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ARTICLE

The Relationship between Students' Anxiety and Internet Use Disorders: A Meta-Analysis

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ABSTRACT

Theoretical models have predicted a positive association between anxiety and Internet use disorders. However, the findings of previous studies are conflicting, with some reporting a positive association and others proposing no relationship between the two. To explore the true relationship between the two and analyze the reasons for the differences, 100 primary studies involving 108,539 subjects were entered into a meta-analysis. The results showed that (1) there was a significant positive correlation between students' anxiety and Internet use disorder (r = 0.330); (2) the moderating effect of anxiety type was significant. (3) The moderating effects of the measurement instrument for Internet use disorder, the measurement instrument for anxiety, the subject's grade level, the subject's region, and the type of publication were not significant. The question of how the different anxiety types of students and IUD have different mechanisms of action needs to be further explored.

KEYWORDS

Students; anxiety; Internet use disorder; meta-analysis

Introduction

Origin

As of December 2022, the total number of Internet users in China exceeds 1 billion, of which 18.7% are under 19 years old, 14.2% are between 20 and 29 years old, and about 32.9% are teenagers [1]. Due to immature psychological development, college and university students are prone to Internet Use Disorder (IUD) in the process of using the Internet [2], a concept developed by the American Psychiatric Association in an appendix to the new Diagnostic and Statistical Manual of Mental Disorders (DSM-5) [3], and it encompasses a wide range of conditions that previously included Internet Addiction (IA) [4–6], Excessive Internet Use (EIU) [7,8], and Problematic Internet Use (PIU) [9–11]. Among other related terms. According to surveys, IUD is prevalent in the adolescent population [12] and about 11.3% among college students [13,14] and about 13.4% among senior students [15]. It can be seen that the study of IUD has a very important practical significance.

In the context of the new Internet, exploring the causes and consequences of IUD is an issue that has become a focal point in the field. Among the many factors that may be associated with IUD, anxiety has received particular attention. It is important to note that anxiety is distinctly different from Anxiety Disorders (also known as Generalized Anxiety Disorder), and in order not to cause confusion, anxiety in this paper refers to the unpleasant and complex emotional state of tension, uneasiness, worry, and annoyance that an individual experiences in response to an impending danger or threat that may pose a danger [16], rather than the "Diagnostic and Statistical Manual of Mental Disorders (DSM)" [16], which is the term used in this article to refer to the complex emotional state of tension, unease, apprehension, and annoyance. Anxiety Disorders as defined by the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) [3]. The relationship between anxiety and IUD has also been addressed in numerous previous theoretical models. The self-defense mechanism model of Anxiety-IUD [17] argueed that when faced with anxiety,

individuals were prone to adopt negative coping styles, such as avoidance, in order to maintain inner balance in order to face it, and individuals who were more likely to adopt negative coping styles tend to be more likely to to develop IUD, and the model suggested that negative coping styles mediate the relationship between anxiety and IUD.

Gao et al. [18], Pang et al. [19], and Weinstein et al. [20] argued that the Internet is used as a tool to cope with anxiety, and that negative emotions, such as anxiety, stimulate an individual to enter a virtual environment. Spending too much time on the virtual environment can lead to IUD. Lavoie et al. [21] suggested that this compensatory internet use is a way of managing emotions by avoiding them or avoiding situations. The social-emotional model [22] and the compensatory internet use model [23] also integrate these ideas.

The Pathological Use Model (PUM) considers anxiety as an outcome of IUD. Specifically, IUD is a form of impulse control disorder [24,25], and although the anonymity of online socialization can increase an individual's sense of control [26], online relationships are a weaker type of relationship than real relationships [27], so if the Internet is used as a "safe haven" and is overly relied upon and used, the social support received by individuals in the real world will be reduced, and individuals will be less satisfied with their real lives, and their levels of social anxiety and depression will be increased [28–30].

The Social-Psychological-Physiological Model (SPPM) suggests that anxiety can be both a cause and a consequence of IUD [31,32]. In the view of the model, IUD is a complex psychological phenomenon that is governed by social, psychological and physiological factors and can lead to a variety of social, psychological and physiological consequences. Among the psychological factors are depression and anxiety. On the one hand, anxious and depressed people are more likely to develop IUD; on the other hand, IUD leads to anxiety, i.e., prolonged use of the Internet leads to the isolation of individuals from the real world which in turn leads to anxiety and depression [31–33].

Whether as a cause or as a consequence, established theories tend to suggest that anxiety and IUD should be significantly and positively correlated. However, primary studies exploring the relationship have reported inconsistent results, with some reporting a significant positive correlation [34] and others showing no correlation [35,36]. If anxiety is not significantly correlated with IUD, then the reasoning of the previous two theories will not be supported by evidence.

As of now, no study has meta-analyzed the relationship between anxiety and IUD. Ran et al. [37] explored the relationship between social anxiety and cell phone addiction using a three-level meta-analysis and found that social anxiety significantly predicted cell phone addiction. However, cell phone addiction and IUD are not a concept at all [38]. Prizant-Passal et al. [39] conducted a meta-analysis of the relationship between social anxiety (social anxiety) and PIU, but only eight primary studies were included, and the number of primary studies was was too small. In this meta-analysis, there were 81 after 2016 and 48 before 2016. Furthermore, Prizant-Passal et al. [39] only studied social anxiety. And whether different types of anxiety may be differently related to IUD is a question that remains to be clarified. This shows that a meta-analysis of the relationship between anxiety and IUD correlation is of great theoretical importance.

Problems and assumptions

Relationship between anxiety and IUD

What exactly is the relationship between anxiety and IUD? There are two views in previous primary research on the relationship between student anxiety and IUD: one view is that there is a significant positive correlation between the two, and the other view is that there is no correlation between the two.

The first view suggested that student IUD is significantly and positively correlated with anxiety [34] [40–42]. Yin et al. [43] used 478 vocational school students as subjects and collected data using the Internet Addiction Diagnostic Questionnaire as well as the Internet Consequences Scale (ICONS) and found that there was an extremely significant positive correlation between students' Internet addiction and anxiety (r = 0.232). Chen et al. [44] surveyed 610 college students using the Self-assessment Scale for Social Anxiety (SSAS) and the Chinese Internet Addiction Scale (CIAS) and found that there was a significant positive correlation between the tendency to Internet addiction and social anxiety (r = 0.240). Tong [45] used 1947 school students over 14 years old and some school youths as subjects and collected data using the Diagnostic Criteria for Internet Addiction and the Symptom Self-Control Scale (SCL-90) and found that there was a moderate positive correlation between Internet addiction and anxiety (r = 0.316). Zhang et al. [46] collected data from 94 middle school students as subjects using the Chinese version of the Youth Diagnostic Questionnaire for Internet Addiction (YDQ) and the Revised Chinese version of the Children's Maternal Conspicuous Anxiety Scale (RCMAS), and found that there was a significant positive correlation between Internet addiction and anxiety (r = 0.550).

The second view was that the correlation between student anxiety and IUD was not significant [35–37] [47]. Zhang et al. [47] used 355 undergraduate students as subjects and collected data using the Internet Addiction Identification Questionnaire (IAQ) developed by Young as well as the Interaction Anxiety Scale (IAS), and found that the difference in anxiety scores between non-internet-addicted and moderately internet-addicted undergraduates was not significant. Lee et al. [35] used 1168 students as subjects and collected data using the Korean version of the Adolescent PIU scale (IAI) and the Center for Epidemiological Studies Depression Scale (CESD) as measurement tools and found that the correlation between anxiety and IUD was not significant.

In summary, the first view was not only supported by the Self-Defense Mechanism Model of Anxiety-IUD, the Social-Emotional Model, the Compensatory Internet Use Model, the Pathological Use Model, and the Socio-Psycho-physiological Model, but also most empirical studies tend to support the first view, and thus we hypothesize that:

H1: There is a degree of positive correlation between students' anxiety and IUD.

Possible moderating variables

So, why do existing studies differ on the definition of the relationship between the two?

First, it may stem from differences in IUD measurement tools. In previous literature, researchers have examined the use of the Internet addiction questionnaire (Young's Internet Addiction Text, YIAT) developed by Young, the Internet Addiction Diagnostic Criteria (IADC), Chinese Internet Addiction Scale (Revised Chen Internet Addiction Scale, CIAS-R), and Internet Addiction Scale (IAS) as IUD measurement tools, but different relationships have been drawn. Feng et al. [48] collected data using the Chinese Internet Addiction Scale (CIAS-R) and measured a correlation coefficient of r = 0.086 between Internet addiction and anxiety; Ren et al. [34] used the Internet Addiction Disorder Diagnostic Scale and came up with a correlation coefficient of r = 0.385. Cao et al. [49] used the Internet Addiction Impairment Scale (IADS), which yielded a correlation coefficient of r = 0.146 for Internet addiction and anxiety; Liu et al. [50] used the Chinese Internet Addiction Scale (CIAS-R), and found a correlation coefficient of r = 0.450. It can be seen that the correlation coefficients obtained from different measurement tools for IUD may also be different. Therefore, we hypothesized:

H2: The relationship between students' anxiety and IUD is moderated by the IUD measurement instrument, and the relationship between anxiety and IUD obtained will be different under different conditions of the IUD measurement instrument.

Second, it may stem from differences in the type of anxiety. There exist three views on the classification of types of anxiety as follows. One, Spielberg divided anxiety into two types: state anxiety and trait anxiety [51], state anxiety is a transient emotional response that includes undesirable emotional reactions and thoughts; while trait anxiety refers to personality traits that are relatively stable anxiety tendencies with individual differences, also called generalized anxiety [52,53]. This view is also supported by Deng et al. [54]. Secondly, Anna Freud classified anxiety into instinctive anxiety, reality anxiety and superego anxiety in The ego and the mechanisms of defence [55]. Instinctive anxiety, or neurotic anxiety, refers to anxiety that arises from the fear that the ego's impulses will overcome the ego; reality anxiety, or objective anxiety, refers to anxiety arising from real, objective dangers in reality; and superego anxiety, or moral anxiety, refers to anxiety that arises from the fear that an individual will do something that goes against the superego, and will experience guilt [56]. Other researchers believe that anxiety can be categorized into body anxiety and cognitive anxiety [57], with cognitive anxiety usually referring to worry, urgency, and those uncomfortable feelings; and body anxiety referring to physiological or physiological processes or sensations. Considering that Spielberg's state-trait conceptual theory has played a great role in promoting anxiety research, this paper adopts Spielberg's categorization to classify anxiety. In previous literature, the relationship between different types of anxiety and IUD has been examined by researchers, but the relationships derived by all are not the same, and the relationship between anxiety and IUD may be influenced by the type of anxiety.

Mohammadkhani et al. [58] surveyed 400 college students and reported a correlation coefficient of 0.250 between trait anxiety and IUD; Tao et al. [59] surveyed 1048 college students and reported a correlation coefficient of 0.400 between trait anxiety and IUD; Lavoie et al. [21] surveyed 2883 adolescents and reported a correlation coefficient of 0.218 between state anxiety and IUD; Zhang et al. [46] surveyed 94 middle school students and reported a correlation coefficient between state anxiety and IUD of 0.550. It can be seen that the correlation coefficients obtained may be different depending on the type of anxiety. Therefore, we hypothesized:

H3: The relationship between students' anxiety and IUD is moderated by the type of anxiety, and different types of anxiety lead to divergent relationships between anxiety and IUD.

Third, the influence of measurement tools that may stem from anxiety. In previous literature, researchers have examined the use of the Self-Rating Anxiety Scale (SAS), the Social Anxiety Scale for Adolescents (SAS-A), the Depression, Anxiety, Stress Scale (DASS-21), the Beck Anxiety Inventory (BAI), and the Symptom Checklist-90 (SCL-90) as anxiety measurement tools. Ostovar et al. [60] collected data from 632 students using the Depression, Anxiety, and Stress Scale (DASS-21), and measured the correlation coefficient between Internet addiction and anxiety to be r = 0.549; Liu [61] collected data from the Self-assessment Scale of Anxiety (SAS), and measured the correlation coefficient between Internet addiction and anxiety was measured as r = 0.244; Seifi et al. [62] collected data using the Depression, Anxiety, Stress Scale (DASS-21), and the correlation coefficient between Internet addiction and anxiety was measured as r = 0.450; Wang et al. [63] collected data using the Social Anxiety Scale to collect data and measured the correlation coefficient between Internet addiction and anxiety as r = 0.164. It can be seen that the correlation coefficients obtained are different for different measurement tools of anxiety. Therefore, we hypothesized:

H4: The relationship between students' anxiety and IUD is moderated by the instrument used to measure anxiety, and the relationship between anxiety and IUD obtained will be different for different conditions of the anxiety measurement instrument.

Fourth, it may stem from differences in subjects' grade levels. In previous literature, researchers have examined the relationship between anxiety and IUD when using elementary and middle school students as well as college students as subjects, but the relationships derived by all are different. Panicker et al. [64] obtained a correlation coefficient of r = 0.200 between smartphone addiction and anxiety using college students as subjects; Javaeed et al. [65] obtained a correlation coefficient of r = 0.060 between Internet addiction and anxiety using college students as subjects.

Zhang [66] concluded that the correlation coefficient between Internet addiction and anxiety was r = 0.648 using middle school students as subjects; Zhang et al. [46] concluded that the correlation coefficient between Internet addiction and anxiety was r = 0.550 using middle school students as subjects. it can be seen that the correlation

coefficients obtained may be different depending on the grade level of the subjects. Therefore, we hypothesized:

H5: The relationship between students' anxiety and IUD is moderated by the grade level of the subjects, and the relationship between anxiety and IUD obtained will be different when students of different grade levels are chosen as subjects.

Fifth, it may stem from differences in the region where the subjects are located. In previous literature, researchers have examined the relationship between anxiety and IUD when subjects from Asia, Europe, North America, and Africa were used as study subjects, but the relationships derived were not the same. Cheng et al. [67] concluded that Internet addiction rates were negatively correlated with the Global National Life Satisfaction Index (GNLSI) and the country-specific Environmental Quality Index (EQI), and thus the region in which the subjects were located could also be a potential moderating The region of the subject may also be a potential moderating variable.

Kheyri et al. [68] surveyed 353 college student subjects in the Asian region and reported a correlation coefficient of r = 0.173; Shan et al. [69] surveyed 3380 college student subjects in Asia and reported a correlation coefficient of r = 0.158.

Koc [70] surveyed 174 college student subjects in the European region and reported a correlation coefficient of r = 0.872, while Woon [71] surveyed 125 secondary school student subjects in the European region and reported a correlation coefficient of r = 0.605. It can be seen that the correlation coefficients obtained may differ depending on the region in which the subjects are located. Therefore, we hypothesized:

H6: The relationship between students' anxiety and IUD is moderated by the district in which the subjects are located, and the relationship between anxiety and IUD obtained will be different when students from different districts are chosen as subjects.

Sixth, it may stem from differences in publication type. Based on previous experience, publication type may also be a potential moderating variable. In previous literature, researchers have examined the relationship between anxiety and IUD in the form of journal articles and dissertations, but all have come up with different relationships. Liu [61] investigated 503 subjects in a dissertation and reported a correlation coefficient of r = 0.244; Song [72] investigated 355 subjects in a dissertation and reported a correlation coefficient of r = 0.190.

Ostovar et al. [60] surveyed 632 subjects in journal articles and reported a correlation coefficient of r = 0.549. Jiang et al. [73] surveyed 1804 subjects in journal articles and reported a correlation coefficient of r = 0.402. It can be seen that correlation coefficients obtained may be different depending on the publication type. Therefore, we hypothesized:

H7: The relationship between students' anxiety and IUD is moderated by publication type, and the relationship between reported anxiety and IUD will vary by publication type.

Methodology

Literature search and selection

This study comprehensively searched the literature up to June 2022 in both Chinese and English. The English literature search databases Google, ELSEVIER, Springer Link, SAGE, Willy, JSTOR, and Web of Science (Core Collection) were searched for students, middle school students, university student, undergraduate student, teenagers, callan, internet addiction, network addiction, excessive Internet use, pathological network use, pathological Internet use, problematic internet use, problematic network use, anxiety, anxiety, etc. Keywords such as "topic" or "full-text" or "analysis" are used in the context of the following. "full text" or "title" search fields. The Chinese literature was mainly searched through CNKI Knowledge Network Database, Wanfang Database, and Wipu Journal Network by keywords such as adolescents, middle school students, college students, students, junior high school students, high school students, Internet addiction, pathological Internet use, problematic Internet use, cell phone addiction, gaming addiction, social network addiction, anxiety, social anxiety, and attachment anxiety, etc., in the search field of "subject" or "full text" or "article title". " or "full text" or "title".

Our search included documents up to February 28, 2023, and resulted in the identification of 100 primary studies for inclusion in our study. The literature search process is shown in Fig. 1.

Literature inclusion and exclusion criteria

Combining the meta-analytic methodology and the requirements of the research topic, the criteria for inclusion in the meta-analytic study were (1) The concepts of anxiety and IUD were clearly defined, and recognized questionnaires or scales for the measurement of anxiety and IUD were used. (2) The study population was a normal student population, including elementary, middle, and high school students. (3) Specific correlation coefficient r-values, or information that can be converted to correlation coefficients such as t-values, F-values, and χ^2-values were reported. (4) Specific sample sizes were reported. (5) The language was Chinese or English.

The exclusion criteria were (1) The type of article was a review, abstract, case report, etc. (2) Incomplete reporting of important data. (3) Unclear definitions of anxiety and IUD-related behaviors. (4) Repeated publications. For example, Cao et al. [74] and Zhou et al. [75] belonged to the same data repetitively published. (5) Students with special status. Such as students with anxiety disorders, as well as other mental disorders and serious physical illnesses [76].

Search results

Initially, 2778 primary studies were searched and obtained, and the final number of papers included in the meta-analysis was 100, of which 38 were in Chinese and 62 were in English, containing 100 effect sizes, with a total sample size of 108,539, and a span of publication years from 2004 to 2022.

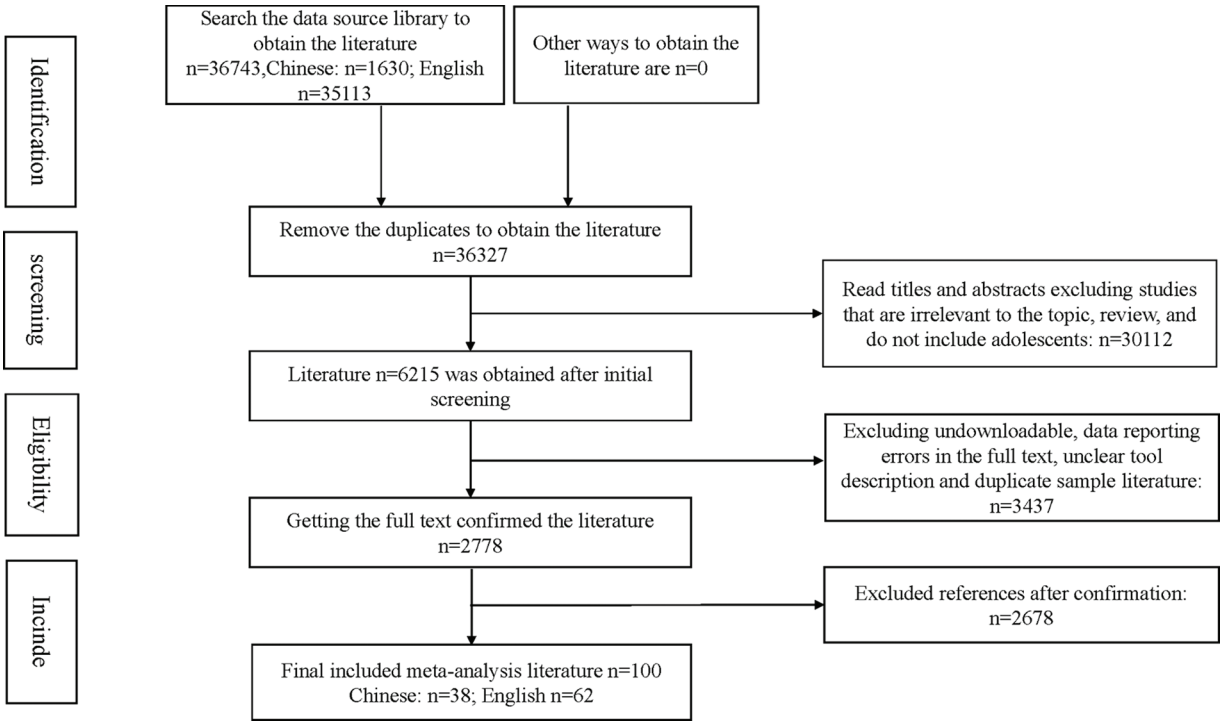

FIGURE 1. Flowchart for inclusion of literature.

Literature coding

The entire literature was included and excluded based on the above criteria, and the literature included in the meta-analysis was coded as follows (see Table 1): literature information (author's name and year of publication of the literature), region of the literature surveyed, population of the study, sample size, measurement tool, language of the literature, type of publication, effect size, male ratio, type of anxiety, and quality score.

The coding process consists of several steps. The first step was to develop a coding plan. Based on the purpose and research questions of this study, the coding plan included the variables listed in Table 2. The second step was to extract information from the study. This study was independently coded by the first author. The third step was to perform cross-checking and validation. The first author completed the coding and then had the second author proofread it one by one. The results showed that the agreement between the two independent coders was 96%, except for a small amount of bias in some of the data. When inconsistencies in coding were encountered, revisions were made after reviewing the original study discussion.

Information extraction

Information extraction is primarily concerned with understanding sample characteristics in the original study and searching for potential moderating variables that may be present [150]. A number of study characteristics were systematically extracted from the primary studies that could serve as potential moderators to explain inconsistencies between the effect sizes of individual studies. These study characteristics are listed in Table 2.

Meta-analysis process

Calculation of effects

The correlation coefficient (Zero order r) was used as the effect size in this study. In the calculation process, each r value was first converted to the corresponding *Fisher's* Z-score with the formula $Z = 0.5 \times \mathrm{In}\left(\frac{1+r}{1-r}\right)$. The Fisher's Z values were then converted to calculate the effect size with the formula $r = \frac{e^{2z}-1}{e^{2z}+1}$. where the variance of Z is $V_z = \frac{1}{n-3}$, n denotes the sample size, and the standard error of Z is $SE_z = \sqrt{V_Z}$.

Several studies have converted existing information to r. Yin et al. [43], Mamun et al. [109], and Radeef et al. [119] by comparing the Internet Addiction Disorder (IAD) group with the non-IAD group by comparing the difference in mental status scores between the IAD and non-IAD groups and reporting t-values, concluding that anxiety was significantly and positively associated with Internet addiction; Wang [132] reported χ^2-values in the primary literature, concluding that anxiety was significantly and positively associated with IUD; Liu [61] and Zhang et al. [47] reported F-values in the original literature and concluded that anxiety was significantly and positively associated with Internet addiction. Instead of directly reporting correlation coefficients based on the correlation between anxiety and

TABLE 1

Coding list of original literature

Author [a]	Year	Region [b]	Grade [c]	Sample size	Gauge		Language [f]	Publication type [g]	Effect value [h]	Male[i]	Quality score	Type of anxiety[j]	Causality[k]
					IUD [d]	Anxiety [e]							
Adalıer et al. [77]	2012	AS	U	126	IAS	other	E	J	0.471	63.50%	16	T	IUD-A
Akin et al. [78]	2011	EU	U	300	other	DASS-21	E	J	0.629	32.00%	16	T	IUD-A
Al Shawi et al. [79]	2022	AS	U	305	YIAT	DASS-21	E	J	0.272	38.40%	15	T	IUD-A
Ali et al. [80]	2019	AS	M-P	300	YIAT	DASS-21	E	J	0.179	76.00%	14	T	IUD-A
Ayar et al. [81]	2018	EU	U	755	other	other	E	J	0.466	59.70%	19	S	A-IUD
Azher et al. [82]	2014	AS	U	300	IAS	BAI	E	J	0.308	50.00%	14	T	IUD-A
Bernal-Ruiz et al. [83]	2017	EU	U	310	other	other	E	J	0.27	42.50%	15	S	IUD-A
Cao et al. U1 [49]	2010	AS	M-P	611	other	other	C	J	0.146	47.00%	20	S	A-IUD
Cao et al. U2 [74]	2010	AS	U	787	other	other	C	J	0.2	30.20%	20	S	A-IUD
Chen et al. [44]	2009	AS	U	610	CIAS	other	C	J	0.24	NA	20	S	A-IUD
Chen et al. [84]	2019	AS	U	489	other	other	C	J	0.23	39.00%	15	T	A-IUD
Choi et al. [85]	2015	AS	U	448	YIAT	other	E	J	0.258	39.70%	17	T	A-IUD
Çınar Özbay et al. [86]	2022	EU	U	958	YIAT	SAS	E	J	0.288	53.10%	17	S	IUD-A
Dalbudak et al. [87]	2013	EU	U	319	IAS	BAI	E	J	0.049	26.60%	19	T	IUD-A
Dalbudak et al. [88]	2014	EU	U	300	YIAS	BAI	E	J	0.292	40.60%	19	T	IUD-A
Ding et al. [89]	2016	AS	U	312	YIAT	other	C	J	0.19	27.20%	16	S	A-IUD
Dong et al. [90]	2020	AS	NA	2050	YIAT	DASS-21	E	J	−0.048	51.60%	16	T	IUD-A
Du et al. [91]	2020	AS	M-P	356	IADQ	SAS-A	C	J	0.248	NA	18	S	A-IUD
Durak et al. [92]	2013	EU	U	448	other	other	E	J	0.18	39.50%	17	S	A-IUD
Erceg et al. [93]	2018	AS	M-P	1320	other	other	E	J	0.368	43.00%	17	T	IUD-A
Feng et al. [48]	2019	AS	M-P	1634	CIAS	SAS-A	E	J	0.086	71.00%	17	S	A-IUD
Gao [94]	2021	AS	M-P	552	CIAS	other	C	D	0.402	44.20%	17	T	IUD-A
Gao et al. [95]	2018	AS	M-P	2259	YIAT	DASS-21	E	J	0.41	46.00%	17	T	A-IUD
Gholamian et al. [96]	2017	AS	M-P	417	YIAT	DASS-21	E	J	0.481	50.10%	15	T	IUD-A
Goel et al. [97]	2013	AS	U	987	YIAT	other	E	J	0.172	31.30%	16	T	IUD-A
Guo [98]	2021	AS	U	600	other	other	C	D	0.29	22.50%	19	S	A-IUD
Ismail et al. [99]	2020	AS	U	525	other	DASS-21	E	J	0.39	66.90%	18	T	IUD-A
Javaeed et al. [65]	2019	AS	U	210	YIAT	DASS-21	E	J	0.06	35.70%	15	T	IUD-A
Jiang et al. [73]	2018	AS	M-P	1804	other	other	C	J	0.402	43.70%	19	S	A-IUD

Table 1 (continued)

Author [a]	Year	Region [b]	Grade [c]	Sample size	Gauge		Language [f]	Publication type [g]	Effect value [h]	Male[i]	Quality score	Type of anxiety[j]	Causality[k]
					IUD [d]	Anxiety [e]							
Kheyri et al. [68]	2019	AS	U	353	YIAT	other	E	J	0.173	0.00%	15	T	IUD-A
Kim et al. [100]	2016	AS	M-P	230	other	other	E	J	0.865	100.00%	15	T	IUD-A
Koc [70]	2011	EU	U	174	other	other	E	J	0.872	44.30%	14	T	IUD-A
Lai et al. [101]	2015	AS	NA	5366	YIAT	SAS-A	E	J	0.13	NA	16	S	A-IUD
Lavoie et al. [21]	2023	NA	NA	2883	YIAT	other	E	J	0.218	44.30%	16	S	A-IUD
Lebni et al. [102]	2020	AS	U	447	YIAT	other	E	J	0.054	48.10%	16	T	IUD-A
Li et al. [103]	2015	AS	NA	312	other	other	C	J	0.43	49.00%	18	S	A-IUD
Li et al. [104]	2019	AS	NA	1105	YIAT	other	E	J	0.29	71.50%	20	T	A-IUD
Li et al. [105]	2021	AS	M-P	2848	other	other	E	J	0.43	49.00%	18	T	A-IUD
Li [106]	2022	AS	NA	825	other	SAS-A	C	D	0.35	43.80%	19	S	A-IUD
Liu [61]	2011	AS	U	503	YIAT	SAS	C	D	0.244	64.00%	15	T	IUD-A
Liu [107]	2021	AS	M-P	837	other	other	C	D	0.4	43.40%	19	S	A-IUD
Liu [50]	2022	AS	M-P	4852	CIAS	SAS	E	J	0.45	49.00%	22	T	IUD-A
Malak et al. [108]	2017	AS	NA	720	YIAT	other	E	J	0.306	50.10%	15	T	A-IUD
Mamun et al. [109]	2019	AS	U	405	YIAT	DASS-21	E	J	0.237	50.10%	18	T	A-IUD
Mohammadk hani et al. [58]	2017	AS	U	400	other	other	E	J	0.25	51.90%	15	T	IUD-A
Molavi et al. [110]	2018	AS	U	358	YIAT	other	E	J	0.39	43.60%	14	S	A-IUD
Musa et al. [111]	2014	AS	M-P	235	YIAT	other	E	J	0.759	0.00%	16	T	IUD-A
Naeim et al. [112]	2020	AS	U	346	IAT	other	E	J	0.6	0.00%	14	S	IUD-A
Ni et al. [113]	2009	AS	U	3557	YIAT	SAS	E	J	0.338	68.18%	15	T	IUD-A
Odacı et al. [114]	2010	EU	U	493	other	other	E	J	0.175	37.50%	16	S	IUD-A
Odacı et al. [115]	2017	EU	U	378	other	DASS-21	E	J	0.431	28.40%	16	T	A-IUD
Ostovar et al. [60]	2016	AS	NA	632	YIAT	DASS	E	J	0.549	68.20%	16	T	IUD-A
Othman et al. [116]	2017	AS	U	267	YIAT	other	E	J	0.056	10.10%	15	T	IUD-A
Ozturk et al. [117]	2013	EU	M-P	303	IAS	other	E	J	0.205	69.30%	16	T	A-IUD
Panicker et al. [64]	2014	AS	U	84	other	DASS-21	E	J	0.2	70.20%	16	T	A-IUD
Peng [118]	2021	AS	M-P	812	other	SAS-A	C	D	0.46	54.83%	18	S	A-IUD
Radeef et al. [119]	2018	AS	U	268	CIAS	DASS-21	E	J	0.085	69.40%	13	T	IUD-A
Ranjan et al. [120]	2023	AS	U	854	YIAT	other	E	J	0.223	67.20%	18	T	IUD-A
Ren et al. [34]	2017	AS	M-P	432	other	other	E	J	0.385	49.00%	15	S	A-IUD
Sayed et al. [121]	2022	AF	U	808	YIAT	DASS-21	E	J	0.35	26.50%	16	T	IUD-A

(Continued)

Table 1 (continued)

Author [a]	Year	Region [b]	Grade [c]	Sample size	Gauge		Language [f]	Publication type [g]	Effect value [h]	Male[i]	Quality score	Type of anxiety[j]	Causality[k]
					IUD [d]	Anxiety [e]							
Seifi et al. [62]	2014	AS	U	209	YIAT	DASS-21	E	J	0.45	63.60%	16	T	IUD-A
Shaikhamadi et al. [122]	2017	AS	M-P	595	IAT	BAI	E	J	0.137	52.10%	16	T	IUD-A
Shan et al. [69]	2021	AS	U	3380	CIAS	other	E	J	0.158	59.02%	16	S-T	IUD-A
Shen et al. [123]	2020	AS	U	8098	CIAS	SAS	E	J	0.723	45.00%	16	T	IUD-A
Song [72]	2020	AS	M-P	355	other	other	C	D	0.19	52.10%	17	S	IUD-A
Stavropoulos et al. [124]	2017	EU	M-P	648	IAT	SCL-90	E	J	0.315	46.40%	16	T	A-IUD
Sun et al. [125]	2007	AS	M-P	1421	other	SAS	C	J	0.137	48.00%	16	T	A-IUD
Tao et al. [59]	2016	AS	U	1048	YIAT	SAS	E	J	0.4	51.50%	17	T	IUD-A
Teng et al. [126]	2021	AS	U	970	other	other	C	J	0.249	27.00%	17	S	A-IUD
Tong [45]	2012	AS	NA	1947	IADC	SCL-90	C	J	0.316	53.00%	15	T	IUD-A
Tong [127]	2019	AS	NA	2872	other	other	C	J	0.295	35.20%	19	S	A-IUD
Tras et al. [128]	2019	EU	U	484	other	other	E	J	0.43	31.40%	17	S	IUD-A
Tu et al. [129]	2022	AS	U	869	YIAT	other	C	J	0.338	35.00%	17	S	A-IUD
Wang [130]	2004	AS	NA	773	other	other	C	D	0.25	49.90%	18	S	A-IUD
Wang [63]	2011	AS	U	606	IADQ	other	C	J	0.164	46.00%	15	S	A-IUD
Wang [131]	2017	AS	U	630	other	other	C	J	0.245	22.15%	18	S	IUD-A
Wang et al. [132]	2020	AS	U	9638	YIAT	SAS	C	D	0.253	NA	14	T	A-IUD
Wang [133]	2020	AS	U	3536	YIAT	other	C	J	0.32	46.00%	17	S	IUD-A
Wang et al. [134]	2022	AS	M-P	1028	other	other	C	D	0.56	49.00%	21	S	A-IUD
Weinstein et al. [20]	2015	AS	U	60	YIAT	other	E	J	0.377	50.00%	16	S	IUD-A
Woon [71]	2020	AS	M-P	125	YIAT	DASS-21	E	J	0.605	50.40%	15	T	IUD-A
Xie et al. [135]	2023	AS	U	234	CIAS	SAS	E	J	0.209	37.00%	17	T	A-IUD
Yadav et al. [136]	2013	AS	M-P	552	YIAT	DASS-21	E	J	0.51	59.40%	15	T	IUD-A
Yang [137]	2017	AS	M-P	728	other	other	C	D	0.26	48.76%	16	S	A-IUD
Yang [138]	2021	AS	M-P	1216	other	SAS	C	D	0.376	49.70%	17	T	IUD-A
Ye et al. [17]	2016	AS	U	997	YIAT	other	C	J	0.28	51.50%	19	T	A-IUD
Yen et al. [139]	2008	AS	U	3662	CIAS	other	E	J	0.129	63.10%	18	T	IUD-A
Yıldız Durak [140]	2020	EU	M-P	451	other	other	E	J	0.017	52.50%	13	S	IUD-A
Yin et al. [43]	2012	AS	NA	478	IADQ	other	C	J	0.232	71.00%	13	S	IUD-A
Younes et al. [141]	2016	NA	U	600	YIAT	DASS-21	E	J	0.35	30.30%	18	T	IUD-A
Yücens et al. [142]	2018	EU	U	392	YIAT	other	E	J	0.215	43.40%	18	S-T	IUD-A

Table 1 (continued)

Author [a]	Year	Region [b]	Grade [c]	Sample size	Gauge		Language [f]	Publication type [g]	Effect value [h]	Male[i]	Quality score	Type of anxiety[j]	Causality[k]
					IUD [d]	Anxiety [e]							
Zhang et al. [47]	2008	AS	U	355	YIAT	other	C	J	0.117	56.00%	15	S	IUD-A
Zhang et al. [143]	2009	AS	U	378	CIAS	other	C	J	0.224	48.00%	16	T	A-IUD
Zhang et al. [144]	2013	AS	U	1807	IADC	other	C	J	0.124	51.00%	17	S	IUD-A
Zhang et al. [145]	2016	AS	U	530	CIAS	other	C	J	0.34	46.00%	18	T	A-IUD
Zhang [146]	2019	AS	U	230	other	other	C	D	0.583	34.30%	15	S	A-IUD
Zhang [66]	2020	AS	M-P	393	other	other	C	D	0.648	52.90%	16	S	A-IUD
Zhang et al. [147]	2021	AS	M-P	2672	other	other	C	J	0.29	41.70%	15	S	A-IUD
Zhang et al. [148]	2021	AS	M-P	94	YIAT	other	E	J	0.55	NA	18	S	A-IUD
Zhang et al. [149]	2022	AS	M-P	999	other	SAS	E	J	0.29	51.00%	18	T	IUD-A

Note: a To reduce space, only the first author is listed in most cases; U1 and U2 are different articles published by the same author. b AS = Asia, EU = Europe, AF = Africa, NA = North America. c M-P = primary and secondary school students, U = university students, and NA indicates that the type of report was not explicitly reported or did not fall into one of the above categories. d AT = Internet Addiction Questionnaire developed by K.S. Young, IADC = Internet Addiction Diagnostic Criteria, CIAS-R = Chinese Internet Addiction Scale, IAS = Internet Addiction Scale, and other = other test scales. e SAS = Self-Rating Anxiety Scale, SAS-A = Social Anxiety Scale for Adolescents, DASS-21 = Depression, Anxiety, and Stress Scale, BAI = Beck Anxiety Inventory, SCL-90 = Symptom Self-Assessment Scale, and SAS-90 = Symptomatic Self-Assessment Scale, other = other test scales. f C = Chinese, E = English. g D = Dissertation, J = Journal paper. h Those not directly reporting *r*-values were converted from *t*-values or χ^2-values or *F*-values. i NA indicates not reported male ratio. j S indicates state anxiety, T indicates trait anxiety, and S-T indicates state-trait anxiety. k A-IUD indicates anxiety leading to IUD, IUD- A indicates IUD causes anxiety.

TABLE 2

Coding table for moderating variables

Moderator variable	Category	Category abbreviation	Effect size quantity
Publication type	Periodicals	J	86
	A PhD thesis	D	14
Subject's grade	Primary and secondary schools	M-P	33
	College	U	55
subject area	Asian	AS	82
	European	EU	15
	North America	NA	2
	Continent	AF	1
Type of anxiety	(psychology) state anxiety	S	41
	Trait anxiety	T	57
	State-Trait Anxiety	S-T	2
IUD measurement tool types	Internet addiction questionnaire developed by young	YIAT	41
	Diagnostic criteria for internet addiction	IADC	2
	Internet Addiction Scale (IAS)	IAS	4
	Chinese Internet Addiction Scale	CIAS-R	11
	Other scales	other	42
Types of anxiety measurement tools	Social anxiety Self-Rating scale	SAS	12
	Depression, Anxiety, Stress scale.	DASS-21	18
	Social anxiety scale for adolescents (SAS-A)	SAS-A	4
	Beck anxiety inventory	BAI	4
	Symptom self-control sale (SCL I-90)	SCL-90	2
	Other scales	other	60
Quality rating	Medium to high quality (12–18)	M-H	86
	High quality (18+)	H	14

IUD, these literatures reported *t*-values, χ^2-values, or *F*-values, which we converted to *r*-values using the correlation formula [151], namely $r = \sqrt{\frac{t^2}{t^2+df}}$; $r = \sqrt{\frac{\chi 2}{\chi 2 + N}}$; $r = \sqrt{\frac{F}{F + df}}$, $df = n_1 + n_2 - 2$.

In this study, the rating criteria of Gignac et al. [152] were used and $r = 0.100$, $r = 0.200$ and $r = 0.300$ were considered as low, moderate and strong correlation, respectively.

Model selection

The main difference between a fixed effects model and a random effects model is the source of the error. In a fixed-effects model, the variation between effect sizes is caused only by random error (from the subjects). In a random effects model, the variation between effect sizes is caused by random error and some systematic error (from a study characteristic, such as publication type). Due to the structure of the errors, the results of fixed effects models cannot be generalized to other situations, but the results of random effects models can be generalized [150]. The research aim of this study was to generalize the findings to other samples, therefore, a random effects model was selected for the meta-analysis [150,153].

Heterogeneity test

The main tests for heterogeneity are the *Q* test and the I^2 test. The *Q* test is a test based on total variation, assuming that the effect sizes follow a chi-square distribution, which indicates significant heterogeneity if $p < 0.05$; according to previous views, 25%, 50%, and 75% of the I^2 values can be considered as the boundaries of low, medium, and high heterogeneity [150,154].

Publication bias

Publication Bias (PB) is an error caused by some unseen selection process, in which those studies with significant results receive a higher likelihood of publication [150]. Fail safe N (*Nfs*), Funnel plot, trim and fill method, Egger's regression are commonly used to detect publication bias.

The failure safety factor (Fail safe N, *Nfs*) is defined as the number of primary studies needed to make the mean effect zero [150]. If *Nfs* is small, less than 5K + 10, then there is a possibility of publication bias. If *Nfs* is large, greater than 5K + 10, then there is a low likelihood of publication bias.

A funnel plot is a scatter plot in which the observed effect size is loaded on the x-axis and its standard error is loaded on the y-axis [150]. The degree of symmetry of the funnel plot will indicate the magnitude of publication bias, with left-

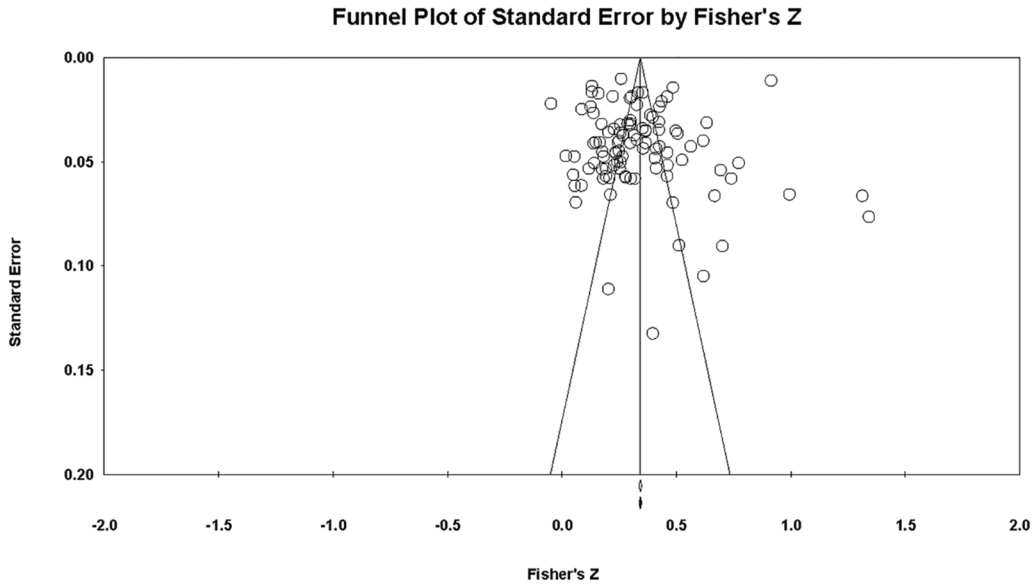

FIGURE 2. Funnel plot for this study.

right symmetry indicating less publication bias and left-right asymmetry indicating more publication bias.

Clipping is often used to adjust for asymmetries in funnel plots [155]. After adding some "missing" data as required by symmetry, the cut-and-patch method re-estimates the total effect size. A small difference in the size of the total effect size before and after clipping indicates a small effect of publication bias; a large difference indicates a large effect of publication bias.

Egger's regression (Egger's regression test) is a meta-analytic publication bias test by linear regression [156]. Egger's linear regression when the intercept is not significant indicates less bias.

This study also obtained unpublished literature as much as possible during the literature search stage to minimize the effect of publication bias.

Quality assessment of original research

In this study, the Basic Quality Assessment of Primary Study, BQAPS [157] was used as a quality assessment tool to assess the quality of studies included in the meta-analysis, based on a scoring criteria, 0–6 was categorized as low quality, 6–12 was categorized as low to medium level, 12–18 was categorized as high to medium level, and 18 or more was categorized as high quality.

Findings

Impact of quality of original research

Based on the scoring criteria, quality assessment showed that 86 of the primary studies were of moderate to high quality (86.00%) and 14 were of high quality (14.00%). The moderating effect of quality scores on the relationship between anxiety and IUD was not significant (Q_B = 0.002, p = 0.963).

The relationship between anxiety and IUD was significantly positive in the medium- and high-quality subgroups, with a correlation coefficient of 0.329% and 95% CI [0.265, 0.389], and in the high-quality subgroup, with a correlation coefficient of 0.330% and 95% CI [0.283, 0.376].

Publication bias test

The funnel plot shows that effect sizes are distributed on both sides of the total effect size, with the complementary black dots to the right of the mean, suggesting that there may be larger effect sizes that were not published (see Fig. 2). Egger's linear regression resulted in a non-significant intercept of −0.978 with a 95% CI [−3.945, 1.989] and a p = 0.515, suggesting that the funnel plot was symmetric in a statistically significant way. *Nfs* = 16187, greater than 5K + 10 = 5 × 100 + 10 = 510, indicating that no negative results were missed. After adding 25 effect sizes, the effect size was 0.394 with a 95% CI [0.389, 0.398], a non-significant difference. Overall, the effect of publication bias on the findings in this study was negligible.

Heterogeneity test

The purpose of the heterogeneity test is to test whether the effect sizes measured between studies are heterogeneous. In this study, the relationship between student anxiety and IUD was tested for heterogeneity and the results are shown in Table 3.

The results in Table 3 show that the Q-tests for the effect values between studies were significant (p < 0.001), indicating that the effect values in the meta-analysis were heterogeneous; the total sample I^2 value was 98.180%, which may be due to the effect of moderating variables.

Main effects analysis

The random effects model was used to estimate the strength of correlation between students' anxiety and IUD, and the results showed that the correlation coefficient between the two was 0.330 with 95% CI [0.289, 0.369]. Based on the reference standard, the correlation coefficient between anxiety and

TABLE 3

Results of heterogeneity test

k	*Q*	*df*	*P*	I^2	Tau^2	*SE*	Variance	*Tau*
100	5440.435	99	0	98.180	0.225	0.012	0.000	0.051

Note: *k* denotes the number of independent samples and *SE* denotes standard error.

IUD in this study was greater than 0.300, and it can be considered that there is a high strength positive correlation between the two [152,158].

Analysis of moderating effects

Moderating effects of IUD's measurement tools

The moderating effect of the measurement tool for IUD was not significant (Q_B = 6.953, p = 0.138) (see Table 4). The relationship between anxiety and IUD was significantly and positively correlated across the five subgroups of studies analyzed in the CIAS-R, IADC, YIAT, IAS, and other, with correlation coefficients of 0.294 (95% CI [0.081, 0.481]), 0.222 (95% CI [0.028, 0.401]), 0.302 (95% CI [0.259, 0.343]), 0.257 (95% CI [0.092, 0.408]), and 0.372 (95% CI [0.324, 0.419]).

Moderating effects of anxiety types

Anxiety type had a significant moderating effect (Q_B = 48.883, p < 0.000) (see Table 4). The relationship between anxiety and IUD was significantly and positively correlated in all three subgroups analyzed in the study: state anxiety, trait anxiety, and state-trait anxiety, with correlation coefficients of 0.310 (95% CI [0.267, 0.351]), 0.349 (95% CI [0.287, 0.408]), and 0.156 (95% CI [0.125, 0.187]), respectively. In descending order: trait anxiety, state anxiety, and state-trait anxiety.

Moderating effects of measurement instruments for anxiety

The moderating effect of the instrument measuring anxiety was not significant (Q_B = 5.418, p = 0.367) (see Table 4).The correlation coefficients for the six subgroups of DASS-21, SAS, SAS-A, BAI, SCL-90, and other were 0.355 (95% CI [0.252, 0.449]), 0.330 (95% CI [0.170, 0.474]), 0.301 (95% CI [0.120, 0.463]), 0.197 (95% CI [0.078, 0.310]), 0.316 (95% CI [0.281, 0.350]), and 0.330 (95% CI [0.291, 0.369]), and the correlation coefficients of the subgroups of the measurement tools of anxiety were not significant differences.

Moderating effects of grade level

The moderating effect of grade level was not significant (Q_B = 2.722, p = 0.099) (see Table 4). The correlation coefficients were 0.377 (95% CI [0.321, 0.429]), and 0.307 (95% CI [0.243, 0.368]) for the two subgroups of middle school and college, respectively. The correlation coefficients for the two subgroups of grade level were not significantly different.

Moderating effects of subjects' location

The moderating effect of the location of the subjects was not significant (Q_B = 1.055, p = 0.788) (see Table 4). Significant positive correlations were found across the four subgroups of studies analyzed in Asia, Europe, Africa, and North America, with correlation coefficients of 0.327 (95% CI [0.281, 0.372]), 0.347 (95% CI [0.232, 0.425]), 0.350 (95% CI [0.288, 0.409]), and 0.281 (95% CI [0.147, 0.405]).

Moderating effect of type of publication

The moderating effect of publication type was not significant (Q_B = 2.176, p = 0.140) (see Table 4). The correlation coefficients for the two subgroups of journal articles and dissertations were 0.320 (95% CI [0.273, 0.366]) and 0.384 (95% CI [0.313, 0.451]), respectively. The difference between the two groups did not reach significance.

Discussion

In order to obtain the true relationship between anxiety and IUD, the present study conducted a meta-analysis of 100 primary studies and found significant moderating effects of the instrument used to measure IUD, the type of anxiety, the instrument used to measure anxiety, the grade level of the subjects, and the region in which the subjects were located.

Main effects of the relationship between student anxiety and IUD

The present study found a high-intensity significant positive correlation between student anxiety and IUD (r = 0.330), validating Hypothesis 1. This result is consistent with the ego-defense mechanism model of anxiety-IUD [17], the socioemotional model [22], the pathological use model [30], and the social-psycho-physiological model [31] were consistent in their predictions.

From a process perspective, anxiety may be both a cause and a consequence of IUD. First, anxiety may lead to IUD. the internal logic is that individuals with high levels of anxiety may have distorted self-perceptions [159,160], experience more negative affect [22], and thus search for security, satisfaction in online use [161,162].

Second, IUD may also lead to anxiety. The underlying logic is that overuse of the Internet leads to a decrease in normal social interactions and impaired social functioning [163–165], which can lead to an individual's anxiety about the future [30,166].

The main reason why some primary studies reported non-significant results of correlation is that their sample sizes were small and not representative enough [35,36,47]. The correlation significant results from this meta-analysis are more credible after integrating the information from multiple samples.

Moderating effects of student anxiety and IUD

Moderating effects of IUD's measurement tools

The moderating effect of the IUD measurement tool on the relationship between anxiety and IUD was not significant

TABLE 4

Moderated effects test of IUD-anxiety relationship

Moderator variable	Heterogeneity test		form	*K*	95% CI		
	Q_B	*df*			Point estimate	Lower limit	Limit
IUD measurement tools	6.953	4	CIAS-R	11	0.294**	0.081	0.481
			IADC	2	0.222**	0.028	0.401
			YIAT	41	0.302***	0.259	0.343
			IAS	4	0.257**	0.092	0.408
			Other	42	0.372***	0.324	0.419
Type of anxiety	48.883***	2	(psychology) state anxiety	41	0.310***	0.267	0.351
			Trait anxiety	57	0.349***	0.287	0.408
			State-Trait anxiety	2	0.156***	0.125	0.187
Anxiety measurement tool	5.418	5	DASS-21	18	0.355***	0.252	0.449
			SAS	12	0.330***	0.17	0.474
			SAS-A	4	0.301**	0.12	0.403
			BAI	4	0.197**	0.078	0.31
			SCL-90	2	0.316***	0.281	0.35
			Other	60	0.330***	0.291	0.369
Grade	2.722	1	Middle school	33	0.377***	0.321	0.429
			College	55	0.307***	0.243	0.368
Location of subjects	1.055	3	Asian	82	0.327***	0.281	0.372
			European	15	0.347***	0.232	0.425
			Continent	1	0.350***	0.288	0.409
			North America	2	0.281***	0.147	0.405
Publication type	2.176	1	Periodicals	86	0.320***	0.273	0.366
			A PhD thesis	14	0.384***	0.313	0.451

Note: *K* indicates number of independent samples, CI is confidence interval; Q_B is the value of heterogeneity test between groups; *p* is significance level of coefficient; $^{**}p < 0.01$, $^{***}p < 0.001$.

($Q_B = 6.953$, $p = 0.138$) and did not support Hypothesis 2. The relationship between anxiety and IUD was significantly and positively correlated across the four subgroups of studies analyzed in the CIAS-R, the IADC, the YIAT, the IAS, and other, with correlation coefficients of 0.294, 0.222, 0.302, 0.257, and 0.372. The effects of the IUD measurement instruments were all on the order of 0.2 and 0.3, indicating that the relationship was consistent across IUD instruments.

Moderating effects of anxiety type

Anxiety type had a significant moderating effect on the relationship between anxiety and IUD ($Q_B = 48.883$, $p < 0.000$), validating Hypothesis 3. The three subgroups analyzed in the study of state anxiety, trait anxiety, and state-trait anxiety were significantly positively correlated, with correlation coefficients of 0.310, 0.349, and 0.156, respectively. These correlation coefficients can be classified into two groups, state anxiety and trait anxiety as a group with correlation coefficients greater than or equal to 0.300, and state-trait anxiety as a group with correlation coefficients less than 0.20. And in descending order, the correlation coefficients are: trait anxiety, state anxiety, and state-trait anxiety.

This result suggests that the magnitude of the association between different types of anxiety and IUD is not consistent. The reason for this result may be that different types of anxiety do not play the same role in the creation, formation, and development of IUD. Anxiety as a cause may be more distant from IUD and its association with IUD is relatively small, whereas anxiety as a consequence may be closer to IUD and its association with IUD is relatively high.

Moderating effects of measurement instruments for anxiety

The moderating effect of the anxiety measurement tool was not significant ($Q_B = 5.418$, $p = 0.367$) and did not support Hypothesis 4. The correlation coefficients for the relationship between anxiety and IUD across the six subgroups of the DASS-21, SAS, SAS-A, BAI, SCL-90, and other were 0.355, 0.330, 0.301, 0.107, 0.316 and 0.330, respectively. The effects of the anxiety measurement instruments were all on the order of 0.300, indicating that the relationship was consistent across anxiety instruments. One of the correlations in the SCL-90 condition was as high as 0.90, the reason for which requires further analysis.

Moderating effects of grade level

The moderating effect of grade level was not significant ($Q_B = 2.722$, $p = 0.099$) and did not support Hypothesis 5. The correlation coefficients for the secondary and tertiary subgroups were 0.377 and 0.307, respectively, suggesting

that there may be stability in the relationship across age groups.

This result is supported by previous research. First, the correlation between the two may be high at both the middle school level and the college level. Li et al. [105] surveyed 2848 middle school students who reported low scores on both anxiety and IUD in the original study, and the correlation between the two was high, with a correlation coefficient of r = 0.430. Peng [118] surveyed 812 high school students who reported Anxiety and IUD scores were both high, and the correlation between the two was high, with a correlation coefficient of r = 0.460; Tu et al. [129] surveyed 869 college students, and both Anxiety and IUD scores reported in the original study were low, whereas the correlation between the two was high, with a correlation coefficient of r = 0.338; Zhang [146] surveyed 230 college students, and the correlation between the both anxiety and IUD scores were high, and the correlation between the two was high, with a correlation coefficient of r = 0.583. Second, there were grade-level differences in IUD use only on individual dimensions, such as the negative consequences dimension, but overall there were no significant grade-level differences in student IUD [167].

Moderating effects of subjects' location

The moderating effect of the region where the subjects were located was not significant (Q_B = 1.055, p = 0.788) and did not support Hypothesis 6. Significant positive correlations were found across the four subgroups of the study analyzed in Asia, Europe, Africa, and North America, with correlation coefficients of 0.327, 0.347, 0.350, and 0.281, respectively.This result suggests that there is a consistency in the relationship of anxiety and IUD across regions. As global interactions and competition increase, global well-being is declining [168], and anxiety levels among adolescents are rising globally [169,170]. This is also supported by previous research, which confirmed through meta-analysis that both anxiety levels and cell phone dependence levels are increasing with each passing year [37].

Moderating effect of type of publication

The results of this study showed that the moderating effect of publication type on the relationship between anxiety and IUD was not significant (Q_B = 2.176, p = 0.140), which did not support Hypothesis 7. This is corroborated with the results of the detection of publication bias. Card [151] stated that one test for publication bias is to compare the differences between the outcomes of the different types of publication, and that if the differences are not significant, then it means that publication bias is not significant. In other words, publication type differences and publication bias in this study are negligible.

Research shortcomings and future prospects

Relative to previous literature [39], the present meta-analysis was extended in two ways. First, 100 primary studies were included in this study, making the findings more reliable. Second, the meta-analysis categorized anxiety and found a significant moderating effect. This implies that not only social anxiety but also other types of anxiety may be related to IUD. However, several previous theoretical models (cognitive-behavioral model, social-emotional model, pathological use model, and socio-psycho-physiological model) did not provide a reasonable explanation for this.

Nonetheless, there are some shortcomings in this study. First, the number of primary studies on some subgroups of moderating variables, such as the area where the subjects were located, was too small. Some had only 1 article. This could lead to potentially unstable results. Second, because the primary studies were not differentiated, the present meta-analysis also failed to separately explore the relationship between anxiety as a cause and IUD, and the relationship between anxiety as a consequence and IUD.

In addition to increasing the number of original studies, future research needs to focus on the following issues. First, further explore the different relationship models between state anxiety, trait anxiety and IUD, and deeply analyze the role of anxiety in the generation, formation and development of IUD. Second, a controlled experiment, or cross-lag study, should be conducted to further determine the causal relationship between anxiety and IUD. Third, further integrate the existing theoretical models (i.e., self-defense mechanism model of anxiety-IUD, social-emotional model, pathological use model, social-psychological-physiological model) to clarify the psychological process of the relationship between anxiety and IUD.

Conclusions

Under the conditions of this study, the following conclusions were obtained in this paper:

(1) There is a high intensity significant positive correlation between student anxiety and IUD.

(2) Anxiety type significantly moderated the relationship between student anxiety and IUD.

(3) The moderating effects of the measurement tool used by the problematic network, the measurement tool for anxiety, the subject's grade level, the subject's region, and the type of publication on the relationship between student anxiety and IUD were not significant.

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