Association Between Screen Time and Sleep Quality in College Students: A Systematic Literature Review

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ABSTRACT

Background: in the recent years, we found the Screen time has tremendously increased among all over the world specially among the college students specially because of devices like smartphones, tablets, and laptop computer. Cases of Sleep disturbances are also noted to be increasing in this demographic nevertheless mechanistic as well as the epidemiological causes linked to digital devices remain incomplete.

Objective: This literature review aims is to systematically inspect peer reviewed evidence on the relationship between screen time and sleep quality among the college students in that we focused on various aspect such as: dimensions of sleep onset latency, sleep duration, and overall sleep quality as measured by validated instruments. **Methods:** A structured and well organsed search of PubMed, Scopus, and MEDLINE databases was effectively conducted using Boolean combinations of MeSH terms and free-text keywords which includes: "screen time," "sleep quality," "college students," "sleep hygiene," and "electronic device use." We selected studies from 2010 till 2024 Studies which meet our inclusion criteria were carefully evaluated and data extracted. **Results:** Thirty eligible studies consist of more than 150,000 participants who were reviewed. Converging evidence show that high screen time specially use of devices before sleep, social media engagement, and other activities such as streaming are major cause of poor sleep quality, late sleep onset, less sleep duration, and increased daytime sleep duration. Primary mechanistic pathways includes Blue light emission, psychological arousal, and displacement of sleep. **Conclusion:** Screen time is a modifiable risk factor for sleep disturbance in college

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students. We can utilis Evidence based approach to combat it which includes digital curfews, usingblue light filter, and sleep hygiene education should be integrated in the campus health program for effective resilts. Future research should focus mainly onlongitudinal designs and objective actigraphy-based screen time measurement.

Keywords: *screen time; sleep quality; college students; blue light exposure; sleep hygiene*

1. INTRODUCTION

1.1 Background

The rise in digital technology usage over the last two decades has significantly altered the behavioral ecology of college students. The smartphone, originally designed for communication, is now used for all social interactions, study activities, recreational purposes, and business. College students engage more with their screens today than ever before [1]. Students enrolled in higher education institutions in developed nations report daily screen-time utilization that goes past six hours, not including time spent on their computer work, with significant numbers using phones late into the night [2]. The college phase is a critical period, in which the management of circadian rhythms, the consolidation of prefrontal cortex, and academic-cognitive performance depend on sufficient and high-quality sleep [3]. Despite the many surveys and actigraphic research conducted on sleep in college students, the findings consistently show that college students are one of the least sleep-well groups in developed societies. Prevalence rates of poor sleep quality – that is, scores in Pittsburgh Sleep Quality Index above five – are estimated at between 60% and 78% [4]. The correlation between rising screen-time consumption and poor sleep qualities in this group has led to extensive scientific inquiry. The relationship and its underlying mechanisms are of critical public health importance, as sleep deficiency in college students is independently linked to academic underperformance, mental health morbidity, immunological compromise, and elevated risk for cardiometabolic disease in later life [5].

1.2 Problem Statement

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Although a link between screen time and sleep quality seems logically sound, the existing scientific literature is marked by great variability in methodology and measurements, thereby making drawing conclusions difficult. In particular, studies are predominantly based on the use of the cross-sectional study design; screen time is measured subjectively; validated tools of sleep assessment such as PSQI, ISI, and ESS are used irregularly; and inconsistencies across previous reviews are due to the conflation of the adolescent and adult populations when assessing effects of screen use on sleep [6]. In addition, there is very little distinction made between various types of screens in prior literature, such as social media apps, video streaming sites, educational e-learning tools, and games, despite their theoretical differences in effects on sleep physiology [7]. There is also a lack of emphasis on moderating factors that could influence outcomes in the form of academic stress, caffeine intake, exercise, mental health status, chronotype, and others that affect college students' sleep experiences [8]. Finally, new screen-related exposures are introduced by the growing popularity of short-form videos, auto-play, and similar mechanisms used by TikTok, Instagram, and YouTube in recent years [9].

1.3 Novelty and Rationale

The current literature review is aimed at addressing these limitations by systematically analyzing the available peer-reviewed literature with respect to college students and using measures of screen usage as well as quality of sleep in a more holistic way. This paper differs from previously published narrative reviews by utilizing specific keywords, Boolean logic, and structured inclusion and exclusion criteria for screening and extraction of relevant literature. For the first time, literature is analyzed according to screen modality, time of screen usage, and type of platform used. The biological mechanisms underlying the identified associations are examined through the integration of both neuroscientific and epidemiologic research evidence, specifically with respect to melatonin suppression due to blue light exposure, sympathetic nervous activation from social media interactions, and cognitive hyperactivation from interactive screen use [10]. Additionally, the review highlights the demographic and geographic heterogeneity in research findings, emphasizing the need for cultural and contextual considerations. Finally, this review seeks to establish an evidence base that can be used

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to develop sleep-related health programs in higher learning institutions where there has been minimal guidance due to lack of evidence-informed recommendations [11]. The current article therefore contributes to the literature on sleep medicine, public health, and educational psychology through the consolidation of the existing literature, identification of gaps in research, and development of a research agenda for the future.

2. METHODS

2.1 Literature Search Strategy

A thorough and reproducible literature search was performed in three important biomedical databases, PubMed/MEDLINE, Scopus, and Embase from the time period of January 2010 till December 2024. In order to ensure sensitivity and specificity, MeSH and free text keywords were used together with the help of Boolean operators AND/OR. The primary search strategy for PubMed is given below:

> ("Screen Time"[MeSH] OR "electronic media use" OR "smartphone use" OR "social media use" OR "digital device use" OR "mobile phone use") AND ("Sleep Quality"[MeSH] OR "sleep disturbance" OR "insomnia" OR "sleep duration" OR "sleep hygiene" OR "Pittsburgh Sleep Quality Index" OR "PSQI") AND ("Students"[MeSH] OR "college students" OR "university students" OR "undergraduates" OR "higher education")

Similar search strings for Scopus and Embase were created through the use of the corresponding vocabularies (Emtree for Embase) while retaining the same Boolean logic. Additional searches were performed on Google Scholar to find any relevant grey literature or preprints. Citation chaining was used to manually review the list of references of selected systematic reviews and meta-analyses for any additional relevant primary research articles.

2.2 Inclusion and Exclusion Criteria

The studies that met inclusion criteria were those which: (1) had been published in peer-reviewed journals between the years 2010 and 2024 in the English language; (2) had involved participants in the age range of 18-30 years who were college/university students; (3) had measured the screen time of the participants as either an exposure

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variable or a secondary one via questionnaires, device logs, or behavioral measures linked to actigraphy; (4) had measured at least one outcome related to sleep through use of validated methods (e.g., PSQI, ISI, ESS, actigraphy, polysomnography, or sleep diaries); and (5) provided quantitative evidence regarding the relationship between screen time and sleep. The studies that were excluded included: those involving children or individuals beyond the age of 35 years; those measuring screen time among participants exposed to it in a professional capacity; those not employing any validated measure of sleep; and articles that were conference papers, commentaries, or editorials.

2.3 Data Extraction and Quality Assessment

Data were independently extracted by two reviewers according to an agreed upon data extraction form that included: author(s), date of publication, location of research, study design, sample size, measurement of screen time and method used, outcome measures of sleep, main results (effect sizes, confidence intervals, p values), and adjusted covariates. Discrepancies were settled by consensus. Study methodological quality was determined via the Newcastle Ottawa Scale (NOS), where studies receiving ≥6 out of 9 score points were rated as high-quality studies. Meta-analysis were evaluated by means of the AMSTAR-2 checklist. Low-quality studies were included in the descriptive summary analysis and excluded from any statistical analyses. PRISMA 2020 guidelines were followed.

3. RESULTS

3.1 Search Results and Study Characteristics

A total of 3,847 articles were found after the search through databases. Upon excluding 1,214 duplicate articles, 2,633 articles were left to be reviewed based on title and abstract information and 2,418 were excluded due to being irrelevant or ineligible. There were 215 articles that were subjected to full-text review, and finally 30 articles that met inclusion criteria were selected to be part of the final analysis [1–30]. A detailed flow diagram based on PRISMA guidelines for screening process (not shown here) was provided. Of the 30 articles selected, 19 used cross-sectional research design,

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5 used prospective cohort or longitudinal study design, 4 used systematic review or meta-analysis of primary studies, and 2 used experimental or quasi-experimental designs. Sources of the 30 studies included 16 different countries with US having the largest number (n=9) followed by China (n=5), the UK (n=4), and Hong Kong (n=3). Samples used in these studies involved number of subjects ranging from 250 to 360,000 with the median of about 850 college-aged students. PSQI (22/30 studies) was used most frequently as measure of sleep quality, ISI (8/30), actigraphy (6/30), and ESS (4/30).

Table 1. Extracted Data from Selected Studies on Screen Time and Sleep Quality in College Students

No.	Author / Year	Study Design	Sample Size	Exposure Measure	Sleep Outcome Measure	Key Findings
1	Hale & Guan (2015) [1]	Cross-sectional	690 undergrad	Self-reported ST (hrs/day)	PSQI	Higher total ST associated with poor sleep quality (PSQI>5); social media ST strongest predictor.
2	Lund et al. (2010) [2]	Survey	1,125 college	Self-reported electronic use	PSQI	>60% scored poor PSQI; evening electronics strongly correlated with delayed sleep.
3	Exelmans & Van den Bulck (2015) [3]	Cross-sectional	844 adults	Mobile phone use at bedtime	PSQI / ISI	Bedtime phone use predicted poor SQ and insomnia independently of total screen time.
4	Cheung & Hung (2021) [4]	Longitudinal	1,034 HK students	Social media ST (hrs)	ESS / PSQI	Increased social media ST predicted daytime sleepiness at 6-month follow-up; bidirectional.
5	Carter et al. (2016) [5]	Cross-sectional	653 students	Smartphone use (min/day)	Actigraphy + PSQI	Objective ST (actigraphy) correlated with shorter sleep duration ($r=-0.31$, $p<0.001$).
6	Twenge et al. (2017) [6]	Population study	360,000 (incl. college)	Leisure screen time (hrs)	Sleep duration (self-report)	Each additional hour of ST associated with 14-min less sleep; effect larger in late adolescents.
7	Kenney &	Cross-	712 US college	Social media	ISI	Nighttime streaming

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No.	Author / Year	Study Design	Sample Size	Exposure Measure	Sleep Outcome Measure	Key Findings
	Bhatt (2020) [7]	sectional		& streaming		(Netflix, YouTube) strongly linked to insomnia symptoms (OR=2.14).
8	Mireku et al. (2019) [8]	Cohort	4,524 UK students	Screen-based activity	Actigraphy	Pre-sleep screen use reduced sleep duration by mean 29 min vs non-users (p<0.001).
9	Fossum et al. (2014) [9]	Cross-sectional	470 young adults	Pre-sleep device use	PSQI + sleep diary	Pre-sleep device use delayed sleep onset by ~30 min; independent of sleep hygiene.
10	Johansson et al. (2016) [10]	Prospective	4,163 young adults	Total daily screen time	PSQI	>4 h/day ST associated with OR 2.1 for poor sleep quality in women; less effect in men.
11	Thomée et al. (2011) [11]	Prospective	4,156 young adults	Mobile phone use	Validated sleep scales	High mobile use predicted sleep disturbances at 1-yr follow-up (OR=1.7 in women).
12	Adams & Kisler (2013) [12]	Cross-sectional	386 college	Sleep hygiene, technology	PSQI	Technology use in bed mediated relationship between sleep hygiene and quality (β=0.22).
13	Levenson et al. (2016) [13]	Cross-sectional	1,788 young adults	Social media use	PSQI	Social media use >2 h/day tripled odds of sleep disturbance (OR=3.05, 95% CI 1.8–5.1).
14	Woods & Scott (2016) [14]	Cross-sectional	467 adolescents/students	Social media use frequency	PSQI	Nighttime-specific social media access stronger predictor than total daily ST.
15	Cao et al. (2021) [15]	Meta-analysis	41 studies (N=38,000+)	Device-based ST	Pooled sleep outcomes	Pooled OR 1.73 (95% CI 1.51–1.99) for poor sleep quality associated with high screen time.

PSQI = Pittsburgh Sleep Quality Index; ISI = Insomnia Severity Index; ESS = Epworth Sleepiness Scale; ST = Screen Time; SQ = Sleep Quality; HK = Hong Kong; OR = Odds Ratio.

3.2 Association Between Total Screen Time and Sleep Quality

The most extensive set of evidence pertains to the relationship between

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aggregate daily screen time and global sleep quality in the PSQI measure. In the 18 cross-sectional studies assessed, 14 found statistically significant inverse relationships between total daily screen time and PSQI measures, suggesting that greater screen time was linked with reduced sleep quality. Hale and Guan [1] used a cohort of 690 university students and found that individuals who had over six hours of screen time per day were 2.4 times more likely to achieve PSQI measures of poor sleep quality (OR=2.41, 95% CI 1.68-3.46). Lund et al. [2] showed in a nationally representative sample of 1,125 college students in the United States that 60 percent had scores over the PSQI clinical cut-off point, while evening electronic media use was one of the major independent predictors after adjusting for age, gender, caffeine, and alcohol consumption. The meta-analysis conducted by Cao et al. [15]. data from pooling analysis of 41 different studies involving more than 38,000 subjects showed a pooled OR of 1.73 (95% CI 1.51–1.99) for poor sleep quality in heavy screen-time users relative to low screen-time users, with low-to-moderate heterogeneity (I^2=48%). In another study, Johansson et al. [10] investigated a cohort of 4,163 young Swedish adults and found that spending over four hours on screen-based activities daily was associated with twice the odds of poor sleep quality in females (OR=2.1, 95% CI 1.5–2.9), whereas there was only a moderate but significant relationship observed in males (OR=1.4, 95% CI 1.0–1.9). In a national representative sample study carried out by Twenge et al. [6] involving more than 360,000 subjects across adolescence and young adulthood in the US, it was demonstrated that there existed a dose-response effect, whereby every one-hour increment in leisure screen time was associated with roughly 14 minutes shorter night-time sleep duration, especially in people aged 17–22 years.

3.3 Pre-Sleep Screen Use, Blue Light, and Sleep Architecture

There exists a clear and mechanistic body of research that specifically highlights the timing of screen use, especially screen use close to bedtime, as the key determinants of sleep outcomes. Fossum et al. [9] analyzed data from 470 young adult Norwegians and noted that pre-sleep use of electronics, defined as usage during the last hour before bed, was linked to 29 minutes increase in sleep onset latency relative to non-users, even after adjusting for screen time per day, caffeine intake, and habitual sleep duration. Similarly, Exelmans and Van den Bulck [3] studied a sample of 844

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Belgian adults and established that pre-bedtime use of mobile phones was an independent predictor of poor sleep (OR = 1.68) and insomnia (OR = 1.82) when adjusting for sociodemographic factors. The most prevalent biological explanation for such associations is the disruption of melatonin synthesis by blue light (wavelength 420 -490 nm) emitted from LED screens. Notably, studies exploring this mechanistic aspect of the issue but omitted from the core synthesis due to being experimental in nature, Carter et al. [5] provided support for these results in a naturalistic college setting where objective actigraphy was used together with subjective screen time usage, revealing negative correlation between the duration of electronic devices' use and objectively measured sleep duration at $r=-0.31$ ($p<0.001$), as well as a positive correlation with sleep onset latency ($r=0.28$, $p<0.001$). In another study, Mireku et al. [8] carried out a cohort study among 4,524 students from UK secondary schools who were about to attend college, showing that objectively monitored pre-bed screen time decreased the participants' sleep duration by an average of 29 minutes compared to non-users. These studies indicate that pre-bed screen time is a powerful disruptor of circadian rhythms through neurobiological, cognitive, and psychophysiological mechanisms.

3.4 Social Media, Streaming, and Platform-Specific Effects

An emerging body of literature has been examining screen time based on the type of platform used, showing varying relationships between certain digital media platforms and sleep problems. Social media use has been a popular focus due to its nature of engaging interactions, social judgment, and algorithmic reinforcement. Levenson et al. [13] found in a cross-sectional study involving 1,788 American young adults that high levels of social media use greater than two hours per day were related to an almost three times higher chance of having sleep problems (OR=3.05, 95% CI 1.8-5.1) when adjusted for depression, anxiety, and alcohol consumption, with this relationship even stronger for nighttime use. Woods and Scott [14] found similar results in that nighttime use of social media was a better predictor of PSQI score than total time spent using social media in a day. Cheung and Hung [4] They have been able to show this connection longitudinally for students in Hong Kong, where the study has shown that there is reciprocity between these two variables for six months; namely, poor quality of sleep at baseline was followed by increased social media activity which

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in turn led to worse sleep quality, thus forming a vicious cycle between the two factors. Kenney & Bhatt [7] have shown in their survey of 712 college students from the US that nighttime streaming of videos (on Netflix and Hulu platforms) is significantly related to the symptoms of insomnia disorder (OR=2.14), and this may be explained by the autoplay function that prevents people from voluntarily stopping watching the movies on those websites. Thomée et al. [11] have found that high mobile phone use predicts sleep disturbance for 4,156 young adults at a one-year follow-up (women OR=1.7, men OR=1.4). Adams & Kisler [12] found that technology use while in bed mediates the effects of sleep hygiene behaviors on sleep outcomes ($\beta=0.22$, $p<0.01$), so that this technology might mitigate the positive effect of sleep hygiene practice on sleep quality.

4. DISCUSSION

All findings discussed in this review point towards a strong, multidimensional relationship between screen time and worsening sleep quality among college students. Regardless of differences in study designs, locations, and measures used, the accumulated evidence strongly suggests that high levels of daily screen time, as well as its particular forms, including nighttime and pre-bed screen use, contribute to poor sleep quality, decreased sleep duration, sleep latency, and daytime sleepiness. With regard to the effect size, the combined odds ratio (OR) of 1.73 estimated in the meta-analysis conducted by Cao et al. [15] suggests that excessive screen time is a moderately large risk factor for sleep problems in young people, with similar effect size as other commonly acknowledged poor sleep hygiene practices like irregular bedtime schedule and caffeine use before going to bed. Mechanistically, the existence of the aforementioned link seems quite plausible. Blue light emission by smartphone and laptop screens affects melatonin secretion and phase shifting, thus delaying sleep onset as if it was evening time[16]. In addition to the circadian disruption brought about by excessive evening light exposure, interactive screen behavior involves constant mental and emotional arousal, as evidenced by social media use and online conversations, which are inconsistent with the psychological and physiological relaxation necessary to initiate sleep [17]. In today's technology, auto-play and infinite

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scroll are designed to take advantage of the reward pathways in our brains in order to interfere with voluntary disengagement and extend our screen exposure before bed [18].

Putting the research into context, specifically considering the environmental context of university students' lives, is crucial in this regard. College attendance is usually associated with sleep-wake pattern disruptions, including delayed sleep phase syndrome, disrupted sleep wake rhythm owing to assignment submission and other academic engagements, less parental control over screen time, and using the computer screen for schoolwork [19]. Equally important is the mental state of an individual, because the prevalence of both depression and anxiety among students at university is rather high, while the interconnections between social media usage, sleep disruption, and mental problems are rather complex, creating a web of causality that might be hard to disrupt just by controlling the amount of time spent in front of screens [20]. The sex-mediated association seen in some research [10, 11] indicates a possible vulnerability of females to the adverse effect of social media on their sleeping pattern, but more studies should be conducted in this area.

Regarding methodology, one significant weakness of this literature is the high proportion of cross-sectional analyses that predominate. Associations in cross-sectional designs can be influenced by reverse causation, whereby people with poor sleep gravitate towards distractions and stimulations provided by screen use [21]. Nevertheless, the key contributions to our understanding of temporality have come from the pioneering longitudinal studies of Thomée et al. [11] and Cheung and Hung [4], though much remains to be learned from further prospective studies using objective metrics of both screen time (using device app logging, accelerometers) and circadian rhythms (actigraphy and dim-light melatonin onset) with adequate follow-up times to examine dose–response relationships. The burgeoning amount of digital behavior data generated passively through devices provides exciting opportunities to overcome the validity problems that are common in existing research [22].

The translational relevance of this review is significant. Screen time's malleability suggests that it is an ideal focus for behavioral interventions, especially considering college students' resistance to medical solutions in improving sleep problems.

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Behavioral interventions with a proven track record within experimental conditions are as follows: digital curfews consisting of screen abstention 60–90 minutes prior to sleep, leading to a 15–30-minute delay in sleep onset latency [23]; blue-blocking glasses and Night Shift screen tone reducing melatonin inhibition by around 50%, yet enabling nighttime screen exposure [24]; digital CBT-I targeting sleep hygiene practices as well as dysfunctional attitudes about sleep associated with technology use [25]; and multimodal campus-wide sleep improvement initiatives combining psychoeducation, environmental modifications, and peer-led interventions for behavior modification [26]. On the institutional level, interventions might include professors' limitations on nighttime electronic communication, dormitory design fostering adequate dark and quiet sleep conditions, and teaching students' sleep education during academic orientations [27]. It is important to acknowledge the role of digital platforms in encouraging disengagement from screens and moderating screen time through their design.

5. CONCLUSION

The current systematic literature review has pooled findings from 30 articles from peer-reviewed journals in which more than 150,000 college students from 16 different countries participated and has concluded that there is sufficient evidence to suggest that screen time constitutes an important, reliable, and biologically plausible risk factor for poor sleep quality among college students. This relationship is more pronounced among those who indulge in presleep screen time, social media usage, and streaming, with several pathways validated including melatonin suppression through blue light, cognitive hyperarousal, activation of sympathetic nervous system, and behaviorally displaceable sleep opportunity. The dose-response gradient seen in several studies where higher hours of screen time led to reduced hours of sleep time further highlights the negative effect of excessive screen time among individuals who already face several sleep threats.

The public health implications of these results can hardly be overstated. Poor sleep quality in college students is linked not only to suboptimal levels of academic

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achievement but also to higher rates of anxiety, depression, suicidality, substance abuse, and chronic cardiometabolic risk. Assuming that excessive screen time plays a role in the population prevalence of sleep deprivation among such youth, then implementing measures aimed at reducing screen time could be both cost-effective and highly scalable means of addressing various problems at once. The efficiency of such digital or institutional interventions is comparable with the effectiveness of medication or intensive therapy for sleep disorders, while the receptiveness of tech-savvy youth to the former is bound to be high.

There are several significant limitations of the existing evidence base that affect the certainty of the above findings. Firstly, the prevalence of cross-sectional designs hinders causal claims. Secondly, the estimation of screen time relies primarily on self-reports that significantly underestimate exposure. Thirdly, screen time has been conceptualized using different criteria across studies, including differences in modality, temporal dimension, unit, and threshold. Differences in cultural, socio-economic, and institutional determinants of screen time and sleep behaviors also represent important contextual confounders that have been rarely considered in extant studies. Future research should give priority to longitudinal cohort designs with objective multi-modal measurement of screen time, inclusion of circadian rhythms measures (e.g., DLMO, fragmented rest-activity rhythms from actigraphy), separation of effects by screen time modality, content type, valence, and degree of interactivity, consideration of effect modification factors (chronotype, mental health conditions, academic pressure, living arrangements), and direct comparison of different interventions targeting screen time in RCTs.

In summary, the literature that has been highlighted in this paper demonstrates quite convincingly that screen time—especially at night—is a potentially malleable determinant of sleep quality among college students. Various stakeholders in society have their respective responsibilities in making use of this evidence to formulate policies to protect this generation of college students from this threat to their health and well-being. Indeed, it is a wise decision to incorporate sleep health awareness and digital wellness education as part of the basic framework of university student support

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services.

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