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Correlation Between Sleep Quality and Functional Motor Skills in Children with Autism Spectrum Disorder

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ABSTRACT

BACKGROUND: Autism Spectrum Disorder (ASD) is a neurodevelopmental condition often associated with deficits in social interaction, communication, and motor skills. Sleep plays a crucial role in the physical, cognitive, and motor development of children. Adequate sleep quality has been associated with better attention, learning, and motor coordination. Conversely, poor sleep can negatively affect neuromuscular function and gross and fine motor skills. In typically developing children, studies have shown that disturbed sleep may hinder motor performance and skill acquisition. However, this relationship remains underexplored in children with autism spectrum disorder (ASD), who often experience both sleep disturbances and motor impairments.

OBJECTIVE: The objective of the study is to find the relationship between sleep quality and functional motor skills in children with autism spectrum disorders.

METHODOLOGY: This study was conducted with 30 participants diagnosed with autism spectrum disorder, over a 4-week period. Subjects were enlisted based on inclusion and exclusion criteria. Sleep quality was assessed using Children's Sleep Habits Questionnaire (CSHQ) and Functional motor skills was assessed using Developmental Coordination Disorder Questionnaire (DCDQ). Data were analyzed using Pearson's correlation coefficient (or Spearman's rank correlation for non-normal data), to determine strength and direction of relationship between sleep quality and functional motor skills

RESULT: This study showed strong negative correlation between sleep quality and functional motor skills in children with autism spectrum disorder which means higher sleep disturbance scores are associated with lower motor coordination scores.

CONCLUSION: The findings of this study concluded that as sleep quality becomes poorer, functional motor skills is increasingly impaired in children with autism spectrum disorder.

KEYWORDS: Autism spectrum disorder, Children's Sleep Habits, Developmental Coordination Disorder, Functional motor skills, Sleep Quality.

INTRODUCTION

Autism is a neurodevelopmental syndrome that is defined by deficits in social reciprocity and communication, and by unusual restricted, repetitive behaviors (American Psychiatric Association 2000). Autism is a disorder that usually begins in infancy, at the latest, in the first three years of life. Parents often first become concerned because their child is not using words to communicate, even though he or she recites passages from videotapes or says the alphabet. In typically developing children, studies have shown that disturbed sleep may hinder motor performance and skill acquisition. Though social deficits may not be immediately obvious in early years, they become gradually more evident as a child becomes more mobile and as other children become more socially sophisticated [1].

Core deficits are identified in 2 domains: social communication/interaction and restrictive, repetitive patterns of behavior. Children and youth with autism spectrum disorder (ASD) have service needs in behavioral, educational, health, leisure, family support, and other areas. Standardized screening for ASD at 18 and 24 months of age with ongoing developmental surveillance continues to be recommended in primary care (although it may be performed in other settings), because ASD is common, can be diagnosed as young as 18 months of age, and has evidenced-based interventions that may improve function.[2]

Autism spectrum disorder it is an important cause of developmental disability worldwide. Its estimated prevalence is 1% in the United Kingdom and 1.5% in the United States. There have been various epidemiological surveys to determine the prevalence estimates of ASD during the past decade. The data based on these surveys showed an increase in the prevalence of ASD worldwide. The prevalence was estimated to be 61.9/10,000 globally in 2012. India is a populous country of nearly 1.3 billion people with children ≤15 years constituting nearly one- third of the population. It has been estimated that more than 2 million people might be affected with ASD in India. Most of the reported studies on ASD are based upon hospital- based data and thus lack information on the prevalence estimates of this disorder in India.[3] Children and adolescents with ASD suffer from sleep problems, particularly insomnia, at a higher rate than typically developing (TD) children, ranging from 40% to 80%. The etiologies of sleep disorders in ASD children are multifactorial, with genetic, environmental, immunological, and neurological factors thought to play a role in the development of ASD. There is evidence that there is an association between the sleep and melatonin rhythms with alterations in this synchronization of the melatonin rhythm causing sleep problems.[4]

In about one-third of the children affected, autism becomes apparent after a period of apparently normal or only relatively delayed development, with a loss of previously acquired abilities. The main clinical feature of this phenomenon, which has been defined as “autistic regression,” is the loss of spoken language, but social interests and other communicative skills are also generally affected.[4]

The diagnosis of autism at a very early age is challenging, due to the phenotypic and etiological heterogeneity of individuals with ASD. Diagnosis is possible at 24 months, but it typically does not occur until 40 months of age. Although both pharmacological and non- pharmacological interventions are available, the care is to support rather than fully treat this disorder. This means that there remains a continued search for more effective diagnostic and treatment methods.[5]

Although not being included in diagnostic criteria, motor skill deficits are prevalent in individuals with ASD. Early descriptions of autism by Kanner included characteristic limitations of the

individual's spontaneous activity and/or failures of the person's body adjustment. More recently, a growing number of experts in ASD have reported the presence of diverse motor impairments, including clumsiness, motor coordination abnormalities, postural instability, and impaired gross and fine motor movements, relative to typically developing people. Dewey et al. (2007) and Green et al. (2009) previously reported poor motor skill prevalence rates among children with ASD to be 59% and 79%, respectively. One of the reasons motor deficiencies in individuals with ASD has received increasing attention is a growing awareness that this characteristic can potentially be used as a diagnostic criterion of this disorder.[5]

Understanding the correlation between sleep quality and functional motor skills could help in improving treatment protocols.[5] Hence this study is aimed to examine the correlation between sleep quality and functional motor skills in children with autism spectrum disorder.

MATERIALS AND METHODS

The study was conducted using an observational study design. Participants were selected using a convenience sampling technique. Caregivers of all participants were informed about the study, and written consent was obtained from each of them. Participants included both males and females aged between 3 to 10 years, who met the "diagnostic criteria for autism spectrum disorder (ASD) as per the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5)" Additionally, participants reported some degree of sleep disturbances along with impairments in motor skills. Exclusion criteria included subjects with secondary disorders, primary sleep disorders, or physical impairments**.**

PROCEDURE

Subjects fulfilling the inclusion criteria were enrolled for the study. A brief introduction about the testing procedure was explained to the Caregivers of the subjects. An initial examination including demographic data was carried out. Subjects were assessed for sleep quality by Children's sleep habits Questionnaire (CSHQ) and functional motor skills was assessed using Developmental coordination disorder Questionnaire (DCDQ). The analysis of these measures was conducted using Pearson's correlation (for normally distributed data) or Spearman's rank correlation (for non-normally distributed data) with a p value less than 0.05 considered statistically significant to examine relationship between sleep quality and functional motor skills in children with autism spectrum disorders.

OUTCOME MEASURES

Children 's Sleep Habits (CSHQ) Questionnaire

One widely used pediatric sleep questionnaire is the Children's Sleep Habits Questionnaire (CSHQ). The CSHQ was developed to screen for sleep disorders for 4–10-year-olds based on the pediatric. The 33-item scale consists of eight subscales: 1) Bedtime Resistance, 2) Sleep Onset Delay, 3) Sleep Duration, 4) Sleep Anxiety, 5) Night Wakings, 6) Parasomnias,

7) Sleep-disordered Breathing, and 8) Daytime Sleepiness. These subscales range in length from 1 to 8 items (Sleep-onset Delay to Daytime Sleepiness). Despite somewhat limited psychometric development, the CSHQ has been used extensively in research to document prevalence of and to characterize sleep disorders in various pediatric populations. Further, it has been used widely in the

emerging literature of sleep disturbances in children with ASD including its use as an outcome measure. It is reported to be a reliable and internally consistent scale for measuring sleep habits in children with autism spectrum disorders.[19]

Developmental Coordination Disorder Questionnaire (DCDQ)

The original version of the Developmental Coordination Disorder Questionnaire (DCDQ) was first published in 1999 and reported in the American Journal of Occupational Therapy in 2000. Scientific information and evidence on the use of the questionnaire refers to the DCDQ'07, although the questionnaire that is given to parents is known as the "Coordination Questionnaire". The DCDQ'07 usually takes parents about 10-15 minutes to complete. The DCDQ'07 consists of 15 items, which group into three distinct factors. The first factor contains several items related to motor control while the child is moving, or while an object is in motion, and is labelled "Control during Movement". The second factor contains "Fine Motor and Handwriting" items, and the third factor relates to "General Coordination". The total score for the revised, 15-item version of the DCDQ'07 ranges from 15 to 75. It's a measure of specific motor tasks that a child encounters in his daily life and a low score will indicate that the child struggles to successfully participate in daily life activities. Reliability and validity of DCDQ have been measured by researchers and Tseng,Fu,Wilson and Hu (2010) and Prado et.al. (2009) have found high reliability (0.94 and 0.97 respectively).[12]

RESULT

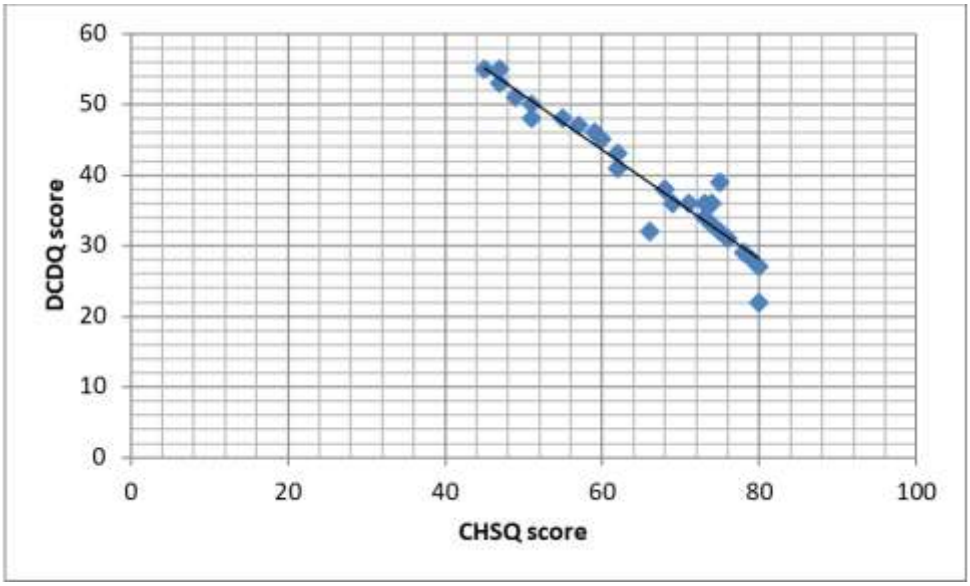

Figure 1.1 Correlation between sleep quality and functional motor skills in children with autism spectrum disorder

This study showed statistically significant strong negative correlation between CSHQ and DCDQ scores ($r = –0.960$, $p < 0.001$), indicating that higher sleep disturbance scores (CSHQ) are associated with lower motor coordination scores (DCDQ). Hence there is a relationship between poor sleep quality and increased motor impairment.

DISCUSSION

The present study was to investigate the relationship between sleep quality and functional motor

skills in children with autism spectrum disorder. Autism Spectrum Disorders" (ASDs) are neurodevelopment disorders and are characterized by persistent impairments in reciprocal social interaction and communication. The etiologies of sleep disorders in ASD children are multifactorial, with genetic, environmental, immunological, and neurological factors thought to play a role in the development of ASD.[4] Although the main feature of this disorder includes the deficits of social relationships, there are many pieces of evidence, indicating that children with autism have different levels of motor skills deficits.[7] The study found a strong negative correlation and concluded that higher sleep disturbance scores are associated with lower motor coordination scores. There is a need of both scientific research and practical interventions to improve the sleep and motor skills (MSs) of children with ASD, with research having shown that poor sleep and poor MSs are problems for children with ASD, while poor sleep is also a problem for their caregivers.[6]

Good sleep is essential for motor skill development, as it supports brain functions like neuroplasticity, motor memory consolidation, and sensorimotor integration. During sleep, especially slow-wave and REM stages, the brain strengthens the neural pathways involved in learning and refining motor tasks. In children with autism spectrum disorder (ASD), poor sleep quality—often linked to circadian rhythm disruptions and altered melatonin levels—can negatively impact cerebellar function and neurotransmitter regulation, such as dopamine and GABA, which are crucial for movement control. As a result, sleep disturbances may hinder coordination, balance, and motor planning. Therefore, improving sleep quality in children with ASD may enhance motor function and overall developmental outcomes.

In this study sleep quality as measured by Children's Sleep Habits Questionnaire (CSHQ), indicated that children with autism spectrum disorders experience disrupted sleep quality

which suggests a pattern of impaired sleep which is commonly observed among children with autism spectrum disorder and their caregivers. among children with ASD, sleep is impaired, remains stably poor, and seems to be one of the most characteristic features of the disorder beyond the core symptoms such as impairment of reciprocal social interactions and communication skills, and the presence of restricted, stereotypical behaviours.11 It was supported by Choi Yeung Andy Tse et.al. (2019) where he highlighted how sleep quality was affected in children with autism spectrum disorders and the value of physical activity on improving the sleep quality in children with ASD.9 Relatively a study by Vernika Tyagi et.al. (2018) was conducted and found out that other issues like the severity of autism along with hyperactivity were associated with sleep quality of children with autism spectrum

disorder.11This study also indicates that functional motor skills, as measured by Developmental Children Disorder Questionnaire (DCDQ) is significantly reduced in children with autism. Motor skill development depends on forming complex connections between

different parts of the brain that link sensory information from the body with information from the environment, plus our innate motivation to plan and execute motor movements.

Supporting this study conducted by Barrodi et.al. (2021) highlighted the idea of the relationship between motor abilities and other growth aspects which may be used in therapeutic interventions. In Conclusion he also highlighted the relationship between motor skills and symptoms of autism spectrum disorder.6 Similarly Bedford et.al. (2015) conducted a cohort study providing evidence on the early motor abilities in young children with ASD can have longitudinal cross-domain influences,

potentially contributing in part with other symptoms that characterise ASD.15

For the current analysis Children's Sleep Habits questionnaire (CSHQ) is used to measure sleep quality among Children with autism spectrum disorder. Correspondingly this scale was used by Anat Zaidman-Zait et.al (2020) where he used CSHQ in examining the factor structure of the CSHQ in children with ASD and their relationship with other factors. This highlights Further delineation of the factor structure of the CSHQ has strong potential to contribute to assessment of sleep problems among children with ASD.[21] Markovich et.al. (2015) demonstrated strong validity and reliability across children population especially autistic kids, supporting its utility as a reliable tool for measuring sleep quality.[14]

In this current study, Developmental coordination disorder questionnaire is used to assess the functional motor skills in children with autism spectrum disorder. It's a measure of specific motor tasks that a child encounters in his daily life and a low score will indicate that the child struggles to successfully participate in daily life activities. Homogenously this scale is used by Tine van Damme et.al. (2021) where he conducted a study on developmental coordination disorder questionnaire to screen for co-occurring motor problems in individuals with ASD. The positive and negative predictive values indicate that the DCDQ can be used to detect motor problems in children with ASD and can exclude the presence of developmental coordination disorder.[22] Jing Hua et.al. (2015) reported the reliability and validity of Developmental Coordination Disorder Questionnaire (DCDQ) which indicated excellent internal reliability in assessing motor disability.[23]

The findings of this study highlight a significant association between poor sleep quality and impaired motor skills in children diagnosed with autism spectrum disorder (ASD). Sleep disturbances, as reported by caregivers through the Children's Sleep Habits Questionnaire (CSHQ), were commonly observed in the study group and correlated with lower scores on the Developmental Coordination Disorder Questionnaire (DCDQ), indicating reduced functional motor abilities. This relationship suggests that disrupted sleep patterns may exacerbate difficulties in motor coordination, which are already prevalent in children with ASD. Addressing sleep quality through targeted behavioral or therapeutic interventions could potentially improve motor function and overall developmental outcomes. The study underscores the importance of incorporating sleep assessments into the management of children with ASD to facilitate holistic care and better quality of life.

This study had some limitations. Firstly, the sample size was limited to children aged 3–10 years, which may not fully represent the broader population of children with autism spectrum disorder (ASD) across different age groups. Future studies could include a wider age range for better generalization. Secondly, although standardized tools like the Children's Sleep Habits Questionnaire (CSHQ) and the Developmental Coordination Disorder Questionnaire (DCDQ) were used, parental reporting could introduce subjective bias affecting the accuracy of the data. Thirdly, comorbidities such as anxiety, depression, or undiagnosed sleep disorders might have influenced sleep quality and motor skills but were not fully accounted for in this study. Lastly, as this was a cross-sectional study, it could not establish causal relationships between sleep quality and motor skill function.

CONCLUSION

The findings of this study concluded that as sleep quality becomes poorer, functional motor skills is increasingly impaired in children with autism spectrum disorder.

Declaration of the patient's consent

The authors attest to having obtained all necessary consent from the caregivers of the participants for inclusion in this study. The caregivers have granted permission for the use of their child's clinical information to be published in this journal. They acknowledge that neither the child's name nor initials will be disclosed. Confidentiality of the participants' personal and medical information was strictly maintained throughout the study, and all data was used solely for research purposes.

REFERENCES

1. Cook EH, Leventhal BL, Amaral DG. Autism spectrum disorders. In: Autism. Routledge; 2013. p. 217-225.
2. Chauhan A, Sahu JK, Jaiswal N, Kumar K, Agarwal A, Kaur J, Singh S, Singh M. Prevalence of autism spectrum disorder in Indian children: a systematic review and meta-analysis. Neurol India. 2019 Jan-Feb;67(1):100-104. doi:10.4103/0028- 3886.253970.
3. Devnani PA, Hegde AU. Autism and sleep disorders. J Pediatric Neurosci. 2015 Oct-Dec;10(4):304-307. doi:10.4103/1817-1745.174438.
4. Ohara R, Kanejima Y, Kitamura M, Izawa KP. Association between social skills and motor skills in individuals with autism spectrum disorder: a systematic review. Eur J Investing Health Psychol Educ. 2020;10(1):276-296. doi:10.3390/ejihpe10010022.
5. Sivertsen B, Posserud MB, Gillberg C, Lundervold AJ, Hysing M. Sleep problems in children with autism spectrum problems: a longitudinal population-based study. Autism. 2012;16(2):139-150. doi:10.1177/1362361311404255.
6. Barrodi Sedehi AA, Ghasemi A, Kashi A, Azimzadeh E. The relationship between the motor skills level and the severity of autism disorder in children with autism. Pedagogy Phys Cult Sports. 2021;25(1):59-65. doi:10.15561/26649837.2021.0108.
7. Lamônica DAC, Giacheti CM, Haduo MDH, dos Santos MJD, da Silva NC, Pinato L. Sleep quality, functional skills, and communication in preschool-aged children with autism spectrum disorder. Res Dev Disabil. 2021; 116:104024. doi: 10.1016/j.ridd.2021.104024.
8. Tse CYA, Lee HP, Chan KSK, Edgar VB, Wilkinson-Smith A, Lai WHE. Examining the impact of physical activity on sleep quality and executive functions in children with autism spectrum disorder: a randomized controlled trial. Autism. 2019;23(7):1699-1710. doi:10.1177/1362361318823910.
9. Filho JVM, de Oliveira AAR, de Bruin VMS, Viana RB, de Bruin PFC. Influence of sleep on motor skill acquisition in children: a systematic review. J Sleep Res. 2025;34(2):e14309. doi:10.1111/jsr.14309.
10. Brand S, Jossen S, Holsboer-Trachsler E, Pühse U, Gerber M. Impact of aerobic exercise on sleep and motor skills in children with autism spectrum disorders: a pilot study. Neuropsychiatric Dis Treat. 2015; 11:1911-1920. doi:10.2147/NDT.S85650.
11. Tyagi V, Juneja M, Jain R. Sleep problems and their correlates in children with autism spectrum disorder: an Indian study. J Autism Dev Disord. 2019; 49:1169- 1181. doi:10.1007/s10803-018-3820-6.
12. Wilson BN, Crawford SG, Green D, Roberts G, Aylott A, Kaplan B. Psychometric properties of the revised developmental coordination disorder questionnaire. Phys Occup Ther Pediatric. 2009;29(2):182-202.
13. Holloway JM, Long T, Biasini F. Concurrent validity of two standardized measures of gross motor function in young children with autism spectrum disorder. Phys Occup Ther Pediatric.

2018;39(2):193-203. doi:10.1080/01942638.2018.1432006.