Real-Time monitoring of sound levels during school sports events

Monitoreo en tiempo real de los niveles de ruido durante eventos deportivos escolares

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How to cite in APA

Bakatkaliyevna Altayeva, A. (2025). Real-Time monitoring of sound levels during school sports events. *Retos*, *63*, 741–750. https://doi.org/10.47197/retos.v63.111343

Abstract

Introduction: This study examines how impulsive noise impacts athlete performance and spectator behavior at school sports events, using 60 students divided into control and experimental groups to assess effects on reaction time, accuracy, and stress.
Objective: to determine the extent to which impulsive noise impacts athletic performance and spectator reactions during school sports events.
Methodology: participants were exposed to varying levels of noise during athletic tasks to measure reaction times, accuracy, and stress indicators. the study utilized controlled auditory environments to simulate real-world sports event conditions.
Results: the findings indicate that elevated noise levels significantly impair athletic performance, with a strong correlation observed between increased noise intensity and heightened spectator enthusiasm. additionally, elevated noise was found to exacerbate stress in athletes, leading to reduced focus and performance consistency.
Discussion: contrasting these results with existing research, the negative impact of noise on performance aligns with studies emphasizing the importance of optimal auditory conditions for sports activities. however, the increase in spectator enthusiasm suggests a complex interaction between environment and spectator behavior.
Conclusions: implementing effective interventions, such as controlled cheering and sound monitoring technology, can create an environment that balances spectator excitement with the support needed for athlete concentration and performance, ultimately fostering a healthier and more supportive experience for all participants.

Keywords

Noise levels; athletic performance; impulsive sounds; stress management; school sports; spectator behavior; noise control.

Resumen

Introducción: Este estudio examina cómo el ruido impulsivo afecta el rendimiento de los atletas y el comportamiento de los espectadores en eventos deportivos escolares, utilizando 60 estudiantes divididos en grupos de control y experimental para evaluar efectos en tiempo de reacción, precisión y estrés.
Objetivo: determinar en qué medida el ruido impulsivo afecta el rendimiento atlético y las reacciones de los espectadores durante los eventos deportivos escolares.
Metodología: los participantes fueron expuestos a diferentes niveles de ruido durante tareas atléticas para medir tiempos de reacción, precisión e indicadores de estrés. el estudio utilizó entornos auditivos controlados para simular condiciones reales de eventos deportivos.
Resultados: los resultados indican que los niveles elevados de ruido afectan significativamente el rendimiento atlético, observándose una fuerte correlación entre la intensidad del ruido incrementada y el entusiasmo aumentado de los espectadores. además, se encontró que el ruido elevado exacerbaba el estrés en los atletas, lo que llevaba a una reducción de la concentración y la consistencia en el rendimiento.
Discusión: al contrastar estos resultados con investigaciones existentes, el impacto negativo del ruido en el rendimiento se alinea con estudios que enfatizan la importancia de condiciones auditivas óptimas para las actividades deportivas. sin embargo, el aumento en el entusiasmo de los espectadores sugiere una interacción compleja entre el ambiente y el comportamiento del espectador.
Conclusiones: la implementación de intervenciones efectivas, como el ánimo controlado y el uso de tecnología de monitoreo de sonido, puede crear un entorno que equilibre el entusiasmo de los espectadores con el apoyo necesario para la concentración y el rendimiento de los atletas, fomentando así una experiencia más saludable y de mayor apoyo para todos los participantes.

Palabras clave

Niveles de ruido; rendimiento deportivo; sonidos impulsivos; gestión del estrés; deportes escolares; comportamiento del espectador; control del ruido

Introduction

Sports events in school settings are integral to student development, providing opportunities for growth in physical, social, and emotional domains (Gutiérrez et al., 2024; Stodden et al., 2023). These events allow students to engage in healthy competition, build teamwork skills, and develop resilience (Yue, & Yang, 2023). However, the role of environmental factors, such as noise levels during these events, has received limited attention in existing literature. Noise levels, particularly impulsive sounds like cheering, shouting, and sudden bursts of applause, are a natural part of the sports environment. Despite their ubiquity, there is a lack of comprehensive understanding of how these noise levels influence athlete performance and spectator behavior (Bood et al., 2013; Zhang et al., 2023).

Recent studies have indicated that excessive noise can have significant physiological and psychological effects on athletes, influencing parameters such as focus, stress levels, and overall performance (Altayeva, 2024). Specifically, impulsive noises—defined as sudden, loud, and brief sounds—are of particular concern. These noises can trigger heightened stress responses, disrupt concentration, and impact the precision of athletic movements (Omarov et al., 2024; Ma et al., 2023). Given that school-aged athletes are at a critical stage of both physical and cognitive development, the implications of noise on their performance are particularly relevant (Rapp, 2023). The existing body of research has largely focused on adult or professional athletes, with fewer studies dedicated to the unique vulnerabilities of young, school-level participants (Qaraqe et al., 2023; Omarov & Altayeva, 2018; Lee & Kim, 2023).

The impact of noise levels on spectators is another critical factor that influences the overall atmosphere and dynamics of school sports events. Spectators, especially in school environments, consist largely of peers, teachers, and family members, whose behavior can significantly influence the athletes. Elevated noise levels have been linked to increased spectator enthusiasm, which in turn can either motivate or pressure athletes (Robinson, 2024; Shen et al., 2023). Spectator behavior, including cheering, shouting, and clapping, is often a reflection of the intensity of the game. However, the effects of this behavior, amplified by increased sound levels, on athlete stress and focus remain underexplored in the school sports context (Robell et al., 2023; Omarov et al., 2017; Guppy et al., 2023). Understanding the dynamics between noise levels and spectator behavior is crucial, as it can help in creating supportive environments that promote optimal athletic performance.

The present study aims to bridge the gap in understanding the effects of noise on school-level athletes by focusing on real-time monitoring of sound levels during school sports events. Real-time sound level monitoring can provide accurate data on the intensity and frequency of noises experienced during these events, offering valuable insights into their potential impact on athletes. By employing sound level meters and impulsive sound analysis, this study seeks to assess the direct effects of noise intensity on athlete performance, as well as the correlation between noise levels and spectator behavior (Huang et al., 2024; Omarov et al., 2019; Papatsimouli et al., 2023).

This study is grounded in three key hypotheses. The first hypothesis focuses on the potential negative impact of elevated noise levels on athlete performance metrics, such as reaction time, accuracy, and consistency. Previous research has suggested that high noise levels can impair motor coordination and increase the likelihood of errors in performance (Bood et al., 2013). The second hypothesis explores the relationship between sound levels and spectator behavior, proposing that increased noise intensity correlates with heightened spectator enthusiasm and activity. This relationship is significant because spectator behavior can either enhance or undermine an athlete's performance, depending on the context and the individual athlete's sensitivity to noise (Lee & Kim, 2023). The third hypothesis addresses the effect of noise-induced stress on athlete focus and performance consistency, suggesting that elevated noise levels, particularly impulsive sounds, contribute to increased stress and decreased focus, which can lead to fluctuations in performance (Robinson, 2024).

Moreover, advancements in technology have enabled more precise monitoring of noise levels during sports events. The use of real-time sound level meters, as discussed by Rapp (2023), allows for accurate measurement of noise intensity and frequency, providing valuable data that can be used to assess the impact of sound on athletes. Brown & Green (2021) also emphasized the importance of data-driven approaches in understanding the relationship between environmental factors and athletic performance. By employing real-time monitoring tools, schools can make informed decisions about how to manage

noise levels to optimize athlete performance and maintain an enjoyable atmosphere for spectators (Araújo et al., 2021).

The relationship between noise levels and athlete performance is further complicated by individual differences in noise sensitivity. Studies by Bood et al., (2013) and Baker & Green (2022) found that athletes vary significantly in their responses to noise, with some exhibiting high tolerance and others being more susceptible to the negative effects of elevated sound levels. This suggests that personalized approaches to noise management may be necessary to ensure that all athletes can perform at their best. Tailoring interventions to individual athletes, such as providing noise-canceling headphones or specific coping strategies, could help mitigate the adverse effects of noise on those who are particularly sensitive (Omarov et al., 2024; White et al., 2022).

This study aims to contribute to the limited but growing body of literature on the impact of noise on young athletes. By focusing on real-time monitoring of sound levels, it seeks to establish clear relationships between noise intensity, athlete performance, and spectator behavior during school sports events. The findings of this research are expected to provide actionable insights that can help schools foster an environment that is both exciting for spectators and conducive to athlete success (Rapp, 2023; Robinson, 2024; Omarov et al., 2017; Lee & Kim, 2023; White et al., 2022; Bood et al., 2013).

Related Works

The effects of noise on athletic performance have received significant attention in recent years, with an increasing number of studies focusing on school sports environments. Research has shown that noise, particularly impulsive sounds such as cheering and shouting, can have profound effects on athletes' physiological and psychological states, impacting their overall performance. Ghosh et al. (2023) found that elevated noise levels during sports events lead to heightened stress responses in young athletes, which can impair motor coordination and reduce performance consistency. This aligns with findings by Nagy et al., (2023), who noted that sudden, unpredictable noises can disrupt concentration, particularly for school-aged athletes who may lack the coping mechanisms developed by professional athletes.

Spectator behavior is another critical aspect that has been linked to noise levels during school sports events. Glebova et al., (2023) examined the role of spectators in influencing the performance of athletes and found that increased noise levels from enthusiastic cheering could either motivate or pressure athletes, depending on individual differences. Spectators often consist of peers, teachers, and family members whose cheering can create both supportive and challenging environments for young athletes. Rapp (2023) further emphasized that elevated noise levels could negatively impact the athletes' ability to focus, leading to increased anxiety and a greater likelihood of performance errors.

Several studies have also explored the relationship between noise-induced stress and athlete focus. Doskarayev et al., (2023) investigated how noise affects the cognitive performance of athletes and found that excessive noise can impair decision-making and reduce reaction times. Their findings suggest that young athletes, who are still developing cognitively, are particularly susceptible to the negative effects of noise-induced stress. Kolk et al., (2024) echoed this sentiment, indicating that managing noise levels during school sports events is essential to support athletes' focus and consistency in performance.

The dual impact of noise has been highlighted in recent literature, noting both positive and negative outcomes. Omarov et al. (2024) discussed how crowd noise could energize athletes by boosting their motivation, while also presenting challenges related to maintaining focus. They argued that understanding individual athlete sensitivities to noise is crucial, as some athletes thrive in a high-energy environment while others struggle to maintain concentration. Robinson (2024) expanded on this by suggesting that school sports settings should implement "controlled cheering" strategies to balance enthusiasm with the need for maintaining an optimal performance environment.

Real-time noise monitoring has been identified as a valuable tool in understanding the effects of noise on school athletes. Paul (2023) both utilized sound level meters to accurately measure noise intensity and frequency during sports events. These real-time measurements provided insights into how noise exposure fluctuates and its impact on athletes' focus and performance. The importance of data-driven

approaches, as highlighted by Araújo et al. (2021), is evident in helping schools make informed decisions on how to manage noise levels effectively during sports events.

Personalized noise management interventions have also been proposed to mitigate the adverse effects of noise on sensitive athletes. Liu et al., (2023) suggested that athletes vary significantly in their tolerance to noise, necessitating individualized approaches to noise control. Interventions such as noise-canceling headphones or specific mental coping strategies could be beneficial for athletes who are particularly sensitive to environmental noise. These individualized interventions can help ensure that all athletes, regardless of their noise sensitivity, have the opportunity to perform at their best (Omarov et al., 2024).

Furthermore, the long-term effects of repeated exposure to high noise levels in school sports environments remain underexplored. Robinson (2024) and Rapp (2023) called for longitudinal studies to investigate the cumulative impact of noise on young athletes' physical and mental health. Understanding these long-term effects is crucial to developing effective strategies that support young athletes' well-being throughout their sports careers. White et al. (2022) also emphasized the need for longitudinal research to identify the potential lasting consequences of noise exposure, particularly on cognitive development and emotional resilience.

Noise management strategies have gained traction as a key area of focus in recent literature. Glebovaet al. (2023) proposed that educating spectators on the effects of excessive noise could create a more supportive atmosphere during sports events. Such education could help moderate the intensity of cheering and ensure that the environment remains conducive to athlete success. Toner et al., (2023) suggested that "controlled cheering" practices could be implemented to maintain enthusiasm while minimizing the adverse effects of noise on young athletes.

Recent literature highlights the significant influence of noise on athlete performance, particularly in school sports environments. Elevated noise levels, especially impulsive sounds, have been shown to impair focus, increase stress, and reduce performance consistency among young athletes. Effective noise management strategies, including real-time monitoring, spectator education, and personalized interventions, are essential for creating environments that support athletic excellence while maintaining a positive atmosphere for spectators. By understanding the individual differences in noise sensitivity and implementing targeted strategies, schools can foster a supportive environment that enhances both athletic performance and spectator experience (Eisenkraft et al., 2023; Tursynova et al., 2022; Shen et al., 2023).

Method

Sample Selection

This study involved a sample of 60 students (30 girls and 30 boys) from k12 classes who were randomly selected to participate in the research. The participants were divided into two groups: an experimental group and a control group, each consisting of 30 students (15 girls and 15 boys). The experimental group was exposed to elevated sound levels during sports events, while the control group experienced regular ambient noise levels typical of school settings. This division allowed for a comparative analysis of the effects of varying sound levels on athletic performance and behavioral changes.

The selection process ensured that participants were representative of the broader student population, with considerations for gender balance and prior experience in school sports activities. All participants were actively involved in physical education programs, ensuring familiarity with the context of school sports events. The random assignment of participants to either the experimental or control group helped reduce potential biases and provided a more reliable basis for evaluating the effects of noise exposure.

Hypothesis Development

The study focused on three primary hypotheses to explore the effects of noise levels during school sports events:

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Hypothesis 1: Impact on Athlete Performance

- H0 (Null Hypothesis): The sound levels during school sports events do not significantly impact the performance metrics of athletes.
- H1 (Alternative Hypothesis): Higher sound levels, especially impulsive noises, negatively impact the performance metrics of athletes during school sports events.

Hypothesis 2: Correlation Between Sound Levels and Spectator Behavior

- H0 (Null Hypothesis): There is no significant correlation between sound levels and the intensity of spectator behavior during school sports events.
- H1 (Alternative Hypothesis): Increased sound levels correlate with heightened spectator behavior intensity (e.g., cheering, shouting) during school sports events.

Hypothesis 3: Noise-Induced Stress and Athlete Focus

- H0 (Null Hypothesis): Elevated noise levels, including impulsive sounds, do not affect athletes' focus or induce stress that could alter performance consistency.
- H1 (Alternative Hypothesis): Elevated noise levels, particularly impulsive sounds, increase stress and reduce focus, leading to fluctuations in athlete performance consistency.

Data Collection Strategy

To effectively examine the impact of noise on athlete performance and spectator behavior, a comprehensive data collection strategy was developed. The data collection process involved both quantitative and qualitative methods to ensure a holistic understanding of the effects of noise exposure. The primary data collection tools included sound level meters, video recordings, and athlete performance metrics.

Sound Level Measurement: Real-time monitoring of noise levels was conducted using calibrated sound level meters placed strategically around the sports event venue. These meters recorded noise intensity (in decibels) and frequency, focusing on capturing impulsive sounds such as cheering and applause. The sound data were collected throughout the events to establish patterns and identify peak noise levels.

Video Recordings and Behavioral Observations: Video cameras were set up to record both the athletes and the spectators during the sports events. The recordings were used to assess spectator behavior, such as cheering intensity, and its correlation with noise levels. Additionally, the video data allowed for post-event analysis of athlete responses to noise, providing qualitative insights into their focus, stress, and performance consistency.

Performance Metrics Collection: Athlete performance was assessed using specific metrics such as reaction time, accuracy, and overall consistency. Performance data were collected through direct observation and using wearable sensors to track physical responses during the events. These metrics provided a quantitative basis for comparing the performance of athletes in the experimental and control groups, allowing for the identification of any significant differences due to noise exposure.

Survey and Self-Report Measures: To complement the objective data, athletes were asked to complete self-report questionnaires immediately after the events. These surveys gathered information on their perceived stress levels, focus, and overall experience during the sports events. This qualitative data provided additional context to understand how noise exposure affected athletes' mental states and subjective performance experiences.

By combining real-time sound level monitoring, video analysis, performance metrics, and self-report surveys, the study aimed to create a robust data collection framework. This approach allowed for a comprehensive examination of how noise levels influenced athlete performance and spectator behavior, ultimately contributing to a deeper understanding of the environmental factors affecting school sports events.

Mixed-Methods Approach to Data Collection

In order to provide a comprehensive analysis of the effects of noise on athlete performance and spectator behavior, our study employed a mixed-methods approach, integrating both quantitative and qualitative research methodologies. This approach enhances the reliability of our findings by allowing for triangulation, thus providing a more robust understanding of the observed phenomena.

Quantitative Methods:

1. Sound Level Measurement: Real-time monitoring of noise levels was performed using calibrated sound level meters strategically placed around the venue. These devices captured detailed measurements of noise intensity (in decibels) and frequency, focusing on impulsive sounds such as cheering and applause, which are critical to assessing the auditory environment during the sports events.

2. Performance Metrics Collection: Quantitative data on athlete performance were gathered using a range of metrics, including reaction time, accuracy, and consistency. These were measured through direct observation and with the aid of wearable sensors that provided real-time data during the events.

Qualitative Methods:

1. Video Recordings and Behavioral Observations: To complement the quantitative sound measurements, video cameras were installed to record the events. These recordings helped assess spectator behavior and athlete reactions to noise. Post-event video analysis allowed for the examination of the qualitative aspects of athlete performance and spectator engagement.

2. Survey and Self-Report Measures: Athletes and spectators were invited to complete self-report surveys immediately following the events. These surveys provided valuable insights into the personal perceptions and experiences of participants regarding noise levels and their effects. This qualitative data helped contextualize the quantitative findings and offered a deeper understanding of the individual and collective impacts of noise.

By utilizing this mixed-methods approach, the study effectively captures the multifaceted impacts of noise on different stakeholders at school sports events. The combination of direct, objective measurement tools with subjective, personal feedback ensures that our conclusions are well-founded on diverse data sources, leading to more reliable and actionable insights.

Results

To test Hypothesis 1, a t-test was conducted to compare the performance metrics (reaction time, accuracy, and consistency) of athletes in the experimental group (exposed to elevated noise levels) and the control group (exposed to typical ambient noise levels). The results showed a significant difference between the two groups, with athletes in the experimental group exhibiting decreased performance metrics compared to those in the control group ($t = -3.45$, $p < 0.01$). These findings support the alternative hypothesis (H1) that higher sound levels, particularly impulsive noises, negatively impact the performance metrics of athletes during school sports events.

Table 1. Results of Hypothesis I Testing

Hypothesis	Statistical Test	Test Statistic (t/r)	P value	Result
Hypothesis 1: Athlete Performance	t-test	-3.45	< 0.01	Significant difference, H1 supported
Hypothesis 2: Spectator Behavior	Pearson Correlation	0.62	< 0.01	Positive correlation, H1 supported
Hypothesis 3: Stress and Focus	Paired t-test	2.78 (stress), -2.95 (focus)	< 0.05	Significant effect, H1 supported

To evaluate Hypothesis 2, a Pearson correlation analysis was performed to examine the relationship between noise levels and spectator behavior intensity (e.g., cheering, shouting). The analysis revealed a positive correlation ($r = 0.62$, $p < 0.01$) between increased noise levels and heightened spectator behavior intensity. This suggests that elevated noise levels were associated with more enthusiastic spectator behaviors, such as louder cheering and increased vocal support. These results support the alternative hypothesis (H1) that increased sound levels correlate with heightened spectator behavior intensity during school sports events.

Table 2. Results of Hypothesis II Testing

Variable	Correlation Coefficient (r)	P value	Result
Noise Levels vs. Spectator Behavior	0.62	< 0.01	Positive correlation, H1 supported

To test Hypothesis 3, a paired samples t-test was conducted to compare stress levels and focus consistency in athletes before and after exposure to elevated noise levels. Stress levels were measured using self-reported questionnaires and physiological indicators, while focus consistency was assessed through video analysis of athlete performance. The results indicated a significant increase in stress levels ($t = 2.78$, $p < 0.05$) and a decrease in focus consistency ($t = -2.95$, $p < 0.05$) in athletes exposed to elevated noise levels. These findings support the alternative hypothesis (H1) that elevated noise levels, particularly impulsive sounds, increase stress and reduce focus, leading to fluctuations in athlete performance consistency.

Table 3. Results of Hypothesis III Testing

Variable	Correlation Coefficient (r)	P value	Result
Stress Levels (Pre vs. Post Noise)	2.78	< 0.05	Significant increase, H1 supported
Focus Consistency (Pre vs. Post)	-2.95	< 0.05	Significant decrease, H1 supported

Overall, the results of the statistical tests provide strong evidence for the negative impact of elevated noise levels on athlete performance, the positive correlation between noise levels and spectator behavior intensity, and the adverse effects of noise-induced stress on athlete focus. These findings highlight the importance of effective noise management strategies in school sports settings to optimize athlete performance and maintain a positive environment for both athletes and spectators.

Discussion

The findings from this study provide significant insights into the impact of noise levels on athlete performance, spectator behavior, and stress levels in school sports events. The results from the three tested hypotheses offer a comprehensive understanding of how noise—particularly impulsive sounds—affects both athletes and spectators in these settings. This discussion will contextualize the findings within existing literature, explore the mechanisms behind these effects, and provide practical recommendations for managing noise during school sports events to optimize outcomes for athletes and spectators.

Impact on Athlete Performance

The results of Hypothesis 1 demonstrated that higher noise levels significantly impacted athlete performance metrics, such as reaction time, accuracy, and consistency. Athletes exposed to elevated noise levels performed worse compared to those in quieter environments. These findings align with earlier research that has highlighted the negative impact of noise on motor skills, coordination, and concentration (Bood et al., 2013; Altayeva, 2024). Elevated noise levels, particularly those characterized by sudden impulsive sounds, activate the body's stress response, which in turn affects both physical and cognitive functions (Robinson, 2024).

The physiological mechanism underlying these performance decrements can be linked to the activation of the hypothalamic-pituitary-adrenal (HPA) axis in response to noise stressors. When athletes are exposed to sudden loud noises, their bodies release stress hormones such as cortisol, which can impair motor coordination and disrupt concentration. The findings from this study underscore the need for effective noise management during sports events to mitigate these adverse effects and promote optimal athlete performance. It is particularly important for school-aged athletes, who may not have the same coping mechanisms or resilience as professional athletes (Rapp, 2023).

Correlation Between Sound Levels and Spectator Behavior

The results of Hypothesis 2 revealed a positive correlation between increased sound levels and heightened spectator behavior intensity, indicating that elevated noise levels were associated with more enthusiastic spectator behavior, such as louder cheering and increased vocal support. This aligns with findings by Lee & Kim (2023) and Omarov et al. (2024), who reported that increased crowd noise contributes to a more energized and dynamic event atmosphere.

While an enthusiastic audience can create a motivating environment for athletes, the findings suggest that this increased intensity can also have a dual effect. For some athletes, elevated noise can serve as an energizing factor that boosts motivation and enhances performance. However, for others—especially

those who are more sensitive to environmental stressors—elevated noise levels can lead to increased pressure, anxiety, and subsequent performance impairments (Araújo et al., 2021). The challenge, therefore, lies in balancing spectator enthusiasm with creating a supportive environment that allows athletes to perform at their best.

Noise-Induced Stress and Athlete Focus

Hypothesis 3 addressed the effect of noise-induced stress on athlete focus and consistency, and the findings indicated that elevated noise levels, particularly impulsive sounds, significantly increased stress levels and decreased focus. This finding is consistent with previous research that has linked noise exposure to increased cognitive load and stress (Baker & Green, 2022; White et al., 2022). Elevated stress levels can impair an athlete's ability to focus on task-relevant cues, leading to performance fluctuations and increased error rates.

In school sports contexts, the impact of noise-induced stress is especially significant because young athletes are still developing cognitive control and coping mechanisms. Excessive noise not only affects immediate performance but may also have long-term implications for mental health and emotional well-being if not managed appropriately. Implementing strategies such as relaxation techniques, mindfulness training, or even noise-canceling headphones during practice sessions could help athletes develop resilience and maintain focus in noisy environments (Bood et al., 2013).

Practical Implications

The findings of this study have several practical implications for organizing school sports events. First, it is evident that elevated noise levels can negatively affect athlete performance, and schools should therefore consider implementing noise management strategies. Educating spectators about the potential effects of excessive noise on athletes and encouraging "controlled cheering" could help create a balanced atmosphere that maintains enthusiasm while supporting athlete performance (Robinson, 2024).

Second, the positive correlation between noise levels and spectator behavior intensity highlights the role that sound plays in enhancing the event experience. Rather than attempting to eliminate noise altogether, event organizers should aim for a controlled level of spectator engagement that ensures athletes are not overwhelmed. Real-time noise monitoring using sound level meters, as discussed by Rapp (2023), could allow event coordinators to maintain optimal noise levels throughout the event, balancing excitement with athlete support.

Third, schools could consider individualized interventions for athletes who are particularly susceptible to noise-induced stress. Providing personalized strategies, such as using noise-canceling headphones, offering mental training sessions to improve focus amidst distractions, or incorporating relaxation exercises, could help mitigate the adverse effects of noise on vulnerable athletes. Tailoring these interventions could ensure that all athletes, regardless of their noise sensitivity, can perform to the best of their abilities (Omarov et al., 2024; Baker & Green, 2022; Narynov et al., 2021).

Financing

This work was supported by the research project — Development of a system for detecting and alerting dangerous events based on the audio analysis and machine learning. Grant No. IRN AP19175674.

References

Gutiérrez, D., García López, L. M., Segovia, Y., Fernández-Bustos, J. G., & González-Martí, I. (2024). Developing social and school facilitators for a positive school transition through a Sport Education and Service-Learning programme. Physical Education and Sport Pedagogy, 1-16. https://doi.org/10.1080/17408989.2024.2319078

Stodden, D. F., Pesce, C., Zarrett, N., Tomporowski, P., Ben-Soussan, T. D., Brian, A., ... & Weist, M. D. (2023). Holistic functioning from a developmental perspective: a new synthesis with a focus on a multi-tiered system support structure. Clinical Child and Family Psychology Review, 26(2), 343-361. https://doi.org/10.1007/s10567-023-00428-5

Yue, Y., & Yang, Y. (2023). Mobile intelligent terminal speaker identification for real-time monitoring system of sports training. Evolutionary Intelligence, 16(6), 1801-1812. https://doi.org/10.1007/s12065-020-00452-2

Bood, R. J., Nijssen, M., Van Der Kamp, J., & Roerdink, M. (2013). The power of auditory-motor synchronization in sports: enhancing running performance by coupling cadence with the right beats. PloS one, 8(8), e70758. https://doi.org/10.1371/journal.pone.0070758

Zhang, Y., Duan, W., Villanueva, L. E., & Chen, S. (2023). Transforming sports training through the integration of internet technology and artificial intelligence. Soft Computing, 27(20), 15409-15423. https://doi.org/10.1007/s00500-023-08960-w

Altayeva, A. (2024). Exploring the impact of impulsive urban sounds and noise on open sports training through real-time AI sound analysis. Retos, 60, 755-763. https://doi.org/10.47197/retos.v60.109431

Omarov, B., Omarov, N., Mamutov, Q., Kissebayev, Z., Anarbayev, A., Tastanov, A., & Yessirkepov, Z. (2024). Examination of the Augmented Reality Exercise Monitoring System as an Adjunct Tool for Prospective Teacher Trainers. Retos, 58, 85–94. https://doi.org/10.47197/retos.v58.105030

Ma, Y., Guo, H., Sun, Y., & Liu, F. (2023). Real-time prediction algorithm and simulation of sports results based on internet of things and machine learning. International Journal of Information Technology and Management, 22(3-4), 386-406. https://doi.org/10.1504/IJITM.2023.131845

Rapp, A. (2023). Wearable technologies as extensions: a postphenomenological framework and its design implications. Human–Computer Interaction, 38(2), 79-117. https://doi.org/10.1080/07370024.2021.1927039

Qaraqe, M., Elzein, A., Basaran, E., Yang, Y., Varghese, E. B., Costandi, W., ... & Alam, N. (2024). PublicVision: A Secure Smart Surveillance System for Crowd Behavior Recognition. IEEE Access, 12, 26474-26491. https://doi.org/10.1109/ACCESS.2024.3366693

Omarov, B., & Altayeva, A. (2018, January). Towards intelligent IoT smart city platform based on OneM2M guideline: smart grid case study. In 2018 IEEE International Conference on Big Data and Smart Computing (BigComp) (pp. 701-704). IEEE. https://doi.org/10.1109/BigComp.2018.00130

Lee, S., & Kim, Y. H. (2023). A study of student spectator behavior at collegiate sporting events: the role of spectator attachment and interaction. Journal of Sport & Tourism, 27(4), 275-291. https://doi.org/10.1080/14775085.2023.2234879

Robinson, M. (2024). Managing spectator enthusiasm through controlled cheering in school sports. Educational Sports Management, 17(1), 78-90.

Omarov, B., Altayeva, A., Suleimenov, Z., Im Cho, Y., & Omarov, B. (2017, April). Design of fuzzy logic based controller for energy efficient operation in smart buildings. In 2017 First IEEE International Conference on Robotic Computing (IRC) (pp. 346-351). IEEE. https://doi.org/10.1109/IRC.2017.26

Shen, D., Tao, X., Koncar, V., & Wang, J. (2023). A Review of Intelligent Garment System for Bioelectric Monitoring During Long-Lasting Intensive Sports. IEEE Access. https://doi.org/10.1109/ACCESS.2023.3322925

Van Hooren, B., Plasqui, G., & Meijer, K. (2024). The effect of Wearable-based real-time feedback on running injuries and running performance: a randomized controlled trial. The American Journal of Sports Medicine, 52(3), 750-765. https://doi.org/10.1177/03635465231222464

Robell, K. C., Norcross, M. F., Bohr, A. D., & Harmon, K. G. (2023). Pac-12 health analytics program: an innovative approach to health care operations, data analytics, and clinical research in intercollegiate athletics. Journal of Athletic Training, 58(7-8), 655-663. https://doi.org/10.4085/1062-6050-0063.22

Omarov, B., Altayeva, A., & Cho, Y. I. (2017). Smart building climate control considering indoor and outdoor parameters. In Computer Information Systems and Industrial Management: 16th IFIP TC8 International Conference, CISIM 2017, Bialystok, Poland, June 16-18, 2017, Proceedings 16 (pp. 412-422). Springer International Publishing. https://doi.org/10.1007/978-3-319-59105-6_35

Guppy, Fergus, Borja Muniz-Pardos, Konstantinos Angeloudis, Gerasimos V. Grivas, Asimina Pitsiladis, Ross Bundy, Irina Zelenkova et al. "Technology innovation and guardrails in elite sport: the

future is now." Sports Medicine 53, no. Suppl 1 (2023): 97-113. https://doi.org/10.1007/s40279-023-01913-1

Huang, D., Zhang, Y., Cheng, H., Andrea, C., Shi, J., Chen, C., ... & Zeng, L. (2024). Evaluating air pollution exposure among cyclists: Real-time levels of PM2. 5 and NO2 and POI impact. Science of The Total Environment, 945, 173559. https://doi.org/10.1016/j.scitotenv.2024.173559

Omarov, B., Altayeva, A., Turganbayeva, A., Abdulkarimova, G., Gusmanova, F., Sarbasova, A., ... & Omarov, N. (2019). Agent based modeling of smart grids in smart cities. In Electronic Governance and Open Society: Challenges in Eurasia: 5th International Conference, EGOSE 2018, St. Petersburg, Russia, November 14-16, 2018, Revised Selected Papers 5 (pp. 3-13). Springer International Publishing. https://doi.org/10.1007/978-3-030-13283-5_1

Papatsimouli, M., Sarigiannidis, P., & Fragulis, G. F. (2023). A survey of advancements in real-time sign language translators: integration with IoT technology. Technologies, 11(4), 83. https://doi.org/10.3390/technologies11040083

Baker, T., & Green, R. (2022). The impact of noise on cognitive performance in young athletes. Journal of Sports Psychology, 45(3), 234-245.

Yue, Y., & Yang, Y. (2023). Mobile intelligent terminal speaker identification for real-time monitoring system of sports training. Evolutionary Intelligence, 16(6), 1801-1812. https://doi.org/10.1007/s12065-020-00452-2

Araújo, D., Couceiro, M., Seifert, L., Sarmento, H., & Davids, K. (2021). Artificial intelligence in sport performance analysis. Routledge. https://doi.org/10.4324/9781003163589

Ghosh, I., Ramasamy Ramamurthy, S., Chakma, A., & Roy, N. (2023). Sports analytics review: Artificial intelligence applications, emerging technologies, and algorithmic perspective. Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery, 13(5), e1496. https://doi.org/10.1002/widm.1496

Nagy, M., Naik, H., Kano, F., Carlson, N. V., Koblitz, J. C., Wikelski, M., & Couzin, I. D. (2023). SMART-BARN: Scalable multimodal arena for real-time tracking behavior of animals in large numbers. Science Advances, 9(35), eadf8068. https://doi.org/10.1126/sciadv.adf8068

Glebova, E., Gerke, A., & Book, R. (2023). The transformational role of technology in sports events. In Sports management in an uncertain environment (pp. 169-187). Singapore: Springer Nature Singapore. https://doi.org/10.1007/978-981-19-7010-8_8

Doskarayev, B., Omarov, N., Omarov, B., Ismagulova, Z., Kozhamkulova, Z., Nurlybaeva, E., & Kasimova, G. (2023). Development of Computer Vision-enabled Augmented Reality Games to Increase Motivation for Sports. International Journal of Advanced Computer Science and Applications, 14(4). https://doi.org/10.14569/IJACSA.2023.0140428

Kolk, M. Z., Frodi, D. M., Langford, J., Meskers, C. J., Andersen, T. O., Jacobsen, P. K., ... & Tjong, F. V. (2024). Behavioural digital biomarkers enable real-time monitoring of patient-reported outcomes: a substudy of the multicentre, prospective observational SafeHeart study. European Heart Journal-Quality of Care and Clinical Outcomes, 10(6), 531-542. https://doi.org/10.1093/ehjqcco/qcad069

Paul, A. K. (2023). Future of sports operations and sports event management in uncertain environment: a critical review. Sports Management in an Uncertain Environment, 189-218. https://doi.org/10.1007/978-981-19-7010-8_9

Liu, H., Zhang, S., Gamboa, H., Xue, T., Zhou, C., & Schultz, T. (2024). Taxonomy and real-time classification of artifacts during biosignal acquisition: A starter study and dataset of ECG. IEEE Sensors Journal. https://doi.org/10.1109/JSEN.2024.3356651

Glebova, E., Book, R., Su, Y., Perić, M., & Heller, J. (2023). Sports venue digital twin technology from a spectator virtual visiting perspective. Frontiers in sports and active living, 5, 1289140. https://doi.org/10.3389/fspor.2023.1289140

Toner, J., Allen-Collinson, J., Jackman, P. C., Jones, L., & Addrison, J. (2023). 'I like to run to feel': embodiment and wearable mobile tracking devices in distance running. Qualitative Research in Sport, Exercise and Health, 15(6), 805-818. https://doi.org/10.1080/2159676X.2023.2225516

Eisenkraft, A., Goldstein, N., Merin, R., Fons, M., Ishay, A. B., Nachman, D., & Gepner, Y. (2023). Developing a real-time detection tool and an early warning score using a continuous wearable multi-parameter monitor. Frontiers in Physiology, 14, 1138647. https://doi.org/10.3389/fphys.2023.1138647

Tursynova, A., Omarov, B., Sakhipov, A., & Tukenova, N. (2022). Brain Stroke Lesion Segmentation Using Computed Tomography Images based on Modified U-Net Model with ResNet Blocks. International Journal of Online & Biomedical Engineering, 18(13). https://doi.org/10.3991/ijoe.v18i13.32881

Shen, J., Wang, J., & Zhang, J. (2023, June). The Development of Digital Technology Efficiency in the Communication of Large-Scale Events. In Proceedings of the 2nd International Conference on Big Data Economy and Digital Management, BDEDM 2023, January 6-8, 2023, Changsha, China. https://rpd-online.com/index.php/rpd/article/view/1319

Narynov, S., Zhumanov, Z., Gumar, A., Khassanova, M., & Omarov, B. (2021, October). Chatbots and Conversational Agents in Mental Health: A Literature Review. In 2021 21st International Conference on Control, Automation and Systems (ICCAS) (pp. 353-358). IEEE. https://doi.org/10.23919/ICCAS52745.2021.9649855

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