internet use and online video gaming. In Aboujaoude, E., & Starcevic, V. (Eds.), *Mental health in the digital age: Grave dangers, great promise* (pp. 46-68). Oxford University Press. <https://doi.org/10.1093/med/9780199380183.003.0003>
- Kircaburun, K., Griffiths, M.D., & Billieux, J. (2019). Psychosocial factors mediating the relationship between childhood emotional trauma and internet gaming disorder: a pilot study. *European Journal of Psychotraumatology, 10*(1). <https://doi.org/10.1080/20008198.2018.1565031>
- Lin, M.P., Wu, J.Y., You, J., Hu, W.H., & Yen, C.F. (2018). Prevalence of internet addiction and its risk and protective factors in a representative sample of senior high school students in Taiwan. *Journal of Adolescence, 62*, 38-46. <https://doi.org/10.1016/j.adolescence.2017.11.004>

- Lu, L., Xu, D.D., Liu, H.Z., Zhang, L., Ng, C.H., ... Xiang, Y.T. (2018). Internet addiction in Tibetan and Han Chinese middle school students: Prevalence, demographics and quality of life. *Psychiatry Research*, 268, 131-136. <https://doi.org/10.1016/j.psychres.2018.07.005>
- Martin-Andrés, A., & Luna-Del-Castillo, J.D. (2004). *Bioestadística para las Ciencias de la Salud*. Norma-Capitel: Norma-Capitel.
- McLaughlin, K.A., & King, K. (2015). Developmental trajectories of anxiety and depression in early adolescence. *Journal of Abnormal Child Psychology*, 43(2), 311-323. <https://doi.org/10.1007/s10802-014-9898-1>
- Mehdzadeh, S. (2010). Self-presentation 2.0: Narcissism and self-esteem on Facebook. *Cyberpsychology, Behavior, and Social Networking*, 13(4). <https://doi.org/10.1089/cyber.2009.0257>
- Müller, K.W., Dreier, M., Beutel, M.E., Duven, E., Giralt, S., & Wölfling, K. (2016). A hidden type of internet addiction? Intense and addictive use of social networking sites in adolescents. *Computers in Human Behavior*, 55, 172-177. <https://doi.org/10.1016/j.chb.2015.09.007>
- Oberst, U., Renau, V., Chamorro, A., & Carbonell, X. (2016). Gender stereotypes in Facebook profiles: Are women more female online? *Computers in Human Behavior*, 60, 559-564. <https://doi.org/10.1016/j.chb.2016.02.085>
- Ofcom (Ed.) (2017). Children and parents: Media use and attitudes report. <https://bit.ly/2Yq5V5b>
- Pew Research Center (Ed.) (2015). Teens, social media, and technology overview 2015. <https://pewrsr.ch/2QB8Xlp>
- Sami, H., Danielle, L., Lihi, D., & Elena, S. (2018). The effect of sleep disturbances and internet addiction on suicidal ideation among adolescents in the presence of depressive symptoms. *Psychiatry Research*, 267, 327-332. <https://doi.org/10.1016/j.psychres.2018.03.067>
- Sotelo-Alonso, I., Rojas-Soto, J.E., Sánchez-Arenas, C., & Irigoyen-Coria, A. (2012). La depresión en el adulto mayor: Una perspectiva clínica y epidemiológica desde el primer nivel de atención. *Archivos en Medicina Familiar*, 14(1), 5-13. <http://bit.ly/2r60tld>
- Sterne, J.A., Sutton, A.J., Ioannidis, J.P.A., Terrin, N., Jones, D.R., Lau, J., Carpenter, R., Rücker, G., Harbord, R.M., Schmid, C.H., Tetzlaff, J., Deeks, J.J., Peters, J., Macaskill, P., Schwarzer, G., Duval, S., Altman, D.G., Moher, D., & Higgins, J.P.T. (2011). Recommendations for examining and interpreting funnel plot asymmetry in meta-analyses of randomised controlled trials. *BMJ*, 343. <https://doi.org/10.1136/bmj.d4002>
- Tsitsika, A.K., Tzavela, E.C., Janikian, M., Ólafsson, K., Iordache, A., ... Richardson, C. (2014). Online social networking in adolescence: Patterns of use in six European Countries and links with psychosocial functioning. *Journal of Adolescent Health*, 55(1), 141-147. <https://doi.org/10.1016/j.jadohealth.2013.11.010>
- Underwood, M.K., & Ehrenreich, S.E. (2017). The power and the pain of adolescents' digital communication: Cyber victimization and the perils of lurking. *American Psychologist*, 72(2), 144-158. <https://doi.org/10.1037/a0040429>
- Walburg, V., Mialhes, A., & Moncla, D. (2016). Does school-related burnout influence problematic Facebook use? *Children and Youth Services Review*, 61, 327-331. <https://doi.org/10.1016/j.childyouth.2016.01.009>
- Wartberg, L., Brunner, R., Kriston, L., Durkee, T., Parzer, P., Fischer-Waldschmidt, G., Resch, F., Sarchiapone, M., Wasserman, C., Hoven, C.W., Carli, V., Wasserman, D., Thomasius, R., & Kaess, M. (2016). Psychopathological factors associated with problematic alcohol and problematic Internet use in a sample of adolescents in Germany. *Psychiatry Research*, 240, 272-277. <https://doi.org/10.1016/j.psychres.2016.04.057>
- Woods, H.C., & Scott, H. (2016). #Sleepyteens: Social media use in adolescence is associated with poor sleep quality, anxiety, depression and low self-esteem. *Journal of Adolescence*, 51, 41-49. <https://doi.org/10.1016/j.adolescence.2016.05.008>
- Wu, C.Y., Lee, M.B., Liao, S.C., & Chang, L.R. (2015). Risk factors of internet addiction among internet users: An online questionnaire survey. *PLoS One*, 10. <https://doi.org/10.1371/journal.pone.0137506>
- Young, K.S. (1998). *Caught in the net*. Wiley.
- Zhang, H.X., Jiang, W.Q., Lin, Z.G., Du, Y.S., & Vance, A. (2013). Comparison of psychological symptoms and serum levels of neurotransmitters in Shanghai adolescents with and without internet addiction disorder: A case control study. *Plos One*, 8(5), 1-4. <https://doi.org/10.1371/journal.pone.0063089>