

# The Moderating Effects of Smart Phone Addiction on the Relationship between Life Satisfaction, Sleep Quality and Academic Achievement among College Students: A Systematic Review

Esupat P. Kone<sup>1</sup> & Lei Hongde<sup>1</sup>

<sup>1</sup> School of Education, Huazhong University of Science and Technology, Wuhan, P.R 430074 China

Correspondence: Lei Hongde, School of Education, Luoyu Rd 1037, Huazhong University of Science and Technology, Wuhan, P.R 430074 China. E-mail: leihongde@hust.edu.cn

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## Abstract

This systematic review investigated the intricate dynamics between smartphone addiction and the well-being of college students, specifically examining its moderating effects on the relationships between life satisfaction, sleep quality, and academic achievement. This review further strengthens the evidence presented in previous studies that emphasize the negative influence of excessive smartphone usage on sleep quality and academic performance. The study employed quantitative observational studies that were obtained from five databases. During the selection process, PRISMA guidelines were followed, and the study incorporated studies from various countries globally, all of which were in English. The studies enrolled 31678 people, with females ranging from 33.1% to 75.5%; studies quality ranged from low to moderate. The results show that life satisfaction is positively associated with perceived academic achievement and also sleep quality is positively associated with the initial level of pre-sleep cognitive arousal, which hence leads to good academic performance. In contrast, Smartphone addiction was positively associated with daytime sleepiness and school disengagement while also negatively associated with Grade Point Average (GPA). Therefore, this study shows excessive use of smartphones among the youth, which in correlation affects the relationship between their life satisfaction, sleep quality and academic achievement. An extensive amount of studies needs to be done on smartphone addiction so that better plans can be made for preventive measures.

**Keywords:** smartphone addiction, life satisfaction, sleep quality, academic achievement, systematic review

## 1. Introduction

In the present digital age, smartphones have become an essential part of our daily lives, converting how people live their daily lives (Tu et al., 2023). These versatile devices offer a multitude of functionalities, including communication, entertainment, and information access (Hitcham et al., 2023). However, the prevalent use of smartphones has raised concerns about its potential impact on the relationship between life satisfaction, sleep quality, and academic achievement among individuals, especially college students. Life satisfaction (LS) is a general and stable inner happiness that emerges from individual experiences in the outside world; therefore, it can impact individual sleep quality and academic achievement (Ness & Saksvik-Lehouillier, 2018). Furthermore, sleep is an inseparable part of human health and life. It is significant for acquiring knowledge and skills through instruction and repetition and maintaining both physical and mental wellness (Bobba et al., 2023). Additionally, Academic achievement (AA) describes academic outcomes which express level of accomplishment of a student during their learning time (Watson et al., 2021a). Therefore, this study delves into the intricate relationship between smartphone addiction, life satisfaction, sleep quality, and academic achievement, aiming to explore the moderating effects of smartphone addiction on these key factors.

Smartphone addiction (SPA) refers to a condition where individuals excessively use their mobile phones, which is typically measured by the frequency of accessing their devices and the total duration spent online within a particular timeframe (Parent & Shapka, 2020). Smartphones offer a variety of applications and services, making them highly attractive and engaging. However, this widespread usage of smartphones has given rise to smartphone addiction, which is characterized by excessive use, dependence, and negative consequences on daily functioning (Schmitgen et al., 2022). Research has indicated that excessive use of smartphones can lead to undesirable consequences, including negative impacts on one's social connections, reduced efficiency, and potential harm to one's mental and physical

well-being (Prodanova & Chopdar, 2023).

Regardless of the fact that smartphone addiction is not yet officially indicated in the DSM5 as one of the non-substance addictions, more and more research is being conducted in this area, investigating different phenomena that occur simultaneously with the excessive use of smartphones (Larsen et al., 2023). SPA has led to concerns which, as a result, scales have been developed. These scales have been developed in many languages, such as English, Spanish, Chinese and Korean (Smartphone Addiction Scale: SAS, Smartphone Addiction. Scale Short Version: SAS-SV) and Arabic (untitled smartphone addiction scale) (Berntsen et al., 2023b).

Hence, through this systematic review, one can gain valuable insights into the moderating effects of smartphone addiction on the intricate interplay between life satisfaction, sleep quality, and academic achievement among individuals so that strategies to mitigate the negative effects of smartphone addiction, enhancement of sleep quality and as well as optimal academic outcomes can be developed in the long run.

## **2. Materials and Methods**

### *2.1 Search Strategy*

The PRISMA 2020 statement guidelines were followed in the conduct of this systematic review. All quantitative observational studies that looked at the moderating effects of smartphone addiction on the relationship between life satisfaction, sleep quality and academic achievement were found in five databases: Wiley Online Library, Elsevier, Springer, JSTOR and Taylor & Francis Online. The articles searched and used were in English, and articles considered were from 2018 January 1<sup>st</sup> up to 2023 December 31<sup>st</sup>. Every reference to the included articles was thoroughly reviewed to make certain that none of the articles were missed or left out.

### *2.2 Search Terms*

A variety of terms were adapted to ensure the identification of all studies concerning SPA and its moderating effects on the relationship between life satisfaction, sleep quality and academic achievement. This is how the search equation was created: “smartphone addiction” OR “smartphone abuse” OR “smartphone overuse” OR “smartphone use” OR “smartphone” OR “handheld device” OR “electronic device” OR “gadget addiction” OR “life satisfaction” OR “satisfaction” OR “life” OR “sleep quality” OR “sleep” OR “academic achievement” OR “Academic Performance” OR “achievement”. When attempting to find solutions for this equation, it was necessary to break it down into multiple components.

### *2.3 Inclusion/Exclusion Criteria*

All the quantitative observational studies (cross-sectional, correlational, explanatory and cross-lagged panel design) on moderating effects of smartphone addiction on the relationship between life satisfaction, sleep quality, and academic achievement were included. This review excluded qualitative research because there were no published guidelines for reporting these reviews (Tong et al., 2012). Conference and meeting articles were excluded because they do not go through an extensive review before their publications; hence, they are unreliable. This study excluded articles with a high risk of bias, for example, on gender and age, and did not include articles without clarity.

### *2.4 Data Extraction*

The authors conducted a separate evaluation of all the studies that were identified in the inclusion/ exclusion criteria. The data extracted from each study included the name of the first author, year of study, study design, country, sample size, age and gender, important definitions or statements, measurements used and the outcomes of each study.

### *2.5 Quality Assessment*

The quality of each study included in this systematic review was evaluated using the modified Newcastle-Ottawa scale, which focused on three study domains: selection, comparability, and exposure. In the selection domain, studies were rated as poor (0 or 1 star), moderate (2 stars), or good quality (3 stars). For the comparability domain, studies were classified as either poor quality (0 stars) or good quality (1 or 2 stars). In the exposure domain, studies were categorized as poor (0 or 1 star), moderate (2 stars), or good quality (3 stars). The GRADE system was employed to assess the evidence quality in the included studies.

## **3. Results**

The search yielded 1,000 references, and after excluding duplicate studies from Wiley online library, Elsevier, Springer, JSTOR and Taylor & Francis Online and after stepwise exclusion of research outside the scope of the review, 36 articles remained for inclusion in this systematic review. The studies included in this systematic review were published articles from 2018 to 2023; sixteen were correlational design, eighteen were cross-sectional, one was

the cross-lagged design, and one was an explanatory mixed method study which can be found in Table 1.

Figure 1 displays a flowchart of the research strategy and study selection process. The data presented in Tables 2, 3, 4 and 5 indicate the quality ratings of the chosen cross-sectional, correlational, cross-lagged panel design and exploratory analysis. The modified Newcastle-Ottawa scale and Table 7 were used to evaluate the overall quality of the studies. The present systematic review comprised thirty-one moderate studies and five poor methodological quality studies.

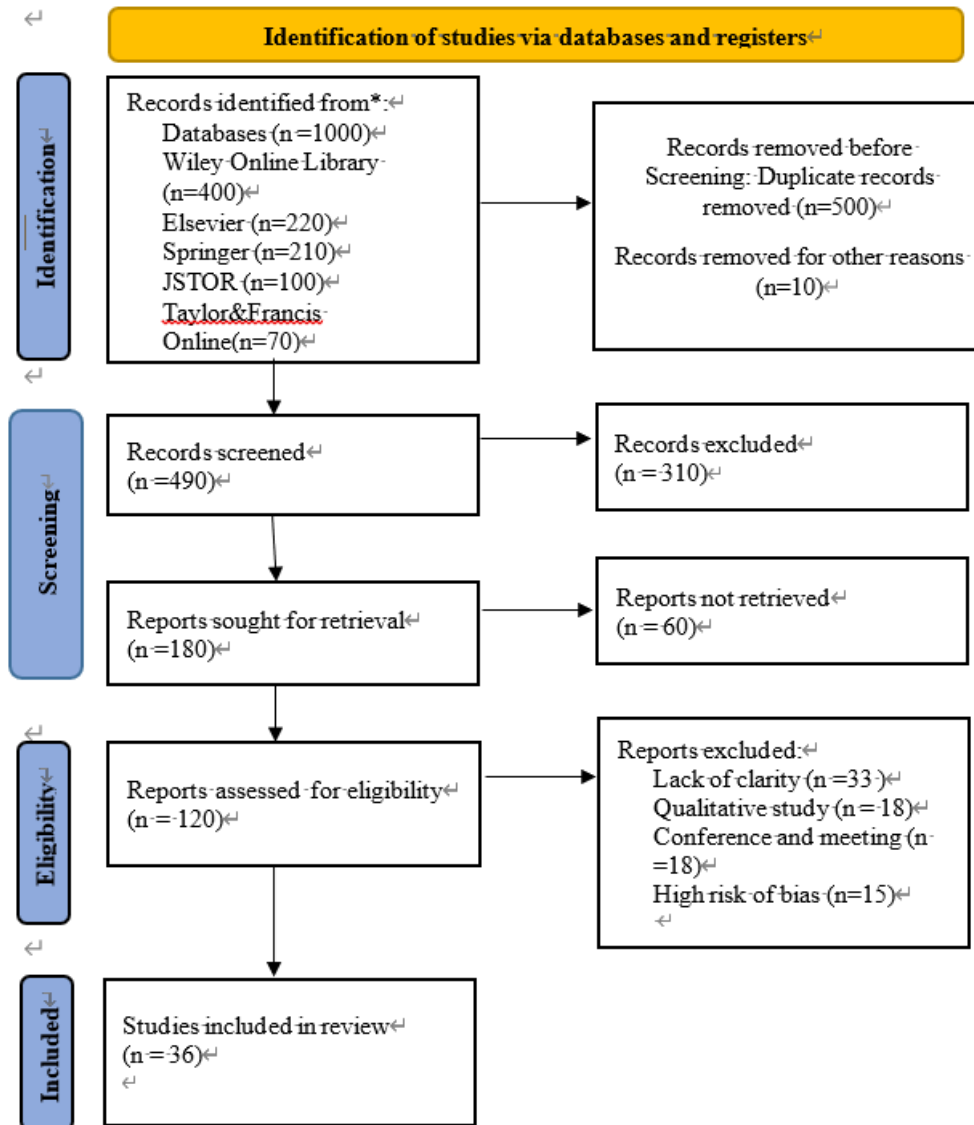


Figure 1. Flow diagram of the process of systematic literature search in accordance with PRISMA guidelines

Table 1. Main Results of Included Studies

Source	Year of study	Study Design	Country	Sample Size	Age Range Mean Age ± SD	OR % Female	Definitions OR Statements	Assessment tool of SPA	Assessment tool for LS, SQ, AA & Other tools used	Outcomes
(Adelantado-Renau et al., 2019a)	2015-2017	Cross sectional	Spain	257	13.9 ± 0.3	47.5%	Adequate sleep has been positively related with health and school achievement outcomes during adolescence.	-	SRA, PSQR	Sleep reported sleep quality was positively associated with academic performance ( $\beta$ ranging from 0.209 to 0.273; all $p < .001$ ).
(Aktürk et al., 2018a)	2017	Correlation, Descriptive	Turkey	1156	-	50.6%	Smartphone addiction is defined as uncontrolled and excessive use of the phone.	SAS-SV UCLA-SV	-	There is a correlation between smartphone addiction and loneliness ( $p > 0.05$ ).
(Arepattamannil & Cairns, 2019a)	-	Cross sectional	Nepal	1817	10-12	49.5%	Children's life satisfaction, a crucial construct in the realm of positive psychology.	-	SLSS, SWLS	The modified SLSS data met the assumptions of the Rasch measurement model, and the internal structure of the modified SLSS represented a hierarchy of item difficulties.
(Carrillo et al., 2021a)	-	Cross sectional	European countries	491	18-80/ 32.07±14.59	74.5%	Life satisfaction (LS) is one of the key elements of subjective wellbeing (SWB).	-	TSWLS, PANAS	All factors were significantly inter-correlated ( $p < .05$ ).
(Jiang et al., 2019a)	2008-2010	Cross sectional	U.S.A	897	8 -18	52.1%	An adolescent's responses to stress, called coping, is a crucial predictor of health and psychological outcomes.	-	SLSS	These paths appeared to indicate that life satisfaction was an antecedent of most coping behaviors ( $\beta = 0.10, p < 0.05$ ).
(Guzmán et al., 2020)	2014–2015	Cross sectional	USA	1348	9-18	53.5%	Life satisfaction refers to students' cognitive assessment of their overall quality of life.	-	BMSLSS	Life satisfaction has a positive association with perceived academic achievement and social functioning, $b = -.06$ , BCa CI [-.101, -.026]; for social: $b = -.05$ , BCa CI [-.073, -.019]).
(Evers et al., 2020a)	-	Cross sectional	Taiwan	2462	13.9±0.72/ 14.3±0.66	47.5%	Reduced amount of sleep leads to negative outcomes such as decreased academic performance.	-	SBI	DSSM, academic performance, and school burnout were significantly correlated ( $\chi^2(7) = 6.755, p < .05$ ).

(Watson et al., 2021a)	-	Cross sectional	New Zealand	1601	13-19	60.8%	Life satisfaction is positively associated with educational outcomes and inversely associated with stress.	-	HGS, ASQ	SWLS,	Both gender self-acceptance and LS were associated positively with PAA (-0.34 ≤ r ≤ -0.14).
(Zhao et al., 2019a)	-	A cross-lagged panel	China	775	11-15/ 13.38±0.89	49.5%	Planning for the future is important for adolescents' development and academic adaptation.	-	FEC, FOQ		Associations between future educational planning and academic achievement were reciprocal F(1, 659) = 5.61, p < .05, η <sup>2</sup> = 0.01.
(Bai et al., 2024)	-	Correlational	China	142	20-25/ 22.09 ± 0.97	57%	IA tendency is considered an addictive behavior that results from excessive Internet use, and severely affecting an individual's sleep quality.	RSFC, DSM-IV	PSQI, MRI		Positive correlation between the IA tendency score and the PSQI score (r = 0.280, p < 0.01; 95 % CI: 0.129-0.430).
(Tu et al., 2023)	2020	Correlational	China	152	20.95 ± 2.03	36.84 %	Problematic smartphone use (PSU) has become a global public health problem.	SAS-SV	PSQI, PSAS-C		Sleep quality was positively associated with the initial level of pre-sleep cognitive arousal (β = 0.17, p < 0.001).
(Xiong et al., 2023)	-	Correlational	China	554	11-17	45.8 %	Adolescents are at risk of becoming addicted to their smartphones.	SAS-SV	PMS, PAA, SBS, DPAS		Adolescents with negative parent-adolescent attachment were significantly more at risk of high smartphone addiction (p < .001).
(Hitcham et al., 2023)	-	Correlational	UK	511	27.23	52.6%	Smartphones have become ubiquitous in society, but their prevalence and indispensability have led to concerns.	SABAS, s-IAT, BFAS	PHQ-9, GAD-7, UPPS-P		Smartphone addiction and actual smartphone use are moderately correlated in large sample of users (r = 0.62, p < .05).
(Berntsen et al., 2023a)	-	Cross sectional	Denmark	209	19-69	41.6%	Smartphones are a ubiquitous part of many people's lives, but little is known about their impact on everyday thought processes.	SSCS, SAS-SV	CES-D, IAMI, BSSS	MW-D, SCS-R,	The scale showed good psychometric properties and correlated meaningfully with other psychometric tests.
(Çobanoğlu et al., 2021)	2019	Descriptive, correlational	Turkey	215	20.91 ± 2.06/18-33	76.3%	Nomophobia is an abbr. for "no-mobile-phone phobia."	SAS-SV	NMP-Q, DAS		Smartphone addiction (β = 0.765; p < 0.01) had a significant positive effect on nomophobia.

(Çevik et al., 2020a)	2018	Cross-sectional	Turkey	677	20.2 ± 2.12	73.6%	Smartphones have become an indispensable component of life as a result of the rapid development of technology.	SAS-SF	MPLS	A significant negative correlation was found between SA and the MPL levels.
(Chung et al., 2018a)	2016	Cross-sectional	South Korea	1796	13–15/14.9 ± 1.8	53.3%	Smartphone overuse can cause not only mobility problems in the wrists, fingers and neck but also interference with sleep habits.	K-SAPS	PDSS	Smartphone use in adolescence is associated with a negative impact on daytime sleepiness. (P < 0.0001).
(Soares et al., 2023)	-	Correlational	Australia	169	18–57/20.70±4.35	69%	Poor readers are individuals who perform at the low end of the academic performance continuum for their age.	-	RAT-A, WAMs	Reading anxiety was not correlated with academic achievement and it did not mediate the relationship between reading ability and academic achievement as expected.
(Gökçeşlan et al., 2021)	-	Correlational	Turkey	500	-	65%	Smartphone usage rates have displayed a rapid increase around the world in the last decade.	SAS	FBS, UCLA-LS	SPA and loneliness (r = 0.198, p ≤ 0.01), SPA and narcissistic personality (r = 0.050, p > 0.01), SPA and family belonging (r = -0.169, p ≤ 0.01).
(Halliday et al., n.d.)	2017-2019	Correlational	Australia	9139	10-13	48.9%	Bullying can result in a long-lasting adverse mental health wellbeing, and academic outcomes.	-	WEC, NAPLAN	Negative association between adolescent cyberbullying victimization, emotional wellbeing and academic achievement.
(Li et al., 2023)	2019	Cross-sectional	China	289	11-18/13.25 ± 1.73	44.6%	There is no doubt that the Internet and smartphones have dramatically changed almost every aspect of everyone's daily life.	PSU	SES	PSU could significantly predict school engagement/disengagement but not the other way around. Also sleep quality could mediate the effect of PSU on both school engagement and disengagement.
(Mafla et al., 2021a)	-	Cross-sectional	Colombia	374	15–24	59.1%	Behavioral addiction is an impulse to repeatedly engage in activities that produce short-term rewards.	SAS-SV	GPA	Smartphone use was significantly and negatively associated with GPA (b = 0.012; 95% confidence interval = 0.005–0.020; P = 0.001).

(Miguel et al., 2021)	2014-2016	Cross-sectional	Spain	96	10 ± 1	39.6%	Childhood academic achievement and cognition are affected by insufficient sleep duration.	-	GT3X+ accelerometers, MRI, K-BIT, Woodcock-Johns on III	WASO occurrences were associated with higher GMV in eight cortical brain regions (k:56-448, P's < .001).
(Sanusi et al., 2022a)	2017-2018	Cross-sectional	Jordan	420	17-27/ 109.9 ± 23.8	75.5%	Smartphone addiction has been associated with sleeping problems and psychological anxiety.	SAS	PSQI, PSS-10	Correlation between SAS and (PSQI) score was significant (r = 0.137, P = 0.005).
(Stefansdottir et al., 2022a)	2015	Exploratory analysis	Iceland	253	15-16	59.3%	Sleep timing and consistency plays a role in the cognitive function and academic performance of teenagers.	-	GT3X+ accelerometers	Both bedtime and night-tonight variability in total sleep time were negatively associated with the average score across all topics.
(Wan Ismail et al., 2020)	2017	Cross-sectional	Malaysia	525	18 ≥	33.1%	Smartphone addiction leads to smartphone repeated use despite negative impact on their wellbeing.	S-scale-M	K-scale-M, DASS, SBQ-R	Internet and smartphone addictions had a positive correlation to depression, anxiety, stress, and suicidality.
(Wolniewicz et al., 2020a)	2017	Correlational	USA	297	19.7 ± 3.96	72.1%	Depression and anxiety severity invoke problematic smartphone use.	SAS, SUFC	FOMOS, BPS-SF, DASS-21	FOMO was significantly related to PSU, boredom proneness, depression and anxiety.
(Harpaz et al., n.d.)	-	Correlational	US, UK, Canada, Israel	351	18-58/ 27.6 ± 8.62	73.4%	Academic achievement can be influenced by a variety of psychological factors.	-	SAQ, NGSS, HSO, SWLS, AGS	Student well-being, coping resources, and self-cultivating characteristics have a positive association with academic achievement.
(Orihuela et al., 2023a)	-	Cross sectional	UK	288	12.01	54%	Academic performance in early adolescence is an important determinant of later academic and nonacademic development.	-	PSMT, FICA, ACES, PDSS, Actigraph GT9X	Shorter sleep duration had negative association with academic performance.
(Zupančić et al., n.d.)	-	Cross-sectional	Croatia, Serbia and Slovenia	2084	21.9 ± 2.84	67%	Burnout during the end of semester can lead to negative academic achievement.	-	BPNSFS, MBI-SS, GPA	Significant negative relationships were found between BPN satisfaction and burnout, as well as positive relationship with GPA across three countries.
(Feraco et al., 2023a)	-	Correlational	Italy	1083	10-18/ 13.37 ± 1.97	38.3%	Adaptability regulates cognitive,	-	PANAS, SRL, AS, ASES, SWLS	Adaptability directly relates to the two study related factors

							behavioral and emotional responses to better academic achievement.			considered, life satisfaction and academic achievement.
(Guimond et al., 2023a)	-	Correlational	Canada	330	12.1±0.28	59%	Children's academic achievement is considerably influenced by genetic factors.	-	PCCS, SBQ	Significant interactions between children estimated genetic disposition for academic achievement and teachers' use of praise. (B = .45, SE = .04, p < .001).
(Tian et al., 2023a)	-	Correlational	China	547	9.00±0.76	45%	Academic achievement (AA) is a widely used indicator of students' performance in school.	-	BMSLSS, BSI, CLS	Girls were associated with positive academic achievement but negative association with life satisfaction and suicidal ideation compared to boys.
(Rosenthal et al., 2022a)	-	Cross-sectional	United States	432	18≤	65%	The prevalence of pedestrian accidents has increased due to smartphone use.	SAS-SV	GPA, ASRS-v1.1	Smartphone addiction is an independent risk factor for pedestrian accidents, and insomnia as a moderator of this Relationship. Teacher-student relationships exerted negative prediction on smartphone Addiction (βsimple=-0.22, t=-4.16, p<0.001), while teacher-student relationships had a stronger negative predictive effect on smartphone addiction at the high level (1 SD above the mean) (βsimple=-0.37, t=-7.32, p<0.001).
(Shi et al., 2023)	-	Correlational	China	598	19.97±1.50 17-25	48.66 %	Teacher-student relationships are important factors affecting smartphone addiction.	SAS-C	CD-RISC	
(Karaoglan Yilmaz et al., 2023a)	-	Correlational	Turkey	843	17-54	67%	Smartphones used by almost every age group have become indispensable component of daily life.	SAS	UCLA Loneliness Scale, BPA	Loneliness significantly affected smartphone addiction and aggression behaviors.



Table 2. Quality assessment of included cross-sectional studies using the Newcastle-Ottawa Scale

Source	Selection		Comparability		Exposure	Subtotal Assessment			Overall	
	Representativeness of Sample	Ascertainment of Exposure	Sample Size	Non Respondents	Assessment of Outcome	Statistical Test	S& Total	C# Total		EΣ Total
(Adelantado-Renau et al., 2019a)	*	**			*	*	Good	Good	Moderate	Moderate
(Areepattamannil & Cairns, 2019b)	*	**			*	*	Good	Good	Moderate	Moderate
(Carrillo et al., 2021b)	*	**			*	*	Good	Good	Moderate	Moderate
(Jiang et al., 2019)	*	**			*	*	Good	Good	Moderate	Moderate
(Guzmán et al., 2020)	*	**			*	*	Good	Good	Moderate	Moderate
(Evers et al., 2020b)	*	**		*	*	*	Good	Good	Moderate	Moderate
(Watson et al., 2021b)	*	*			*	*	Good	Good	Moderate	Moderate
(Berntsen et al., 2023b)	*	**			*	*	Good	Good	Moderate	Moderate
(Çevik et al., 2020b)	*	**			*	*	Good	Good	Moderate	Moderate
(Chung et al., 2018a)	*	**				*	Good	Poor	Moderate	Poor
(Li et al., 2023)	*	**			*	*	Good	Good	Moderate	Moderate
(Mafla et al., 2021b)		**				*	Moderate	Poor	Moderate	Poor
(Sanusi et al., 2022b)	*	**			*	*	Good	Good	Moderate	Moderate
(Wan Ismail et al., 2020)	*	**			*	*	Good	Good	Moderate	Moderate
(Orihuela et al., 2023b)		**			*		Moderate	Good	Moderate	Moderate
(Zupančič et al., 2023)		**				*	Moderate	Poor	Moderate	Poor
(Rosenthal et al., 2022b)	*	**			*	*	Good	Good	Moderate	Moderate
(Migueles et al., 2021b)	*	**			*	*	Good	Good	Moderate	Moderate

\*—Study adequately filled criteria for this sub-domain; \*\*—When the study uses valid instruments it is offered 2 stars for ascertainment of the exposure in the selection domain;

S&—selection total; C#—comparability total; and EΣ—exposure total.

Table 3. Quality assessment of included correlational studies using the Newcastle-Ottawa Scale

Source	Selection		Comparability		Exposure	Subtotal Assessment			Overall		
	Representativeness of Sample	Ascertainment of Exposure	Sample Size	Non Respondents	Confounders Are Controlled for	Assessment of Outcome	Statistical Test	S& Total		C# Total	EΣ Total
(Aktürk et al., 2018b)		**			*		*	Moderate	Good	Moderate	Moderate
(Bai et al., 2024)	*	**			*		*	Good	Good	Moderate	Moderate
(Tu et al., 2023)	*	**			*		*	Good	Good	Moderate	Moderate
(Hitcham et al., 2023)	*	**	*		*		*	Good	Good	Moderate	Moderate
(Xiong et al., 2023)	*	**			*		*	Good	Good	Moderate	Moderate
(Çobanoğlu et al., 2021)	*	**	*		*		*	Good	Good	Moderate	Moderate
(Soares et al., 2023)	*	**			*		*	Good	Good	Moderate	Moderate
(Gökçearsan et al., 2021)		**					*	Moderate	Poor	Moderate	Poor
(Halliday et al., 2023)	*	**			*		*	Good	Good	Moderate	Moderate
(Wolniewicz et al., 2020b)	*	**			*		*	Good	Good	Moderate	Moderate
(Harpaz et al., 2023)	*	**			*		*	Good	Good	Moderate	Moderate
(Feraco et al., 2023b)	*	**			*		*	Good	Good	Moderate	Moderate
(Guimond et al., 2023b)		**					*	Moderate	Poor	Moderate	Poor
(Tian et al., 2023b)	*	**			*		*	Good	Good	Moderate	Moderate
(Shi et al., 2023)	*	**			*		*	Good	Good	Moderate	Moderate
(Karaoglan Yilmaz et al., 2023b)	*	**			*		*	Good	Good	Moderate	Moderate

\*–Study adequately filled criteria for this sub-domain; \*\*–When the study uses valid instruments it is offered 2 stars for ascertainment of the exposure in the selection domain;

S&–selection total; C#–comparability total; and EΣ–exposure total

Table 4. Quality assessment of included cross-lagged panel design studies using the Newcastle- Ottawa Scale

Source	Selection			Comparability		Exposure	Subtotal			Overall	
	Representativeness of Sample	Ascertainment of Exposure	Sample Size	Non Respondents	Confounders Are Controlled for	Assessment of Outcome	Statistical Test	S& Total	C# Total		EΣ Total
(Zhao et al., 2019b)	*	**			*		*	Good	Good	Moderate	Moderate

\*-Study adequately filled criteria for this sub-domain; \*\*-When the study uses valid instruments it is offered 2 stars for ascertainment of the exposure in the selection domain;

S&-selection total; C#-comparability total; and EΣ-exposure total.

Table 5. Quality assessment of included Explanatory mixed method study using the Newcastle-Ottawa Scale

Source	Selection			Comparability		Exposure	Subtotal			Overall	
	Representativeness of Sample	Ascertainments of Exposure	Sample Size	Non Respondents	Confounders Are Controlled	Assessment of Outcome	Statistical Test	S& Total	C# Total		EΣ Total
(Stefansdottir et al., 2022b)	*	**			*		*	Good	Good	Moderate	Moderate

\*-Study adequately filled criteria for this sub-domain; \*\*-When the study uses valid instruments it is offered 2 stars for ascertainment of the exposure in the selection domain;

S&-selection total; C#-comparability total; and EΣ-exposure total

Table 6. Thresholds for Quality Assessment using the Newcastle- Ottawa Scale

Quality Rating	Points in Selection Domain	Points in Comparability	Points in Exposure Domain
Good	≥3	≥2	≥2
Moderate	2	≥1	≥2
Poor	0-1	0	1

3.1 Life Satisfaction (LS) and Academic Achievement (AA)

According to this review, participants with a high decreasing LS were found with high decreasing Academic Achievement and a confidence level of (p<0.05) (Tian et al., 2023b). Life satisfaction was significantly associated with academic achievement(Watson et al., 2021b) (r =0.15; p< 0.001). Academically, students who have a high level of life satisfaction also tend to experience a higher degree of life satisfaction (Feraco et al., 2023b). In both genders, LS is positively associated with perceived AA (-0.34 ≤r≤ -0.14). Most research suggests that positive LS is simultaneously related to higher Grade Point Averages (GPAs) (β =0.12, p < 0.01) (Areepattamannil & Cairns, 2019b). Recent research shows that levels of LS are positively associated with high academic efficacy (Wu et al., 2020), social support (β =0.12, p < 0.01) and problem-solving (β = 0.12, p < 0.01), which all keep aspects for a good academic achievement (Jiang et al., 2019b).

3.2 Life Satisfaction (LS) and Sleep Quality (SQ)

Adolescents with less life satisfaction are affected by shorter sleep duration (N=288, p<.05; p<.01) and therefore affect other domains such as cognitive processes, reasoning and verbal ability (β = -0.16, p < 0.01) (Orihuela et al., 2023b). Notably, it expresses the positive attitude of the individual towards his or her life (Watson et al., 2021b), and LS has a significant association with an individual’s past, present or future(p < .05) (Carrillo et al., 2021b). One of the crucial issues in the lives of younger adults is the issues related to their sleep patterns (Jiang et al., 2019b). (Evers

et al., 2020b) found out that among young adults (18–25 years), a sleep efficiency of less than 64% is regarded as poor sleep quality ( $p < 0.01$ ).

### 3.3 Sleep Quality (SQ) and Academic Achievement (AA)

According to the review done, Sleep-reported SQ was positively associated with academic performance ( $\beta$  ranging from 0.209 to 0.209; all  $p < 0.001$ ) (Adelantado-Renau et al., 2019b) and also SQ was positively associated with the initial level of pre-sleep cognitive arousal ( $\beta = 0.17$ ,  $p < 0.001$ ) (Tu et al., 2023). Reduced overnight sleep or altered sleep patterns have been associated with severe drowsiness and poor academic achievement, while girls 23.9% were classified as at-risk smartphone users than boys (15%,  $P < 0.0001$ ).

### 3.4 Smartphone Addiction (SPA)

Smartphone use in adolescence is associated with a negative impact on daytime sleepiness with an impact of ( $p < 0.0001$ ) (Drapeau, 2022). Smartphones lead to excessive use since they are portable and can be easily carried around by the user, unlike desktops or laptops. Smartphone addiction and actual smartphone use are moderately correlated in a large sample of users ( $r = 0.62$ ,  $p < 0.05$ ) (Hitcham et al., 2023). Subsequently, a study suggested that adolescents with negative parent-adolescent attachment were significantly more likely to have high smartphone addiction ( $P < 0.001$ ) (Xiong et al., 2023).

### 3.5 The Moderating Effects of Smartphone Addiction

Getting enough sleep is crucial for students to enhance their academic achievements. Smartphone users get less than six hours of sleep per night when compared with low-risk users ( $p < 0.0001$ ) (Chung et al., 2018a); based on the report, good sleep quality is important among university students (Papi & Cheraghi, 2021). There are several factors that affect SQ, such as the use of electronic gadgets during bedtime (Bobba et al., 2023), disturbed sleep due to social media reciprocates and affects academic performance, leading to burnout of students ( $X^2(7) = 6755$ ,  $p < 0.05$ ) (Evers et al., 2020b). In addition to excessive use of smartphones, the quality of sleep can also have an impact on one's educational performance ( $p < 0.05$ ) (Tian et al., 2023b). Memory can be negatively impacted by excessive use of smartphones, leading to poor quality of sleep, decision-making, learning, and concentration level of students; the correlation between SPA and SQ score was significant ( $r = 0.137$ ,  $P = 0.005$ ) (Sanusi et al., 2022b). This may result in students receiving low grades in their tutorials (Ness & Saksvik-Lehouillier, 2018). Therefore, the principle concern of this review is to assess the moderating effects of smartphone addiction on the relationship between life satisfaction, sleep quality and academic achievement, as shown in Figure 2.

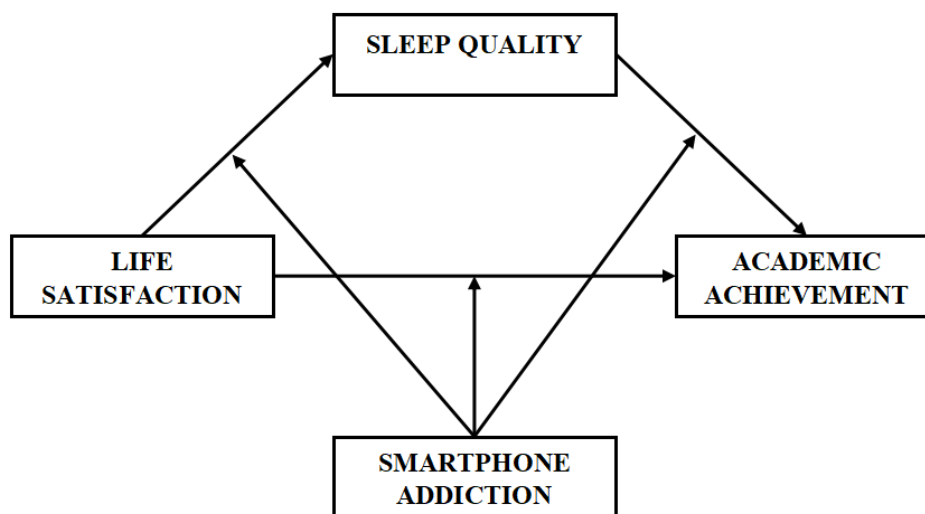


Figure 2. A model figure of The Moderating effects of Smartphone addiction on the relationship between life satisfaction, sleep quality and academic achievement

#### 4. Discussion

The above findings acknowledge that the moderating effects of smartphone addiction on the relationship between life satisfaction, sleep quality and academic achievement are a rising concern in today's world. Despite the growing body of research on smartphone addiction, its impact on academic outcomes is understudied and remains to be clarified (Halliday et al., 2023). Most research is done on adolescents' smartphone addiction but less is known on college students, the reason being that college students are adults. Most college students are young adults who just finished adolescence and still need guidance hence more research on college students is needed.

In recent years, the proliferation of smartphones has raised concerns about excessive use and addiction (Tateno & Kato, 2022). Studies have directly investigated and shown that there is positive optimal level of association, life satisfaction, and academic achievement ( $p < .05$ ), henceforth facilitating positive outcomes (Ahmadi & Ahmadi, 2020). Good sleep improves brain performance, mood, and health (Williamson et al., 2020); therefore, sleep quality is significantly associated with academic performance ( $p < .001$ ), while not getting enough quality sleep raises the risk of many disorders, diseases and impaired memory and ability to learn (Adelantado-Renau et al., 2019a). Academic achievement is a crucial aspect of college life, and factors that influence it must be thoroughly examined. This study highlights the potential influence of life satisfaction and sleep quality on academic achievement (Smith & Konik, 2022) and the potential role of smartphone addiction in these relationships; even from the review, life satisfaction and sleep quality have shown a positive association with Academic Achievement by an outcome of  $(-0.34 \leq -0.14)$  (Watson et al., 2021a).

The research to date suggests that smartphone addiction displays substantial linkages with several key school outcomes (Shi et al., 2023). It appears that few students can barely accomplish tasks using smartphones at colleges or classrooms, while females are prone to excessive smartphone use (23.9%) compared to males (15.1%,  $P < 0.001$ ); the differences are quite interesting and vividly showing that smartphones have become a potential form of distraction (Chung et al., 2018b). For students with low literacy skills and a steady urge to multitask on social media, blending the purposeful use of smartphones into everyday activities can be particularly challenging (Wan Ismail et al., 2020). Then, the main advantage of the tool tends to go to waste. Therefore, psychoeducation needs to be done on college students in order to raise awareness about smartphone addiction. Colleges can instill strict rules on students not using their smartphones during lectures and also invest in social activities that can make the students interact more rather than stay on their smartphones.

#### 5. Conclusion

The findings of this review contribute to the already available information on the relationship between life satisfaction, sleep quality and academic achievement. Exploring these variables in conjunction provides a nuanced understanding of their interplay. It contributes to the growing field of research on technology use (Astin, 1970) and its effects on well-being and academic outcomes (Zupančič et al., 2023).

Therefore, this systematic review has addressed the significance of smartphone addiction as a potential moderator in the relationship between life satisfaction, sleep quality and academic achievement. Moreover, the complexity of Smartphone addiction is reflected, among other things, by the levels at which it has been studied and the methods by which it has been investigated.

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