

# Sleep quality of Chinese designers and the effects of digital screen time, stress, and job responsibility

Yongchun Mao<sup>1,2</sup>, Cunyuan Yang<sup>3</sup>, Gunasunderi Raju<sup>1</sup>

<sup>1</sup>School of Distance Education, Universiti Sains Malaysia, Penang, Malaysia

<sup>2</sup>School of Arts and Design, Qilu University of Technology (Shandong Academy of Sciences), Jinan, China

<sup>3</sup>International Design school for Advanced Studies, Hongik University, Jongro-gu, South Korea

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## ABSTRACT

The aim of this study was to describe the sleep status of Chinese designers and to identify the factors that affect their sleep quality. A total of 393 Chinese designers participated in the survey, which collected data on demographic information, digital screen time, stress, and the pittsburgh sleep quality index (PSQI). The average PSQI score of Chinese designers was 6.77, with 29% scoring equal to or higher than 9, indicating poor sleep quality. The most common sleep problem was difficulty falling asleep. Designers with management responsibilities had poorer sleep quality: the PSQI scores for those in design project management ( $M=8.74$ ,  $SD=3.829$ ) and design and management ( $M=9.05$ ,  $SD=3.475$ ) were significantly higher than for those in dedicated design ( $M=5.34$ ,  $SD=2.908$ ). There was a positive correlation between digital screen time for entertainment, work stress, other stress, and PSQI. The model equation was  $PSQI=1.160+0.276 * entertainment+0.675 * work stress+0.569 * other stress$ , with an  $r$  square of 0.232. Chinese designers should improve their sleep quality by reducing electronic entertainment and relieving stress. Managers in the design industry should pay special attention to their own sleep quality.

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## Corresponding Author:

Gunasunderi Raju

School of Distance Education, Universiti Sains Malaysia

11800 Gelugor, Penang, Malaysia

Email: rgunasunderi@usm.my

## 1. INTRODUCTION

Sleep plays a very important role in individuals' physical and mental health and is an essential function for humans [1]. Poor sleep can lead to physiological disorders, including type 2 diabetes [2], and cardiovascular disease [3]. Poor sleep is also related to individual mental health [4], such as anxiety and depression [5], aggression [6], and cognitive function changes [7].

A significant increase in screen time can lead to poor sleep (including longer sleep latency and poorer sleep quality) and a lack of physical activity, resulting in higher levels of anxiety [8]. There is a strong relationship between nighttime electronic device use and the temporal process of sleep disorders [9], [10]. Longer average screen time before sleep and during sleep has been associated with poor sleep quality, decreased sleep efficiency, and longer sleep latency [11], [12]. Designers are heavy users of electronic screens [13], as their work requires a lot of computer-aided design software to help them efficiently complete design tasks [14]–[16]. Moreover, they use electronic devices, such as TVs, smartphones, and tablets, for work and entertainment. In addition to the compulsory use of electronic screens at work, engaging in entertainment activities using electronic devices like smartphones before sleep is also a significant source [17], [18].

Stress is an important factor that can affect personal health and may lead to mental and physical health conditions, including depression [19], cardiovascular diseases [20], atherosclerosis [21], and type 2 diabetes [22]. An aspect of particular significance is that stress has been recognized as a significant factor contributing to sleep disorders, especially among working adults [23], [24]. Work is a significant source of stress for employed individuals, and it is a major health and safety issue [25], [26]. Work-related stress can affect employees' job satisfaction and sleep quality [23], [27], [28]. Chinese designers experience high levels of work-related stress, which originates from multiple aspects [29]. First, heavy workloads are very common among Chinese designers. Continuous working hours can make designers feel exhausted and stressed, as researchers have found that working more than 40 hours per week can lead to a decrease in sleep quality [30], [31]. Second, work difficulty is another source of stress because design requires a high level of creativity, which makes the job challenging for designers. In addition, multiple work tasks add to stress. Third, pressure from bosses and colleagues, including deadlines, competition for promotion, relationships with colleagues, and income, also contributes to stress among designers [29], with managers facing even more pressure [32]. Besides work stress, Chinese designers also face various pressures from their personal lives, including financial pressure, social pressure, health pressure, and family pressure [33].

Designers usually provide design solutions based on user needs, with most designs being created using computers. They generally work for the design companies or design departments of companies, and some work as independent designers. Their job responsibilities include dedicated design, design project management, and design and management. Chinese designers face high work pressure, as they need to meet the demands of clients and superiors while maintaining the creativity of their work. The health of Chinese designers is not optimistic, with many experiencing suboptimal or poor health status. The quality of their sleep is a concerning issue, as it directly affects their health and indirectly impacts their work and lives. However, there are currently very few studies on the sleep quality of designers, which represents a research gap that needs to be filled. Lack of clarity regarding the current state of sleep quality among Chinese designers, coupled with the potential ramifications of overlooking this issue, could exacerbate the situation. This study utilized a cross-sectional survey methodology to conduct a statistical analysis of sleep quality among Chinese designers, considering their demographic variables. The findings of this study furnish designers and scholars with insights into the current sleep conditions among Chinese designers, thereby emphasizing the gravity of this concern. This study fills the research gap in the current lack of research on the sleep quality of designers and provides inspiration and ideas for future scholars focusing on designer health issues. Furthermore, insights from exploring the factors that affect the sleep quality of Chinese designers can inform recommendations for improving their sleep quality.

## 2. METHOD

### 2.1. Participants

All participants assessed in this study were Chinese designers. They included employees of design companies, employees of design departments of companies, and independent designers. Data were collected through an online survey conducted using the Chinese app "Wenjuanxing," and 450 designers from various parts of China participated. After excluding incomplete or meaningless questionnaires, the final number of samples was 393. The study was conducted in compliance with the principles of the Declaration of Helsinki and was approved by the Biomedical Research Ethics Committee of Shandong Provincial Hospital (SWYX: NO.2022-532, 11/21/2022).

### 2.2. Measures

This study used a cross-sectional design to obtain descriptive information on the electronic screen usage time, stress, and sleep quality of Chinese designers. The questionnaire was written in Chinese and consisted of five parts: instructions, demographic information, digital screen time, stress, and the pittsburgh sleep quality index (PSQI), of which stress and PSQI were subjective scales. Participants were asked to fill out the questionnaire based on their recent experiences in the past month. In both the offline and online questionnaires, informed consent forms were attached. It generally took 5 to 10 minutes for participants to complete the survey.

The survey of sleep quality used the PSQI developed by Dr. Buysse, a psychiatrist at the University of Pittsburgh, in 1989 [34]. The PSQI consists of 7 components, including subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction, with a total of 19 questions. The total score range is 0–21, with higher scores indicating poorer sleep quality. Generally, a score of 0–3 is considered to be very good for sleep quality, 4–8 is classified as fairly good for sleep quality, 9–16 is classified as fairly bad for sleep quality, and a score of 17 or higher indicates very bad sleep quality. Digital screen time includes three items: digital screen time for work, digital screen time for entertainment, and digital screen time in bed. Participants were asked to fill in the average time per day, in hours, for each item. Stress

included two items: work stress and other stress. Participants were asked to complete a 7-point Likert scale (where 1 represents no stress at all, 4 represents general stress, and 7 represents extreme stress).

### 2.3. Statistical analyses

This study utilized SPSS for Windows v. 26.0 (IBM, Armonk, NY, United States) for data analysis. Frequency and percentages were used to describe demographic information, while mean and variance were used to describe digital screen time, stress, and PSQI. Descriptive statistics were used to analyze the results of the PSQI subscales. In this study, demographic information, digital screen time, and stress were independent variables, and PSQI was the dependent variable. ANOVA, Chi-square tests, and linear regression were used to analyze the relationship between some variables and the PSQI. A  $p \leq 0.05$  was considered significant.

## 3. RESULTS

### 3.1. Demographic information

The demographic information of the participants is presented in Table 1. The number of male ( $n=195$ ) and female ( $n=198$ ) participants was similar, indicating that there was no significant gender bias or discrimination in the design industry. Most designers were relatively young, with 77.6% of designers being under 30 years old, and only 4.1% of designers being over 36 years old. Correspondingly, the design work experience of designers was also mostly less than 10 years (99.5%), with 74.6% of designers having less than five years of work experience. Most designers worked for design companies (43.5%) or design departments of companies (37.7%), with few working as independent designers or in other positions. About 40.4% of the designers were fully or partially responsible for the design project management.

Table 1. Demographic information of participants

Variables	Categories	n	Percentage
Gender	Male	195	49.6
	Female	198	50.4
Age (years)	20–25	147	37.4
	26–30	158	40.2
	31–35	72	18.3
	36–40	16	4.1
Design work experience (years)	0–5	293	74.6
	6–10	98	24.9
	11–15	2	0.5
Type of employer	Design company	171	43.5
	Design department of company	148	37.7
	Independent designer	45	11.5
	Others	29	7.4
Job responsibility	Dedicated design	234	59.5
	Design project management	96	24.4
	Design and management	63	16.0

### 3.2. Screen time and stress

The Chinese designers in this study spent a long time on their digital screens daily, as shown in Table 2. Digital screen time for work reached 6.9 hours, while digital screen time for entertainment reached 3.3 hours, for a total of 10.2 hours. It was common for them to use electronic devices before bedtime, as only 15.8% of designers reported not using them before sleeping. The average duration of the digital screen time in bed was 1.6 hours. Table 3 shows that the designers were also under a lot of stress, with average values of 3.8 for work stress and other types of stress.

Table 2. Daily screen time of Chinese designers

Categories	n	M	SD
Work (hours)	393	6.9	2.52
Entertainment (hours)	393	3.3	1.615
Bed (hours)	393	1.6	1.02

Table 3. Stress of Chinese designers

Categories	n	M	SD
Work stress	393	3.8	1.70
Other stress	393	3.8	1.77

### 3.3. Sleep quality

The average PSQI score of the Chinese designers was 6.77, with a standard deviation of 3.67, indicating a positively skewed distribution, as shown in Figure 1. Based on the scoring standard indicated in the Methods section (0–3=very good, 4–8=fairly good, 9–16=fairly bad, and 17 and above=very bad), we

divided the designers' sleep quality into four levels. Figure 2 shows sleep quality of Chinese designers and corresponding results of different job responsibilities. Overall, designers with fairly good sleep quality accounted for the majority at 52%, followed by fairly bad and very good at 28% and 19%, respectively, while only 1% of designers had very bad sleep quality, as shown in Figure 2(a). The corresponding results for the three job responsibilities are shown in Figures 2 (b)-(d). The average sleep duration of the Chinese designers was 7.85 hours (SD=.418), with the lowest sleep duration being four hours and the highest being 12 hours. In the past month, the most common factors that affected designers' sleep were difficulty falling asleep, followed by waking up during the night or early morning, nightmares, and other factors. Table 4 presents the results on sleep latency, subjective sleep quality, medicine use, and feeling sleepy or tired. Difficulty falling asleep for 30 minutes was the most common sleep problem among the Chinese designers, which was experienced by 66.2% of them at least once a week.

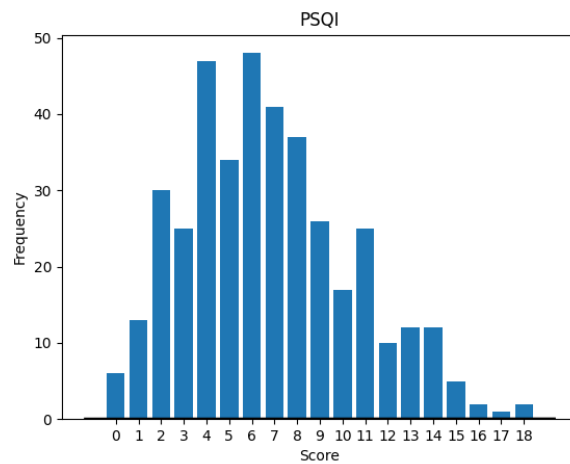


Figure 1. Histogram of the PSQI scores of Chinese designers

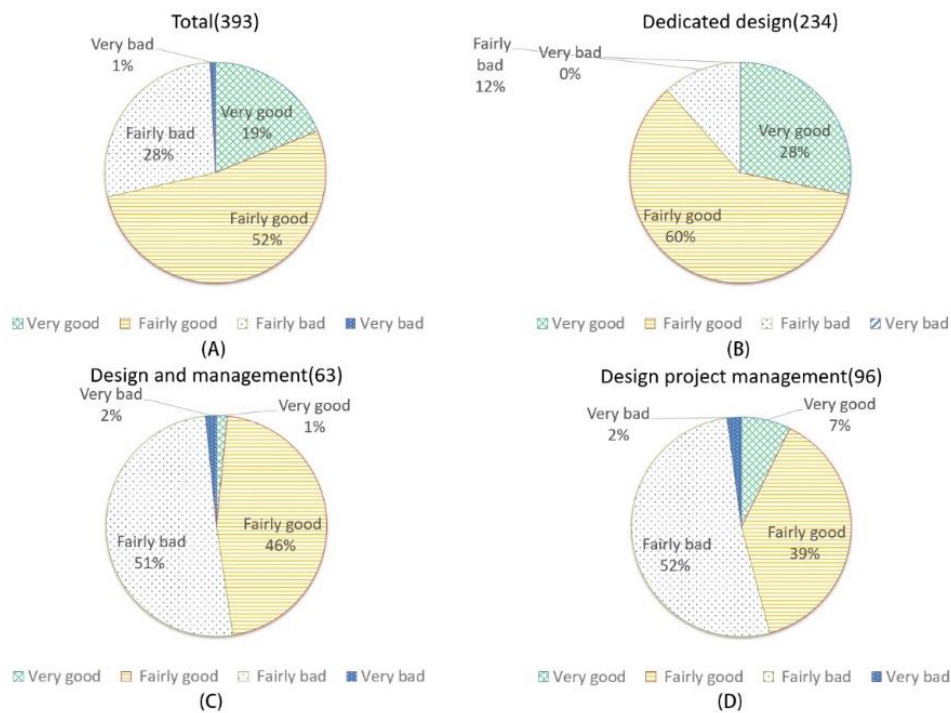


Figure 2. Sleep quality of Chinese designers and corresponding results of different job responsibilities, (a) total (393), (b) dedicated design (234), (c) design and management (63), and (d) desain apject management (96)

Table 4. Results of PSQI questions

Questions	Option 1	Option 2	Option 3	Option 4
Question 2	≤15 min (35.6%)	16-30 min (37.9%)	31- 60 min (14.5%)	≥60 min (12.0%)
Question 6	Very good (23.9%)	Fairly good (45.5%)	Fairly bad (21.9%)	Very bad (8.7%)
Question 7	None (93.9%)	<1 per week (4.8%)	1-2 per week (4.0%)	≥3 per week (1.0%)
Question 8	None (20.9%)	<1 per week (26.0%)	1-2 per week (27.2%)	≥3 per week (26.0%)
Question 9	None (27.2%)	<1 per week (30.5%)	1-2 per week (26.2%)	≥3 per week (16.0%)

### 3.4. Association between sleep quality and job responsibility

We conducted independent sample t-tests for gender and one-way ANOVAs for age, design work experience, and type of employer, but none of the results showed significance. ANOVA was also conducted for job responsibility, with the result of equal variance ( $p=0.01$ ), and Welch's test showed significance [ $F(2, 390)=55.651, p<0.01$ ]. Post hoc tests showed that those working in dedicated design ( $M=5.34, SD=2.908$ ) had significantly lower PSQI scores than those in design project management ( $M=8.74, SD=3.829$ ) and design and management ( $M=9.05, SD=3.475$ ), whereas there was no significant difference between the PSQI scores of those in design project management and those in design and management as shown in Figure 3.

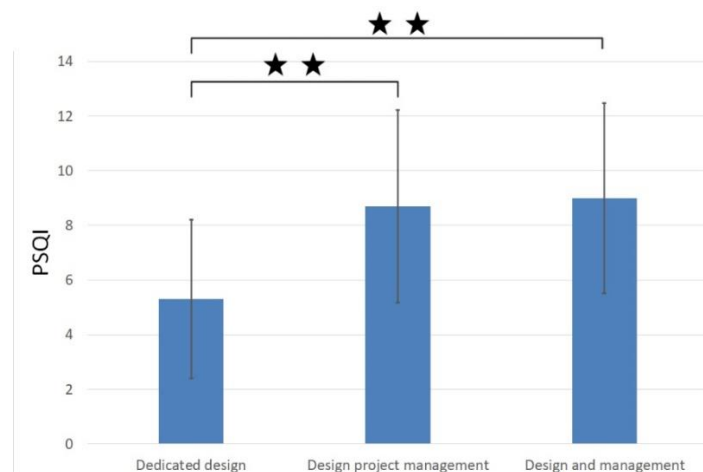


Figure 3. Multiple comparisons of the effects of job responsibility on PSQI (★★ denotes  $p \leq 0.01$ )

According to the PSQI scores of the Chinese designers, their sleep quality was categorized as very good, fairly good, fairly bad, and very bad. The corresponding results for the three job responsibilities are different. The Chi-square test result was  $\chi^2=13.83, p<0.01$ , indicating a significant difference in sleep quality among the three job responsibilities. As shown in Figure 2, although the proportion of bad sleep quality was not high overall (less than 30%), it exceeded 50% for designers working in design project management or design and management.

We also conducted an analysis of sleep duration, work stress, and other stresses reported by the participants. The results showed that the Chinese designers working in design project management ( $M=7.59, SD=1.4$ ) and design and management ( $M=7.27, SD=1.3$ ) had significantly lower sleep duration than those in dedicated design ( $M=8.12, SD=1.39$ ), with  $F(2, 390)=11.600$  and  $p<0.01$ . Further, designers in design project management ( $M=4.13, SD=1.9$ ) and design and management ( $M=4.06, SD=1.7$ ) had significantly higher other stress levels than those in the dedicated design sector ( $M=3.53, SD=1.7$ ), with  $F(2, 390)=4.958$  and  $p=0.007$ . Work stress also showed significance [ $F(2, 390)=4.958, p=0.05$ ]. The Chinese designers in design and management ( $M=4.24, SD=1.7$ ) had significantly higher work stress levels than those in dedicated design ( $M=3.66, SD=1.7$ ), with  $p=0.02$ . There was no significant difference between those working in design project management and those working in design and management.

### 3.5. Correlation between sleep quality, screen time, and stress

Table 5 shows a positive correlation ( $p<0.01$ ) between entertainment, work stress, and other stress with PSQI. Linear regression analysis was conducted with PSQI as the dependent variable and entertainment,

work stress, and other stress as independent variables. The results are shown in Table 6. The model equation was  $PSQI=1.160+0.276* \text{entertainment}+0.675* \text{work stress}+0.569* \text{other stress}$ , with an  $r^2$  of 0.232, indicating that these three independent variables explained 23.2% of the variance in PSQI. The F-test of the model was significant, with  $F(3,389)=39.181$  and  $p<0.001$ , indicating a significant impact. All three factors had a positive effect on PSQI scores: work stress had the greatest impact on sleep quality, followed by other stress, and lastly, screen time for entertainment.

Table 5. Correlations between PSQI and screen time (work, entertainment, and bed) and stress (work stress and other stress)

PSQI	Work	Entertainment	Bed	Work stress	Other stress
r	-.052	.182**	.094	.375**	.339**
p	.306	.000	.063	.000	.000

Table 6. Multiple linear regression analysis of PSQI with entertainment, work stress, and other stress

Variables	Unstandardized coefficients		Standardized coefficients	t	p	R	R square
	B	SE	Beta				
Constant	1.160	0.564		2.055	.041		
Entertainment	0.273	0.103	0.119	2.658	.008	0.482	0.232
Work stress	0.675	0.098	0.313	6.894	0.000		
Other stress	0.569	0.094	0.274	6.068	0.000		

#### 4. DISCUSSION

The Chinese designers surveyed in this study spent a long time each day using digital screens at work, averaging 6.9 hours per day. Designers need to use computers, Macs, or other productivity tools to carry out tasks such as information collection, sketching, model making, and work communication, making the use of digital screens inevitable [13], [14]. Long-term use of electronic screens can cause health problems, such as eye strain and shoulder and upper arm pain [35] and can also cause anxiety [8]. Despite this, the Chinese designers in this study spent an average of 3.3 hours a day on entertainment using digital screens, which is consistent with their younger age group [36]. Considering that the average sleep time reported in this study was 7.85 hours, the daily screen time of Chinese designers accounts for 63% of non-sleep time, exceeding most people [35]. In other words, Chinese designers dedicate merely 5.95 hours each day for activities apart from sleep and electronic screen engagement. This alarming statistic underscores the acute level of dependence on electronic screens for work and life among Chinese designers, necessitating urgent attention and resolution [37]. We found that the Chinese designers experienced a similar level of stress at work and other aspects of their lives, with a subjective rating of 3.8. They generally felt moderate stress, which came from different sources. Stress from work and other aspects affected the designers sleep, an issue that has been reported by other professions [33], [38].

In general, the results of the PSQI indicate that the sleep quality of the Chinese designers was not ideal, with 29% scoring 9 or above, indicating fairly bad or very bad sleep quality. Very few of the designers had good sleep quality. Therefore, there is a need for an overall improvement in the sleep quality of Chinese designers. Chinese designers achieve an average daily sleep duration of 7.85 hours, aligning with the recommended sleep duration of 7 to 9 hours suggested by the US National Sleep Foundation [39]. However, this does not imply that Chinese designers possess satisfactory sleep quality. Chinese designers tended to go to bed very late at night, with 86.3% of them falling asleep after 11 pm. Difficulty falling asleep was identified as the most important factor affecting the sleep quality of the designers, with 66.2% of designers experiencing difficulty falling asleep for at least 30 minutes once per week. This is likely related to the use of digital screens before bed and stress [9].

Notably, the Chinese designers in this study almost never took medication to help them sleep. In fact, almost all Chinese people who experience sleep problems do not take sleeping pills [40]. More than 70% of the designers had trouble staying awake or lacking enthusiasm at least once a week, and part of the reason was poor sleep quality [41]. The Chinese designers had an accurate perception of their own sleep quality, as the subjective results were consistent with the total PSQI score, indicating that the designers were actually aware of their own sleep conditions, especially those with poor sleep quality. However, due to work, life, physical condition, and personal bias, they have not been able to solve their sleep problems.

We categorized the job responsibilities of designers into three types: i) dedicated design, ii) design project management, and iii) design and management. The results clearly indicate that designers whose jobs involved managing design projects reported significantly decreased sleep quality, with over 50% of them having fairly bad or very bad sleep quality. This is because compared to positions that only involve design, managers have more responsibility and work difficulty [42], which leads to a reduction in their sleep time

and an increase in work and other pressures. Additionally, longer working hours are also a reason for poor sleep quality in management positions. Thus, the sleep issues of designers responsible for management need to be given special attention. If left unresolved for an extended period, it will seriously affect their health.

Screen time and stress also have an impact on sleep quality, but not all screen time is related to sleep quality. The increase in screen time for entertainment is accompanied by a decline in sleep quality, consistent with previous research findings [36], [43]. Nevertheless, the increased screen utilization for work tasks, which commands a substantial time allocation, does not manifest a discernible correlation with sleep quality. While engaging with screens during work may result in designers experiencing physical and visual fatigue, this practice does not significantly modify the total work duration, nor does it distinctly influence work intensity due to the diverse extents of screen engagement. Moreover, screen usage during work transpires neither within the sleep environment nor immediately prior to sleep, thereby rationalizing the confined influence on sleep quality. Work stress and other stresses were positively correlated with PSQI scores in this study, indicating that increased stress is accompanied by a decrease in sleep quality [27], [44], [45]. The regression models showed that stress had a stronger correlation with sleep quality than screen time [33]. Stress was the main factor affecting sleep quality, and we confirmed that work stress had a greater impact on sleep quality than other stressors among the Chinese designers, although these two had the same score. Chinese designers face significant work and life stress, which requires help from both companies [46] and families [47]. Designers themselves also need to actively adjust their mentality to reduce stress and improve sleep quality. The designer's work requires digital screen time during work that cannot be reduced. Therefore, we suggest that designers reduce their digital screen time for entertainment [37] and adopt healthier leisure activities.

We investigated the current sleep quality status of Chinese designers and identified risk factors of their sleep. We found negative correlations between sleep quality and screen time, work stress, and other stress. Additionally, managerial responsibilities exacerbate the deterioration of sleep quality. However, there are limitations to our study. First, in terms of sample selection, we used a combination of online and offline methods to recruit participants. Given that China is a vast country, there is room for improvement in the representativeness of the Chinese designer population. Second, we identified factors related to sleep quality, including digital screen time for entertainment, work stress, and other stress, but the regression model showed that these three variables could explain only 23.2% of the variance, indicating that there may be other factors that need to be explicated in future research. Third, our classification of stress factors was somewhat simple, as other stresses may contain different factors. Therefore, future research should consider a more detailed and reasonable independent variable design. Fourth, we did not consider the physical health of the Chinese designers, such as illness or physical discomfort, which is an important aspect related to sleep quality. Finally, our study did not have a control group; therefore, we could not determine whether changes in these factors could significantly improve sleep quality, thus lacking validation.

## 5. CONCLUSION

Sleep quality among Chinese designers is an issue that deserves continuous attention. Our findings show that the Chinese designers, who were mainly young adults, had poor sleep quality. They were aware of their poor sleep quality, with difficulty falling asleep being the most common issue. Despite this, they still went to bed late every day. These designers spent a lot of time facing digital screens every day, whether for work or entertainment. In addition, they faced moderate levels of work stress and other stress. Digital screen time for entertainment, work stress, and other stress were all positively correlated with PSQI scores, meaning that an increase in these three factors corresponded to a decrease in sleep quality. Among these, work stress had the greatest impact on sleep quality. The nature of the work that the designers were responsible for also had an important influence. The responsibility of project management in their work (whether full or partial responsibility) resulted in shorter sleep times and higher stress levels, which were linked to poorer sleep quality.

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## BIOGRAPHIES OF AUTHORS






**Yongchun Mao**    is a PhD student at Universiti Sains Malaysia. He also works for School of Arts and Design, Qilu University of Technology (Shandong Academy of Sciences) as a lecturer. He received his MA degree in the School of Urban Design at Wuhan University. His research interests include human factors, graphical interface and occupational health. He can be contacted at email: maoyongchun@student.usm.my.



**Cunyuan Yang**    is a PhD candidate at Hongik University. Current research interests are design management, focusing on the human-centered approach to product and brand design. Interested in distributed innovation, and hope to improve the management and operation efficiency of the whole supply chain and improve the production capacity by designing the innovation path. He can be contacted at email: design.cunyuan@gmail.com.



**Gunasunderi Raju**    is a lecturer at Universiti Sains Malaysia. She got a PhD degree of Polymer Chemistry from Universiti Sains Malaysia. She is interested in occupational safety and health, natural rubber latex, tobacco leaf and kenaf, biocomposites and hybrid composites and biopolymers and biodegradables. She can be contacted at email: rgunasunderi@usm.mt.