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Prevalence of social media addiction across 32 nations: Meta-analysis with subgroup analysis of classification schemes and cultural values

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ABSTRACT

In the cyber era, people interact with others not only face-to-face but also through social media platforms such as Facebook and Instagram. Social media addiction has emerged as a problem of global concern, with researchers all over the world conducting studies to evaluate how pervasive the problem is. However, the prevalence rates of social media addiction reported in the literature vary dramatically. The present meta-analysis aimed to systematically synthesize the extant research on social media addiction prevalence. Subgroup analysis and meta-regression were conducted to investigate whether the prevalence rates would differ by classification schemes, cultural values, and demographic factors. The meta-analysis involved 63 independent samples with 34,798 respondents from 32 nations spanning seven world regions. The random-effects meta-analytic findings revealed variations in prevalence among studies adopting distinct classification schemes. The pooled prevalence estimate was 5% (95% CI: 3%–7%) for studies adopting monothetic or strict monothetic classifications. A higher pooled prevalence estimate (13%; 95% CI: 8%–19%) was found for studies adopting a cutoff for severe level or strict polythetic classifications, and that estimate was even higher (25%; 95% CI: 21%–29%) for studies adopting a cutoff for moderate level or polythetic classifications. Moreover, cross-cultural comparisons revealed the pooled prevalence estimate obtained in collectivist nations (31%; 95% CI: 26%–36%) to be twofold higher than that obtained in individualist nations (14%; 95% CI: 9%–19%). This meta-analysis indicates that both the classification scheme used and cultural factors should be considered when interpreting the prevalence findings on social media addiction.

1. Introduction

Social media have emerged as a near-ubiquitous aspect of everyday life in the cyber age. As of July 2020, there were about four billion active social media users worldwide, with more than half of them being users of Facebook (Kemp, 2020; Statista, 2020). Social media enable people to make new friends and maintain contacts with existing social network members without geographical or time constraints (e.g., Cheng, Lau, & Luk, 2020; Cheng, Wang, Sigerson, & Chau, 2019), but problematic use can impair users' psychosocial functioning and well-being (e.g., Hussain & Griffiths, 2019; Ponnusamy, Iranmanesh, Foroughi, & Hyun, 2020). For instance, some individuals are so engaged in Instagram that they feel distressed when they are unable to use it during work. Such misuse is widely referred to as social media addiction (e.g., Hou, Xiong, Jiang, Song, & Wang, 2019; Hussain & Starcevic, 2020).

Since Facebook's launch in 2004, myriad studies have investigated Facebook addiction and its association with problems in various life domains such as academic/work and interpersonal relations (e.g., Busalim, Masrom, Zakaria, & W. N., 2019; Sindermann, Elhai, & Montag, 2020). For symptom assessment, some researchers have adapted existing validated measures of Internet addiction by altering the context from "Internet" to "Facebook" or "social media" (e.g., Glass, Li, & Pan, 2014), whereas others have constructed new sets of items specifically designed to assess the symptoms of social media addiction and compiled them into measures, such as the Facebook Intrusion Questionnaire (Elphinston & Noller, 2011) and Social Media Disorder Scale (Van Den Eijnden, Lemmens, & Valkenburg, 2016).

The Bergen Facebook Addiction Scale (BFAS; Andreassen, Torsheim, Brunborg, & Pallesen, 2012) is by far the most widely used measure of social media addiction (Duradoni, Innocenti, & Guazzini, 2020). With

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reference to both diagnostic criteria and conceptual frameworks of behavioral addiction (American Psychiatric Association, 1994; Griffiths, 2005), the scale assesses six core components: salience, tolerance, mood modification, relapse, withdrawal, and conflict. Each of these components consists of three items, yielding a total of 18 items in the full version of the BFAS. A brief 6-item version was created by selecting the item with the highest factor loading in each of the six components. With the emergence of more popular social media applications (e.g., Instagram, Twitter), many individuals now have more than one social media account (e.g., Swart, Peters, & Broersma, 2017). Accordingly, the BFAS was modified to expand the scope of inquiry from Facebook to multiple social media applications. Both the BFAS and modified Bergen Social Media Addiction Scale (BSMAS; Andreassen, Pallesen, & Griffiths, 2017) display good psychometric properties (Andreassen et al., 2017, 2012).

Prevalence studies have adopted the validated BFAS and BSMAS as screening tools to identify individuals with social media addiction (Çakici, Babayiğit, Karaaziz, & Cumhur, 2020; Khumsri, Yingyeun, Manwong, Hanprathet, & Phanasathit, 2015). A review of the literature reveals considerable between-study variability in prevalence rates, with some reporting single-digit rates (e.g., Marcial, 2013; Wang, Sigerson, & Cheng, 2019), and others reporting more than 40% of respondents to be classified as social media addiction (e.g., Busalim et al., 2019; Khumsri et al., 2015). Such wide variations make it difficult for scholars, mental health professionals, and policymakers to gain an accurate understanding of how widespread this emergent problem is and/or to draw concrete conclusions for guiding intervention design or policy formulation.

A close examination of individual studies using the BFAS and BSMAS reveals considerable differences in the classification schemes adopted to distinguish individuals with social media addiction from those without. With reference to the screening method for gaming disorder (Lemmens, Valkenburg, & Peter, 2009), Andreassen et al. (2012) recommended two schemes: a more liberal polythetic classification with a cutoff of 3 (the mid-point of a 5-point scale) on at least two-thirds of items, and a more conservative monothetic classification with the same cutoff on all items. Some scholars consider endorsement of the mid-point to be too liberal, and have thus advocated for the use of strict monothetic and polythetic classifications with a cutoff of 4 (e.g., Gul, Yurumez Solmaz, Gul, & Oner, 2018; Pontes, Taylor, & Stavropoulos, 2018). Other researchers use another different cutoff score in their case classifications. For instance, Bányai et al. (2017) proposed a cutoff of 19 (out of a sum score of 30) based on the findings of their latent profile analysis. Given that several classification schemes with distinct cutoffs have been proposed, the present meta-analysis aimed at synthesizing the available data on the prevalence rates derived from a variety of classification schemes.

As social media addiction is an emergent problem that has raised public concern globally, prevalence studies have been conducted in many different countries. The BFAS and BSMAS have been translated into multiple languages, such as Chinese (Leung et al., 2020), Persian (Hosseini, Momeni, Vatanparast, Hosseinzadeh, & Rabani, 2020), Polish (Błachnio & Przepiorka, 2016), and Turkish (Uysal, Satici, & Akin, 2013). Cross-cultural theories postulate that individuals from different countries hold distinct cultural values that influence their thoughts and behaviors, with individualism (vs. collectivism) being the most fundamental and pervasive dimension of national culture (e.g., Hofstede, 2001; Triandis, 2001). Members of individualist countries are prone to viewing themselves as separate from others, whereas those of collectivist countries tend to view themselves as an integral part of their social networks (Markus & Kitayama, 2001). A recent cross-cultural study indicates that compared with individuals with an independent self-construal, those exhibiting an interdependent self-construal tend to be more vulnerable to the fear of missing out (Dogan, 2019), which is a major predictor of social media addiction (e.g., Fabris, Marengo, Longobardi, & Settanni, 2020). As members of individualist countries are characterized by an independent self-construal (Cheng et al., 2011), we posited that social media addiction prevalence rates may differ by cultural individualism, with higher rates in collectivist (vs. individualist) countries.

2. Methods

2.1. Search strategies

The PRISMA statement was followed to enhance reporting accuracy and reliability. Potentially relevant articles were identified using the Boolean string: ("social medi*" OR "social networking site*" OR "social network site*" OR "SNS" OR "online networking site*" OR "online network site*" OR "ONS" OR "facebook" OR "twitter" OR "whatsapp" OR "wechat" OR "instagram" OR "snapchat" OR "tiktok" OR "youtube") AND ("addict*" OR "problematic" OR "disorder" OR "patholog*" OR "dependenc*" OR "excess*" OR "compulsi*" OR "abuse"). Studies were eligible if they reported one or more prevalence rates yielded by the BFAS or BSMAS. No limit was placed regarding the date, language, type, and publication status nor the sample characteristics to maximize the number of eligible studies.

Potentially relevant studies available prior to 2020 were identified through a systematic search of 28 electronic databases (see Table S1 in online supplementary materials for a complete list), with forward and backward citation tracking of the eligible studies. Hand searches of existing reviews on social media addiction (Andreassen, 2015; Duradoni et al., 2020; Kuss & Griffiths, 2011; Ryan, Chester, Reece, & Xenos, 2014) and the proceedings of major relevant conferences were also conducted. The gray literature was mined through multiple sources (see Table S1). Finally, study authors were approached to obtain unpublished papers, analyses, and/or data. An initial literature search was performed in August 2020, and then updated in October and December 2020.

2.2. Study selection and data extraction

Two independent coders initially scanned the titles and abstracts to identify a pool of potentially eligible studies, whose full text was then perused for data extraction. Both coders were blinded to the study aims and hypotheses.

A structured coding scheme was developed prior to article screening. This scheme was piloted on the first 25 studies, with between-coder discrepancies resolved by team consensus. After the calibration exercise, the coders screened the remaining articles independently. Intercoder reliabilities for the final codings were all above accepted levels (Krippendorff alpha's $\geq$ 0.72). The coding scheme is displayed in the online supplementary materials (Table S2).

The summary measure was the prevalence rate of social media addiction. The prevalence rates were either extracted from eligible reports or computed by dividing the number of respondents with social media addiction by the total number of respondents. As some studies reported separate prevalence rates for diverse geographic areas (e.g., nation, local region), each independent sample within the eligible studies was adopted as the unit of analysis.

2.3. Synthesis of results

Meta-analysis of prevalence was performed using the MetaXL package (version 5.3; EpiGear International) and Stata (version 16.1; StataCorp LLC), with the prevalence rate of social media addiction and 95% confidence interval (CI) estimated using a random-effects model with Freeman-Tukey double arcsine transformation (see Section S1 in online supplementary materials for details of these statistical approaches). Between-study heterogeneity was examined using both Cochrane Q and I^2 statistics. A significant Q statistic and I^2 greater than 75% justified the adoption of the random-effects model.

To locate the sources of heterogeneity, subgroup analysis was undertaken to examine whether the prevalence estimates varied by

classification scheme (6 schemes), geographical region (7 regions), cultural individualism group (2 subgroups), and age group (3 subgroups). Moreover, meta-regression was conducted to examine the moderation effects of three continuous variables: year of study, gender composition (percentage of female participants), and cultural individualism scores. Cultural individualism scores were extracted from Hofstede (2018) database, and nations with a score of 50 (mid-point) or above were categorized as individualist while those with a score below 50 were categorized as collectivist in subgroup analysis. The prevalence estimates of two subgroups were considered significantly different from each other if there were no overlaps between their 95% CIs.

Possible outliers were detected using boxplot analysis. If outliers were detected, then the meta-analysis was rerun using the outlier removal method such that the pooled estimate derived from this alternative analysis could be compared with that derived from the full set of studies. To evaluate the stability of findings, sensitivity analysis was conducted by excluding one sample at a time to check whether the pooled prevalence estimate would be significantly altered by any individual sample.

2.4. Risks of bias within and across studies

Within-study bias refers to problems encountered by individual studies that may bias the meta-analytic findings, and this kind of bias was evaluated by assessing the quality of each study. Six domains of study quality were rated: statistical power, probabilistic sampling, sample heterogeneity, study design (cross-sectional vs. longitudinal), measurement reliability, and measurement validity (see Table S2 for details for coding of each domain). As only one included study featured a longitudinal design (Brailovskaia & Margraf, 2017), the domain of study design was omitted in the study-quality assessment owing to the absence of between-study variability. For the remaining domains, a study-quality score of "1″ (low risk) or "0" (high or possible risk) was assigned according to well-established criteria (e.g., Cheng, Cheung, & Lo, 2016; Holmbeck et al., 2008). These scores were aggregated to obtain a composite score ranging from 0 to 5. A higher score indicated better study quality with a lower risk of within-study bias. An additional meta-analysis was performed using a quality-effects model, which took the composite study-quality scores of individual studies into account when computing statistical parameters (Doi, Barendregt, Khan, Thalib, & Williams, 2015). Moreover, a series of subgroup analyses were conducted to further evaluate the potential influence of each indicator of study quality.

The risk of publication bias across studies was visualized in a Doi plot, with a Luis Furuya-Kanamori (LFK) index that exceeds ± 1 indicating asymmetry (Furuya-Kanamori, Barendregt, & Doi, 2018). Trim-and-fill procedures were performed if major asymmetry was identified (Duval, 2005). Finally, subgroup analysis was performed to compare the prevalence estimates between published and unpublished studies.

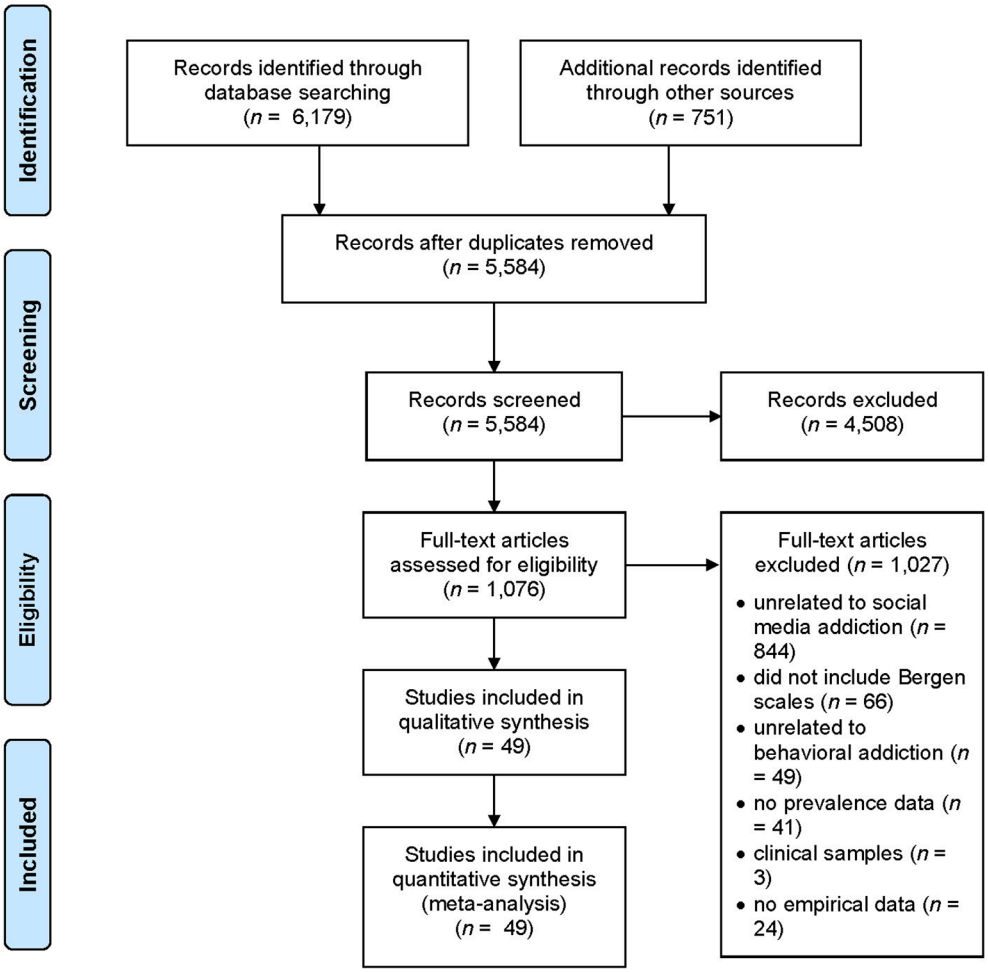

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Fig. 1. PRISMA flow diagram of study selection process.

3. Results

3.1. Study characteristics

The search and study-selection processes are depicted in a PRISMA flow diagram (see Fig. 1). As shown in Figure 1, 49 studies that met the eligibility criteria were included in the meta-analysis. The majority of them (78%) were published. The articles reporting these studies were published or posted on websites between January 2013 and December 2020. The prevalence estimates did not vary by the year of study, coefficient = -0.02, t = -0.68, p = .50.

The original English version of BFAS/BSMAS was used in 41% of the studies, and the remainder were translated measures in 13 languages: Arabic, Burmese, Chinese, French, German, Hebrew, Hungarian, Persian, Polish, Portuguese, Spanish, Thai, and Turkish. Most of the eligible studies (74%) examined Facebook addiction while the others focused on social media addiction in general.

The 49 eligible studies contained 63 independent samples totaling 34,798 respondents (mean = 552, range = 39–6,018). The overall age composition of the pooled studies skewed young (mean = 24), and the gender composition skewed towards females (mean = 56% females). The samples were from 32 nations spanning seven world regions (see Table 1).

About 21% were adolescent samples, 54% of the samples were university or college student samples, and 25% were community adult samples. Adolescent samples tended to have a higher prevalence (35%, 95% CI: 27%-43%) than both university student (23%, 95% CI: 18%-28%) and community adult (19%, 95% CI: 12%-27%) samples. However, the prevalence estimate did not vary by the gender composition of the samples, coefficient = -0.20, t = -0.51, p = .61. The table describing the major characteristics of the entire pool of independent samples and statistical power calculations are available in the online supplementary materials (Table S3 and Section S2).

3.2. Overall prevalence of social media addiction

The results of random-effects meta-analysis revealed a pooled social media addiction prevalence of 24% (95% CI = 21%–28%, Q = 4007.88, p < .0001, I^2 = 98%). The prevalence estimates ranged from 0% to 82%.

Boxplot analysis identified one outlier (Azizi, Soroush, & Khatony, 2019), which was eliminated in an alternative analysis. The overall prevalence estimate was highly similar after the outlier removal strategy had been applied (see Table 1). Moreover, sensitivity analysis revealed no obvious changes in the pooled prevalence estimates (range: 23.4%–24.8%), indicating the stability and reliability of the meta-analytic findings.

3.3. Prevalence of social media addiction by classification scheme

The present review identified six classification schemes adopted by researchers. The prevalence estimates derived from each are listed in Table 1. As shown in the middle panel of the table, both monothetic and strict monothetic classifications yielded very low prevalence rates, with no differences between these two schemes. Higher prevalence rates were found in studies adopting strict polythetic classifications or a cutoff for severe level. The highest prevalence rates were found in studies adopting more liberal classifications (polythetic or a cutoff for moderate level), with highly comparable rates derived from the two schemes.

We further synthesized the findings by performing additional analyses by reordering the six classification schemes into three broad categories. The results are summarized in Table 1. The pooled prevalence rates for the eligible studies that operationalized social media addiction as individuals having very severe, severe, and moderate-to-severe symptom levels were 5%, 13%, and 25%, respectively. As none of their 95% CIs overlapped with one another, these synthesized findings were more clear-cut and parsimonious than the previous findings drawn from all six schemes.

Table 1
Prevalence estimates of social media addiction by classification method and geographical-cultural factor.

	k	Prevalence	95% CI Lower	Upper
Sample				
Pooled (random-effects model)	63	24%	21%	28%
Pooled (random-effects model with outlier removed)	62	23%	20%	27%
Classification Method				
Classification scheme[a]				
Strict monothetic (≥4 on all the items)	12	5%	2%	9%
Monothetic (≥3 on all the items)	12	5%	2%	8%
Strict polythetic (≥4 on at least 67% of the items)	17	16%	8%	27%
Polythetic (≥3 on at least 67% of the items)	25	24%	18%	31%
Cutoff for severe level (cutoff ≥ 24 out of 30[b] or ≥ 72 out of 90[b])	10	8%	4%	12%
Cutoff for moderate level (cutoff ≥ 18/19 out of 30[b] or ≥ 54/57 out of 90[b])	28	26%	22%	31%
Symptom severity (classification scheme)[a]				
Very severe only (strict monothetic/monothetic)	24	5%	3%	7%
Severe (strict polythetic/cutoff for severe level)	27	13%	8%	19%
Moderate-to-severe (polythetic/cutoff for moderate level)	53	25%	21%	29%
Geographical-Cultural Factor				
Geographical region[c]				
North America	9	15%	7%	26%
Western/Northern Europe	6	8%	4%	12%
Eastern/Southern Europe	5	20%	13%	28%
Asia	24	31%	25%	38%
Middle East	11	29%	17%	44%
Africa	5	37%	26%	48%
Latin/South America	2	18%	8%	30%
Cultural individualism cluster[d]				
Individualist nations	19	14%	9%	19%
Collectivist nations	42	31%	26%	36%

Note. k = number of prevalence estimates.
[a] Some researchers have adopted more than one classification scheme within a study.
[b] The 6-item version has a total score of 30 while the 18-item version has a total score of 90.
[c] An Internet sample without specification of study location was excluded from this analysis.
[d] One study that recruited an ethnic-minority sample and an Internet sample without specification of study location were excluded from this analysis.

3.4. Prevalence of social media addiction by geographical-cultural factors

Subgroup analysis revealed differences in prevalence rates among samples recruited from diverse geographical regions. As shown in the lower panel of Table 1, the prevalence estimates obtained in North America and Western/Northern Europe tended to be lower than those in Africa, Asia, and the Middle East.

As expected, meta-regression revealed a significant moderator effect of cultural individualism, coefficient = -0.0043, t = -2.83, p = .006, R^2 = 0.12. The lower panel of Table 1 similarly shows higher prevalence estimates of social media addiction in collectivist nations (31%) than individualist ones (14%).

3.5. Risk of bias within and across studies

The study-quality assessment revealed a moderate risk of within-

study bias across the eligible studies. As shown in the upper panel of Table 2, the quality-effects model showed that the overall prevalence estimate remained the same after the composite score of all study-quality domains had been controlled for.

The assessment of individual study-quality domains is also summarized in Table 2. Specifically, the sample size of most studies was sufficiently large to yield adequate statistical power. More than 60% of the studies reported that the BFAS or BSMAS was reliable. As the other studies did not report such information, it is unclear whether the items in that cluster of studies were internally consistent. In addition, more than half of the studies had unknown validity, as many researchers used translated measures without providing any validation evidence. The more serious issues that potentially threatened study quality were the failure to meet the criteria of sample heterogeneity and probabilistic sampling. Specifically, most studies recruited homogeneous samples (mainly students) using non-probabilistic sampling methods. However, subgroup analysis indicated that neither issue was an influential factor in the prevalence estimates, $ps > .18$.

With respect to the publication bias evaluation, Fig. 2 presents a Doi plot with no asymmetry (LFK index = 0.20). Similarly, the results yielded from the random-effects trim-and-fill model indicated that no imputation or adjustment of the prevalence estimate was necessary. Finally, there were no significant differences in the prevalence estimate generated by published studies versus unpublished ones, coefficient = 0.14, $t = 1.56$, $p = .12$. Taken together, these results show that publication bias was not a concern.

4. Discussion

The present meta-analysis synthesized social media addiction prevalence rates derived from 63 independent samples from 32 nations spanning seven world regions. The prevalence estimates varied widely across studies and nations, from as low as 0% to as high as 82%. Nuanced analysis of this diverse body of findings indicates that the prevalence rates can be categorized into three main clusters by the classification scheme used. The first cluster, for which the overall prevalence was 5%, includes studies adopting conservative schemes such as monothetic or strict monothetic classifications. The second, for which the overall prevalence was 13%, includes studies adopting a cutoff for severe level or strict polythetic classifications. The third, for which the overall prevalence was 25%, includes studies adopting relatively lenient cutoff for moderate level or polythetic classifications. In addition, the prevalence rate also varied by cultural region. Social media addiction prevalence was twofold higher for members of collectivist regions than those of individualist regions.

These nuanced findings demonstrate that social media addiction is a heterogeneous problem that exhibits a spectrum of symptom severity. Such heterogeneity is similarly observed in other psychiatric disorders, such as alcohol abuse and gambling disorder (American Psychiatric Association, 2013), in which a positive diagnosis may have varied clinical presentations. Stark differences in prevalence rates across studies can be clarified by using different symptom thresholds to classify the severity of social media addiction. For example, a cutoff for moderate level or polythetic classification may serve the purpose of identifying a broad group of at-risk clients who can benefit from targeted prevention efforts. Such data may have broader policy implications. Specifically, the high prevalence in some countries may signal the need to prioritize mental health promotion among social media users, prompting policymakers in those countries to formulate corresponding information technology and/or public health policies.

In contrast, the use of more conservative monothetic or strict monothetic classification schemes may be appropriate if social media addiction is to be considered a psychiatric diagnosis in the future, so as to safeguard against over-diagnosis and the possible negative stigma associated with mislabeling. More research is needed to evaluate the symptom threshold at which individuals who engage in addictive social media use experience significant distress and functional impairment, and the degree to which social media addiction shares similar etiological and neurocognitive pathways to those leading to substance use and other behavioral addictions (e.g., Aydın, Obuća, Boz, & Ünal-Aydın, 2020; Balıkçı, Aydın, Sönmez, Kalo, & Ünal-Aydın, 2020; Ünal-Aydın, Balıkçı, Sönmez, & Aydın, 2020). Furthermore, the variations across classification schemes highlight the importance for researchers to state clearly the scheme adopted for case classification to avoid any misinterpretation of the reported prevalence data.

In addition to classification scheme, the present meta-analysis indicates that the prevalence estimate of social media addiction also differs among cultural regions. Higher prevalences are found in collectivist nations than individualist ones. Such cultural differences may be attributable to compliance to ingroup norms. According to the theory of cultural tightness-looseness (Gelfand, Harrington, & Fernandez, 2017), collectivistic societies are characterized by a "tight" culture with strong ingroup norms, and their members are expected to conform to ingroup values and behave according to widely shared norms. In contrast, individualist societies are characterized by a "loose" culture that allows coexistence of dissimilar norms across groups, and deviations from group's attitudes and behaviors are largely tolerated.

It is noteworthy that social media use is driven by not only one's own urge but also others' pressure (e.g., Fabris et al., 2020). Members of individualist cultures may be subject mainly to internal demands (e.g., mood modification) to use social media, whereas those of collectivist cultures may be subject to both internal demands and external ones (e.g., ingroup norms) that may enhance their vulnerability to social media addiction. Cross-cultural findings document that social media users from collectivist (vs. individualist) countries tend to have denser and closer relations with other users (Choi, Chu, & Kim, 2012), and their pressure to comply to ingroup norms may be stronger. Moreover, members of collectivist (vs. individualist) cultures are more likely to use social media to elicit social support, seek peer approval, and form consensus (e.g., Chan & Cheng, 2016; Kim, Sohn, & Choi, 2011). Taken together, the stronger pressure to conform to ingroup norms and greater motivation to maintain ingroup relations in culturally "tight" collectivist societies may increase their members' proneness to social media addiction.

Apart from these hypothesized variations in prevalence rate, age differences were also found. The higher prevalence of social media addiction among younger samples is attributable to their higher levels of digital literacy and competence (e.g., Spante, Hashemi, Lundin, & Algers, 2018; Wang et al., 2019). Specifically, youngsters are apt to multitasking and prefer graphics over words for communication (Chen, Teo,

Table 2
Summary of study-quality assessment.

	k	Prevalence	95% CI Lower	Upper
Quality-Effects Meta-Analysis				
Pooled estimate (quality-effects model)	63	24%	19%	29%
Subgroup Analysis of Individual Study-Quality Domain				
Statistical power				
Adequate	57	24%	20%	27%
Inadequate	6	32%	19%	47%
Probabilistic sampling				
Probabilistic	17	32%	25%	39%
Non-probabilistic	46	22%	17%	26%
Sample heterogeneity				
Heterogeneous	17	18%	11%	26%
Homogeneous	46	27%	23%	31%
Measure reliability				
Adequate	40	24%	20%	29%
Not specified	23	24%	19%	30%
Measure validity				
Validated	24	19%	13%	25%
Not yet validated/not specified	39	28%	23%	33%

Note. k = number of prevalence estimates. CI = confidence interval.

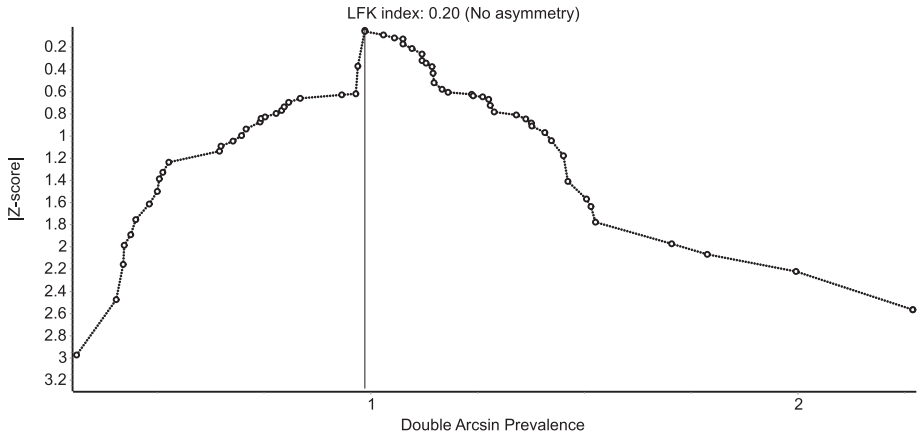

Fig. 2. Doi plot analysis and Luis Furuya-Kanamori (LFK) index for detecting the risk of publication bias. The modeled standard error is plotted against the double arcsine transformed prevalence of individual independent samples ($k = 63$).

& Zhou, 2016). Hence, they can manage to use social media while performing routine tasks, and have strong preference for using social media to present and express themselves through non-text means such as photos, videos, graphics, and emoji (e.g., Chae, 2017; Highfield & Leaver, 2016). Compared with older generations, youngsters gain access to social media at a much earlier age, and thus feel more comfortable to use social media as a means of communication and are more vulnerable to social media addiction (e.g., Ho, Lwin, & Lee, 2017; Monacis, de Palo, Griffiths, & Sinatra, 2017). Such generational differences deserve greater attention from researchers who are interested in studying social media addiction at a societal level. From a practical perspective, the high prevalence in adolescence unveils the need to allocate more public resources on mental health services to prevent or treat social media addiction in this high-risk group.

Some methodological issues are noted in our meta-analytic review. The majority of the included studies recruited student samples using non-probabilistic sampling methods, such as convenient and snowball sampling. As noted above, the data derived from young, student samples are not generalizable to those derived from older adult samples. In addition, an imbalanced gender ratio is found in many of the included studies, and the findings of these studies may be biased. As females are found to use Facebook more frequently than males (e.g., Ruleman, 2012), more gender-balanced studies should be conducted to minimize this potential bias in the future research on social media addiction. Moreover, although the present review included studies conducted in 32 nations spanning seven geographical regions, none of the participants are from the West Pacific region (e.g., Australia, New Zealand) and residents of Latin and South American countries are underrepresented. Conclusions regarding social media addiction prevalence drawn from the present pool of included studies should be interpreted with caution.

To address these limitations, the following future research directions are proposed. First, when designing future prevalence research, efforts should be made to recruit samples with a balanced gender ratio and broad age range. Probabilistic sampling methods should be used to yield more accurate social media addiction prevalence in any given population. Second, large-scale multinational studies are encouraged for more robust tests of cultural differences at both the individual (i.e., independent vs. interdependent self-construal) and national (i.e., cultural individualism vs. collectivism) levels through multilevel analyses (e.g., Cheng, Cheung, Montasem, et al., 2016). Finally, the use of structured clinical interview protocols can inform the assessment and management of social media addiction, such that individuals at risk for social media addiction can be evaluated for related mental health conditions and receive timely support to bolster their psychological well-being.

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CRediT authorship contribution statement

Cecilia Cheng: Conceptualization, Methodology, Formal analysis, Resources, Software, Writing - original draft, Supervision, Project administration, Funding acquisition. **Yan-ching Lau:** Investigation, Data curation, Visualization. **Linus Chan:** Investigation, Data curation. **Jeremy W. Luk:** Validation, Writing - review & editing.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.addbeh.2021.106845.

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