Global prevalence of internet addiction among university students: a systematic review and meta-analysis

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Purpose of review
The prevalence of internet addiction among university students has been extensively studied worldwide, however, the findings have been mixed. This meta-analysis aimed to examine the global prevalence of internet addiction in university students and identify its potential moderators.

Recent findings
A total of 101 eligible studies, comprising 128020 participants across 38 countries and territories, were included. The pooled global prevalence of internet addiction among university students was 41.84% [95% confidence interval (95% CI): 35.89–48.02]. Significant differences in the prevalence were observed across different income levels, regions, periods of COVID-19 pandemic, and cut-off values of the Internet Addiction Test (IAT). Sample size was negatively associated with internet addiction prevalence, while depression prevalence was positively associated with internet addiction prevalence. Male students had a significantly higher risk of internet addiction compared to female students [pooled odd ratio (OR): 1.32, 95% CI: 1.19–1.46].

Summary
This meta-analysis found that the prevalence of internet addiction was high among university students, which has increased since the COVID-19 pandemic. Screening and intervention measures to address internet addiction should prioritize students with an increased risk including male students, those from lower-income regions and those with depression.

Keywords
internet addiction, meta-analysis, prevalence, university students

INTRODUCTION

With the acceleration of urbanization worldwide, internet and digital technologies, including artificial intelligence, have rapidly increased alongside the expansion of urban areas. Internet- and artificial intelligence (AI) powered systems now play a significant role in urban infrastructures, such as traffic management, public safety and education [1–4]. As a result, internet usage has increased rapidly, becoming an indispensable part of daily life. However, this digital transformation has raised concerns about internet addiction in both research and clinical practice globally. Furthermore, AI driven internet platforms personalizing and optimizing online experiences may further intensify the risk of internet addiction [5]. The concept of internet addiction, first introduced in the late 1990 s, is characterized by

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KEY POINTS

- The pooled global prevalence of internet addiction in university students was 41.84% (95% CI: 35.89–48.02).
- Income level, region, stage of the COVID-19 pandemic, IAT-20 cut-off values, sample size, and the prevalence of depression were moderators influencing the prevalence of internet addiction.
- Male university students had a significantly higher risk of internet addiction compared to their female counterparts.

excessive and problematic internet use [6]. Internet addiction was initially conceptualized as a generalized impulse control disorder [7], but other researchers argued that internet addiction should be classified as a behavioral addiction [8,9]. Regardless, internet addiction has emerged as a significant public health concern due to the negative physical and psychological health effects, including mental health problems such as depression, anxiety, loneliness, and poor sleep quality [10▪▪,11,12▪].

It is well recognized that young adults and adolescents are particularly vulnerable to develop internet addiction [13,14]. In this sub-population, university students are among the most active internet users, making them particularly susceptible to internet addiction. Several meta-analyses have examined the prevalence of internet addiction among university students across different countries and regions [15▪▪,16–19]. For instance, a meta-analysis of 11 studies reported that the internet addiction prevalence was 43.42% [95% confidence interval (95% CI): 28.54–58.31] among college students in Ethiopia [18], while another meta-analysis of 70 studies found that the corresponding rate was 11.3% (95% CI: 10.1–12.5) in China [16]. The wide variation in the pooled prevalence of internet addiction indicates the important influence of geographic and socioeconomic factors as well as other demographic and health-related factors on internet addiction prevalence among university students. To facilitate the development of prevention and treatment strategies, understanding the global prevalence of internet addiction and its demographic and health-related moderators is crucial for resource allocation to address the widespread problem of internet addiction.

Substantial heterogeneity between studies on internet addiction prevalence among university students has been observed in previous meta-analyses [15▪▪,16]. Apart from differences in various demographic and health-related factors, the heterogeneity could be partly attributed to the use of different assessment tools [16,18,20]. Hence, it is critical to evaluate the prevalence of internet addiction using specific standardized assessment tools to enable meaningful comparison. Despite the availability of numerous assessment tools on internet addiction in the past years, there is currently no consensus on a single standardized assessment for internet addiction, largely due to the broad spectrum of online behaviors, the blurred division between internet use and abuse, and the ongoing debate regarding the psychopathology of internet addiction [21]. However, of the assessment tools, the 20-item Internet Addiction Test (IAT) is the first validated instrument to assess internet addiction that covers the key characteristics of pathological internet use [21,22], and is also the most widely used internet addiction assessment tool globally [20].

Given the above considerations, this meta-analysis aimed to evaluate the global prevalence of internet addiction in university students as assessed by the IAT-20 and identify its potential moderators (e.g., demographic and health-related).

MATERIALS AND METHODS

This meta-analysis was conducted according to the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) guidance [23] and Meta-Analysis of Observational Studies in Epidemiology (MOOSE) [24], and was registered with the International Platform of Registered Systematic Review and Meta-analysis Protocols (INPLASY; registration number: INPLASY2024110114). Major international databases (PubMed, Web of Science, Embase, and PsycINFO) were systematically and independently searched by two researchers (X.L. and Z.C.) from their inception to April 17, 2024, using the search terms shown in Table S1, http://links.lww.com/YCO/A90.

According to the PICOS acronym, the inclusion criteria of the meta-analysis were as follows: Participants (*P*): undergraduate university students; intervention (*I*): not applicable; control (*C*): not applicable; outcomes (*O*): the prevalence of internet addiction in college students measured by the IAT-20 scale with specified cutoff values [6,22]; study design (*S*): cross-sectional study or cohort studies (only baseline data of cohort studies were extracted). The exclusion criteria were as follows: studies published in non-English languages; studies without a description of sampling method. Three researchers (X.L., Z.G., and Z.C.) independently screened the titles and abstracts of relevant literature and then read the full texts for eligibility. In the case of any disagreement, consensus was achieved via discussion with a senior researcher (Y.T.X.).

The three researchers independently extracted data from eligible studies using a standardized extraction form. Study characteristics (e.g., the title, first author, publication year, journal, survey time, sampling method, country, study design and sample size) and participant characteristics (e.g., sex, residency, smoking habit, drinking habit, and related mental health condition (i.e., depression, sleeping problems, and anxiety) were extracted. Internet addiction assessment data were also extracted, including IAT-20 cut-off values, number of participants with internet addiction and mean IAT-20 total score.

An eight-item assessment instrument for epidemiological studies was used to assess the study quality [25,26], described in Table S2, http://links.lww.com/YCO/A90. The total score ranged from 0 to 8, and the study quality was classified as low (0–3 points), moderate (4–6 points), or high (7–8 points). Any disagreement was addressed with the senior author to resolve the discrepancy.

All data analyses were conducted with R (*version 4.3.1*, The R Foundation, Vienna, Austria), using the *meta* package (*version 4.3.3*). Prevalence data were logit transformed or log transformed when appropriate. The pooled prevalence of internet addiction and its 95% CIs or odds ratio (OR) were calculated by random-effects model. Heterogeneity among studies were evaluated using the I^2 statistic, with a value above 50% indicating high heterogeneity [27].

To explore the sources of heterogeneity, subgroup analyses and meta-regression were conducted for categorical variables and continuous variables, respectively. The subgroup analyses focused on categorical variables: income level (i.e., high income, upper middle income, low middle income, and low income) [28], region (i.e., East Asia & Pacific, Europe & Central Asia, Latin America & Caribbean, Middle East & North Africa, South Asia, and Sub-Saharan Africa), Corona Virus Disease 2019 (COVID-19) pandemic (i.e., before and during) [29], sampling method (i.e., probability sampling and nonprobability sampling), sex (i.e., male and female), and cut-off value (i.e., ≥20, >30, ≥40, ≥50, and >50). Meta-regression analyses were conducted based on the following continuous variables: sample size, mean age, total study quality assessment score, proportion of male, urban residency, smoking, drinking, depression, sleeping problem and anxiety.

Publication bias was assessed using Funnel plots and Egger's test. The stability of the results was tested using the sensitivity analysis through the "leave-one-out method", where individual studies were removed sequentially. *P* value less than 0.05 was considered statistically significant (two-tailed).

RESULTS

Of a total of 5537 records initially retrieved, 1542 duplicate records were excluded. Among the remaining 3995 records, 3269 were removed after screening the title and abstracts. After the full text of 726 potentially eligible studies were examined, 723 were retrieved. Finally, 101 studies were included in this meta-analysis, and the details are described in Fig. 1.

Study characteristics

As shown in Table 1 [59–159], the included studies comprised a total of 128 020 participants across 38 countries and territories, with sample sizes ranging from 120 to 30 581. Most were conducted in South Asia (29 studies) and Middle East & North Africa (26 studies). The mean age of the study samples ranged from 15.3 to 26.3 years. More than half of the studies were conducted before the COVID-19 pandemic (54.5%). Nineteen studies had reported depression, while 16 studies reported sleeping problems and 13 studies reported anxiety. The quality assessment scores ranged from 3 to 8, with 1 study rated as low quality (1.0%), 82 studies as moderate quality (81.2%), and 18 studies as high quality (17.8%) (Table S2, http://links.lww.com/YCO/A90).

Pooled prevalence of IA in university students

Among the 101 included studies, the prevalence rates of internet addiction in university students ranged from 6.9 to 98.3%, and the pooled prevalence of internet addiction was 41.84% (95% CI: 35.89–48.02, $I^2 = 99.6\%$) (Fig. 2).

Subgroup and meta-regression analyses

There were significant differences in the pooled prevalence of internet addiction across income levels ($P = 0.007$), with the highest prevalence in low-income countries (55.5%; 95% CI: 37.9–71.8; $n = 8$; $I^2 = 99.1\%$), followed by lower-middle-income countries (50.3%; 95%CI: 41.6–58.9; $n = 44$; $I^2 = 99.1\%$), high-income countries (32.6%; 95% CI: 18.5–50.6; $n = 12$; $I^2 = 99.2\%$), and upper-middle-income countries (31.0%; 95% CI: 23.0–40.3; $n = 37$; $I^2 = 99.6\%$). Similarly, there were significant regional differences ($P < 0.001$), with the highest prevalence in Sub-Saharan Africa (56.8%; 95% CI: 40.5–71.9; $n = 10$; $I^2 = 98.9\%$), followed by the Middle East & North Africa (49.8%; 95% CI: 37.9–61.6; $n = 26$; $I^2 = 98.7\%$), South Asia (49.1%; 95% CI: 37.8–60.5; $n = 29$; $I^2 = 99.2\%$), East Asia & Pacific (30.6%; 95% CI: 20.6–42.7; $n = 18$ $I^2 = 99.7\%$), Latin

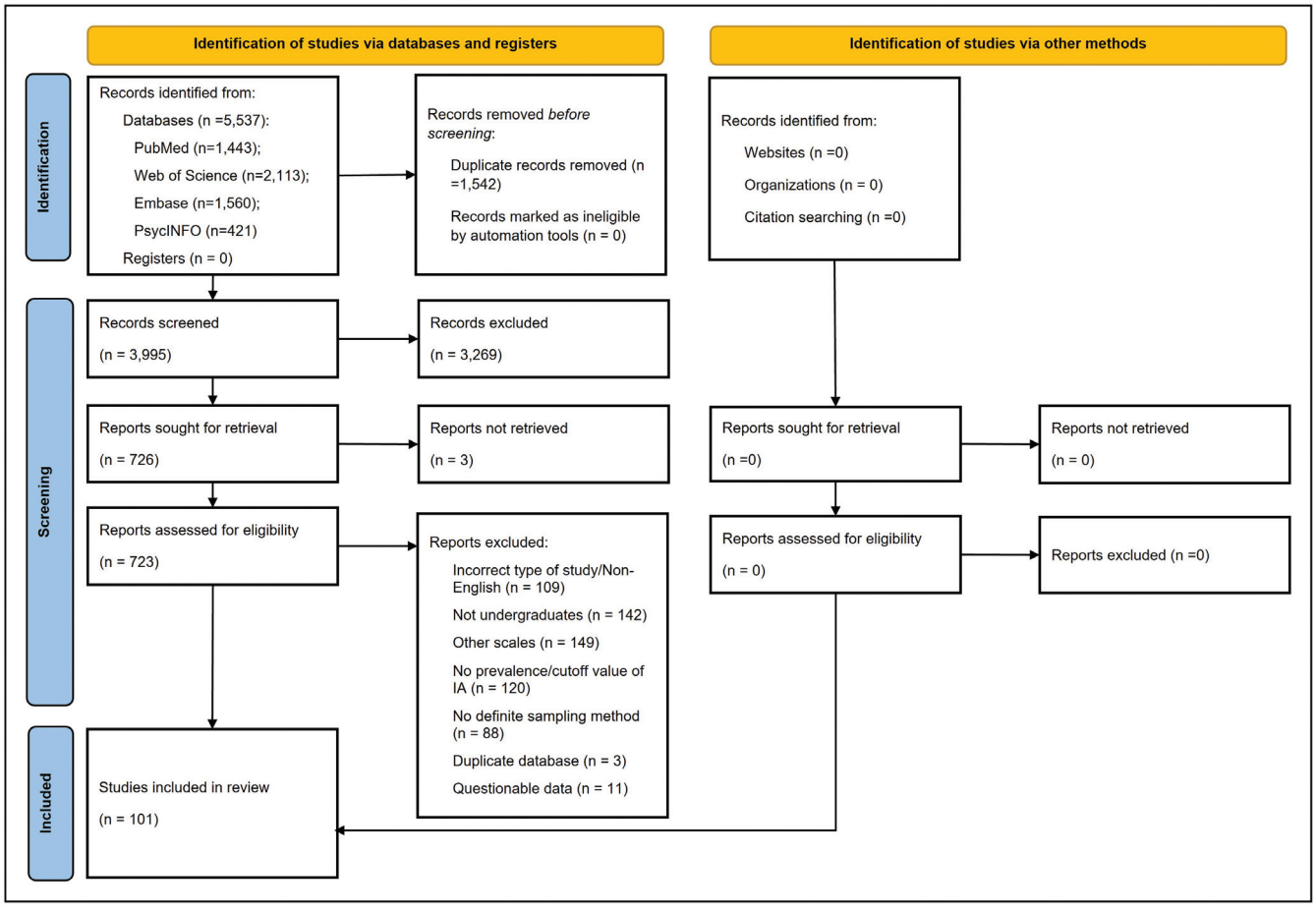

FIGURE 1. Flow diagram of study selection procedure.

America & Caribbean (24.6%; 95% CI: 14.1–39.4; $n = 5$; $I^2 = 99.0\%$), and Europe & Central Asia (21.2%; 95% CI: 13.3–32.1; $n = 13$; $I^2 = 99.1\%$).

The pooled prevalence of internet addiction was significantly higher during the COVID-19 pandemic ($P = 0.021$), with prevalence rates of 37.6% (95% CI: 30.2–45.7; $n = 55$; $I^2 = 99.5\%$) and 54.1% (95% CI: 42.6–65.2; $n = 23$; $I^2 = 99.5\%$) before and during the pandemic, respectively. There were significant differences in the prevalence of internet addiction among studies using different IAT-20 cut-off values ($P < 0.001$). The most common cut-off values were at least 20, more than 30, at least 40, at least 50, and more than 50, with pooled prevalence rates of 81.3% (95% CI: 67.9–90.0; $n = 9$; $I^2 = 96.3\%$), 67.3% (95% CI: 58.7–74.9; $n = 19$; $I^2 = 98.2\%$), 52.7% (95% CI: 42.2–62.8; $n = 9$; $I^2 = 97.1\%$), 27.4% (95% CI: 22.4–33.2; $n = 52$; $I^2 = 99.4\%$), and 16.9% (95% CI: 7.9–32.3; $n = 3$; $I^2 = 99.0\%$), respectively. In contrast, no significant difference was found between studies with different sampling methods ($P = 0.145$) and sex ($P = 0.146$) (Table 2).

In meta-regression analyses (Table 3), sample size was negatively associated with the prevalence of internet addiction (β=-0.0001, $z = -2.2781$, $P = 0.023$), while depression prevalence was positively associated with the internet addiction prevalence (β=0.0283, $z = 4.3354$, $P < 0.001$). No significant associations were found between age, sex, urban residency, smoking, drinking, sleeping problems, anxiety, or study quality and the prevalence of IA.

Comparison of prevalence of internet addiction between male and female students

There were 56 studies that reported the prevalence of internet addiction in both male and female participants, including 25 258 male participants and 37 280 female participants. Male university students had a significantly higher risk of having internet addiction compared to female students, with a pooled OR of 1.32 (95% CI: 1.19–1.46) (Fig. 3).

Publication bias and sensitivity analyses

Funnel plot assessment and Egger's test both revealed significant publication bias in both meta-analyses

Table 1. Basic characteristics of studies included in this meta-analysis

No.	Ref	Study site	Income level	Survey time	COVID-19 pandemic	Study design	Sampling method	Age [mean (SD) / range]	Instrument/ cut-off	mean score of measures	Prevalence of Internet addiction (%)			Male (%)	Urben residence (%)	Smoking (%)	Drinking (%)	Depression (%)	Sleeping problem (%)	Anxiety (%)	Quality assessment score
											Total (IA/sample size)	Male (IA/sample size)	Female (IA/sample size)								
1	Abdel-Salam *et al.*, 2019 [59]	Saudi Arabia	H	2016–2017	Before	C-S	M	20.9 (1.7)	IAT-20 ≥ 50	NR	51.4 (190/370)	NR	51.4 (190/370)	0.0	NR	NR	NR	NR	NR	NR	5
2	Ademoyegun *et al.*, 2024 [60]	Nigeria	LM	January-June 2023	During	C-S	C	21.3 (2.6)	IAT-20 > 30	34.7	57.6 (294/510)	NR	NR	37.6	NR	NR	NR	NR	NR	52.6	4
3	Adhikari *et al.*, 2022 [61]	Nepal	LM	June-August 2019	Before	C-S	M	16–25	IAT-20 ≥ 20	NR	73.0 (260/356)	74.2 (155/209)	71.4 (105/147)	58.7	NR	NR	NR	NR	NR	NR	6
4	Al-Gamal *et al.*, 2014 [62]	Jordan	LM	2013–2014	Before	C-S	SR	21.2 (1.4)	IAT-20 ≥ 50	NR	40.0 (235/587)	39.0 (98/251)	40.8 (137/336)	42.8	NR	NR	NR	NR	NR	NR	7
5	Ali *et al.*, 2017 [63]	Egypt	LM	October-November 2016	Before	C-S	M; S	17–25	IAT-20 ≥ 50	NR	47.7 (280/587)	56.9 (119/209)	42.6 (161/378)	35.6	61.8	NR	NR	NR	NR	NR	7
6	Amano *et al.*, 2023 [64]	Ethiopia	L	August 2021	During	C-S	M; CS	23.0 (2.3)	IAT-20 > 30	NR	53.6 (399/745)	NR	NR	65.0	60.0	4.8	34.0	43.5	NR	NR	6
7	Angane *et al.*, 2020 [65]	India	LM	NR	NR	C-S	S	19.3 (1.5)	IAT-20 ≥ 50	35.6	18.0 (36/200)	NR	NR	51.0	NR	NR	NR	NR	NR	NR	7
8	Ansari *et al.*, 2016 [66]	Iran	UM	2015	Before	C-S	S	21.4 (2.6)	IAT-20 ≥ 50	41.4	25.3 (96/380)	33.8 (49/145)	20.0 (47/235)	38.2	NR	NR	NR	NR	NR	NR	5
9	Araby *et al.*, 2020 [67]	Egypt	LM	April-May 2019	Before	C-S	CS	18–23	IAT-20 ≥ 50	NR	74.2 (560/755)	NR	NR	27.4	52.8	NR	NR	NR	NR	NR	6
10	Asrese *et al.*, 2020 [68]	Ethiopia	L	February-March 2018	Before	C-S	SR	21.4 (1.7)	IAT-20 ≥ 50	NR	35.2 (286/812)	33.6 (180/535)	38.3 (106/277)	65.9	NR	NR	NR	NR	NR	NR	5
11	Aznar-Diaz *et al.*, 2020 [69]	Mexican and Spain	UM; H	October-December 2019	Before	C-S	C	20.8 (3.4)	IAT-20 > 50	31.8	11.7 (89/758)	13.2 (36/272)	10.9 (53/486)	35.9	NR	NR	NR	NR	NR	NR	5
12	Banal *et al.*, 2023 [70]	Jammu	LM	NR	NR	C-S	R	NR	IAT-20 ≥ 50	35.9	15.4 (77/500)	16.7 (41/245)	14.1 (36/255)	49.0	NR	NR	NR	NR	37.4	NR	5
13	Bener *et al.*, 2013 [71]	Qatar	H	September 2009-October 2010	Before	C-S	M; S	NR	IAT-20 ≥ 50	NR	19.1 (162/847)	NR	NR	NR	NR	NR	NR	NR	NR	NR	6
14	Bhandari *et al.*, 2017 [72]	Nepal	LM	September-November 2015	Before	C-S	R	21.0 (2.2)	IAT-20 ≥ 40	37.1	35.4 (332/937)	NR	NR	45.4	NR	9.1	19.1	21.2	NR	NR	5
15	Biolcati *et al.*,2017 [73]	Italy	H	NR	NR	C-S	C	18–36	IAT-20 ≥ 50	NR	10.1 (44/436)	NR	NR	NR	NR	NR	NR	NR	NR	NR	3
16	Bisen *et al.*, 2020 [74]	India	LM	January 2016-April 2017	Before	C-S	R	18–24	IAT-20 ≥ 50	36.1	12.5 (200/1600)	13.6 (109/800)	11.4 (91/800)	50.0	64.3	NR	NR	NR	NR	NR	7
17	Brito *et al.*, 2023 [75]	Brazil	UM	2016–2017	Before	C-S	M	NR	IAT-20 ≥ 40	NR	47.9 (744/1553)	44.3 (252/569)	49.9 (491/983)	36.6	NR	11.0	44.9	NR	51.4	NR	7
18	Cai *et al.*, 2023 [76]	China	UM	March-April 2023	During	C-S	C	18–20	IAT-20 ≥ 40	41.3	55.8 (1177/2108)	50.8 (486/957)	60.0 (691/1151)	45.4	NR	NR	NR	NR	NR	NR	7

Table 1 (*Continued*)

No.	Ref	Study site	Income level	Survey time	COVID-19 pandemic	Study design	Sampling method	Age [mean (SD) / range]	Instrument/ cut-off	mean score of measures	Prevalence of Internet addiction (%)			Male (%)	Urben residence (%)	Smoking (%)	Drinking (%)	Depression (%)	Sleeping problem (%)	Anxiety (%)	Quality assessment score
											Total (IA/sample size)	Male (IA/sample size)	Female (IA/sample size)								
19	Cai *et al.*, 2021 [77]	China	UM	September-October 2020	During	C-S	CSS	19.7 (1.4)	IAT-20 ≥ 50	NR	23.3 (249/1070)	25.7 (68/265)	22.5 (181/805)	24.8	57.3	NR	NR	NR	NR	NR	6
20	Cao *et al.*, 2011 [78]	China	UM	March 2008	Before	C-S	M; CS	NR	IAT-20 ≥ 50	NR	6.9 (350/5061)	NR	NR	NR	NR	NR	NR	NR	NR	NR	6
21	Chen *et al.*, 2017 [79]	China	UM	NR	NR	C-S	M; CS	20.3 (1.1)	IAT-20 > 50	NR	36.9 (202/547)	42.5 (102/240)	32.6 (100/307)	43.9	NR	9.5	14.3	NR	NR	NR	6
22	Cincik *et al.*, 2023 [80]	Turkey	UM	2019–2020	Before & During	C-S	R	18–35	IAT-20 > 50	NR	9.7 (138/1419)	11.0 (55/500)	9.0 (83/919)	35.2	NR	NR	NR	NR	NR	NR	6
23	Condori-Meza *et al.*, 2021 [81]	Peru	UM	December-February 2021	During	C-S	C	21.8 (3.3)	IAT-20 ≥ 50	NR	14.7 (124/844)	17.6 (53/301)	13.1 (71/543)	35.7	NR	3.8	27.4	NR	NR	NR	5
24	Corrêa Rangel *et al.*, 2022 [82]	Brazil	UM	October 2017-June 2018	Before	C-S	R	NR	IAT-20 ≥ 50	NR	20.0 (84/420)	21.8 (47/216)	18.1 (37/204)	51.4	NR	NR	NR	25.7	22.6	47.9	7
25	Demenech *et al.*, 2023 [83]	Brazil	UM	August 2016-March 2017	Before	C-S	R	NR	IAT-20 > 30	NR	41.7 (428/1026)	43.7 (180/411)	40.6 (249 /614)	40.1	NR	9.9	75.9	18.7	NR	NR	6
26	Dhamnetiya *et al.*, 2021 [84]	India	LM	April-May 2019	Before	C-S	S	NR	IAT-20 ≥ 50	NR	41.3 (83/201)	42.4 (56/132)	39.1 (27/69)	65.7	NR	NR	NR	NR	NR	NR	5
27	Ehsan et. al., 2021 [85]	Pakistan	LM	July 2018-August 2019	Before	C-S	S	20.9 (1.5)	IAT-20 ≥ 20	NR	90.3 (343/380)	92.3 (131/142)	89.1 (212/238)	37.4	NR	NR	NR	NR	NR	NR	5
28	Ercan *et al.*, 2021 [86]	Turkey	UM	2019–2020	Before & During	C-S	S	NR	IAT-20 ≥ 50	NR	17.6 (172/980)	NR	NR	NR	NR	NR	NR	NR	NR	NR	5
29	Esen *et al.*, 2021 [87]	Turkey	UM	May-December 2017	Before	C-S	S	21.1 (2.0)	IAT-20 ≥ 50	31.8	16.8 (211/1257)	25.5 (93/364)	13.2 (118/893)	29.0	NR	15.9	4.1	NR	NR	NR	5
30	Feizy *et al.*, 2020 [88]	Iran	UM	September-December 2018	Before	C-S	Census	22.3 (3.0)	IAT-20 ≥ 50	NR	21.3 (64/300)	NR	NR	42.1	NR	NR	NR	NR	NR	NR	6
31	Gedam *et al.*, 2016 [89]	India	LM	August-September 2015	Before	C-S	R	19.7 (1.3)	IAT-20 ≥ 50	NR	21.6 (129/597)	30.6 (45/147)	18.7 (84/450)	24.6	NR	NR	NR	41.2	NR	44.1	8
32	George *et al.*, 2019 [90]	India	LM	NR	NR	C-S	M	21.3 (1.3)	IAT-20 ≥ 20	32.2	70.5 (141/200)	NR	NR	50.0	NR	NR	NR	NR	NR	NR	4
33	Ghamari *et al.*, 2011 [91]	Iran	UM	2009	Before	C-S	S	21.0 (1.4)	IAT-20 ≥ 50	32.7	10.8 (50/462)	17.9 (29/162)	7.0 (21/300)	35.1	89.2	NR	NR	NR	NR	NR	5
34	Ghosh *et al.*, 2018 [92]	India	LM	November-December 2015	Before	C-S	E	NR	IAT-20 ≥ 20	NR	55.5 (86/155)	64.0 (55/86)	44.9 (31/69)	55.5	77.4	NR	NR	NR	NR	NR	5
35	Güneş *et al.*, 2023 [93]	Turkey	UM	October-December 2020	During	C-S	R	21.2 (2.0)	IAT-20 ≥ 50	28.0	8.4 (49/581)	NR	NR	21.0	NR	18.6	9.5	NR	NR	NR	5

Table 1 (*Continued*)

No.	Ref	Study site	Income level	Survey time	COVID-19 pandemic	Study design	Sampling method	Age [mean (SD) / range]	Instrument/ cut-off	mean score of measures	Prevalence of Internet addiction (%)			Male (%)	Urben residence (%)	Smoking (%)	Drinking (%)	Depression (%)	Sleeping problem (%)	Anxiety (%)	Quality assessment score
											Total (IA/sample size)	Male (IA/sample size)	Female (IA/sample size)								
36	Guo *et al.*, 2021 [94]	China	UM	2019	Before	C-S	M; CS	19.9 (1.6)	IAT-20 ≥ 50	33.0	8.7 (2661/30581)	NR	NR	42.3	NR	26.0	69.0	NR	NR	NR	7
37	Gupta *et al.*, 2018 [95]	India	LM	November 2015-April 2018	Before	C-S	R	19.1 (1.0)	IAT-20 ≥ 50	NR	25.3 (96/380)	26.3 (62/236)	23.6 (34/144)	62.1	NR	NR	NR	NR	NR	NR	6
38	Hammad *et al.*, 2024 [96]	Saudi Arabia	H	April-May 2023	During	C-S	R	21.2 (3.3)	IAT-20 ≥ 20	45.4	89.1 (301/338)	NR	NR	52.7	NR	28.4	NR	NR	NR	NR	5
39	Haque *et al.*, 2016 [97]	Malaysia	UM	October 2015	Before	C-S	R	22.0 (1.5)	IAT-20 > 30	43.5	81.0 (113/139)	NR	NR	40.3	NR	NR	NR	NR	NR	NR	6
40	Hussain *et al.*, 2018 [98]	Pakistan	LM	January-June 2015	Before	C-S	R	NR	IAT-20 > 40	NR	41.7 (50/120)	48.1 (25/52)	36.8 (25/68)	43.3	NR	NR	NR	NR	NR	NR	5
41	Ibrahim *et al.*, 2022 [99]	Egypt	LM	2019–2020	Before & During	C-S	S	21.9 (1.1)	IAT-20 ≥ 50	57	66.0 (212/321)	NR	NR	45.5	72.3	NR	NR	88.2	NR	NR	4
42	Jaafar *et al.*, 2022 [100]	Malaysia	UM	July-December 2021	During	C-S	S	21.0 (1.4)	IAT-20 ≥ 40	49.5	81.5 (216/265)	NR	NR	50.9	NR	NR	NR	NR	NR	NR	5
43	Jagan *et al.*, 2023 [101]	India	LM	September-October 2018	Before	C-S	R	17–19	IAT-20 ≥ 50	51.9	47.4 (93/196)	45.5 (40/88)	49.1 (53/108)	44.9	NR	NR	NR	NR	NR	NR	6
44	Jain *et al.*, 2020 [102]	India	LM	NR	NR	C-S	R	NR	IAT-20 ≥ 70	NR	12.5 (52/417)	NR	NR	NR	NR	NR	NR	NR	NR	NR	7
45	Jaiswal *et al.*, 2020 [103]	India	LM	NR	NR	C-S	R	19.9 (2.0)	IAT-20 > 30	50.3	93.8 (288/307)	NR	NR	NR	NR	NR	NR	NR	NR	NR	5
46	Kandri *et al.*, 2014 [104]	Greece	H	NR	NR	C-S	C	20.8 (2.2)	IAT-20 ≥ 40	42.7	58.8 (303/515)	67.2 (119/177)	54.4 (184/338)	34.4	NR	NR	NR	NR	NR	NR	4
47	Karimy *et al.*, 2020 [105]	Iran	UM	2019	Before	C-S	S	21.0 (3.2)	IAT-20 ≥ 50	NR	39.0 (109/279)	45.7 (16/35)	38.1 (93/244)	12.5	NR	7.9	NR	NR	NR	NR	6
48	Kashfi *et al.*, 2023 [106]	Iran	UM	2018	Before	C-S	S	NR	IAT-20 ≥ 50	NR	31.6 (53/168)	NR	NR	NR	NR	NR	NR	NR	27.6	NR	5
49	Khan *et al.*, 2017 [107]	Pakistan	LM	January-May 2015	Before	C-S	C	19.3 (1.0)	IAT-20 ≥ 50	38.1	16.7 (54/322)	14.3 (25/175)	19.7 (29/147)	54.3	NR	NR	NR	NR	NR	NR	4
50	Khanbabaei *et al.*, 2022 [108]	Iran	UM	NR	NR	C-S	C	24.3 (4.2)	IAT-20 ≥ 40	40.1	47.7 (125/262)	NR	NR	56.1	NR	NR	NR	NR	NR	NR	4
51	Khazaie *et al.*, 2023 [109]	Iran	UM	December 2017-May 2018	Before	C-S	S	22.8 (3.1)	IAT-20 ≥ 50	NR	68.8 (289/420)	NR	NR	46.7	NR	NR	NR	NR	NR	NR	4
52	Ksiksou *et al.*, 2023 [110]	Morocco	LM	November 2022-January 2023	During	C-S	R	20.1 (1.2)	IAT-20 > 30	31.4	68.3 (265/388)	NR	NR	28.9	NR	NR	NR	NR	NR	NR	6
53	Kumari *et al.*, 2022 [111]	India	LM	January-March 2021	During	C-S	PPS	NR	IAT-20 > 30	NR	70.5 (155/220)	79.7 (106/133)	56.3 (49/87)	60.5	NR	NR	NR	NR	67.3	NR	5
54	Lan *et al.*, 2020 [112]	Vietnam	LM	NR	NR	C-S	R	NR	IAT-20 70	NR	25.3 (109/431)	27.8 (30/108)	24.5 (79/323)	25.1	NR	NR	NR	39.2	NR	43.9	7

Table 1 (*Continued*)

No.	Ref	Study site	Income level	Survey time	COVID-19 pandemic	Study design	Sampling method	Age [mean (SD) / range]	Instrument/ cut-off	mean score of measures	Prevalence of Internet addiction (%)			Male (%)	Urben residence (%)	Smoking (%)	Drinking (%)	Depression (%)	Sleeping problem (%)	Anxiety (%)	Quality assessment score
											Total (IA/sample size)	Male (IA/sample size)	Female (IA/sample size)								
55	Latifeh *et al.*, 2022 [113]	Syria	L	May-June 2022	During	C-S	C; SB	17–34	IAT-20 > 30	33.5	51.9 (1014/1953)	NR	NR	37.9	NR	22.2	8.5	33.2	NR	30.3	5
56	Lu *et al.*, 2020 [114]	China	UM	December 2019	Before	C-S	M; CS	NR	IAT-20 ≥ 50	NR	21.4 (1233/5757)	NR	NR	36.4	NR	NR	NR	NR	NR	NR	8
57	Mahmoud *et al.*, 2022 [115]	Egypt	LM	January-October 2021	During	C-S	CS	21.8 (2.2)	IAT-20 ≥ 50	NR	44.6 (234/525)	56.2 (164/292)	30.0 (70/233)	55.6	55.4	NR	NR	NR	64.6	NR	5
58	Mamun *et al.*, 2020 [116]	Bangladesh	LM	November-December 2018	Before	C-S	C	20.3 (2.1)	IAT-20 ≥ 60	NR	16.5 (100/605)	18.3 (57/312)	14.7 (43/293)	51.6	40.7	NR	NR	NR	NR	NR	4
59	Mboya *et al.*, 2020 [117]	Tanzania	LM	May-June 2018	Before	C-S	R	23.8 (2.4)	IAT-20 ≥ 50	38.8	31.0 (155/500)	34.2 (100/292)	26.4 (55/208)	58.4	NR	NR	NR	NR	NR	NR	5
60	Mellouli *et al.*, 2018 [118]	Tunisia	LM	2012–2013	Before	C-S	M	NR	IAT-20 ≥ 50	NR	63.2 (182/288)	NR	NR	NR	NR	NR	NR	NR	NR	NR	7
61	Mengistu *et al.*, 2021 [119]	Ethiopia	L	May-June 2019	Before	C-S	M; CS	20.7 (1.8)	IAT-20 ≥ 50	NR	19.4 (148/761)	23.1 (105/455)	14.1 (43/306)	59.8	NR	NR	NR	23.4	NR	28.0	7
62	Miskulin *et al.*, 2022 [120]	Croatia	H	January-February 2020	Before	C-S	R	NR	IAT-20 ≥ 20	NR	74.4 (444/597)	NR	NR	NR	NR	NR	NR	NR	NR	NR	6
63	Mohamed *et al.*, 2024 [121]	Sudan	L	October-December 2022	During	C-S	SR	NR	IAT-20 > 30	43.9	75.5 (232/307)	NR	NR	36.2	NR	NR	NR	NR	NR	NR	4
64	Mohammadbeigi *et al.*, 2016 [122]	Iran	UM	NA	NA	C-S	M	21.7 (2.9)	IAT-20 ≥ 40	35.2	28.7 (73/254)	41.0 (16/39)	26.6 (57/214)	15.4	NR	NR	NR	NR	NR	NR	5
65	Muche *et al.*, 2021 [123]	Ethiopia	L	February-March 2018	Before	C-S	M; S	21.4 (1.7)	IAT-20 ≥ 50	NR	35.2 (286/812)	NR	NR	65.9	NR	NR	NR	NR	NR	NR	6
66	Nagarajappa *et al.*, 2023 [124]	India	LM	June-September 2020	During	C-S	C	22.2 (2.0)	IAT-20 ≥ 60	55.3	27.5 (224/814)	31.4 (74/236)	26.0 (150/578)	29.0	NR	NR	NR	NR	NR	NR	6
67	Oliveira *et al.*, 2023 [125]	Portugal	H	April-June 2020	During	C-S	C	NR	IAT-20 > 30	30.3	45.3 (124/274)	NR	NR	NR	NR	NR	NR	NR	NR	NR	5
68	Oluwole *et al.*, 2021 [126]	Nigeria	LM	NR	NR	C-S	R	24.4 (2.8)	IAT-20 > 30	32.6	82.9 (107/129)	NR	NR	64.3	NR	0	NR	NR	20.0	NR	4
69	Orsolini *et al.*, 2022 [127]	Italy	H	January-February 2021	During	C-S	SB	23.2 (2.8)	IAT-20 ≥ 50	41.3	23.3 (266/1141)	20.6 (77/374)	24.6 (189/767)	32.8	NR	NR	NR	NR	NR	NR	5
70	Parmar *et al.*, 2022 [128]	India	LM	November-December 2021	During	C-S	PS	NR	IAT-20 > 30	NR	51.9 (200/385)	NR	NR	45.5	NR	NR	NR	51.2	30.6	NR	4
71	Paudel *et al.*, 2021 [129]	Nepal	LM	NR	NR	C-S	E	20.9 (1.9)	IAT-20 ≥ 40	40.5	50.2 (248/494)	50.3 (89/177)	50.2 (159/317)	35.8	NR	NR	NR	30.2	42.3	NR	4
72	Pramanik *et al.*, 2012 [130]	Nepal	LM	January-April 2012	Before	C-S	R	19–23	IAT-20 ≥ 20	NR	84.6 (110/130)	81.5 (53/65)	87.7 (57/65)	50.0	NR	NR	NR	NR	NR	NR	5

Table 1 (*Continued*)

No.	Ref	Study site	Income level	Survey time	COVID-19 pandemic	Study design	Sampling method	Age [mean (SD) / range]	Instrument/ cut-off	mean score of measures	Prevalence of Internet addiction (%)			Male (%)	Urben residence (%)	Smoking (%)	Drinking (%)	Depression (%)	Sleeping problem (%)	Anxiety (%)	Quality assessment score
											Total (IA/sample size)	Male (IA/sample size)	Female (IA/sample size)								
73	Rajasekhar *et al.*, 2023 [131]	India	LM	September 2018-October 2019	Before	C-S	M; S	20.0 (1.9)	IAT-20 ≥ 30	31.5	51.0 (1038/2035)	53.3 (715/1341)	46.5 (323/694)	65.9	68.3	NR	NR	34.8	22.0	47.8	6
74	Ramn-Arbués *et al.*, 2021 [132]	Spain	H	2019–2020	Before& During	C-S	C	22.0 (5.4)	IAT-20 ≥ 50	41.7	21.2 (148/698)	23.8 (67/281)	19.4 (81/417)	40.3	NR	23.4	NR	18.6	NR	22.6	5
75	Ranjan *et al.*, 2021 [133]	India	LM	NR	NR	C-S	E	18.0 (0.8)	IAT-20 > 30	NR	79.5 (679/854)	NR	NR	67.2	75.9	NR	NR	NR	NR	35.0	4
76	Romero-Rodríguez *et al.*, 2022 [134]	Spain	H	February 2020	Before	C-S	C	22.2 (3.9)	IAT-20 ≥ 50	NR	12.4 (126/1013)	13.9 (35/252)	12.0 (91/761)	24.9	NR	NR	NR	NR	NR	NR	4
77	Rosliza *et al.*, 2018 [135]	Malaysia	UM	April-August 2016	Before	C-S	CS	19–24	IAT-20 ≥ 40	NR	64.3 (207/322)	75.4 (86/114)	58.2 (121/208)	35.4	NR	NR	NR	NR	NR	NR	7
78	Sahraian *et al.*, 2016 [136]	Iran	UM	NR	NR	C-S	CS	21.5 (2.6)	IAT-20 ≥ 20	23.2	54.7 (152/278)	NR	NR	38.8	NR	NR	NR	NR	NR	NR	4
79	Salama *et al.*, 2020 [137]	Egypt	LM	June–August 2018	Before	C-S	R	20.0 (1.2)	IAT-20 ≥ 50	NR	47.5 (289/608)	53.8 (168/312)	40.9 (121/296)	51.3	70.7	68.9	NR	NR	NR	NR	7
80	Samaha *et al.*, 2019 [138]	Lebanon	LM	NR	NR	C-S	C	21.9 (2.2)	IAT-20 ≥ 50	NR	26.2 (156/596)	NR	NR	NR	NR	NR	NR	NR	NR	NR	4
81	Sayyah *et al.*, 2019 [139]	Iran	UM	2015–2016	Before	C-S	R	19.6 (1.4)	IAT-20 ≥ 20	NR	98.3 (297/302)	100.0 (78/78)	97.8 (219/224)	25.8	NR	NR	NR	NR	NR	NR	4
82	Selvamani *et al.*, 2022 [140]	India	LM	April-August 2020	During	C-S	C	NR	IAT-20 > 30	NR	70.7 (198/280)	NR	NR	NR	NR	NR	NR	NR	NR	NR	4
83	Seo *et al.*, 2021 [141]	Korea	H	September-December 2019	Before	C-S	C	26.3 (4.4)	IAT-20 ≥ 50	NR	11.5 (47/408)	11.4 (29/255)	11.8 (18/153)	62.5	NR	NR	NR	13.5	NR	NR	4
84	Shehata *et al.*, 2021 [142]	Egypt	LM	October -November 2020	During	C-S	S	NR	IAT-20 ≥ 50	NR	87.7 (654/746)	87.8 (215/245)	87.6 (439/501)	32.8	59.2	NR	NR	NR	NR	NR	5
85	Shi *et al.*, 2019 [143]	China	UM	September-November 2017	Before	C-S	R	19.7 (1.5)	IAT-20 > 30	29.6	44.7 (565/1264)	NR	NR	41.1	50.9	NR	NR	NR	NR	NR	6
86	Siddik *et al.*, 2024 [144]	Bangladesh	LM	July 2022-February 2023	During	C-S	C	13–19	IAT-20 50	NR	63.0 (4830/7667)	61.7 (1738/2816)	63.7 (3090/4851)	36.7	NR	NR	NR	75.0	NR	60.0	5
87	Simcharoen *et al.*, 2018 [145]	Thailand	UM	2015	Before	C-S	C	20.9 (1.8)	IAT-20 > 30	28.2	36.7 (119/324)	NR	NR	43.2	NR	NR	NR	NR	NR	NR	4
88	Singh *et al.*, 2017 [146]	India	LM	September-December 2015	Before	C-S	S	21.1 (0.1)	IAT-20 > 20	24.8	64.1 (123/192)	61.7 (79/128)	68.8 (44/64)	66.7	NR	NR	NR	NR	NR	NR	6

Table 1 (*Continued*)

No.	Ref	Study site	Income level	Survey time	COVID-19 pandemic	Study design	Sampling method	Age [mean (SD) / range]	Instrument/ cut-off	mean score of measures	Prevalence of Internet addiction (%)			Male (%)	Urben residence (%)	Smoking (%)	Drinking (%)	Depression (%)	Sleeping problem (%)	Anxiety (%)	Quality assessment score
											Total (IA/sample size)	Male (IA/sample size)	Female (IA/sample size)								
89	Tahir *et al.*, 2021 [147]	Dominican Republic; Egypt; Guyana; India; Mexico; Pakistan; Sudan	UM; LM; H; LM; UM; LM; L	June-July 2020	During	C-S	C	15–44	IAT-20 > 30	39.7	67.6 (1859/2749)	NR	NR	36.0	84.1	9.9	NR	NR	73.5	NR	4
90	Tayhan Kartal *et al.*, 2021 [148]	Turkey	UM	March-June 2019	Before	C-S	R	20.7 (1.6)	IAT-20 ≥ 50	30.3	13.0 (57/437)	22.4 (26/116)	9.7 (31/321)	26.5	NR	NR	NR	NR	NR	NR	5
91	Tenzin *et al.*, 2018 [149]	Bhutan	LM	May-January 2017	Before	C-S	M; CS	21.7 (1.7)	IAT-20 ≥ 50	42.5	34.3 (282/823)	NR	NR	51.9	NR	NR	NR	NR	NR	NR	6
92	Torabi *et al.*, 2020 [150]	Iran	UM	NR	NR	C-S	R	NR	IAT-20 ≥ 50	44.0	35.0 (140/400)	NR	NR	38.8	NR	NR	NR	NR	NR	NR	4
93	Umeta *et al.*, 2022 [151]	Ethiopia	L	July-August 2021	During	C-S	R	NR	IAT-20 > 30	NR	79.4 (201/253)	NR	NR	68.8	49.0	5.9	17.4	NR	NR	NR	6
94	Wang *et al.*, 2017 [152]	China	UM	NR	NR	C-S	S; CS	20.8 (1.5)	IAT-20 ≥ 50	NR	12.8 (138/1080)	NR	NR	32.9	NR	NR	NR	NR	NR	NR	7
95	Wang *et al.*, 2020 [153]	China	UM	September-November 2018	Before	C-S	S	18.8 (1.2)	IAT-20 > 40	NR	28.2 (1054/3738)	26.0 (404/1552)	29.7 (650/2186)	41.5	NR	NR	NR	NR	30.1	NR	6
96	Yadav *et al.*, 2022 [154]	India	LM	NR	NR	C-S	S	22.6 (3.5)	IAT-20 ≥ 50	NR	84.5 (492/582)	91.4 (244/267)	78.7 (248/315)	45.9	NR	NR	NR	NR	NR	NR	5
97	Yang *et al.*, 2019 [155]	China	UM	2018	Before	C-S	R	18.2 (0.7)	IAT-20 ≥ 50	NR	17.4 (733/4211)	16.2 (231/1428)	18.0 (502/2783)	33.9	NR	3.3	45.4	1.5	12.8	NR	5
98	Ye *et al.*, 2016 [156]	China	UM	May-June 2012	Before	C-S	CS	19.7 (1.2)	IAT-20 ≥ 50	NR	22.3 (540/2422)	26.7 (383/1433)	15.9 (157/989)	59.2	NR	9.3	11.6	33.9	42.6	19.7	6
99	Younes *et al.*, 2016 [157]	Lebanon	LM	September-December 2015	Before	C-S	R	20.4 (1.8)	IAT-20 ≥ 50	30	16.8 (101/600)	23.6 (43/182)	13.9 (58/418)	30.3	NR	11.4	27.4	27.7	65.1	55.3	5
100	Zenebe *et al.*, 2021 [158]	Ethiopia	L	2018–2019	Before	C-S	M; CS	21.4 (1.8)	IAT-20 > 30	NR	85.0 (466/548)	NR	NR	53.1	NR	11.3	25.4	NR	NR	NR	7
101	Zhao *et al.*, 2021 [159]	China	UM	June-July 2020	During	C-S	C	20.0 (1.3)	IAT-20 ≥ 50	NR	28.4 (3191/11254)	30.9 (1251/4054)	26.9 (1940/7200)	36.0	NR	NR	NR	41.5	35.0	32.6	6

Abbreviations: Before, Before the COVID-19 pandemic; C, Convenient sampling; CS, Cluster sampling; C-S, cross-sectional; CSS, Consecutive Sampling; During, During the COVID-19 pandemic; E, enumerative sampling; H, High income; L, Low income; LM, Low middle income; M, Multistage sampling; NR, not reported; PPS, Probability Proportional to Size sampling; PS, Purposive sampling; R, Random sampling; S, Stratified sampling; SB, Snowball sampling; SR, Systematic Random sampling; U, Upper middle income.

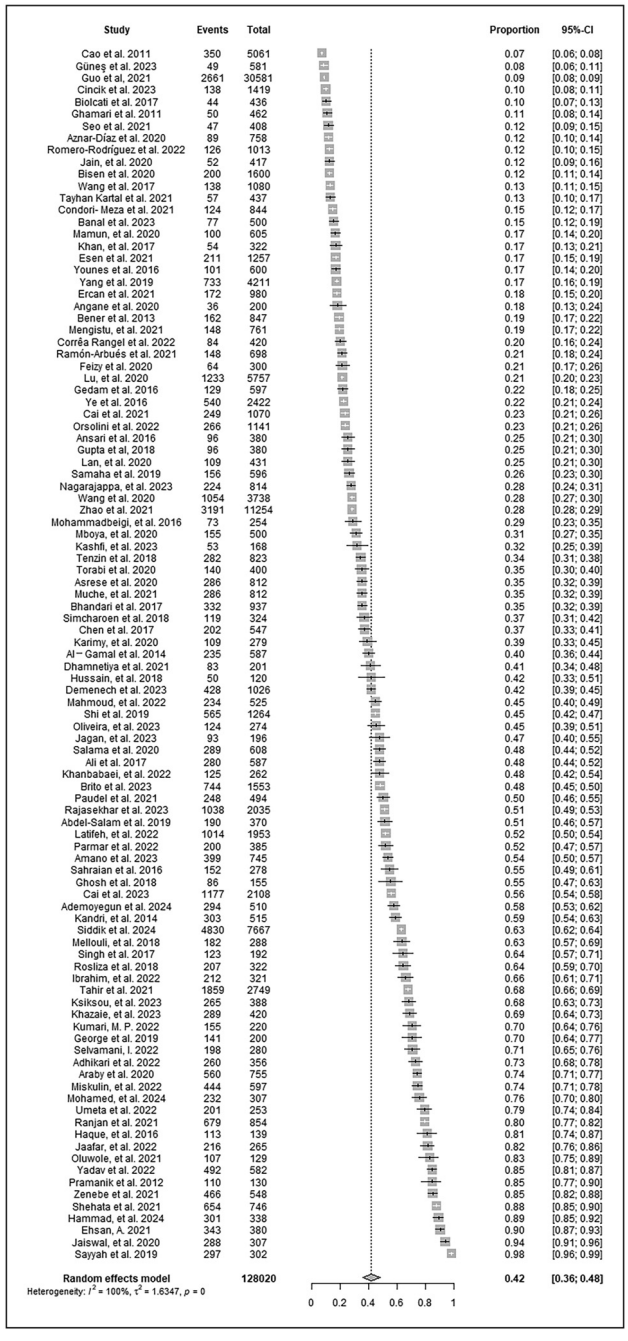

FIGURE 2. Meta-analysis of prevalence of internet addiction in university students.

of the prevalence of internet addiction (Egger's test $t = 2.73$; $P = 0.008$, Figure S1A, http://links.lww.com/YCO/A90) and odd ratio of internet addiction between male and female (Egger's test $t = 3.30$, $P = 0.002$, Figure S1B, http://links.lww.com/YCO/A90). In the sensitivity analysis, the pooled prevalence of internet addiction remained robust, indicating that no individual study significantly influenced the overall results (Figure S2, http://links.lww.com/YCO/A90). Similar results were found in the sensitivity analysis in the meta-analysis of OR of internet addiction between male and female students (Figure S3, http://links.lww.com/YCO/A90).

DISCUSSION

To the best of our knowledge, this was the first meta-analysis that specifically used the IAT-20 to assess the global prevalence of internet addiction among university students. Based on the 101 eligible studies with 128 020 participants from 38 countries and territories, the pooled global prevalence of internet addiction in university students was 41.84% (95% CI: 35.89–48.02). Subgroup analysis and meta-regression analyses revealed that income level, region, stage of the COVID-19 pandemic, IAT-20 cut-off values, sample size, and the prevalence of depression were moderators influencing the prevalence of internet addiction. Furthermore, the comparison of internet addiction prevalence between sexes revealed that male university students had a significantly higher risk of internet addiction compared to their female counterparts.

The pooled global prevalence of internet addiction in university students in this meta-analysis (41.84%, 95% CI: 35.89–48.02) is considerably higher than the corresponding figure in all-age populations (14.22%, 95% CI: 12.90–15.65) [20] and healthcare professionals (9.7%, 95% CI:5.8–13.6) [30] reported in previous meta-analyses. Previous studies also found that internet addiction was common among university students [15▪▪,18,19]. For instance, the pooled prevalence of internet addiction in Ethiopian university students (43.42%, 95% CI: 28.54–58.31) [18] was similar, while the pooled prevalence in Iranian university students (31.51%, 95% CI: 26.47–36.55) [19] and Asian university students (24.3%, 95% CI: 19.8–29.5) [15▪▪] were relatively lower. The higher prevalence rates of internet addiction among university students might be attributed to factors related to the developmental stages of adolescence and early adulthood. Given that they are the most active internet users of all age groups, they are more likely to develop internet addiction [14,31]. As this stage of development is crucial for exploring new identities and establishing independence [32], the internet could offer timely opportunities and vast spaces for university students to explore, experiment and engage with their identities [33,34], thus leading to high internet use. Furthermore, growing independence among university students coupled with need for self-regulation and less supervision from parents or teachers, might result in fewer restrictions on internet use [35,36]. Moreover, university students are more likely to use the internet as a coping mechanism when faced

Table 2. Subgroup analyses of prevalence of internet addiction

Subgroups	Categories	No. of studies	Events	Sample size	Proportion (95%CI)	I^2(%)	*P*-value within subgroups	*P*-value across subgroups
Income Level	High income	12	2200	7008	32.6 (18.5, 50.6)	99.2%	<0.001	**0.007**
	Upper middle income	37	16247	82552	31.0 (23.0, 40.3)	99.6%	<0.001	
	Low middle income	44	14832	29520	50.3 (41.6, 58.9)	99.1%	<0.001	
	Low income	8	3032	6191	55.5 (37.9, 71.8)	99.1%	<0.001	
Region	East Asia & Pacific	18	12904	70982	30.6 (20.6, 42.7)	99.7%	<0.001	**<0.001**
	Europe & Central Asia	13	2127	9719	21.2 (13.3, 32.1)	99.1%	<0.001	
	Latin America & Caribbean	5	1424	4230	24.6 (14.1, 39.4)	99.0%	<0.001	
	Middle East & North Africa	26	6283	13014	49.8 (37.9, 61.6)	98.7%	<0.001	
	South Asia	29	10999	21949	49.1 (37.8, 60.5)	99.2%	<0.001	
	Sub-Saharan Africa	10	2574	5377	56.8 (40.5, 71.9)	98.9%	<0.001	
COVID-19 pandemic	Before	55	17482	80703	37.6 (30.2, 45.7)	99.5%	<0.001	**0.021**
	During	23	16456	35417	54.1 (42.6, 65.2)	99.5%	<0.001	
Sampling method	Probability sampling	73	22032	89231	44.5 (37.0, 52.3)	99.5%	<0.001	0.145
	Nonprobability sampling	27	16074	38489	35.8 (27.6, 44.9)	99.5%	<0.001	
Sex	Male	56	9389	25258	35.1 (30.0, 41.1)	99.3%	<0.001	0.146
	Female	57	12824	37650	29.5 (24.8, 35.1)	99.5%	<0.001	
Cut-off value	≥20	9	2134	2736	81.3 (67.9, 90.0)	96.3%	<0.001	**<0.001**
	>30	19	7706	12655	67.3 (58.7, 74.9)	98.2%	<0.001	
	≥40	9	3425	6710	52.7 (42.2, 62.8)	97.1%	<0.001	
	≥50	52	16896	87176	27.4 (22.4, 33.2)	99.4%	<0.001	
	>50	3	429	2724	16.9 (7.9, 32.3)	99.0%	<0.001	

Before, Before the COVID-19 pandemic; During, During the COVID-19 pandemic.
Bold font: $p < 0.05$.

Table 3. Meta-regression analyses of prevalence of internet addiction

Variables	No. of studies	Coefficient	Standard error	95% CI of coefficient	z-value	*p*-value
Sample size	101	−0.0001	3.74E-05	−0.0002; −1.2E-05	−2.2781	**0.023**
Age (year)	65	−0.0040	0.0527	−0.1074; 0.0993	−0.0768	0.939
Male, %	89	0.0151	0.0095	−0.0036; 0.0338	1.5849	0.113
Urban, %	17	0.0003	0.0048	−0.0090; 0.0096	0.0614	0.951
Smoke, %	21	−0.0004	0.0041	−0.0085; 0.0077	−0.0985	0.922
Drink, %	15	−0.0008	0.0031	−0.0069; 0.0052	−0.2704	0.787
Depression, %	19	0.0283	0.0065	0.0155; 0.0411	4.3354	**<0.001**
Sleeping problem, %	16	0.0028	0.0029	−0.0028; 0.0084	0.9714	0.331
Anxiety, %	13	0.0106	0.0123	−0.0134; 0.0346	0.8632	0.388
Study quality assessment	101	−0.2137	0.1162	−0.4415; 0.0142	−1.8380	0.066

Bold font: $p < 0.05$.

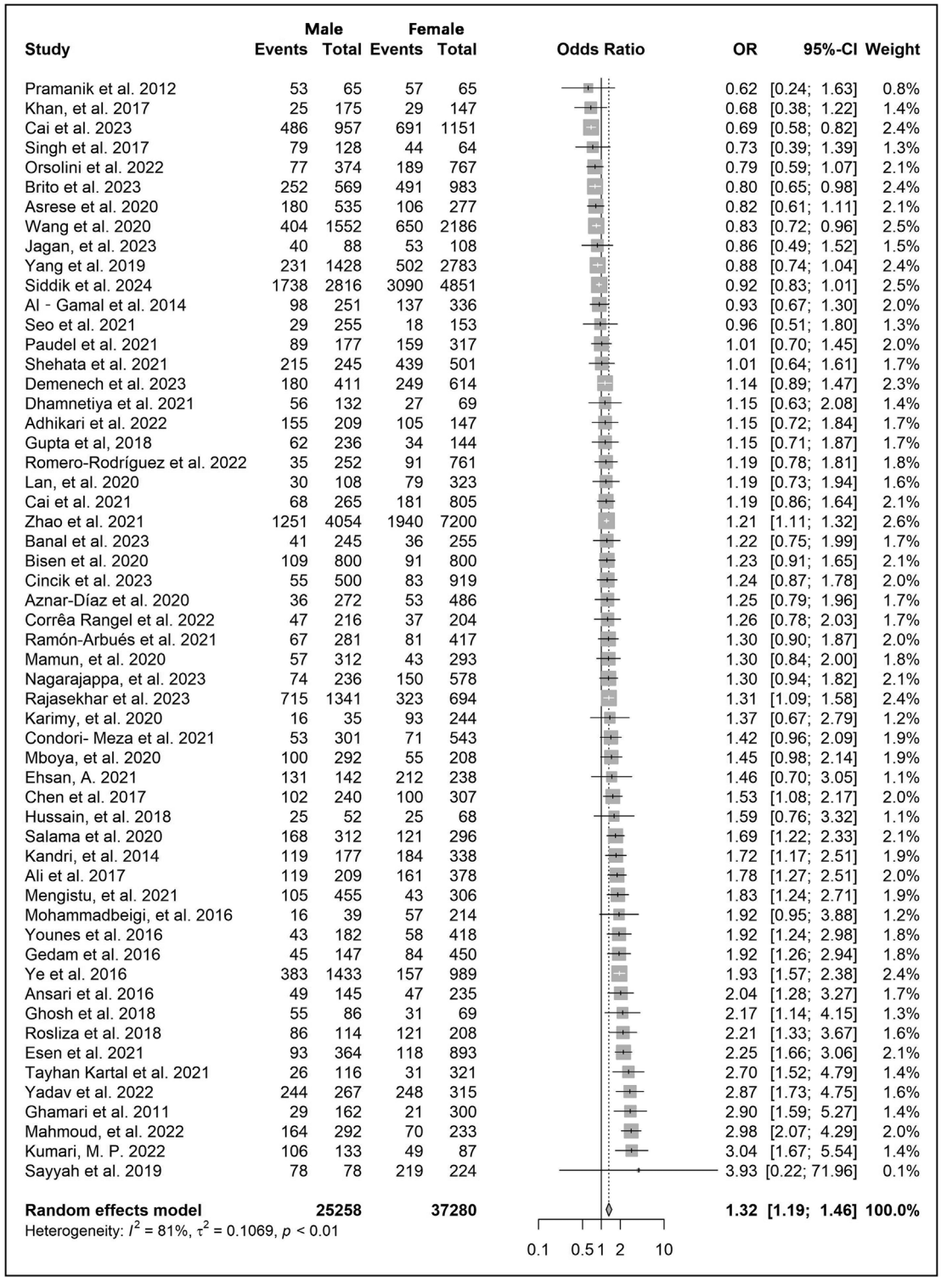

FIGURE 3. Odds ratio of internet addiction between male and female university students.

with increasing academic and psychosocial stressors [37,38]. In addition, with the shift towards online courses and assignments, such academic expectations would encourage greater internet use among university students [3,39]. The blurring of boundaries between academic and recreational internet use might foster unhealthy internet usage, making disengagement difficult when needed.

Subgroup analyses found a higher pooled prevalence of internet addiction among university students in low and lower-middle income countries, and also certain geographic regions including

Sub-Saharan Africa, the Middle East & North Africa, and South Asia, where they were predominantly represented by studies from Ethiopia, Iran, Egypt, and India. Similar results were also found in a global meta-analysis of internet addiction in the general population [20]. Such differences in internet addiction prevalence might suggest socioeconomic and geographic factors in the disparity in internet addiction among university students [40]. First, lower life satisfaction and poorer environmental conditions strongly associated with economic disadvantages might lead young people to use the internet as a means for coping with life challenges to escape from reality [41]. As economic disadvantages also limit access to other offline recreational activities as well as mental health resources, university students could revert to spending excessive time online [42]. Furthermore, there might be cultural differences in lower income countries and regions in terms of recognizing internet addiction as a problem needing intervention, thus exacerbating the development of internet addiction among young people [43].

Consistent with previous findings [44,45], we found that studies conducted during the COVID-19 pandemic had reported increased internet addiction prevalence, which is in line with global reports of the impact of the pandemic on excessive internet use, partly attributed to social distancing and post-traumatic stress [44]. During the pandemic, mass lockdowns and school closures isolated university students from their peers and limited their social interactions to online communication, which likely increased the time spent using their electronic devices on the internet, which might have contributed to the development of internet addiction [46,47▪]. Moreover, as the effects of social withdrawal could be extended suggesting that internet addiction might not subside immediately following the end of lockdowns due to the pandemic [48]. Additionally, the psychological issues resulting from the COVID-19 pandemic, including stress, depression, and anxiety, might further contribute to an increase in prevalence of internet addiction [38].

The IAT cut-off values were significantly associated with the reported prevalence of internet addiction, with higher cut-off values generally resulting in lower internet addiction prevalence [16,20]. Higher IAT cutoff values indicate more stringent assessment criteria for internet addiction, which might generate lower prevalence figures compared to studies using less stringent criteria. As reported in other meta-analyses [16,49], we found that studies with a larger sample size had a lower prevalence of internet addiction. This negative association between sample size and prevalence could be explained by the greater statistical power with larger sample size having more robust estimates that were less prone to random variation, therefore resulting in lower prevalence figures [50,51].

Meta-regression analyses revealed that the prevalence of depression was significantly associated with internet addiction prevalence in university students. Previous research found a bidirectional relationship between depression and internet addiction [12▪]. Individuals with depression might use the internet as a means of coping with negative emotions, which could increase the risk of internet addiction. In contrast, internet addiction might exacerbate depression by reducing real-life social interactions and hindering the development of social skills [12▪]. We also found that male students had a higher risk of internet addiction, which supports previous findings on sex differences in internet addiction [52]. This could be attributed to a greater neuropsychological reward response and peer pressure to online gaming in men, resulting a higher risk of internet addiction due to stronger tendency to have addictive online behavior [53,54]. Additionally, gender norms that discourage emotional expression in males might drive male university students to use the internet as a coping mechanism to escape external stressors and difficulties, potentially leading to excessive internet use [55].

There are several strengths of this study, including the large number of included studies, inclusion of study cohorts from multiple regions, and use of sophisticated analysis methods (e.g., subgroup and meta-regression analyses) to identify moderators of internet addiction prevalence. However, several limitations should be acknowledged. First, similar to previous epidemiological meta-analyses [56–58], there was high heterogeneity, although subgroup analyses were performed. Second, publication bias was significant since studies with higher prevalence rates were more likely to be published. Third, studies published in non-English languages and those using different assessment tools were not included, which might cause selection bias.

In conclusion, our study found that the prevalence of internet addiction was high among university students globally, which has increased since the COVID-19 pandemic. To address internet addiction, screening and intervention measures should be prioritized for high-risk population, particularly male students, those from lower-income regions and those with depression.

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Conflicts of interest

The authors have no conflicts of interest to declare.

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