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MONITORING SLEEP AND HEART RATE IN CHILDREN: ASSESSMENT BASED ON DIGITAL TECHNOLOGIES

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Abstract
Assessing sleep quality and heart rate in children is considered essential for maintaining their health. Thanks to digital technologies, it has become possible to identify and analyze these indicators in real time. This article explores how smart devices, biosensors, mobile applications, and artificial intelligence algorithms can be used to monitor sleep and heart rhythm in children. It highlights the advantages of these technologies and presents findings from practical studies. The clinical significance of the monitoring results and future perspectives are also discussed.

Keywords: sleep monitoring, heart rate, children's health, digital healthcare, smart devices, artificial intelligence, wearable technologies

Introduction

Maintaining children’s health requires assessing their sleep quality and heart rhythm. Digital technologies have enabled real-time identification and analysis of these parameters. This article discusses how to implement sleep and heart rate monitoring in children using smart devices, biosensors, mobile apps, and AI algorithms. It also explores the benefits of these technologies, practical research findings, clinical significance of monitoring results, and future prospects.

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Methodology

This article is based on the following key methods:

Literature review: Over 40 scientific articles published between 2018 and 2023 were reviewed from sources such as PubMed, Scopus, Google Scholar, and WHO databases.

Clinical observation: Sleep quality and heart rhythm were assessed through observation of 100 children aged 6–12 years.

Instrumental tests: Methods such as polysomnography (PSG), Holter monitoring (24-hour ECG), oximetry, and vegetative tests were applied.

Statistical analysis: Correlation was evaluated using Pearson correlation, logistic regression, and t-test methods.

Results

Prevalence of sleep disorders (in 100 children):

Insomnia – 28%

Sleep apnea – 16%

Parasomnia (sleepwalking, bruxism) – 9%

Hypersomnia – 7%

Normal sleep (control group) – 40%

Heart rhythm abnormalities:

Sinus tachycardia – 18%

Sinus bradycardia – 9%

Extrasystole – 5%

Prolonged QT interval – 2%

Normal heart rhythm – 66%

Observation findings:

Children with sleep disorders had 2.3 times higher incidence of heart rhythm disturbances ($p < 0.05$).

80% of children with sleep apnea experienced nocturnal hypoxia, which led to reflex bradycardia.

According to Holter ECG results, the average decrease in heart rate during sleep was 15–25%.

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Discussion

Relationship between sleep and heart rhythm:

This link is primarily mediated by the autonomic nervous system (ANS). During sleep, sympathetic activity decreases, and parasympathetic dominance increases. However, sleep disorders heighten sympathetic activity, leading to increased heart rate and blood pressure.

Hypoxia and stress hormones: Sleep-related hypoxia activates the hypothalamic-pituitary-adrenal axis, increasing the production of stress hormones (cortisol, adrenaline), which elevate heart rate and blood pressure.

Scientific Basis

Beebe DW (2020): Children with insufficient sleep exhibit slowed cardiac conduction and ECG changes.

Marcus CL (2021): Children with sleep apnea show signs of myocardial hypertrophy.

Psychological factors: Psychological stress, anxiety, and depressive states in children also impair sleep quality and disrupt heart rhythm. Thus, the proper functioning of these systems is closely tied to mental health.

Conclusion

Monitoring children's sleep and heart rhythm using digital technologies presents significant innovations in healthcare. These systems expand opportunities for early warning, diagnosis, and personalized care. In the future, integrating such technologies into preschools, pediatric hospitals, and primary care practices will become increasingly important.

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