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Research Article / Araştırma Makalesi

Investigation of Physical Activity Participation Blue Light Exposure and Sleep Disorders in Children with Intellectual Disabilities

Zihinsel Engelli Çocuklarda Fiziksel Aktivite Katılımı Mavi Işık Maruziyeti ve Uyku Bozukluğunun İncelenmesi

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ABSTRACT

Objective: The aim of this study is to examine the differences in blue light exposure and sleep disorders based on the physical activity participation of children with intellectual disabilities.

Material and Methods: The sample of this descriptive cross-sectional study consists of 197 families with children aged 6-16 years with mild or moderate intellectual disabilities living in Malatya, Türkiye. Demographic characteristics such as the participants' age, gender, weight, school type and parents' educational status, as well as daily usage hours of television, phone, computer, or tablet, physical activity participation status, and whether they were licensed athletes, were questioned. To evaluate sleep disturbances in individuals with intellectual disabilities, the "Sleep Disturbance Scale for Children (SDSC)" was used. Data analysis was performed using the SPSS Statistics software. Normality was evaluated by the Kolmogorov-Smirnov test and the distribution was found to be normal. The data obtained were analyzed using the Independent Samples T-Test and Pearson Correlation.

Results: A positive and significant relationship was found between the Sleep Disturbance Scale for Children scores and total daily blue light exposure ($r = 0.296$, $p < 0.01$) as well as pre-sleep blue light exposure ($r = 0.439$, $p < 0.01$). No statistically significant difference was observed between the SDSC scores of those who participated in physical activity and those who did not. No statistically significant difference was observed between the total daily blue light exposure or pre-sleep blue light exposure of those who participated in physical activity and those who did not ($p > .05$). Additionally, a statistically significant correlation was identified only between being a licensed athlete and total daily blue light exposure ($p < 0.05$).

Conclusion: There is a positive relationship between blue light exposure and sleep disturbances in individuals with intellectual disabilities. However, physical activity participation alone did not affect SDSC score and blue light exposure, and in fact, the total daily blue light exposure of licensed children was higher than that of non-licensed children.

Keywords: *Intellectual disabled people, physical activity, screen exposure, blue light, sleep disorders*

ÖZ

Amaç: Bu çalışmanın amacı, zihinsel engelli çocukların fiziksel aktiviteye katılım durumlarına göre mavi ışık maruziyeti ve uyku bozukluğu farklılıklarını incelemektir.

Materyal ve Yöntemler: Tanımlayıcı kesitsel tipteki bu çalışmanın örneklemi, Malatya, Türkiye'de yaşayan yaşları 6-16 arasında hafif veya orta düzeyde zihinsel engelli çocuklara sahip 197 aileden oluşmaktadır. Katılımcıların yaşı, cinsiyeti, kilosu, okul türü ve ebeveynlerin eğitim durumu gibi demografik özelliklerin yanı sıra günlük televizyon, telefon, bilgisayar veya tablet kullanım süreleri, fiziksel aktiviteye katılım durumları ve lisanslı sporcu olup olmadıkları sorgulanmıştır. Zihinsel engelli bireylerde uyku bozukluklarını değerlendirmek için "Çocuklar İçin Uyku Bozukluğu Ölçeği (ÇUBÖ)" kullanılmıştır. Verilerin analizi SPSS istatistik yazılımı ile yapılmıştır. Normallik Kolmogorov-Smirnov testi ile test edilmiş ve dağılımın normal olduğu belirlenmiştir. Elde edilen veriler Bağımsız Örneklem T-Testi ve Pearson Korelasyonu ile analiz edilmiştir.

Bulgular: Çocuklar İçin Uyku Bozukluğu Ölçeği puanları ile günlük toplam mavi ışık maruziyeti ($r = 0.296$, $p < 0.01$) ve uyku öncesi mavi ışık maruziyeti ($r = 0.439$, $p < 0.01$) arasında pozitif ve anlamlı bir ilişki bulunmuştur. Fiziksel aktiviteye katılanlar ile katılmayanların SDSC skorları arasında istatistiksel olarak anlamlı bir fark gözlemlenmemiştir. Fiziksel aktiviteye katılanlar ile katılmayanların toplam günlük mavi ışık maruziyeti veya uyku öncesi mavi ışık maruziyeti arasında istatistiksel olarak anlamlı bir fark gözlemlenmemiştir ($p > 0.05$). Ayrıca, yalnızca lisanslı sporcu olma ile günlük toplam mavi ışık maruziyeti arasında istatistiksel olarak anlamlı bir ilişki bulunmuştur ($p < 0.05$).

Sonuç: Zihinsel engelli bireylerde mavi ışık maruziyeti ile uyku bozuklukları arasında pozitif bir ilişki bulunmaktadır. Ancak, fiziksel aktiviteye katılım, tek başına SDSC skorlarını ve mavi ışık maruziyetini etkilememiş hatta lisanlı çocukların toplam günlük mavi ışığa maruziyeti lisanlı olmayan çocuklara göre daha fazladır.

Anahtar Sözcükler: *Zihinsel engelli bireyler, fiziksel aktivite, ekran maruziyeti, mavi ışık, uyku bozuklukları*

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INTRODUCTION

Intellectual disability, defined as a permanent impairment in cognitive functioning, complicates daily activities, self-care skills, academic success, and participation in social environments (1). The challenges faced by individuals with intellectual disabilities (ID) negatively affect their lives as members of society, leading to limitations in fulfilling their tasks and responsibilities. However, physical activity (PA) and sports have been shown to improve various populations physically, cognitively, socially, and mentally (3-5). Similarly, studies have reported that PA and sports significantly contribute to improving the health, enhancing the quality of life, and fulfilling the societal roles of individuals with ID, who are among the disadvantaged groups in society (6). In addition to supporting individuals with ID physically and health-wise, PA and sports provide opportunities for socialization, helping them lead a more functional and higher-quality life (6). PA and sports also accelerate the rehabilitation process of individuals with disabilities, improving their fitness, muscle strength (7), balance, flexibility, cognitive skills, and quality of life, while making positive contributions to mitigating some of their limitations (8). The positive effects of PA and sports on individuals with ID need to be supported by quality sleep (9) to be maximized.

Sleep is a process governed by the suprachiasmatic nucleus in the brain's hypothalamus, which plays a role in melatonin secretion. The suprachiasmatic nucleus serves as the control center of the sleep-wake cycle (10). The quality, optimal duration, and timing of sleep are crucial for health (11). This is because physiological functions such as memory, emotional behaviors, learning, metabolic activities, digestion (12), and physical performance (13) are influenced by sleep patterns. While sleep affects physical performance, participation in PA has also been reported to positively affect sleep (14). However, the relationship between sleep and PA can sometimes be disrupted due to various factors. Lifestyle changes brought by modern life, staying awake until late hours, and long-distance travel are among the factors leading to sleep deprivation, adversely affecting individuals (15).

One of these factors is blue light emitted by media devices such as smartphones, televisions (TV), tablets and computers which have rapidly taken over our lives (16). Blue light, with its short wavelength (446-477 nm), affects circadian rhythm by suppressing the melatonin hormone (17). While blue light enhances wakefulness and positively affects cognitive skills and reaction time, it reduces sleep quality and duration and delays sleep onset (18). It has been reported that reducing blue light exposure before bedtime alleviates sleep problems and improves sleep quality in individuals with insomnia (19). Failure to block blue light exposure negatively impacts physical and cognitive skills (18). Similar to normal individuals, blue light exposure in individuals with ID restricts cognitive, social, and physical performance (20). Compared to normal individuals, individuals with ID have a shorter optimal sleep duration (21) and sleep approximately 18 minutes less than their peers. Additionally, the sleep quality of individuals with ID is 93% lower than that of normal individuals (22). Identifying factors contributing to sleep problems is crucial for individuals with ID to experience a healthy sleep process.

Although the literature includes various studies revealing the relationship between PA participation, blue light exposure and sleep disorders, research specifically targeting individuals with ID is limited. Therefore, the aim of this study is to examine the relationship between blue light exposure and sleep quality based on the PA participation of children with ID. The hypothesis of this study is that participation in PA influences blue light exposure and sleep disorders in children with ID.

MATERIAL and METHODS

The population consists of families living in Malatya who have children aged 6-16 with mild or moderate intellectual disabilities.

The sample of this descriptive cross-sectional study consists of 197 families with children aged 6-16 years (74 female, 193 male) with mild or moderate sedentary intellectual disabilities living in Malatya, Türkiye. Individuals with intellectual disabilities have been previously assessed and diagnosed by the Guidance and Research Center (RAM) in the province where their residence is located. For this process, families must first have their child undergo a medical evaluation at a fully equipped hospital and obtain a Special Needs Report for Children. Following this, in addition to the medical report, an intelligence test is administered by a specialist at RAM centers.

Individuals with moderate intellectual disability have an IQ score between 35-50, while those with mild intellectual disability have an IQ score between 50-70. The entire process is conducted in accordance with the standards set by the American Psychiatric Association (APA).

The sample size of the study was determined using the G Power 3.1 software (23).

Based on the power analysis conducted with an alpha level (α=0.05), power (1-ß=0.90), and effect size (0.5), it was determined that a minimum of 192 participants should be

of children with additional diagnoses accompanying intellectual disability, those with an acute illness during the study period, and those using medication were excluded from the study.

Before the study, the families were provided with the necessary information about the purpose of the research and its contribution to the literature. Written and signed informed consent forms were obtained from those who agreed to participate. Furthermore, the research process was conducted in accordance with the principles of the Declaration of Helsinki. The research process is presented in Figure 1.

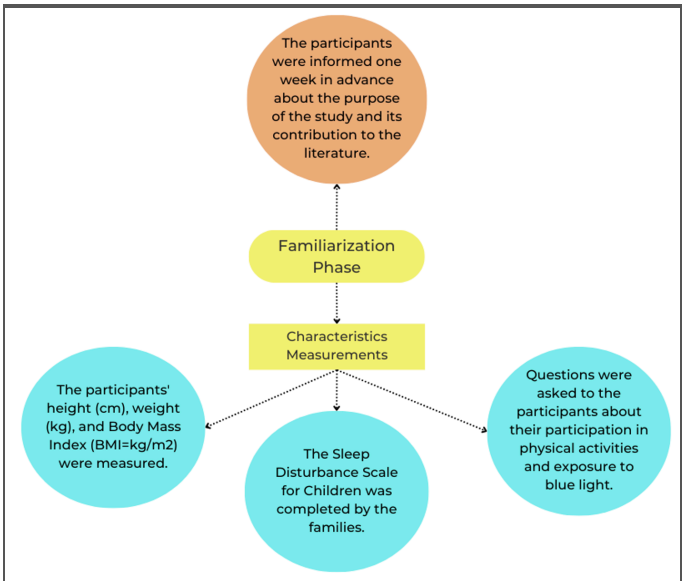

Figure 1. Experimental process of study

The ethical suitability of the study was approved by the İnönü University Scientific Research and Publication Ethics Committee with decision number 2024/6423. The descriptive information of the participants (gender, age, height, weight, body mass index, education level, physical activity participation status, licensed sports participation, blue light exposure, and SDSC score) is shown in Table 1.

Data Collection Tools

In order to determine the relationship between blue light exposure and sleep quality based on the physical activity (PA) participation status of ID individuals, demographic characteristics such as age, gender, weight, school type and parental education levels, as well as daily usage of TV, phone, computer or tablet, participation status in PA and whether they are licensed athletes or not were inquired.

To assess sleep disorders and sleep problems in ID individuals the " Sleep Disturbance Scale for Children (SDSC)" developed by Bruni et al. in 1996, was implemented (24). The Turkish validity and reliability studies of the scale were conducted by Ağadayı et al. in 2020 (25). The 26-item scale includes: sleep onset and maintenance disorders (items 1-5, 10, 11), sleep respiration disorders (items 13-15), wake-up disturbances (items 17, 20, 21), sleep-wake transition disorders (items 6-8, 12, 18, 19), excessive sleepiness disorders (items 22-26), and sweating disorders during sleep (items 9, 16). Parents were asked to consider their child's sleep process over the past 6 months and respond to the questions on the scale. The scale which uses a 5-point Likert type, scored between 1 and 5. The first question provides the total sleep duration the second question gives the sleep onset time and starting from the third question each item is rated between 1 and 5. The lowest score that can be obtained from the scale is 26 and the highest score is 130. The data obtained from this scale were evaluated based on the total score and a score of 39 or higher indicates the presence of a sleep disorder. The participants' families were invited to the school. The assessment was conducted face-to-face at the school. The scale was administered in a quiet room with sufficient natural light. Before the administration, the participants were once again informed about the study and the application of the scale.

Table 1. Identifying Information of Participation

Variables		N	%
Gender	Female	74	37.6
	Male	123	62.4
Education Level	Primary School	33	16.8
	Secondary School	27	13.7
	High School	137	69.5
Participation in Physical Activity	Yes	96	48.7
	No	101	51.3
Licensed Sport Status	Yes	27	13.7
	No	170	86.3
Variables		**N**	**X±SS**
Age (year)	Female	74	15.56±0.81
	Male	123	14.04±2.77
	Total	197	14.61±2.36
Height (cm)	Female	74	157±6.42
	Male	123	158±18.21
	Total	197	158±14.00
Body Weight (kg)	Female	74	61.75±12.34
	Male	123	61.97±20.29
	Total	197	61.89±17.69
BMI (kg/m^2)	Female	74	24.74±4.66
	Male	123	23.78±7.07
	Total	197	24.14±6.28
Total Blue Light Exposure Throughout the Day (hour)	Female	74	6.87±3.99
	Male	123	6.47±3.17
	Total	197	6.62±3.50
Pre-Sleep Blue Light Exposure (hour)	Female	74	1.51±1.88
	Male	123	1.40±1.56
	Total	197	1.44±1.68
SDSC Score	Female	74	43.41±12.55
	Male	123	40.29±10.03
	Total	197	41.46±11.12

BMI: Body Mass Index, SDSC: Sleep Disturbance Scale for Children

Statistical Analysis

IBM SPSS (version 25.0, Armonk, NY) statistical software was used for data analysis. The normality of the data was tested using the Kolmogorov-Smirnov test and it was found that the distribution followed a normal distribution. Descriptive statistics for demographic data were presented as percentage (%), number (n), mean and standard deviation (X±SS). The statistical significance level was set at p<0.05. The Independent Samples T-test was used to determine the differences between the groups. The correlation between blue light exposure and sleep disorder was analyzed using Pearson correlation.

RESULTS

A weak but significant positive correlation was found between total daily blue light exposure and SDSC (r=.296, p<0.01) as well as between pre-sleep blue light exposure and SDSC score (r=.439, p<0.01). (Table 2) It was determined that as blue light exposure increased sleep disorders also increased in ID children.

No statistically significant difference was observed between the SDSC scores of those who participated in physical activity and those who did not. No statistically significant difference was observed between the total daily blue light exposure or pre-sleep blue light exposure of those who participated in physical activity and those who did not (p > .05). Participation in physical activities was not found to associate blue light exposure or sleep disorders. (Table 3)

Table 2. Correlation Between Participants' Blue Light Exposure and SDSC Score

Variables	N	r	p
Total Blue Light Exposure Throughout the Day (hour)	197	0.296	0.000**
Pre-Sleep Blue Light Exposure (hour)	197	0.439	0.000**

**: p< .001, r: Correlation Coefficient

Table 3. Participation in Physical Activity and Exposure to Blue Light and SDSC Score

Variables	Participation in Physical Activity	N	X+SS	t	p
SDSC Score	Yes	96	40.12±11.63	-1.658	0.099
	No	101	42.74±10.51		
Total Blue Light Exposure Throughout the Day (hour)	Yes	96	6.62±3.56	0.002	0.998
	No	101	6.62±3.45		
Pre-Sleep Blue Light Exposure (hour)	Yes	96	1.50±2.09	0.447	0.656
	No	101	1.39±1.17		

p<0.05

There was a statistically significant difference between participants status as licensed athletes and only total daily blue light exposure (p<0.05). It was determined that children who were licensed athletes had higher levels of blue light exposure. (Table 4)

There was no statistically significant difference in SDSC score, total daily blue light exposure, and pre-sleep blue light exposure between participants based on gender (p>0.05). There is no difference between males and females in terms of blue light exposure and sleep disorders. (Table 5)

Table 4. Licensed Sports Participation Status and SDSC and Blue Light Exposure

Variables	Licensed Sport Status	N	X±SS	t	p
SDSC Score	Yes	27	41.22±14.43	-0.123	0.902
	No	170	41.50±10.55		
Total Blue Light Exposure Throughout the Day (hour)	Yes	27	7.77±3.65	1.854	0.038*
	No	170	6.44±3.45		
Pre-Sleep Blue Light Exposure (hour)	Yes	27	2.44±2.71	2.175	0.656
	No	170	1.28±1.40		

*p<,05

Table 5. Blue Light Exposure and SDSC Score According to Gender

Variables	Gender	N	X+SS	t	p
SDSC Score	Female	74	43.41±12.55	0.135	0.056
	Male	123	40.29±10.03		
Total Blue Light Exposure Throughout the Day (hour)	Female	74	6.87±3.99	0.726	0.469
	Male	123	6.47±3.17		
Pre-Sleep Blue Light Exposure (hour)	Female	74	1.51±1.88	0.143	0.655
	Male	123	1.40±1.56		

p<0.05

DISCUSSION

In ID children, in addition to cognitive, social, mental, and physical impairments, sleep problems are frequently observed. To improve the quality of life of these individuals and support the rehabilitation process, it is necessary to support all areas of development as well as to identify potential problems and take preventive measures. Therefore, the aim of this study is to examine the differences in blue light exposure and sleep disorders based on the physical activity participation of children with intellectual disabilities.

As a result of this study, it was found that as the duration of blue light exposure throughout the day and before sleep increased, sleep disorders also increased. Many studies have investigated the relationship between blue light exposure and sleep disorders. These studies emphasize that blue light exposure negatively affects individuals sleep duration and quality (18,19,26). These findings are consistent with the data from this study. Other studies with different methodological approaches support the findings of this study (19,27). In a study, it was found that the use of blue light blocking lenses before sleep provided beneficial results for individuals with sleep disorders (19). Similarly, wearing blue light filtering glasses was found to support sleep quality (27). The existing literature reports similar results regarding the potential negative effects of blue light (18,19,26). It is believed that these negative effects are related to the inhibitory role of blue light on the secretion of melatonin hormone (17).

This study was conducted with ID individuals, a different population group, but the obtained data were found to be similar to those of typically developing individuals. This suggests that ID individuals and typically developing individuals may have similar circadian functioning. A study focusing on the impact of functional losses in the cerebrum of ID individuals on the circadian rhythm reported similar circadian functioning as in typically developing individuals (28). These data show that blue light exposure has negative effects in ID individuals as well.

When looking at the SDSC score based on the participants' physical activity status, it was found that individuals who participated in physical activity had lower average values, but no statistically significant difference was observed. Physical activities are considered as a non-pharmacological method to treat sleep disorders (29,30). Contrary to this evidence in this study, it was found that physical activity did not have a beneficial effect on sleep disorder symptoms in ID children and this finding contradicted the literature. For example, Maaskant et al. reported in their study that high physical activity was associated with more stable and less fragmented sleep (31). Additionally, Ezati et al. found in their study with 67 participants that 8-week aerobic exercise program improved participants sleep quality (32). The reason for the contradiction of this study's findings with the existing literature is believed to be related to the lack of information regarding the type and intensity of physical activity the participants engaged in. The intensity of physical activity and the type of exercise are important determinants of sleep (31,32).

Another important finding from this study is that there was no significant relationship between participants' participation in physical activity and total daily blue light exposure and pre-sleep blue light exposure. Yıldız and Yıldız (33) reported comparable results in their investigation of the association between physical activity levels and screen exposure time among university students. They found no relationship between physical activity levels and screen exposure. This was attributed to the study being conducted during the COVID-19 pandemic, during which participants were subjected to periods of lockdown, negatively affecting their physical activity levels. Contrary to studies that did not report a significant relationship between physical activity and blue light exposure, one research has reported a significant relationship (34). A negative correlation has been detected between digital game addiction and physical activity levels. Through digital games, blue light exposure of individuals increases, but physical activity mitigates digital game addiction. As physical activity levels increase, digital game addiction decreases. These data show that an increase in physical activity levels leads to positive outcomes by reducing blue light exposure (34). In another study, Serrano-Sanchez et al. reported a negative correlation between screen time and participation in physical activities among adolescent participants. A decrease in physical activity was associated with an increase in screen time, and it was reported that participation in regular and organized physical activities could be used as a non-pharmacological method to counter the potential negative effects of screen exposure (35). The data obtained in this study mostly contradict studies conducted in different populations. This is believed to be due to the high prevalence of sedentary behavior profiles in ID individuals (36). The current findings show a negative correlation between blue light exposure and the intensity and frequency of physical activity (34,35). However, the lack of data on the physical activity levels of ID individuals in this study is an important limitation.

Among licensed athletes, no significant relationship was found between SDSC score and pre-sleep blue light exposure. However, total daily blue light exposure was higher in the licensed athlete group and found to be statistically significant. Participation in physical activities has positive effects on sleep and blue light exposure, but the intensity and type of physical activity are important determinants (37). In this study, the type and frequency of sports activities of licensed athletes were not known. Additionally, the high total daily blue light exposure is thought to be due to the characteristics of the sample group. ID individuals often lead isolated lives, as they frequently encounter barriers when performing daily living activities (38). As a result, individuals with ID may become more socially isolated and exposed to increased blue light. Nearly 1 in 2 individuals is exposed to about 4 hours or more of blue light daily (39). In this study, it was found that licensed athletes with ID were exposed to approximately 8 hours of blue light. This suggests that when they are inactive later in the day, they tend to use blue light-emitting devices such as televisions, tablets, and phones. This study only included families with ID children. The findings are limited to the answers provided by these families to the SDSC scale and the demographic questionnaire. Another important limitation is the lack of data on the type, intensity, and frequency of physical activity in ID individuals. The absence of this data limited the process of evaluating the relationship between physical activity, blue light exposure, and sleep. Another limitation of this study is the wide age range of the participants.

CONCLUSION

There is a positive relationship between blue light exposure and sleep disturbances in individuals with intellectual disabilities. However, physical activity participation alone did not affect blue light exposure.

Ethics Committee Approval / Etik Komite Onayı

The approval for this study was obtained from Inönü University Clinical Research Ethics Committee, Malatya, Türkiye (Decision no: 2024/6423, Date: 03-12-2024).

Conflict of Interest / Çıkar Çatışması

The authors declared no conflicts of interest with respect to authorship and/or publication of the article.

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Author Contributions / Yazar Katkıları

Concept Design: MT, ÖE; Supervision/ Consultancy: ÖE, AK; Materials: MT, AK; Data Collection and Processing: MT, ÖE, AK; Analysis and Interpretation: MT, AK; Literature Review: MT, ÖE; Writing: MT, ÖE; Critical Review: ÖE, AK. All authors contributed to the final version of the manuscript and discussed the results and contributed to the final manuscript.

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