

Nonlinear Association Between Smartphone Usage Duration and Online Social Anxiety: An Empirical Study Based on Chinese College Students

Shaohua Li, Jiaying Feng, Xiaohan Zhang *

Renji College, Wenzhou Medical University, Wenzhou 325000, China

*corresponding author email: nncayenne@163.com

Abstract

This study aimed to investigate the relationship between smartphone use duration and online social anxiety among Chinese college students, with particular focus on potential nonlinear characteristics. Using a cross-sectional design with questionnaire survey, data were collected from a sample of college students. Daily smartphone use duration was assessed through self-report measures, while online social anxiety was measured using the General Online Social Anxiety Inventory Scale (GAAIS). Descriptive statistics revealed that participants used smartphones for an average of 6.83 hours daily ($SD = 2.76$) with a multimodal distribution, and had a mean online social anxiety score of 30.31 ($SD = 10.14$). As the data did not meet normality assumptions, Spearman's rank correlation analysis was employed to examine the relationship between variables. Results indicated a weak positive correlation between smartphone use duration and online social anxiety ($\rho = 0.192$, $p < .001$), with a notable nonlinear pattern: in the low to moderate usage range (1-6 hours), anxiety levels increased with usage time, while in the high usage range (>6 hours), this association plateaued, demonstrating a "saturation effect." These findings challenge the simple linear assumption that "more usage leads to higher anxiety" and support a more complex relationship model. The results provide important implications for developing smartphone use guidelines and targeted mental health interventions for college students. Future research should explore the differential impact of various usage purposes and patterns on social anxiety, as well as potential mediating or moderating mechanisms in this relationship.

Keywords

Smartphone use duration; Online social anxiety; Nonlinear relationship; College students; Social media.

1. Introduction

1.1. Research Background

With the rapid development of mobile Internet technology, smartphones have become an indispensable tool in the daily life of modern people. Chinese college students are particularly heavy users of smartphones, with a penetration rate exceeding 98%, and their average daily usage significantly surpasses that of other demographic groups. Research indicates that Chinese college students use their mobile phones for an average of more than 5 hours daily. Even during the COVID-19 pandemic, this average daily usage increased to 7.4 hours [1]. At the same time, the widespread use of smartphones has been linked to a series of mental health issues. Studies have found a positive correlation between social anxiety and excessive smartphone use, with social anxiety accounting for 31.5% of the variance in smartphone addiction scores [2].

1.2. Literature Review and Theoretical Framework

Existing studies have extensively explored the association between mobile phone use and various mental health outcomes. Research has found that excessive smartphone use correlates with negative mental health indicators such as depression and anxiety, particularly with prolonged usage [3]. However, findings regarding the nature of this relationship remain inconsistent. One study suggests that the association between mobile phone use and mental health may be non-linear, with non-users and excessive users exhibiting poorer mental health outcomes compared to moderate users^[4]. This finding supports the "moderate use hypothesis," challenging the simplistic linear assumption that "greater use leads to greater harm."

The prevalence of online social anxiety—a specific manifestation of social anxiety in digital environments—warrants significant attention. A study revealed that online social anxiety is a prominent issue among university students, particularly during social media use, where individuals may experience negative emotions such as tension, fear, and anxiety [5]. Direct investigations into the link between mobile phone use and online social anxiety remain relatively limited and inconsistent. While some studies report associations between social anxiety and smartphone dependency—especially in social media contexts, where individuals with higher social anxiety levels exhibit stronger dependency [6]—others show weak or non-significant correlations. These contradictory findings may stem from unaddressed non-linear relationships or uncontrolled confounding variables.

Theoretical explanations for the connection between mobile phone use and online social anxiety may draw from multiple frameworks. The Fear of Missing Out (FoMO) theory proposed by Przybylski et al. posits that excessive mobile phone use amplifies individuals' persistent monitoring of social information, fostering hypervigilance toward online social performance^[7].

1.3. Research Aims and Implications

There are several obvious shortcomings in the existing studies: First, most of them focus on the correlation between mobile phone addiction and mental health, and there are few studies on the duration of use in general users. Secondly, less attention is paid to the relationship between mobile phone use and online social anxiety, especially the potential nonlinear characteristics of this relationship. Finally, there is a lack of in-depth research on Chinese college students as a high-risk group. Therefore, this study aims to explore the relationship between mobile phone use time and online social anxiety among Chinese college students, paying special attention to the non-linear characteristics of this relationship. Specifically, this study has the following three goals: (1) To describe the distribution characteristics of college students' mobile phone use time and online social anxiety; (2) Analyzing the correlation between mobile phone use time and online social anxiety; (3) Explore whether the correlation is nonlinear. This study has important theoretical and practical significance. At a theoretical level, the findings will enrich the understanding of the relationship between digital media use and mental health, especially to validate potential non-linear relationship models. At the practical level, the research findings can provide empirical evidence for the formulation of college students' mobile phone use health guidelines, and provide references for campus mental health education and intervention strategy design.

2. Research method

2.1. Research object

In this study, 948 Chinese university students were selected by convenient sampling method.

2.2. Research design

This study adopted a cross-sectional research design and collected data through a questionnaire survey to explore the relationship between college students' mobile phone use time and online social anxiety. The independent variable of the study was the average daily mobile phone use time and the dependent variable was the level of online social anxiety.

2.3. Research tool

2.3.1. General demographic information questionnaire

Basic demographic information such as gender, age, grade and major of the subjects was collected.

2.3.2. Cell phone use survey

The duration of mobile phone use was obtained through self-report, and the subjects were asked to report their average daily mobile phone use time (hours/day). The questionnaire clearly states that "Use" Refers to any form of mobile operation, including but not limited to social media browsing, short video viewing, gaming, learning, shopping, etc. At the same time, the questionnaire also collected the use of mobile phones before going to bed, screen brightness Settings and other related information as auxiliary research data.

2.3.3. General Online Social Anxiety Scale

In this study, the General Online Social Anxiety Scale (GAAIS) was used to assess the level of online social anxiety of the subjects. The scale contains 10 entries, using a 5-level Likert score (from "1" to "5"). Completely disagree To 5 "Couldn't agree more"). The scale ranges from 10 to 50 points, with higher scores indicating higher levels of online social anxiety. In this study, the Cronbach's α coefficient of this scale was 0.86, indicating good internal consistency. The scale mainly measures the anxiety experience of individuals in the use of social media platforms (such as wechat), including the worry of negative evaluation of shared content, tension in social interaction, hesitation and unease when Posting or replying to messages. This scale is particularly suitable for evaluating the psychological experience of Chinese college students on mainstream social media platforms, which is highly consistent with the purpose of this study.

2.4. Data analysis

Data analysis was performed using R software (version 4.4.0). First, descriptive statistical analysis was carried out on the study variables, including the calculation of the mean, standard deviation, median, interquartile distance and other indicators, and the histogram and box plot were used to show the distribution characteristics of the data. Secondly, the Shapiro-Wilk test and Q-Q plot were used to evaluate the normal distribution of the data. Since none of the study variables were consistent with the hypothesis of normal distribution, Spearman's correlation coefficient was used to analyze the intensity and direction of the correlation between mobile phone use time and online social anxiety. In order to show the relationship between the two variables more comprehensively, the local weighted scatter smoothing method is also used to draw a non-parametric fitting curve to show the possible nonlinear relations directly. The significance level for all statistical tests was set at $\alpha = 0.05$.

3. Result

3.1. Descriptive statistical analysis

This study investigated the relationship between mobile phone use time and online social anxiety in 948 college students. The descriptive statistical results of the main study variables are presented below.

3.1.1. Duration of mobile phone use

The average duration of mobile phone use among college students in the study sample was 6.83 hours/day (SD = 2.76), with a median of 7 hours/day, ranging from a minimum of about 1 hour to a maximum of about 13 hours. The interquartile shows that 25% of students use it for less than 5 hours and 75% use it for less than 9 hours. Shapiro-Wilk test results ($p < .001$) indicates that the mobile phone usage time data deviates significantly from the normal distribution. Figure 1 shows the distribution histogram and density curve of mobile phone use time, showing obvious multi-peak distribution characteristics, with the main peak appearing at 5-6 hours and the secondary peak appearing at about 9 hours, indicating that there may be subgroups with different usage patterns in the sample.

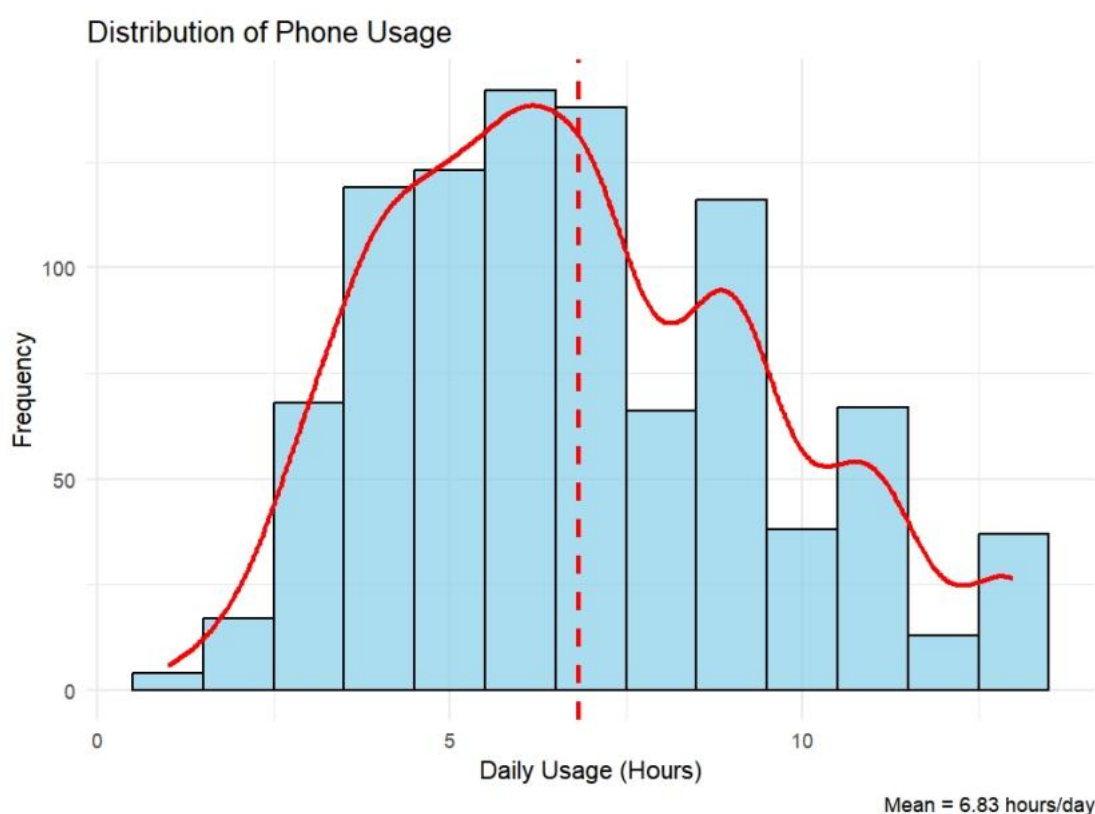


Figure. 1 distribution of phone usage

As shown in Figure 2, the boxplot further confirms that the middle 50% of the data is concentrated in the 5-9 hour interval, and the distribution is relatively uniform. The Q-Q plot (Figure 3) shows that the data points deviate from the theoretical normal distribution line at multiple points, especially at both ends of the distribution, further supporting the conclusion of the non-normal distribution.

3.1.2. Online social anxiety

The average score for online social anxiety among college students in the sample was 30.31 (SD = 10.14), with a median of about 31 and scores ranging from about 10 at the lowest to about 50 at the highest. The quartile spacing indicates that 25% of the students scored less than about 24 points and 75% of the students scored less than about 37 points.

Shapiro-Wilk test results ($p < .001$) indicates that the online social anxiety score also does not conform to the normal distribution hypothesis. Figure 4 shows the distribution of social anxiety scores, showing a complex multi-modal distribution pattern, especially with a significant peak at the 30th point, which may represent some critical value of the scale or reflect clear subgroup differences in the sample.

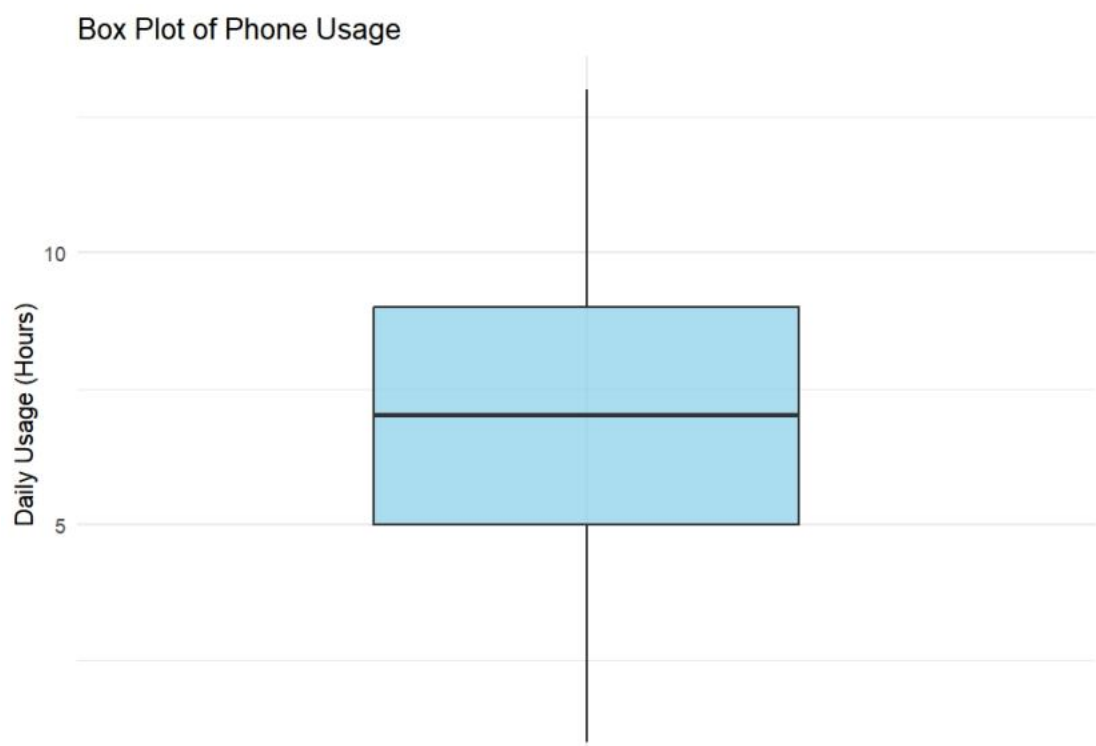


Figure. 2 box plot of phone usage

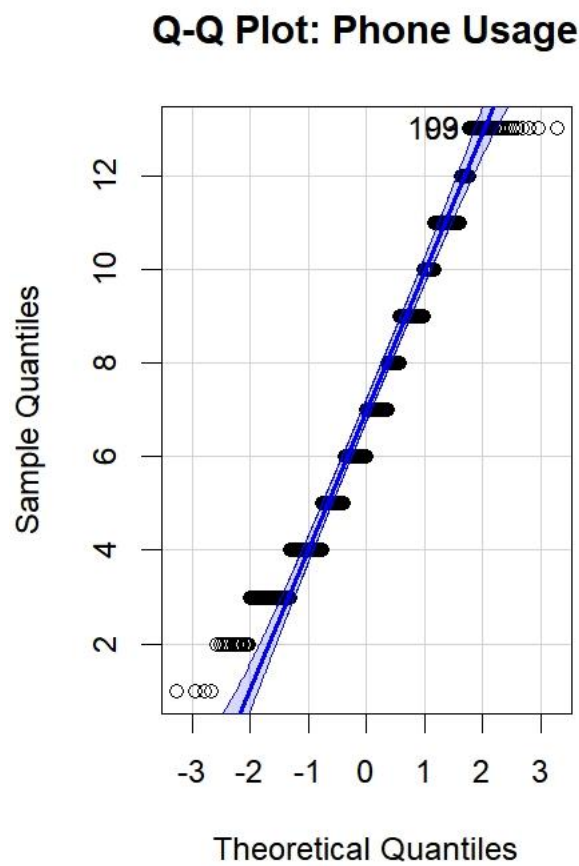


Figure.3 Q-Q plot : phone usage

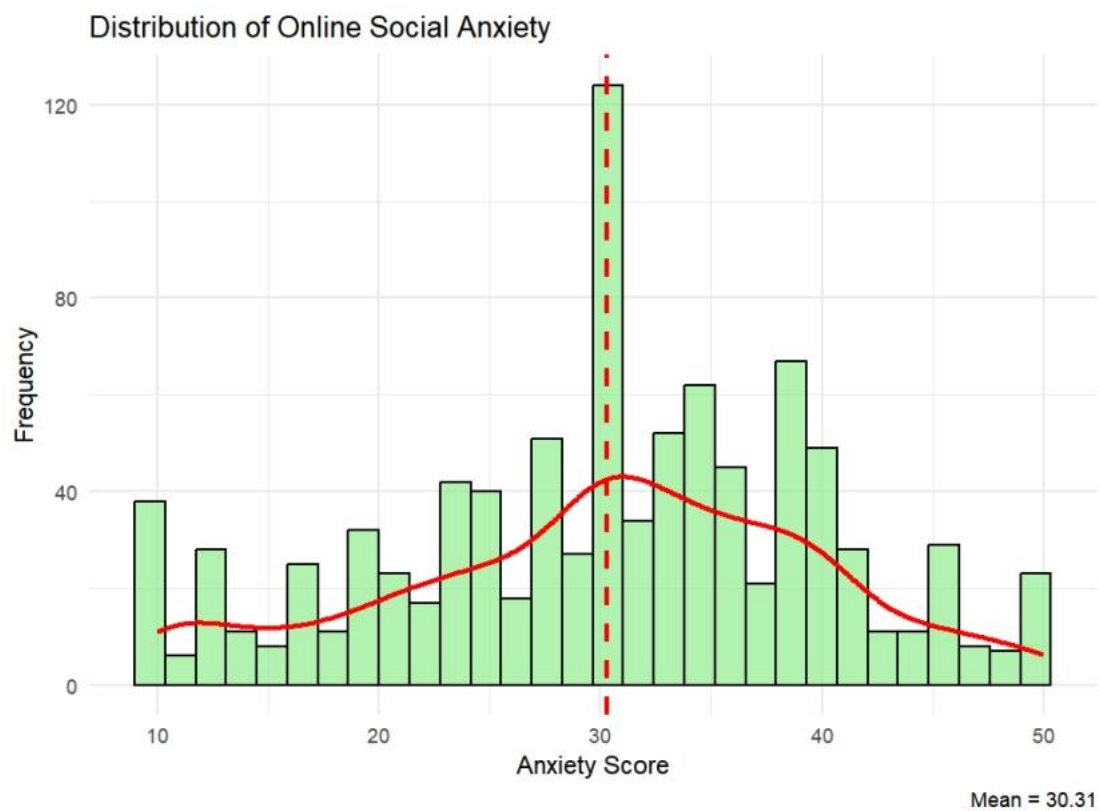


Figure.4 Disturbution of online social anxiety

The box plot in Figure 5 shows that social anxiety scores are relatively evenly distributed, with the central region concentrated between 24 and 37 points. The Q-Q figure (Figure 6) shows that the sample distribution deviates from the theoretical normal distribution line in many places, especially in the low subregion, which further confirms the non-normal distribution characteristics of the data.

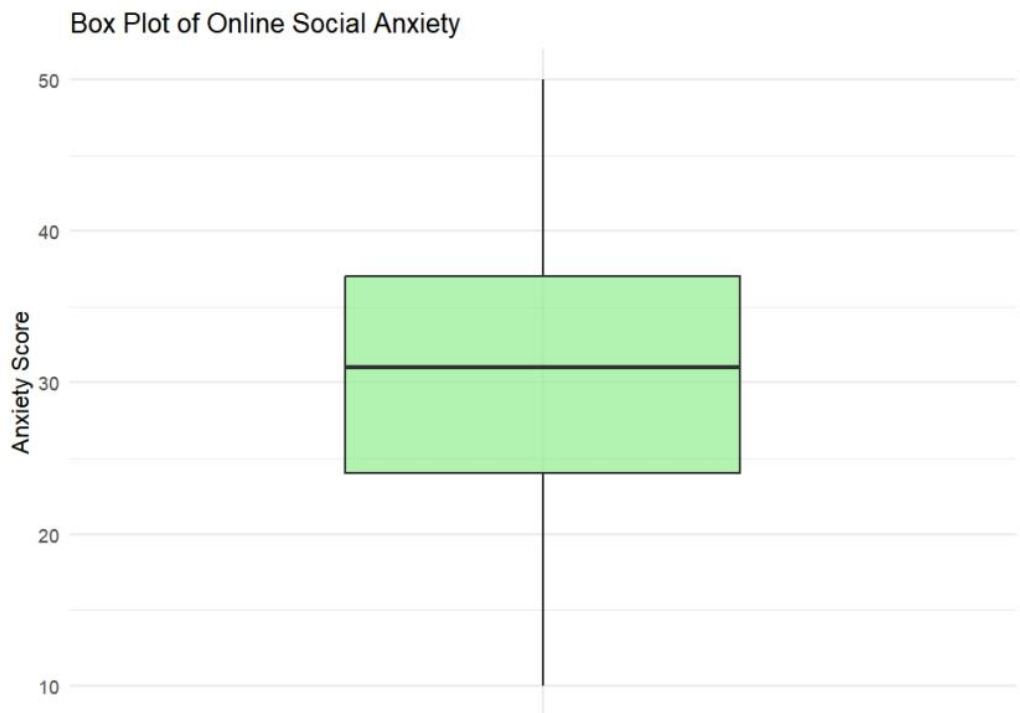


Figure.5 Box plot of online social anxiety

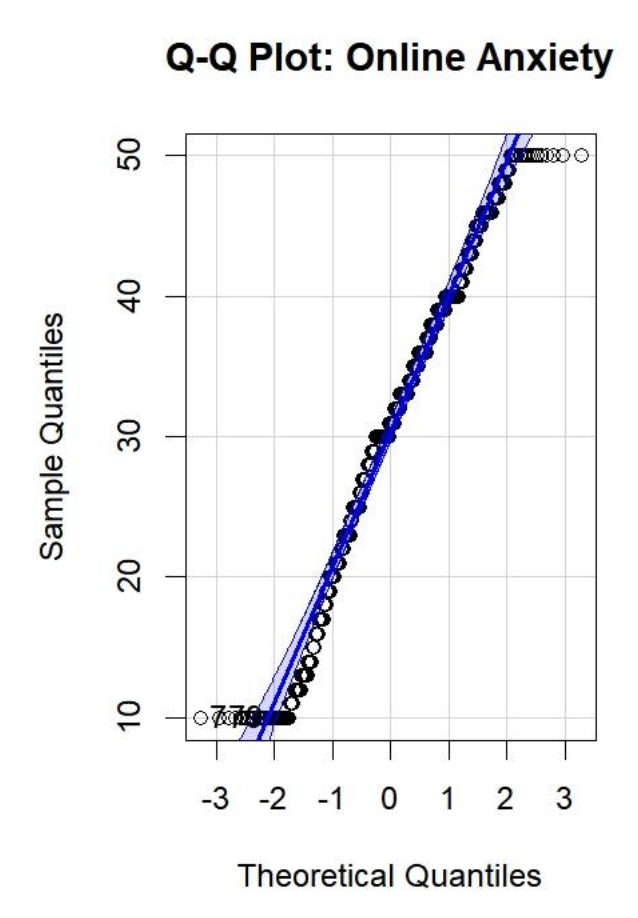


Figure.6 Q-Q plot online anxiety

3.2. Correlation analysis

Since none of the study variables were consistent with the hypothesis of normal distribution, this study used Spearman correlation analysis to explore the correlation between mobile phone use time and online social anxiety. The results showed that there was a weak positive correlation between the two variables ($\rho = 0.192$, $p < .001$), as shown in Figure 7. Figure 7 shows the scatter plot and fitting curve of mobile phone use time and online social anxiety. The scatter plot and the smooth trend line reveal the nonlinear relationship between the two variables. In the area of low use duration (about 1-6 hours), the level of social anxiety showed an obvious upward trend with the increase of use time; However, in the medium-high use duration region (more than 6 hours), the relationship flattens out, and the increase in anxiety level is no longer obvious, showing a potential "Saturation effect".

It is worth noting that although the correlation coefficient is small ($\rho = 0.192$), the very low p value ($p < .001$) suggests that this association is highly statistically significant and unlikely to be due to random factors. In addition, at any given level of cell phone use, social anxiety scores show large individual differences and dispersion, suggesting that other factors besides cell phone use duration (such as purpose of use, mode of use, personal characteristics, etc.) may also influence social anxiety levels. Overall, the correlation analysis results support a weak but statistically significant positive correlation between mobile phone use time and online social anxiety, and reveal the non-linear characteristics of this relationship. The association between increased cell phone use and increased social anxiety was mainly reflected in the range of low to moderate use, while the association became less obvious in the range of high use.

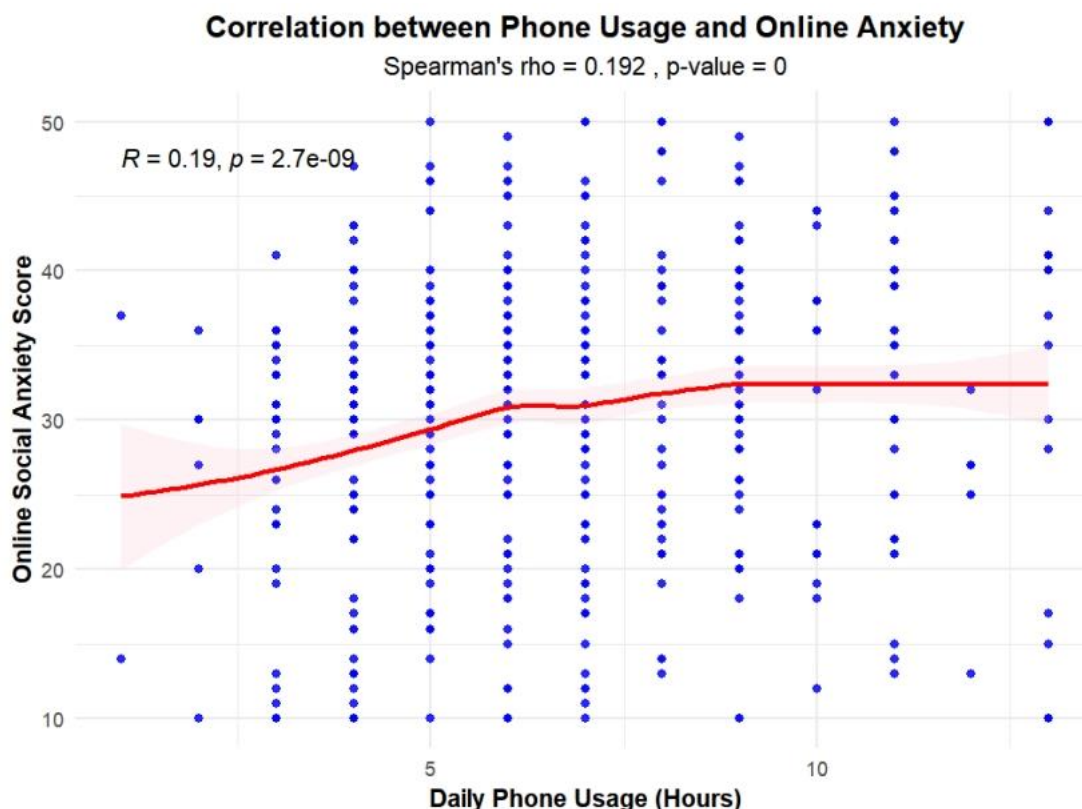


Figure.7 Correlation between Phone Usage and Online Anxiety

4. Conclusion

4.1. Key findings

This study explores the relationship between college students' mobile phone use time and online social anxiety. The results showed that there was a weak positive correlation between them ($\rho = 0.192, p < .001$), this association was statistically significant, although low in strength. In particular, the relationship was non-linear: in the range of low to moderate cell phone use (about 1-6 hours), the level of social anxiety increased with the increase of time use; In the higher use duration range (6 + hours), the association flattens out, showing a "Saturation effect".

The study also found that the average duration of mobile phone use of college students was 6.83 hours/day, and the distribution showed multi-peak characteristics, suggesting that there were subgroups with different usage patterns in the sample. Online social anxiety scores also showed a non-normal distribution, with a significant peak at the 30-point mark, which may reflect a specific threshold or classification point.

4.2. Theoretical significance

The results of this study have implications for understanding the relationship between mobile phone use and mental health. First, the discovery of nonlinear relationships challenges the "The more you use, the higher your anxiety." The simple linear hypothesis supports a more complex relational model. This finding is consistent with the use-gratification theory, which holds that the effectiveness of media use depends on motivation and satisfaction, rather than just the amount used. Second, the findings support the "Moderate use hypothesis" That is, there is a use time threshold beyond which further increases in use time may not lead to significant changes in the level of social anxiety. This may be related to changes in psychological adaptation mechanisms or use patterns and purposes. Finally, although the association was weak, the

statistically significant association showed that the duration of mobile phone use was indeed a relevant factor in social anxiety, supporting the basic idea of a link between technology use and mental health, while also suggesting the important role of other factors in this relationship.

4.3. Research limitations and future directions

This study also has some limitations: First, the cross-sectional design cannot determine causality, and future studies can further explore the causal mechanism between the two using longitudinal design or experimental methods. Second, only the length of use dimension is examined without in-depth analysis of qualitative factors such as content, purpose, and mode of use, which may play an important role in explaining the relationship between the two variables. Finally, the sample is limited to college students in a specific region, so the generalization of the research results should be cautious. In conclusion, this study confirmed the existence of a weak but statistically significant positive correlation between mobile phone use time and online social anxiety, and revealed the non-linear characteristics of this relationship. These findings provide empirical evidence for understanding the complex relationship between mobile phone use behavior and mental health of contemporary college students, and also provide reference for formulating targeted intervention strategies.

References

- [1] Jiang, W., Luo, J., Guan, H., Jiang, F., & Tang, Y.-L. (2022). Problematic mobile phone use and life satisfaction among university students during the COVID-19 pandemic in Shanghai, China. *Frontiers in Public Health*, 9, 805529.
- [2] Turgeman, L., Hefner, I., Bazon, M., Yehoshua, O., & Weinstein, A. (2020). Studies on the relationship between social anxiety and excessive smartphone use and on the effects of abstinence and sensation seeking on excessive smartphone use. *International Journal of Environmental Research and Public Health*, 17(4), 1262.
- [3] Mayerhofer, D., et al. (2024). The association between problematic smartphone use and mental health in Austrian adolescents and young adults. *Healthcare*, 12(6), 600.
- [4] Studer, J., Marmet, S., Wicki, M., Khazaal, Y., & Gmel, G. (2022). Associations between smartphone use and mental health and well-being among young Swiss men. *Journal of Psychiatric Research*, 156, 602–610.
- [5] Research Group on Digital Mental Health. (2025). Network analysis of internet addiction, online social anxiety, fear of missing out, and interpersonal sensitivity among Chinese university students. PMC. Retrieved April 6, 2025.
- [6] Zhang, J. (2025). Immediate and longitudinal predictive effects of self-body images on college students' mobile social media dependence: The mediating role of social anxiety. *Advances in Psychology*, 15(4), 9–18.
- [7] Przybylski, A. K., Murayama, K., DeHaan, C. R., & Gladwell, V. (2013). Motivational, emotional, and behavioral correlates of fear of missing out. *Computers in Human Behavior*, 29(4), 1841–1848.