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ORİJİNAL ARAŞTIRMA ORIGINAL RESEARCH

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Multi-category Prevalence of Meta-analysis: The Prevalence of Level of Internet Addiction in Turkey

Çok-Kategorili Prevalansın Meta-analizi: Türkiye'de İnternet Bağımlılığı Düzeyinin Prevalansı

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ABSTRACT Objective: Internet addiction is described as the inability to control his or her use of the internet, which causes psychological disturbances as well as physical problems. The aim of this study was to determine the prevalence of internet addiction levels in Turkey and besides to detect the changes of the prevalence of the levels with respect to the publication year (before and after 2013), age range (12-18 to 18+), education level (secondary, high, collage and mixed), and geographical region (north, central, east, west, south and mixed). **Material and Methods:** A meta-analysis of multi-category prevalence was applied on multi-category proportions (not, potentially and addicted) that computed as separate categories and pooled simultaneously. Publication bias examined through visual inspections of funnel and Doi plots, and Luis Furuya-Kanamori (LFK) index was used as a quantitative measure. Subgroup analysis was performed for the selected covariates. MetaXL was preferred in this analysis. **Results:** The prevalence of internet addiction was changed between 3% and 7%. The prevalence of addiction was increased especially after 2013, among educated people 18 years old who live in the central region of Turkey. As expected, internet addiction prevalence increased as the education level rose (6% [95% CI, 4-10%]). In addition, high potential addiction was observed in the adolescents who lives in the south. **Conclusion**: The increasing trend indicates the necessity of education on awareness and reasonable steps should be taken to prevent internet addiction.

Keywords: Internet addiction; problematic internet use; prevalence; meta-analysis; MetaXL

ÖZET Amaç: İnternet bağımlılığı, fiziksel sorunların yanı sıra psikolojik rahatsızlıklara da neden olan kontrol edilemeyen internet kullanımı olarak tanımlanmaktadır. Bu çalışmanın amacı, Türkiye'de internet bağımlılığı düzeyinin prevalanslarını incelemek ve bu prevalansların; yayın yılı (2013 öncesi ve sonrası), yaş aralığı (12-18 ile 18+), eğitim düzeyi (ortaokul, lise, üniversite ve karma) ve coğrafi bölge (kuzey, orta, doğu, batı, güney ve karma) bazında değişimini incelemektir. **Gereç ve Yöntemler:** Ayrı kategoriler olarak hesaplanan ve eşzamanlı olarak birleştirilen çok kategorili prevalansın meta-analizi, çok kategorili (bağımlı değil, potansiyel ve bağımlı) oranlara uygulanmıştır. Yayın yanlılığı, huni ve Doi grafikleri ile görsel olarak incelendi ve nicel bir ölçü olarak Luis Furuya-Kanamori (LFK) indeksi kullanıldı. Seçilen ortak değişkenler için alt grup analizi yapıldı. Bu analizde, MetaXL tercih edilmiştir. **Bulgular:** Türkiye'nin internet bağımlılığı prevalansının %3 ile %7 arasında değiştiği saptanmıştır. Türkiye'nin Orta-Anadolu bölgesinde yaşayan 18 yaşındaki eğitimli kişilerde bağımlılık prevalansı özellikle 2013 yılından sonra artmıştır. Beklenildiği gibi eğitim seviyesi yükseldikçe internet bağımlılığı oranı artmıştır (%6 [%95 GA] %4-10). Ayrıca güneyde yaşayan ergende yüksek potansiyel bağımlılık gözlenmiştir. **Sonuç:** Artan trend, farkındalık eğitiminin gerekliliğine işaret ediyor ve internet bağımlılığını önlemek için makul adımlar atılmasını gerektiriyor.

Anahtar kelimeler: İnternet bağımlılığı; problemli internet kullanımı; prevalans; meta-analiz; MetaXL

Internet is a global computer network in which connecting millions of computers to share information and resources with each other. The basis of the internet was established in the United States of America in the 1960s and spread out all over the world. Even though, internet meets the needs of most people, causes the addiction if not used in a proper way. Hence, it can adversely affect human life by causing problems such as psychological disturbances, social and academically as well as physical problems and neurological complications. In 1991 Shotton and in 1995 Griffiths, studied in England on com-

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puter addiction and notions of technological addictions, respectively.[1,2] The term "internet addiction" was proposed by Dr. Ivan Goldberg in 1996 for pathological compulsive internet use.[3] The first serious proposal for diagnostic criteria was advanced in 1996 by Dr. Young, modifying the Diagnostic and Statistical Manual of Mental Disorders, 4th ed.[4] Problematic Internet Use (PIU), computer addiction, internet addiction, compulsive internet use, pathological internet use, and many other labels can be found in the literature.[5-7]

World Health Organization (WHO) using the term pathological computer use instead of internet addiction (IA) as the condition involves online and/or offline computer usage. In 2015, WHO reported the prevalence of PIU within Europe ranges from 1% in Norway to 18% in the United Kingdom. In contrast, the range in the United States of America is reported as 0-26% and 7-23% in Hong Kong.[8]

Turkey Statistics Institution (TURKSTAT) reports the most comprehensive research on internet usage in Turkey. The reports are being updated periodically. TURKSTAT (2016) "Information and Communication Technology (ICT) Usage in Households and by Individuals" data show that the highest usage rates were observed in 16-24 in the 16-74 age group.[9]

Numerous IA studies have been independently conducted across Turkey, examining the prevalence of social, educational and health problems faced by participants. This meta-analysis examined all studies published between January 2000-September 2018.

MATERIAL AND METHODS

SEARCH STRATEGY

Five electronic databases-Embase, PubMed, the Global Health database, Cochrane CENTRAL, and Google Scholar were searched for studies on IA. The search for studies was restricted with studies published in English and Turkish. The following search terms were used: (internet bağımlılığı or addiction) and (problematic internet use or problemli internet kullanımı or compulsive internet use or pathological internet use) and IAS (Internet Addiction Scale) or İBÖ (İnternet Bağımlılık Ölçeği) or PIU (Pathological Internet Use) and (computer addiction) and (Turkey).

STUDY SELECTION, DATA EXTRACTION

The selection considered article and conference titles, then abstracts, and finally full-text articles and conference. The selection included original articles of studies that reported IA outcomes (number and total). The outcomes of interest were in three categories: not, potentially and addicted. Case study, pre-and post-treatment and studies not carried out in Turkey were excluded.

DATA SYNTHESIS AND ANALYSIS

In all the studies, multi-category proportions of not, potentially and addicted were computed as separate categories and pooled simultaneously. MetaXL was preferred in this analysis. MetaXL is an add-in for meta-analysis in Microsoft Excel for Windows. It uniquely supports inverse variance heterogeneity and quality impact models as well as all major meta-analysis methods. An easy way to do network meta-analysis. The output is in the table and graphic formats. MetaXL has improved methodology of a meta-analysis of multi-category prevalence and adjusted bias analyses. By allowing "big" studies to make a greater contribution to the pooled effect, the overall bias of an estimator is decreased. MetaXL using the double arcsine square root transformation in computing the pooled proportions to stabilizes the variance of the proportion and results back transformed for reporting 95% confidence intervals around pooled estimates were computed.[10] In MetaXL, the double arcsine and back transformation are determined as follows, respectively.

$$t = sin^{-1}\sqrt{\frac{n}{N+1}} + sin^{-1}\sqrt{\frac{n+1}{N+1}} \quad (1)$$

$$\bar{P} = \begin{cases} \bar{s}, & if\ \frac{\bar{s}}{\bar{v}} < 2\ or\ \left(\frac{1-\bar{s}}{\bar{v}}\right) < 2 \\ 0.5\left\{1 - sgn(cos\bar{t})\left[1 - \left(sin\bar{t} + \frac{(sin\bar{t}) - \frac{1}{sin\bar{t}}}{\frac{1}{\bar{v}}}\right)^2\right]^{0.5}, & otherwise \end{cases} \quad (2)$$

Where $\bar{s} = \left(sin\frac{\bar{t}}{2}\right)^2$, is used when sin t is close to 0. $\bar{t}$ is the pooled t, $\bar{P}$ is the pooled prevalence and $\bar{v}$ is the pooled variance, respectively.

The user can choose between fixed and random effects model for three different type of prevalence: untransformed, logit transformed and double arcsine transformed. To compute confidence interval (CI) "exact methods" is used.

To determine heterogeneity (statistical or methodological) excited among studies that included in the meta-analysis I^2 and Cochran's Q statistics were used to examine the percentage variation across studies as well as drawing forest plot to graphically present individual and pooled estimates.[11]

PUBLICATION BIAS

Publication bias examined through visual inspections of funnel and doi plots. While funnel plot is a scatterplot of treatment effect against a measure of precision, doi plot is a scatterplot against a Z-score. Doi plot is more sensitive than the funnel plot. The interpretation, however, is much like that of the funnel plot: a symmetrical plot gives no reason to suspect publication bias, an asymmetrical one does. Luis Furuya-Kanamori (LFK) index is a quantitative measure of doi plot asymmetry, if the value is within±1, it is interpreted as a no asymmetry.[12]

SUBGROUP ANALYSIS

Subgroup analyses were performed to asses the sources of heterogeneity. By altering various study selection covariates including a year of publication of study (the cut off was determined based on TURKSTAT report, especially on 2013 and then the internet use widespread), the population of study (by age and education level) and region of the study were computed.

RESULTS

From the five electronic databases, 4,255 studies were identified. 3,465 of them were excluded by title and 549 were duplicates. 241 titles for abstract were reviewed, from which 129 abstracts were excluded, leaving 112 abstracts for review. Upon review of these abstract as full text, 74 were excluded, thereby leaving 38 studies to be included in the meta-analysis (Figure 1).

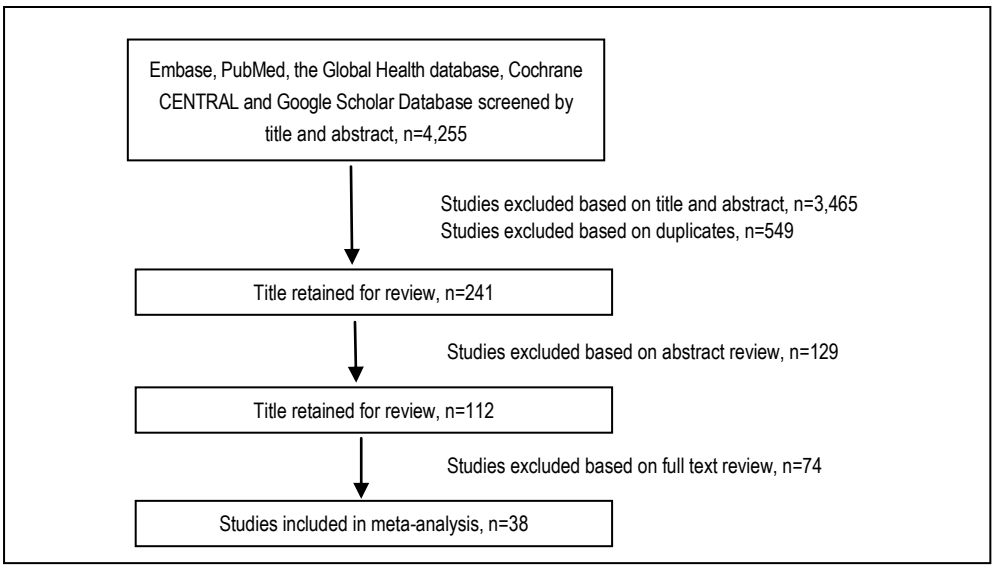


FIGURE 1: Summary of literature search and selection of studies.

The characteristics of the 38 included studies were summarized in Table 1. The sample size varied from small to large (range 47-1938, total 20,091). Most publications were published after 2013 (60.5%). Most of the study group consisted of 12-18 age group (57.9%), college education level (42.1%) and central region (28.9%).

TABLE 1: Characteristics of the included studies.

Criteria	Cut off	Number of studies (%)
Year of publication	<=2013	15 (39.5)
	>2013	23 (60.5)
Age	12-18	22 (57.9)
	18+	16 (42.1)
Education level	Secondary	5 (13.2)
	High	13 (34.2)
	Collage	16 (42.1)
	Mixed	4 (10.5)
Region	North	6 (15.8)
	Central	11 (28.9)
	East	4 (10.5)
	West	10 (26.4)
	South	3 (7.9)
	Mixed	4 (10.5)

Most of the research on IA in Turkey were made after 2013, on the adolescent group, secondary-High school education level and the central region (Table 1).

POOLED RESULTS

Table 2 illustrates the pooled results, with the normalization option of MetaXL selected. The pooled estimates did not differ much between models and transformation methods, with the random effects model produced a bit smaller proportion for potentially and addicted category. The CIs of the random effects model was the widest.

Because of a more intensive variant of an intervention was used: participants were older, or more educated than in other studies, the random effect model was performed. Among random models, the narrowest range was given for logit transformation (Table 2).

Among 38 studies with available information, the pooled prevalence of not IA was 69% (95% CI, 58-74), potentially and addicted prevalence were 26% (95% CI, 18-32), and 5% (95% CI, 3-7), respectively (Table 2). In Figure 2, the forest plots of the three categories were given. The 38 studies were given in alphabetic order.[13-50] Substantial heterogeneity was observed for each category (I^2=99%, p=0.001).

TABLE 2: Pooled results and CIs for three categories, by transformation method and model.

Model	Transformation	Category	Pooled	LCI	HCI	Range
		Not	0.728	0.723	0.733	0.01
	None	Potentially	0.218	0.213	0.222	0.009
		Addicted	0.055	0.053	0.057	0.004
		Not	0.509	0.502	0.517	0.015
Fixed	**Logit**	Potentially	0.335	0.328	0.342	0.014
		Addicted	0.097	0.093	0.102	0.009
		Not	0.648	0.642	0.654	0.012
	Arcsine	Potentially	0.268	0.262	0.274	0.012
		Addicted	0.063	0.06	0.066	0.006
		Not	0.638	0.563	0.714	0.151
	None	Potentially	0.275	0.2	0.351	0.151
		Addicted	0.086	0.01	0.162	0.152
		Not	0.691	0.575	0.742	0.167
Random	**Logit**	Potentially	0.256	0.183	0.322	0.139
		Addicted	0.053	0.035	0.073	0.038
		Not	0.668	0.566	0.735	0.169
	Arcsine	Potentially	0.256	0.185	0.34	0.155
		Addicted	0.068	0.028	0.118	0.09

CI: Confidence interval.

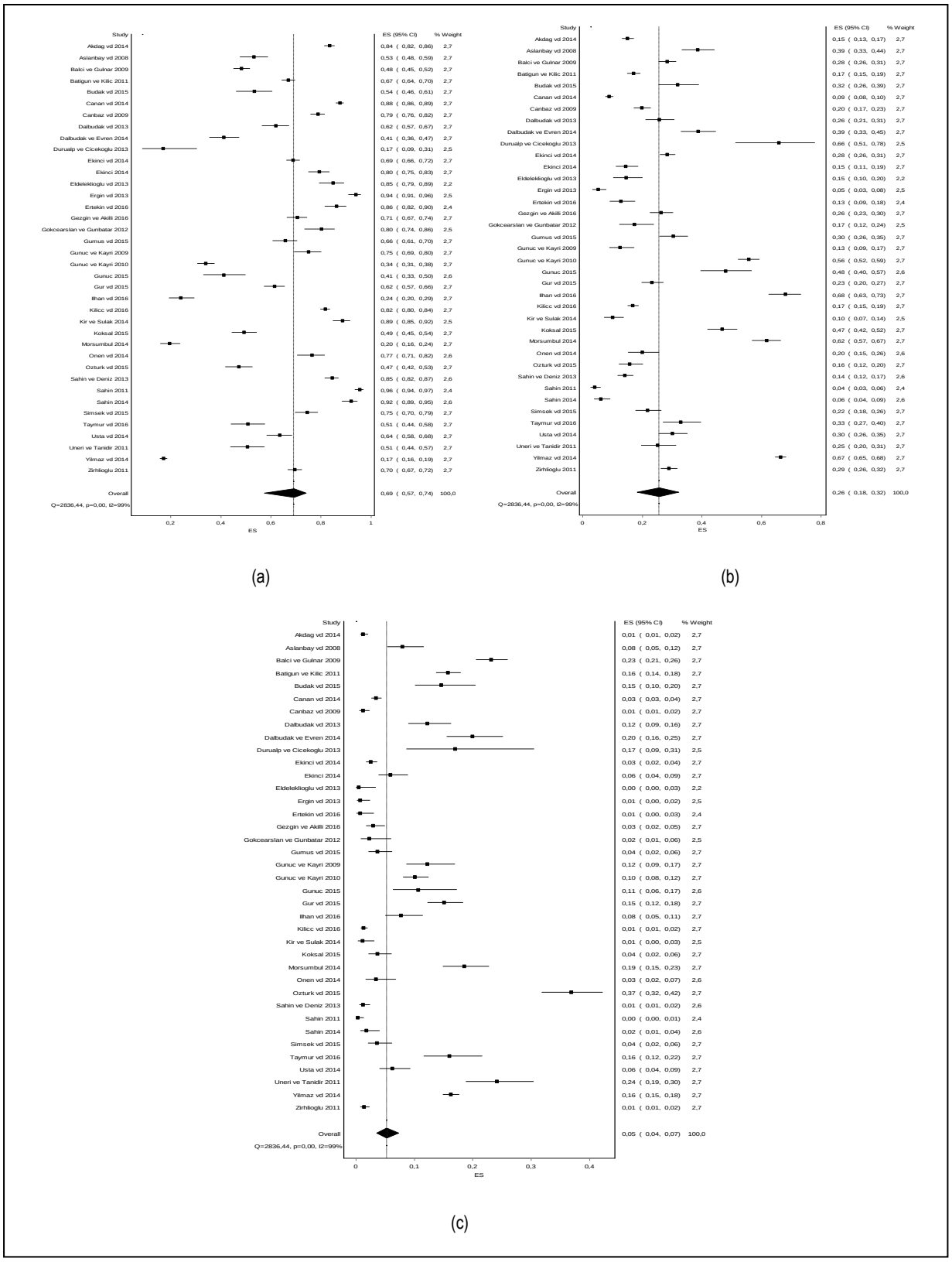


FIGURE 2: Forest plots for not (a), potentially (b) and addicted (c) prevalence on the logit scale (ES).

To determine publication bias funnel and doi plots were used as a visual inspection and LFK index as a quantitative measure of doi plot asymmetry. The doi plots for three categories were more or less symmetrical suggesting no gross bias (Figure 3). The LFK index of not addiction was 0.40, potentially and addicted prevalence was -0.85 and -0.88, respectively.

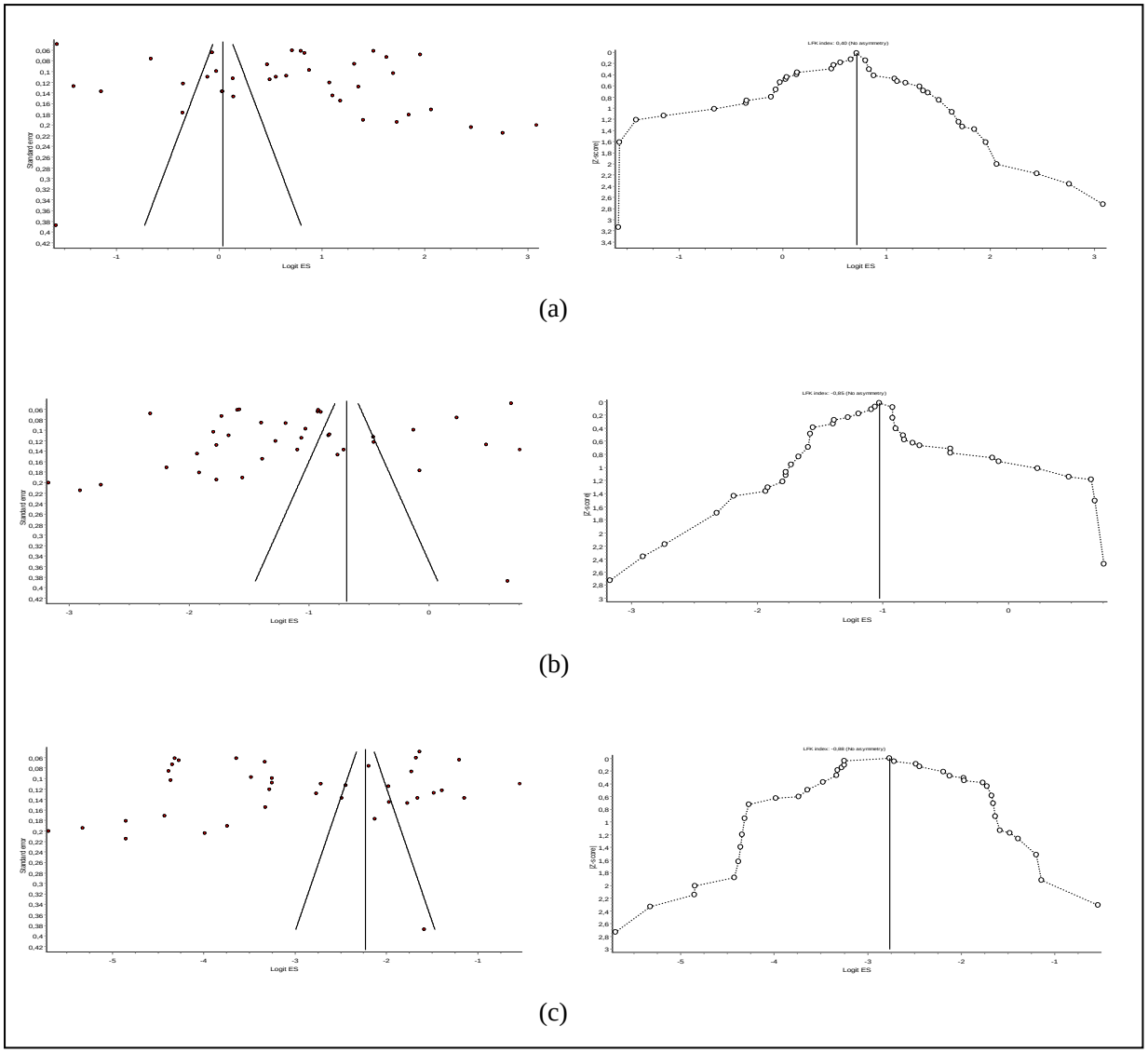


FIGURE 3: Funnel plots (left) and doi plots (right) for not (a), potentially (b) and addicted (c) prevalence on the logit scale (ES).

Subgroup analysis was performed for the selected covariates for all three categories (Table 3). In general, based on selected covariates, the prevalence of IA was changed between 3% and 7%, the prevalence of potential addiction was changed between 15% and 32%. Finally, the prevalence of not addiction was changed between 58% and 82%.

TABLE 3: Subgroup analysis based on selected criteria.

Criteria	Cut off	Number of studies	Not addicted	Potentially addicted	Addicted	Heterogeneity I^2 (%)	p value
Year of publication	<=2013	15	0.73 (0.56; 0.80)	0.23 (0.14; 0.33)	0.04 (0.03; 0.08)	98	<0.001
	>2013	23	0.67 (0.50; 0.76)	0.27 (0.17; 0.39)	0.06 (0.03; 0.09)	99	<0.001
Age	12-18	22	0.68 (0.51; 0.77)	0.28 (0.17; 0.39)	0.04 (0.02; 0.07)	99	<0.001
	18+	16	0.71 (0.57; 0.78)	0.23 (0.15; 0.32)	0.06 (0.04; 0.10)	97	<0.001
Education level	Secondary	5	0.71 (0.43; 0.87)	0.26 (0.10; 0.50)	0.03 (0.01; 0.09)	98	<0.001
	High	13	0.69 (0.45; 0.82)	0.26 (0.12; 0.44)	0.05 (0.02; 0.11)	99	<0.001
	Collage	16	0.71 (0.57; 0.79)	0.23 (0.15; 0.32)	0.06 (0.04; 0.10)	98	<0.001
	Mixed	4	0.58 (0.22; 0.84)	0.37 (0.11; 0.70)	0.05 (0.01; 0.17)	98	<0.001
Region	North	6	0.82 (0.70; 0.89)	0.15 (0.08; 0.25)	0.03 (0.02; 0.06)	96	<0.001
	Central	11	0.60 (0.39; 0.72)	0.32 (0.18; 0.47)	0.08 (0.04; 0.14)	98	<0.001
	East	4	0.71 (0.39; 0.89)	0.25 (0.08; 0.53)	0.04 (0.01; 0.13)	98	<0.001
	West	10	0.70 (0.47; 0.82)	0.24 (0.11; 0.40)	0.06 (0.02; 0.2)	99	<0.001
	South	3	0.66 (0.50; 0.78)	0.31 (0.20; 0.46)	0.03 (0.02; 0.06)	91	<0.001
	Mixed	4	0.64 (0.38; 0.82)	0.29 (0.13; 0.52)	0.07 (0.03; 0.17)	99	<0.001

When stratified by publication years, the prevalence of addiction was 4% (3-8%) before 2013. It increased to 6% (3-9%) after 2013.

The subgroup analysis for age showed that the prevalence of IA in young people was more than adolescents 6% (4-10%). As expected, IA prevalence was increased as the education level increased, 6% (4-10%). While the highest IA was observed in the center 8% (4-14%), the lowest addiction was observed in north and south 3% (2-6%).

DISCUSSION AND CONCLUSION

The increasing number of publications on IA in Turkey is encouraging, showing an interest among researchers in Turkey.

In this study, the first multi-category meta-analysis was conducted to determine the prevalence of level of IA in Turkey by using MetaXL. MetaXL is an add-in for meta-analysis in Microsoft Excel for Windows. For three approaches (non-transformed, logit, and double arcsine) the multi-category prevalences of IA were computed based on the random effect model. Because of the narrowest range among random effect models, the logit transformation was preferred and the subgroup analysis conclusions were made based on it. Respectively the pooled prevalence of level of addiction was found 69%, 26%, and 5% for not, potentially, and addicted.

The bias of publication was handled by funnel and doi plots were used as a visual inspection and LFK index as a quantitative measure of doi plot asymmetry. No gross bias was observed.

The heterogeneity was assessed by subgroup analysis. The prevalence of addiction was increased especially after 2013, among educated people aged over 18 that lived in the central region of Turkey. Besides, high potential addiction was observed in the adolescent who lived in the south.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

This study is entirely author's own work and no other author contribution.

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