UNIVERSIDAD & SOCIEDAD
Presentation date: November, 20224
Date of acceptance: February, 2025
Publication date: April, 2025

COMPARISON

OF DIFFERENT TYPES OF INTERVENTIONS TO IMPROVE MOBILE PHONE ADDICTION AMONG UNIVERSITY STUDENTS

COMPARACIÓN DE DIFERENTES TIPOS DE INTERVENCIONES PARA MEJORAR LA ADICCIÓN AL TELÉFONO MÓVIL ENTRE ESTUDIANTES UNIVERSITARIOS

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Suggested citation (APA, seventh ed.)

Liu, X. & Binti Baharudin, S. M. (2025). Comparison of different types of interventions to improve mobile phone addiction among university students. ***Universidad y Sociedad, 17***(2), e5093.

ABSTRACT

This study assessed the efficacy of four interventions for mobile phone addiction among university students through meta-analysis and network meta-analysis. Databases such as CNKI, Web of Science, PubMed, Cochrane Library and EMBASE were searched to collect randomised controlled trials of four interventions for mobile phone addiction in university students and to assess the effects of these interventions on mobile phone addiction in this population. The search was conducted from the beginning of the databases until 24 September 2024. Data were analysed using Revman 5.4 and Stata 17.0 software. All four interventions were statistically significant in reducing mobile phone addiction among university students compared to the non-intervention group (SMD = -2.27, 95% CI: -2.84, -1.70, $p < 0.01$). A network meta-analysis indicated that a sports intervention (Sucra = 87.3) was the most likely effective intervention for mobile phone addiction among university students.

Keywords: Mobile phone addiction, University students, Different interventions, Network meta-analysis, Intervention effect.

RESUMEN

Este estudio evaluó la eficacia de cuatro intervenciones para la adicción a teléfonos móviles entre estudiantes universitarios a través de metanálisis y metanálisis de redes. Se realizaron búsquedas en bases de datos como CNKI, Web of Science, PubMed, Cochrane Library y EMBASE para recopilar ensayos controlados aleatorios de cuatro intervenciones para la adicción a los teléfonos móviles en estudiantes universitarios y para evaluar los efectos de estas intervenciones sobre la adicción a los teléfonos móviles en esta población. La búsqueda se realizó desde el inicio de las bases de datos hasta el 24 de septiembre de 2024. Los datos se analizaron mediante el software Revman 5.4 y Stata 17.0. Las cuatro intervenciones fueron estadísticamente significativas en la reducción de la adicción a los teléfonos móviles entre los estudiantes universitarios en comparación con el grupo sin intervención (DME = -2,27, IC del 95%: -2,84, -1,70, $p < 0,01$). Un metanálisis en red indicó que una intervención deportiva (Sucra = 87,3) era la intervención más probablemente eficaz para la adicción al teléfono móvil entre los estudiantes universitarios.

Palabras clave: Adicción al teléfono móvil, Estudiantes universitarios, Diferentes intervenciones Metaanálisis en red, Efecto de la intervención.

INTRODUCTION

A significant public health concern nowadays is persistent mobile phone addiction (MPA), which is particularly common among young people. Due to their increased freedom from parental limitations and more free time during school, university students are more prone to losing self-control, which may result in addiction to mobile phone use or other addictive habits. Excessive smartphone use may result in significant repercussions, particularly mobile phone addiction (MPA), which can also be referred to as, excessive smartphone use, smartphone addiction, compulsive mobile phone use, problematic mobile phone use, and mobile phone dependence. Mobile phone addiction (MPA) is a behavioral addiction defined by an individual's inability to regulate obsessive mobile phone use, resulting in significant adverse effects on physical, psychological, and social functioning.

Our research across 24 nations, including 83 samples and 33,831 people, indicates a worldwide increase in problematic smartphone use (Olson et al., 2022). Recent surveys have shown that 39 % of Indian university students exhibit a high level of mobile phone addiction. According to research conducted on Chinese medical students, the occurrence rate of MPA was found to be as high as 52.8% (Liu et al., 2022). The rate of mobile phone addiction among Jordanian university students is 64.2% (Abuhamdah & Naser, 2023). Numerous studies indicate that excessive smartphone use might result in health issues, such as musculoskeletal pain, visual impairment, migraines, and discomfort in the wrists or neck. Moreover, the excessive use of mobile phones might result in many adverse outcomes, such as subpar academic achievement and the tendency to delay academic tasks. Additionally, there are adverse psychological consequences, including anxiety, depression, frustration, and stress (Zhang et al., 2020). Consequently, it is essential to implement effective ways to mitigate mobile phone addiction among university students.

Implementing scientifically efficient methods to mitigate mobile phone addiction among university students has emerged as a multidisciplinary concern. The research reviewed in this study indicates that the current therapies for mobile phone dependency mostly consist of general psychological interventions, cognitive-behavioral interventions, and exercise prescription interventions. Prior research has shown a negative correlation between smartphone use and levels of physical activity. Systematic physical activity can be effective in alleviating mobile phone addiction. The effectiveness of the interventions has also been verified in several clinical randomised controlled trials (RCT), such as behavioural therapies such as Mindfulness behavioral cognitive treatment (MBCT) (Lan et al., 2018) and Cognitive-behavioral group treatment (CBGT) (Anthony, 2022). Adjuvant therapies (exercise or physical activity) have also been shown to be effective in reducing mobile phone addiction among university students (Xiao et al., 2021). Although researchers have investigated the correlation between various interventions and MPA university students through correlational studies, randomized controlled trials, and meta-analyses, no studies have comprehensively compared the efficacy of different interventions or determined the most effective interventions for MPA university students.

Network meta-analyses (NMA) are widely recognized as reliable for evaluating several therapies, surpassing the limitation of comparing just two interventions. The primary benefit of this approach compared to conventional Meta-analysis is its capacity to provide direct evidence via quantitative comparisons of several therapies that are combined for comparable issues. We used Network Meta-Analysis (NMA) to combine and assess the comparative efficacy of several therapies for university students with MPA. Additionally, we investigated the effectiveness and underlying mechanisms of these interventions. We used NMA's two-dimensional clustered ordination diagram to evaluate and prioritize the impacts of various exercise modalities in a comprehensive way, aiming to determine the most effective interventions for university students with MPA.

The main objective of this network meta-analysis was to gather pertinent high-quality information about the efficacy of several treatments aimed at mitigating mobile phone addiction and to quantitatively assess the effectiveness of various exercise regimens for students addicted to the internet. The research sought to determine the best suitable intervention for university students with mobile phone addiction by thoroughly evaluating and grading the efficacy of several intervention approaches.

MATERIALS AND METHODS

This review uses the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (or PRISMA) statement for reporting. The a priori approach used was made available by the PROSPERO worldwide prospective registrant of systematic reviews, CRD42024561712. Ethical approval and informed consent are not necessary for this report, given that there are no participants.

A thorough examination of five electronic databases (CNKI, PubMed, Cochrane, Embase, and Web of Science) was performed to uncover randomized controlled trials (RCTs) assessing the impact of several interventions on

mobile phone addiction. The search covered the period from the establishment of the databases until July 2024, and we only considered studies published in English or Chinese. The search technique included three keyword strings: interventions, MPA, and university student-related terms. The precise search technique is outlined as follows: ("Technology Addictions" OR "Mobile Phone Addiction" OR "Addiction, Mobile Phone" OR "Addictions, Mobile Phone" OR "Mobile Phone Addictions" OR "Phone Addiction, Mobile" OR "Cell Phone Addiction" OR "Addiction, Cell Phone" OR "Cell Phone Addictions" OR "Video Game Addiction" OR "Addictions, Video Game" OR "Addiction, Video Game" OR "Game Addiction, Video" OR "Video Game Addictions") AND ("Randomized controlled trial" OR "Controlled clinical trial" OR "Random" OR "Placebo" OR "Clinical trials as topic" OR "Trial" OR "Intervention" OR "Treat" OR "Therapy" OR "Program" OR "Workshop" OR "Train") AND ("college students" OR "university students" OR "undergraduate students").

Import the studies that have been recognized and retrieved into the EndNote X9 program. The de-duplication function in Endnote was used to remove duplicates. Two reviewers conducted the screening and processing, separately examining the titles and abstracts and evaluating the articles based on established inclusion criteria. Additionally, two reviewers conducted separate evaluations of the whole text of the papers that were included. A checklist for include relevant information was filled out for each research, and judgments for excluding information were described in detail. The reference lists and referenced articles of each included research were meticulously examined to guarantee the absence of any relevant studies that were overlooked. Throughout all phases, any inconsistencies in the collected findings were handled by consensus or by engaging a third reviewer.

The literature search, as well as the inclusion, screening, and exclusion criteria for this investigation, were formulated in strict adherence to the PRISMA statement and the five specific components: P (Population), I (Intervention), C (Comparison), O (Outcome), and S (Study Design). The criteria for eligibility in the study are as follows. The study should include: (1) University students evaluated and diagnosed with mobile phone addiction. (2) The study strategy was limited to randomized controlled trials. (3) The Mobile Phone Addiction Scale scores of patients with mobile phone addiction, post-intervention, were used as an evaluative metric for the efficacy of various interventions. (4) A pre-test/post-test framework was used to gather pre-test and post-test assessments of mobile phone addiction scores from both experimental and control group participants.

Exclusion criteria:(1) Redundant studies. (2) Non-randomized controlled trials (Non-RCT) investigations. (3) Descriptive research, case-control studies, qualitative analysis, and case reports. (4) Non-journal papers, including dissertations. (5) Literature for which the whole text was inaccessible. (6) Studies with missing or unreported data. (7) Literature review integrated with meta-analysis. (8) Non-English or non-Chinese literature.

The researchers performed an autonomous literature review and acquired pertinent data. Following data screening and extraction, the analytical process included cross-verification. The reviewers reached a consensus on the final selection of papers. The (PICO) criteria structure, which includes specified population, intervention, control, and outcomes, was adhered to. The reviewers retrieved (1) general information, which included the author's name, title of the publication, and the year it was published. (2) They collected details about the participants, such as their age, gender, and degree of mobile phone addiction. (3) The intervention type includes information about the type, duration, and frequency per week. It contains comprehensive data about the size of the experimental group, the size of the control group, the gender distribution, the treatments used in both groups and the evaluation instruments employed to evaluate the outcome indicators. (4) Specify the kind of outcome measure, including verified scales and associated outcomes. One author organized the information into standardized tables, which were then checked and approved by another author.

The outcome measures of these main studies are as follows: (1) Mobile Phone Addiction Tendency Scale (MPATS): including 17 items and four sub-scales, with scores ranging from 0 to 80, where higher scores indicate a heightened likelihood of mobile phone addiction; (2) Mobile Phone Addiction Index (MPAI): including 17 items and 4 subscales. An elevated MPAI score indicates increased mobile phone addiction. (3) Smartphone Addiction Scale (SAS-C): consisting of five characteristics and 20 questions, higher scores indicate more dependency.

Two researchers examined the risk of bias using the Cochrane Handbook 5.1.0 Methodological Quality Assessment Criteria. Evaluations included critical elements such the randomized sequence generation, allocation concealment, blinding of both investigators and participants, selective reporting, completeness of outcome data, and other biases. The assessment of "low-risk bias", "high-risk bias", and "unclear-risk bias" was represented by different hues, namely green, red, and yellow. Each dispute was thoroughly deliberated and ultimately resolved by the third researcher.

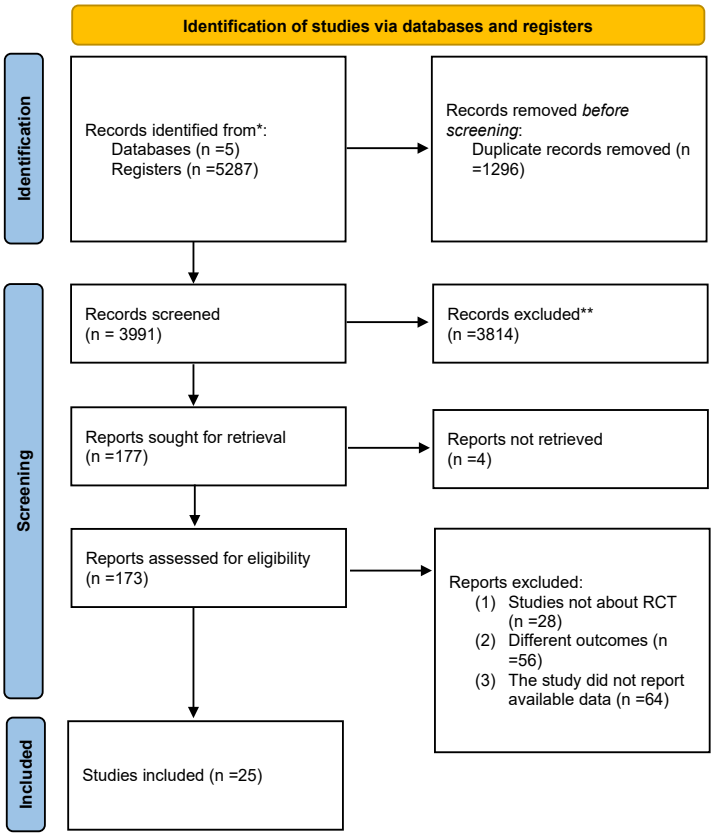
Traditional meta-analyses were conducted using RevMan 5.4, whereas web-based meta-analyses were executed with Stata 17.0 software, continuous variables served as outcome indicators. Given the variability of scales used for outcome indicators in the literature, a random effects model was utilized for the meta-analysis, using standardized mean difference (SMD) and 95% confidence intervals (CI) as measures of impact magnitude. Statistical heterogeneity was assessed using the χ^2 test; an I^2 value of ≤ 50% signifies the absence of heterogeneity among the included studies, while an I^2 value of > 50% indicates the presence of heterogeneity. In cases of heterogeneity, sensitivity analyses and subgroup analysis will be employed to investigate its sources.

Network Meta-analyses were conducted using Stata software, and all effect sizes are shown as 95% confidence intervals, with $P < 0.05$ being statistically significant. Nodal analyses were used to assess inconsistency. If $P > 0.05$, the difference between the direct and indirect comparisons was not of statistical significance, indicating consistency between the two outcomes, therefore a consistency model was used; otherwise, an inconsistency model was utilized. The surface under of the cumulatively ranked probability plot (SUCRA) was used for assessing and comparing the effects of different interventions. When $0 \leq SUCRA \leq 100$, a higher score indicates a more favorable intervention impact.

RESULTS AND DISCUSSION

A cumulative amounting to 5287 results was acquired by the search methodologies used in CNKI (1266), Web of Science (1225), PubMed (1050), Cochrane Library (1443), and EMBASE (303). After deduplication, a total of 1296 studies were eliminated. Additionally, 3814 papers were discarded based on their titles and abstracts. Out of the remaining 177 documents, a full-text screening was conducted. Eventually, 25 materials were found to meet the inclusion requirements (Figure 1), consisting of 18 documents in Chinese and 7 documents in English.

Fig 1. Flow diagram of the article screening process.



Source: own elaboration

Table 1 presents the fundamental details of the included research. The 25 studies included a total of 1533 MPA university students. The studies examined four different types of interventions: group counselling, sports intervention, cognitive behavioral intervention, and general psychological intervention. The control group interventions did not involve any interventions.

The findings indicated that out of the research analyzed, only 17 provided a detailed account of the precise random sequence approach used for grouping. The other articles did not provide a thorough description of the allocation method. However, all 25 publications included in the analysis contained comprehensive data. Figure 2 provides comprehensive information.

Table 1: Fundamental features of the research covered.

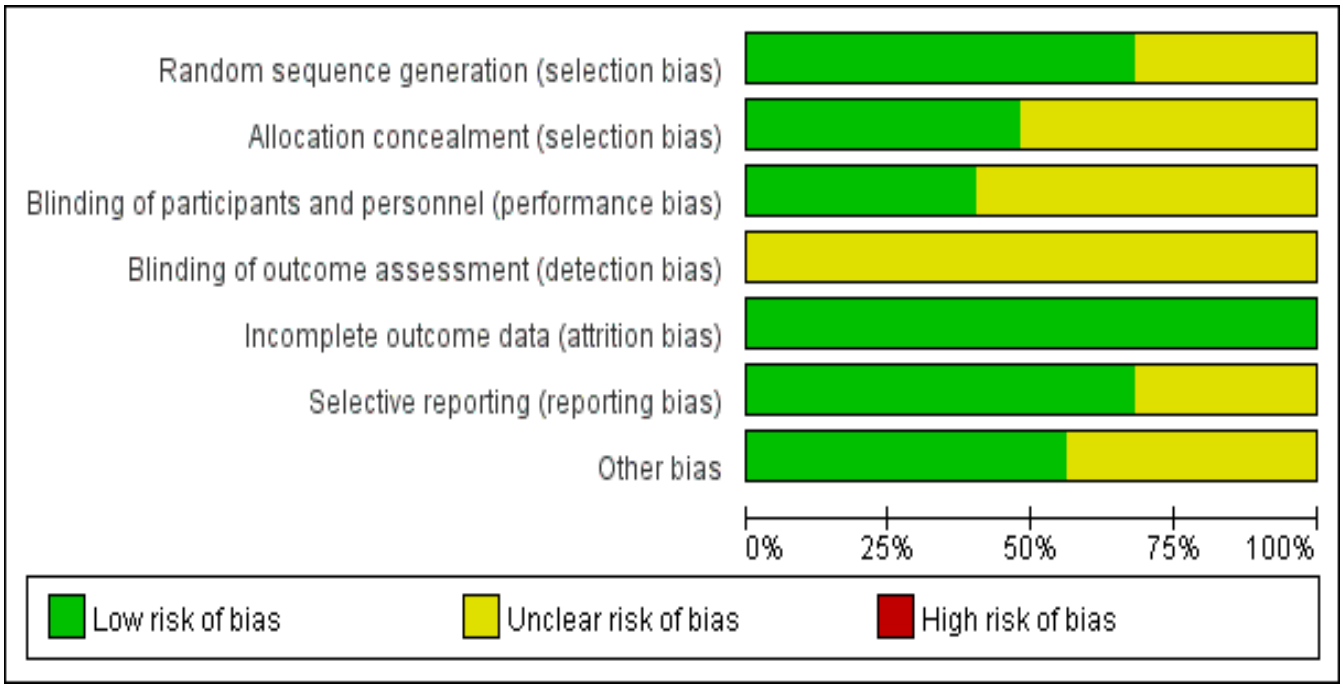
Reference	Country (Language)	Participant characteristics			Experiment group		Outcome measurements
		Sample source (Age)	Sample size(T/C)	Gender (female/male)	Type of intervention	Intervention duration	
Fan et al., 2021	China (Chinese)	College (20.13+1.02)	(32/32)	(32/32)	Sports Intervention	14 weeks	SAS-C
Ge et al., 2015	China (Chinese)	university (21.24±1.08)	(18/18)	(12/24)	Sports Intervention	18 weeks	MPAI
Jia et al., 2021	China (Chinese)	College (20.72±1.31)	(20/20)	NR	Sports Intervention	10 weeks	MPAI
Lu et al., 2020	China (English)	College (18.77 ±1.30)	(31/34)	(17/48)	Sports Intervention	12 weeks	MPAI
Wang & Wang, 2021	China (Chinese)	College	(30/30)	NR	Sports Intervention	18 weeks	MPATS
Xiao et al., 2021	China (English)	university (18.95±0.89)	(31/34)	(18/47)	Sports Intervention	12 weeks	MPAI
Zhang et al., 2022	China (Chinese)	College (20.27±1.95)	(21/21)	NR	Sports Intervention	8 weeks	MPATS
Zhang et al., 2024	China (English)	university (20.11±0.64)	(30/30)	(36/24)	Sports Intervention	8 weeks	SAS-C
Zhou et al., 2023	China (Chinese)	College (18.93±1.90)	(121/116)	(113/124)	Sports Intervention	10 weeks	MPATS
Zhu, 2017	China (Chinese)	College (20.72±1.30)	(30/30)	(34/26)	Sports Intervention	8 weeks	MPATS
Wang, 2019	China (Chinese)	University	(31/39)	(30/40)	General psychological intervention	8 weeks	MPATS
Chen, 2021	China (Chinese)	College	(17/18)	(14/21)	General psychological intervention	8 weeks	MPATS
Ding et al., 2018	China (Chinese)	College	(28/27)	NR	General psychological intervention	8 weeks	MPATS
Wu et al., 2024	China (Chinese)	College (19.28±0.84)	(15/15)	(18/12)	General psychological intervention	8 weeks	MPAI
Lan et al., 2018	China (English)	University (21.3±1.3)	(41/29)	NR	Cognitive behavioral intervention	8 weeks	MPATS
Liu et al., 2024	China (English)	College (17.8 ± 1.8)	(22/22)	(31/13)	Cognitive behavioral intervention	1 week	MPATS
Lu et al., 2020	China (English)	College (19.21 ± 1.02)	(30/34)	(20/44)	Cognitive behavioral intervention	12 weeks	MPAI

Wang et al., 2018	China (Chinese)	university	(41/41)	(77/5)	Cognitive behavioral intervention	4 weeks	MPATS
Deng et al., 2016	China (Chinese)	University (18.4±0.5)	(7/7)	NR	Group counseling	12 weeks	MPAI
Ding et al., 2018	China (Chinese)	University (21±2)	(7/7)	NR	Group counseling	5 weeks	MPATS
Qing et al., 2019	China (Chinese)	College	(34/34χ	(24/44χ	Group counseling	8weeks	MPATS
Ren & Wang, 2022	China (Chinese)	University (19.3±2)	(17/17)	(18/16)	Group counseling	6 weeks	SAS-C

T: experimental group; C: control group; MPATS: Mobile Phone Addiction Tendency Scale; MPAI: Mobile Phone Addiction Index; SAS-C: Smartphone Addiction Scale

Source: own elaboration

Fig 2. Risk of bias in the included research.

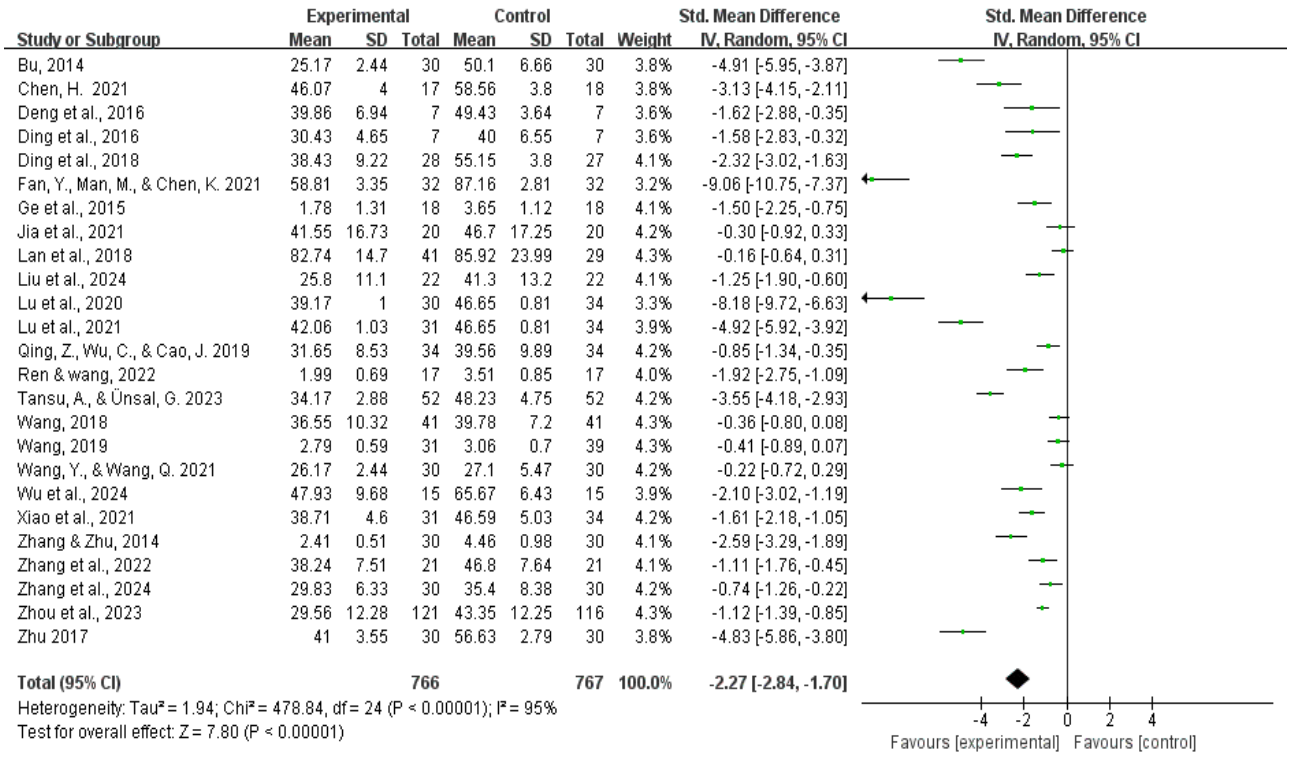


Source: own elaboration.

This research included 25 publications that examined the effect of various interventions on mobile phone addiction among university students via direct comparison. Four different interventions were involved, the whole sample size included 1533 cases. The meta-analysis findings indicated (Figure 3): I2 = 95%, substantial heterogeneity among the included studies, and used a random effects model. The results of the combined effect: SMD = -2.27, 95% CI: -2.84, -1.70, $p < 0.01$. The study revealed a significant decrease in the mobile phone addiction score in the intervention group compared to the control group.

We classified the results based on intervention length, measuring instruments, and interventions. Table 2 presents the outcomes of the subgroup analysis. The findings demonstrate that the disparities between the intervention length subgroup ($p = 0.04$) and the outcome measure subgroup ($p = 0.05$) were statistically significant. The overall effect was markedly diminished in each analyzed subgroup. Within intervention measure subgroups, the I^2 value indicates a reduction in heterogeneity within the group counselling intervention subgroup. ($I^2 = 46\%$, $p < 0.01$).

Fig 3. Effect of interventions on overall mobile phone addiction score.



Source: own elaboration.

Table 2. Subgroup analysis to evaluate the effects of therapies on mobile phone addiction.

Variable	Number of trials	Sample size		Meta-analysis			Heterogeneity	
		EG	CG	SMD	CI	pa	I2	pb
All	25	766	767	-2.27	(−2.84,-1.70)	–	95%	<0.01
Intervention duration								
≤8	15	416	412	−1.75	(−2.37,−1.13)	0.04	93 %	<0.01
>8	10	350	355	−3.18	(−4.38, -1.98)		95 %	<0.01
Outcome measurement								
MPAI	9	238	248	−2.80	(−4.06,-1.54)	0.05	96 %	<0.01
SAS-C	4	131	131	−3.68	(−6.00,-1.35)		97%	<0.01
MPATS	12	397	388	−1.46	(−2.05,-0.94)		88 %	<0.01
Intervention measure								
Sports intervention	11	394	395	−2.59	(−3.53,-1.64)	0.14	96%	<0.01
General psychological intervention	4	91	99	−1.95	(−3.24,-0.66)		92 %	<0.01
Cognitive behavioral intervention	6	216	208	−2.55	(−4.06,-1.04)		97 %	<0.01
Group counseling	4	65	65	-1.38	(−1.98,-0.78)		46 %	<0.01

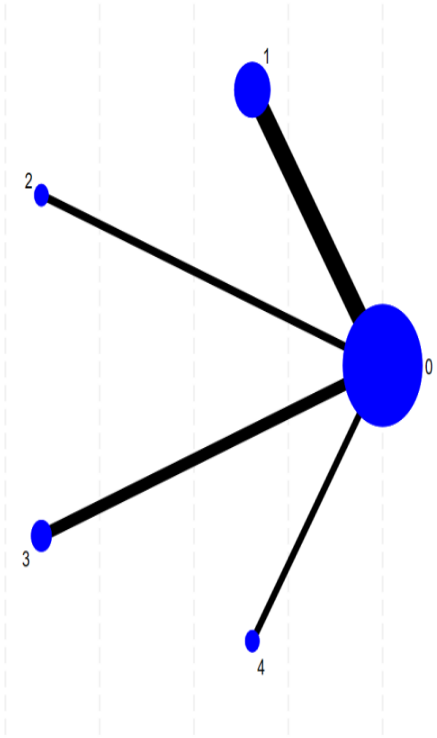
EG:experimental group; CG:control group; MPAI: Mobile Phone Addiction Index; SAS-c: Smartphone Addiction Scale; MPATS: Mobile Phone Addiction Tendency Scale; Pa value for the between-subgroup difference; Pb value for the heterogeneity within subgroups by Q test.

Source: own elaboration.

Sensitivity analyses were performed by excluding individual studies on a study-by-study basis, and no significant outliers were found in the study-by-study analysis. The results showed that the SMD = -2.03, 95% CI: -2.57, -1.50, $p < 0.01$. to 2.34 95% CI: -2.94, -1.74, $p < 0.01$ after excluding individual studies. This indicates that the results of this study are stable and therefore the results of this analysis are considered reliable.

A network meta-analysis including 39 research was conducted to evaluate which intervention had the most effective impact. In the network diagram (Figure 4), '1' denotes the control group, '2' signifies the sports intervention, '3' indicates the general psychological intervention, '4' represents cognitive behavioural treatments, and '5' refers to counselling intervention. The circle's area signifies the magnitude of the intervention study sample size, while the connection's thickness indicates the quantity of studies conducted between the two interventions. The overall impact of the four intervention strategies on university students' mobile phone reliance is assessed by indirect comparison with the control group. Due to the absence of a complete loop in the mesh interaction among the intervention measures, an inconsistency test is unnecessary. The mesh meta-analysis employs the consistency model for data analysis.

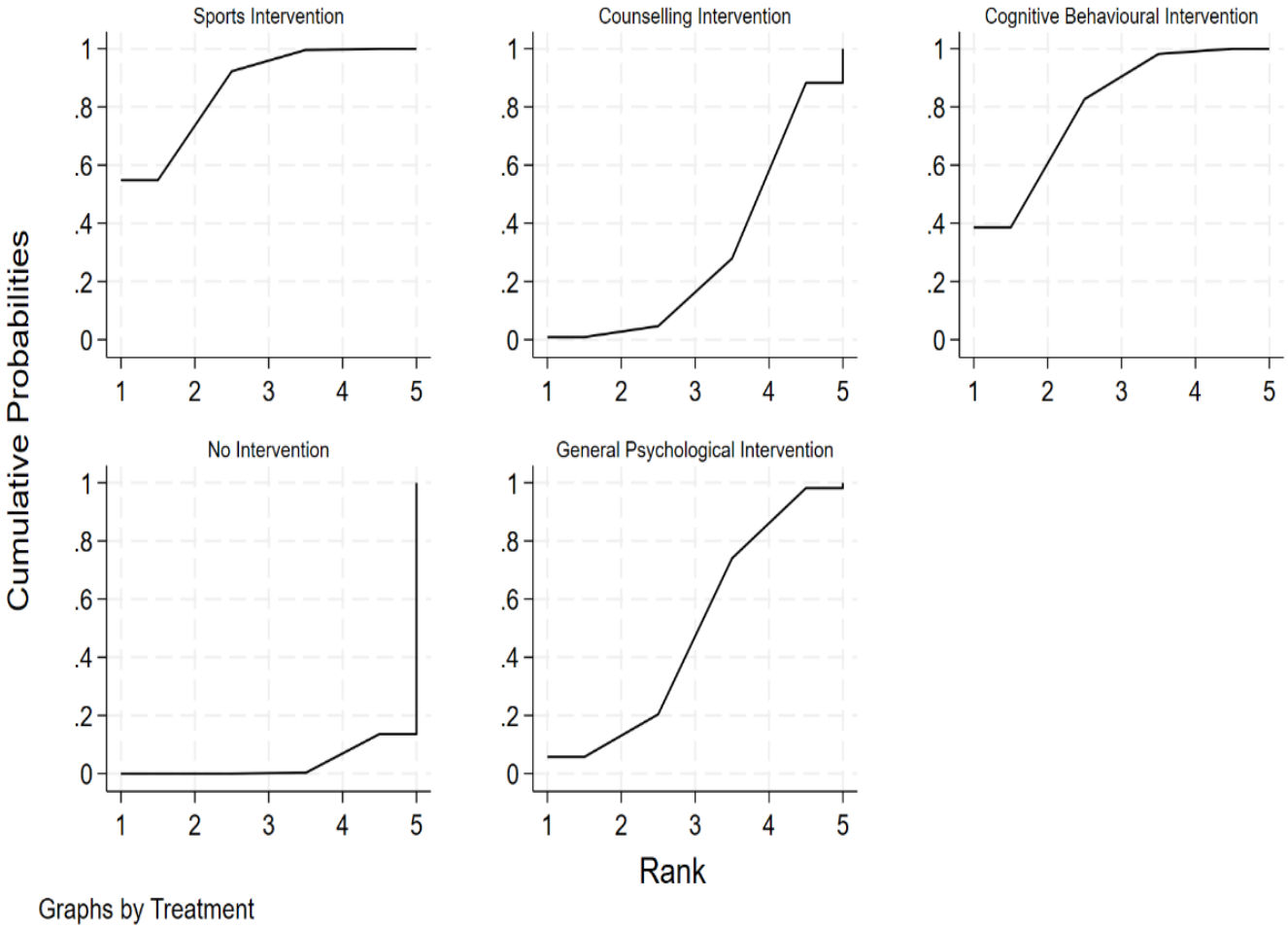
Fig 4. Network meta-analysis diagram for investigating the effectiveness of interventions in addressing mobile phone addiction.



Source: own elaboration.

The SUCRA approach was used to evaluate the efficacy of several interventions in mitigating mobile phone addiction among university students, and an SUCRA chart illustrating the impacts of these interventions was created, as seen in Figure 5. Interventions ranked by effectiveness based on SUCRA (Table 3). The ranking of effectiveness for different exercise modalities was as follows: sports intervention (SUCRA = 87.3) > cognitive behavioral intervention (SUCRA = 79.2) > general psychological intervention (SUCRA = 49.5) > group counseling (SUCRA = 31.1)> no intervention (SUCRA=3.0).

Fig 5. SUCRA graph of effectiveness among interventions.



Source: own elaboration.

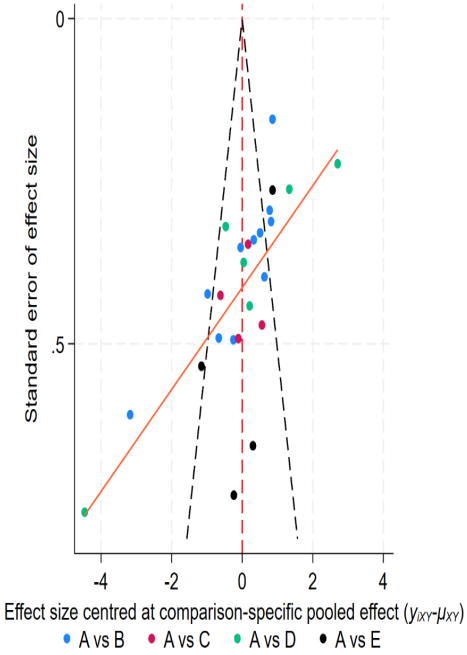
Table 3. SUCRA values for interventions.

Treatment	SUCRA	Prbest	MeanRank
No intervention	3.0	0.0	4.9
sports intervention	87.3	56.6	1.5
general psychological intervention	49.5	5.5	3.0
cognitive behavioral intervention	79.2	37.0	1.8
group counseling	31.1	1.0	3.8

Source: own elaboration.

The research examined the publication bias of all comparisons between experimental and control groups in the literature using the corrected comparison funnel plot methodology. The axis that runs horizontally denotes the impact's magnitude, while the axis that runs vertically indicates the standard error. Figure 6 displays the test findings. The figure illustrates that the effect values from various studies are symmetrically distributed around the median line of the funnel plot; however, certain studies exhibit asymmetry in their effect values, indicating a small-sample effect. Nonetheless, the overall research literature demonstrates a low probability of publication bias.

Fig 6. Comparison-adjusted funnel plot of mobile phone addiction scores.



Source: own elaboration.

This is an initial network meta-analysis of the effectiveness of different intervention modalities in improving outcomes for mobile phone-addicted university students. This study included 25 RCTs from 5 databases in English and Chinese. A conventional meta-analysis including 25 trials was performed. The study included four distinct interventions to evaluate their effects against a no-intervention control group. The study's findings indicated that all interventions significantly decreased the overall MPA score in comparison to the no-intervention control group. The total effect size was −2.27, with a 95 % CI of −2.84 to −1.70, $p<0.01$. This network meta-analysis evaluated the efficacy of four distinct interventions by analyzing ranked likelihoods of effect size and SUCRA values, demonstrating that sports interventions were the most beneficial in mitigating mobile phone addiction among university students. This result has consistent results with previous studies, according to a comparative study on mobile phone addiction interventions published by Lu et al. (2020), which showed that multiple interventions were effective in reducing problematic smartphone use, and that sports intervention were effective in improving mobile phone addiction among university students.

This study examines university students, noting that they often experience significant academic pressure, which can result in depression, anxiety, and other emotional disturbances. Consequently, they frequently utilize smartphone functionalities, such as watching videos and playing games for extended periods, to alleviate irritability. Due to their limited self-awareness and ample free time, this behaviour may foster a dependence on mobile devices among university students. Simultaneously, dependency on mobile phones will be used to diminish control power, further impairing inhibitory control capabilities. Some studies have shown that active participation in sports can eliminate this adverse effect, because it can replace the time spent on mobile phones, and sports can also improve interpersonal skills and improve the quality of life (Liu & Sun, 2023). In general, exercise can reduce addictive behavior and improve a series of symptoms caused by addiction.

In this traditional meta-analysis, results were examined by subgroups categorized by outcome measurement, Intervention measure, and Intervention duration, revealing significant differences among the outcome measurement and intervention duration subgroups, whereas no significant differences were observed among the intervention subgroups. This may stem from the interventions originating from many disciplines with varying theoretical and practical methodologies, leading to restricted validity among the interventions. Due to the large inter-study heterogeneity, these findings may only be regarded as preliminary.

The findings of this study indicate that sports intervention, cognitive-behavioral intervention, group counselling intervention, and general psychological intervention all effectively diminished mobile phone addiction among university students. Among these, the exercise prescription intervention proved to be the most efficacious and had the greatest likelihood of being designated as the optimal approach. Nonetheless, this result must be validated with caution, and the benefits of the reticulated Meta should be used in the future to integrate more and superior quality. In the future, we should use the Net Meta to include additional and superior literature for validation. Several studies have investigated the impact of sports in conjunction with other interventions on mobile phone addiction among university students. The findings suggest that the most effective approach may be to combine exercise with psychosocial interventions or other positive therapies (Liu et al., 2022). This is an important direction that should be explored in future research on mobile phone addiction interventions for university students.

Limitations

This research has certain limitations and possible sources of bias that need acknowledgment. Initially, there exists a publication bias about small sample probabilities in the literature included in this investigation, and several publications lack clarity regarding allocation concealment and blinding. Ambiguity in research design diminishes the quality of the literature and may influence the evaluation of intervention effects. Secondly, the research considered was published only in English and Chinese, mostly in Chinese. Factors influencing mobile phone addiction among university students differ according on cultural origins, perhaps resulting in skewed findings. Third, the outcome indicators measured in the literature included in this analysis are all assessed using scales, which are susceptible to subjective influences and may impact the research findings. Fourth, the chosen papers provided little information about the extent of mobile phone addiction among university students. We anticipate other relevant studies in the future to investigate the efficacy of interventions for university students with varying levels of mobile phone addiction and to further augment the study findings.

CONCLUSIONS

This meta-analysis indicates that sports intervention, cognitive-behavioral intervention, general psychological intervention and group counseling intervention were all effective in mitigating mobile phone addiction among university students. Notably, sports intervention demonstrated the highest probability of being the most effective approach and exhibited the strongest impact on reducing mobile phone addiction, followed by cognitive-behavioral intervention, general psychological intervention and group counseling intervention. This finding requires validation via other scientific and high-quality investigations in the future.

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