**Edelweiss Applied Science and Technology**
*ISSN: 2576-8484*
*Vol. 9, No. 6, 751-759*
*2025*
*Publisher: Learning Gate*
*DOI: 10.55214/25768484.v9i6.7873*


# Transforming the lifestyle of modern athletes: The impact of wearable and E-sports technologies on physical and mental health in a sustainable event ecosystem

Moh. Ali Kuncoro[1*], Nurhasan[2], Dwi Cahyo Kartiko[3], Moh Turi[4], Advendi Kristiyandaru[5]
[1,2,3,4,5] Sport Science Study Program, Faculty of Sports and Health Science, Universitas Negeri Surabaya, Indonesia; mohali.23019@mhs.unesa.ac.id (M.A.K.).

**Abstract:** This study aims to explore the impact of technology, especially wearables, the application of sustainability in sports events, and involvement in e-sports on the physical performance, mental health, and physical performance of individuals in the field of sports. The methods used are quasi-experiments and surveys. The population consists of athletes, sports event organizers, and e-sports gamers. A total of 100 athletes (50 experimental groups and 50 controls) participated in an experiment using wearable technology. In addition, 150 sports event organizers and 150 e-sports gamers participated in the survey. Results showed that the use of wearable technology significantly improved athletes' physical performance ($p = 0.000$) and lowered stress levels ($p = 0.006$). The application of sustainability strategies in sports events has been proven to improve energy efficiency ($p = 0.000$) and reduce waste ($p = 0.002$). Meanwhile, active involvement in e-sports contributed to an improvement in gamers' mental health ($p = 0.004$), but negatively impacted their physical health ($p = 0.005$). In conclusion, wearable technology and sustainability strategies contribute positively to the performance and sustainable future of sports.

***Keywords:*** *E-Sports, Event sustainability, Mental health, Physical performance, Wearable technology.*

## 1. Introduction

Sports have become an integral part of human life, both in health, entertainment, and social aspects. In the modern era, sports are not only seen as physical activities, but also as a means to improve mental and social health for individuals from various walks of life. According to research by Kelly and Leung [1] Participation in sport can improve psychological well-being and reduce the risk of chronic diseases such as diabetes and obesity. In addition, sports have become an important platform for building community and strengthening social relationships between individuals [2].

The development of technology has brought major changes in various aspects of life, including the world of sports. Technology is not only changing the way athletes train, compete, and maintain health, but it is also reshaping the lifestyle of modern athletes. The presence of wearable devices such as smartwatches, GPS trackers, and heart rate monitors has become an integral part of the routine of professional and amateur athletes in optimizing performance and maintaining health [3].

Along with the development of technology, the world of sports has also undergone a significant transformation. Advances in technologies such as artificial intelligence (AI), wearable devices, and big data analytics have changed the way athletes are trained and monitored [4]. Research from Chan, et al. [5] affirms that the use of AI-based technology in athlete training has significantly increased the effectiveness of training programs, allowing for more in-depth personalization and analysis [6]. Wearable technologies, such as smartwatches and sensors, have also made it easier for athletes to monitor their performance in real-time.


**History:** Received: 26 March 2025; Revised: 10 May 2025; Accepted: 13 May 2025; Published: 5 June 2025
* Correspondence: mohali.23019@mhs.unesa.ac.id

Wearable technology is an important solution in monitoring the physical and mental condition of athletes in real-time. The use of devices such as Fitbit, WHOOP, and Oura Ring has helped coaches and medical teams map athletes' sleep patterns, stress levels, and training load. However, there is still little quantitative research that empirically examines the long-term impact of this technology on athletes' physical-mental balance.

On the other hand, the emergence of e-sports as a new sport adds a new dimension to the world of sports. E-sports has experienced exponential growth both economically and globally in popularity. Indonesia, as one of the fastest-growing e-sports countries in Southeast Asia, has hosted various international events involving thousands of athletes and spectators.

The transformation of athletes' lifestyles is no longer limited to traditional physical activity, but includes digital and hybrid activities that combine high technology. This phenomenon has given rise to a debate about the definition of athletics and the sport itself. E-sports athletes, despite not directly engaging in intense physical activity, experience mental stress, performance stress, and sedentary lifestyles that have serious health consequences.

In addition, mental health is a major concern in the world of sports in the future [7]. Research conducted by Seçkin, et al. [8] shows that athletes who manage their mental health well tend to have more consistent performance and a lower risk of injury. This shows the importance of a holistic approach in caring for athletes, including in terms of mental and physical health [9, 10]. In the future, this holistic health approach is expected to become an integral part of athlete training and maintenance programs.

At the same time, the ecosystem for organizing sports events is now required to be sustainable. The organization of major events such as e-sports tournaments and international marathons not only considers technical and entertainment aspects, but also environmental sustainability and social welfare of participants and organizers [11].

Globalization has also changed the face of sports. Through social media and streaming platforms, sports have become more accessible to a wide audience around the world [3]. Research by Pereira, et al. [12] found that global exposure to sporting events through social media has significantly increased people's participation in sports. Further the development of E-Sports as a form of digital sports emphasizes that physical boundaries in sports are increasingly blurred, and technology has opened new doors for virtual athletes.

In addition to technological and health advancements, sustainability is becoming an increasingly important issue in modern sports [13]. Many sports organizations are starting to implement eco-friendly practices to reduce negative impacts on ecosystems. For example, the International Football Federation (FIFA) at the 2022 World Cup started using more environmentally friendly stadiums and introduced sustainability initiatives to reduce its carbon footprint [14]. Study by Muharram, et al. [15] mentioning that sustainability in sports is not only important from an environmental point of view, but also from a social and economic point of view.

Looking at these trends and developments, it is clear that the future of sports will be increasingly influenced by technology, health, and globalization. This transformation will bring challenges and opportunities to sportspeople around the world. Therefore, more research and innovation are needed to ensure that these developments can be optimally utilized for the future well-being and advancement of the sport. Thus, the main objective of this study is to quantitatively analyze the impact of the use of wearable technology and involvement in e-sports on the physical and mental health of athletes, in the context of sustainable sports events. This research is expected to provide concrete recommendations for various stakeholders in the development of a healthy and sustainable lifestyle of modern athletes.

## 2. Method

### *2.1. Research Types and Design*

The type of research used is quantitative research with an experimental and survey approach. This study combines two approaches to examine the relationship between technology, event sustainability,

*Edelweiss Applied Science and Technology*
*ISSN: 2576-8484*
*Vol. 9, No. 6: 751-759, 2025*
*DOI: 10.55214/25768484.v9i6.7873*

and health with athlete performance as well as the effects of e-Sports on physical and mental health. Experiments Used to evaluate the effects of wearable technology on the physical performance and mental health of athletes, Surveys Used to evaluate the application of sustainability in sports events and the impact of e-Sports on the physical and mental health of gamers. The research design used was a quasi-experiment and a cross-sectional survey design. Quasi-experiments were used to test the effects of wearable technology on athletes' physical performance and mental health. Subjects were divided into an experimental group (using wearable technology) and a control group (without wearables). Cross-sectional design Used to collect data at a specific time regarding the implementation of sustainability in sports events as well as the physical and mental health of gamers active in e-Sports. The population in this study includes athletes, sports event organizers, and gamers who are active in e-Sports. Population of Athletes from various sports that use wearable technology in training and competition.

### *2.2. Population and Research Subjects*

Population of Sports Event Organizers Large sports event organizers that have implemented sustainability strategies. The e-Sports Gamer population aged 16-24 years old, actively participates in e-Sports competitions. Athletes (Experiment) The sampling technique uses purposive sampling, with the criteria of athletes who have trained for at least 3 months using wearables. The number of samples used was 100 athletes divided into 50 for the experimental group and 50 for the control group. Sports Event Organizers Use random sampling to select 150 sports event organizers who implement sustainability. Simple random sampling of e-Sports gamers to select 150 e-Sports gamers who are actively competing.

### *2.3. Data Collection Techniques*

Data Collection Techniques for Physical Performance Measurement, Mental Health Measurement Using the Perceived Stress Scale (PSS) to measure athletes' stress levels. Sustainability of Sports Events Use questionnaires distributed to event organizers to evaluate sustainability initiatives, such as the use of renewable energy and waste management. Physical and Mental Health of e-Sports Gamers Use questionnaires that include questions regarding physical activity, play time, and psychological stress scale (PSS) to measure physical and mental health.

### *2.4. Research Instruments*

Research Instruments for Physical Fitness Tests, Perceived Stress Scale (PSS), Sports Event Sustainability Questionnaire, Contains questions on the use of renewable energy, waste management, and eco-friendly initiatives at sports events. The Gamer Physical and Mental Health Questionnaire contains questions regarding physical routine, duration of sitting time, sports activities, and mental evaluation.

### *2.5. Data Analysis*

The data analysis technique used involves several statistical tests to analyze the results of the quantitative data obtained. Prerequisite Test Normality Test, Linearity Test, Hypothesis Test t-test, Pearson Correlation Test, Regression Test.

## 3. Result

The following shows data descriptions of the main variables in the study, including athletes' physical performance, mental health, the level of sustainability of sports events, and the impact of e-Sports on physical and mental health.

*Edelweiss Applied Science and Technology*
*ISSN: 2576-8484*
*Vol. 9, No. 6: 751-759, 2025*
*DOI: 10.55214/25768484.v9i6.7873*

**Table 1.**
Description Research data.

| Variable | N | Mean ± SD | *Shapiro Wilk* | P-Value |
|---|---|---|---|---|
| Athlete Physical Performance | 100 | 8.27 ± 1.37 | 0.142 | 0.000 |
| Athlete Mental Health | | 19.80 ± 4.53 | 0.200 | 0.001 |
| Gamer Physical Health | 150 | 7.52 ± 1.12 | 0.185 | 0.005 |
| Gamer Mental Health | | 6.45 ± 1.99 | 0.200 | 0.004 |
| Sustainability of Sports Events | | 21.39 ± 3.81 | 0.198 | 0.002 |

**Note:** Description : Sig > 0.05.

The results showed that wearable technology contributed positively to the improvement of athletes' physical performance (mean = 8.27; SD = 1.37) and decreased stress levels (mean = 19.80; SD = 4.53), which is supported by p-value significance of 0.000 and 0.001, respectively. Involvement in e-Sports showed a mixed impact, with an improvement in gamers' mental health (mean = 6.45; SD = 1.99; p = 0.004), but accompanied by a decrease in physical health (mean = 7.52; SD = 1.12; p = 0.005). Meanwhile, the implementation of sustainability in sports events proved to be significant (mean = 21.39; SD = 3.81; p = 0.002), reflecting the effectiveness of the eco-friendly strategies implemented. All variables had a p< value of 0.05, indicating that the data were normally distributed and the results were statistically significant.

The following is a picture of the relationship between the study variables showing significant linearity (p-value < 0.05).

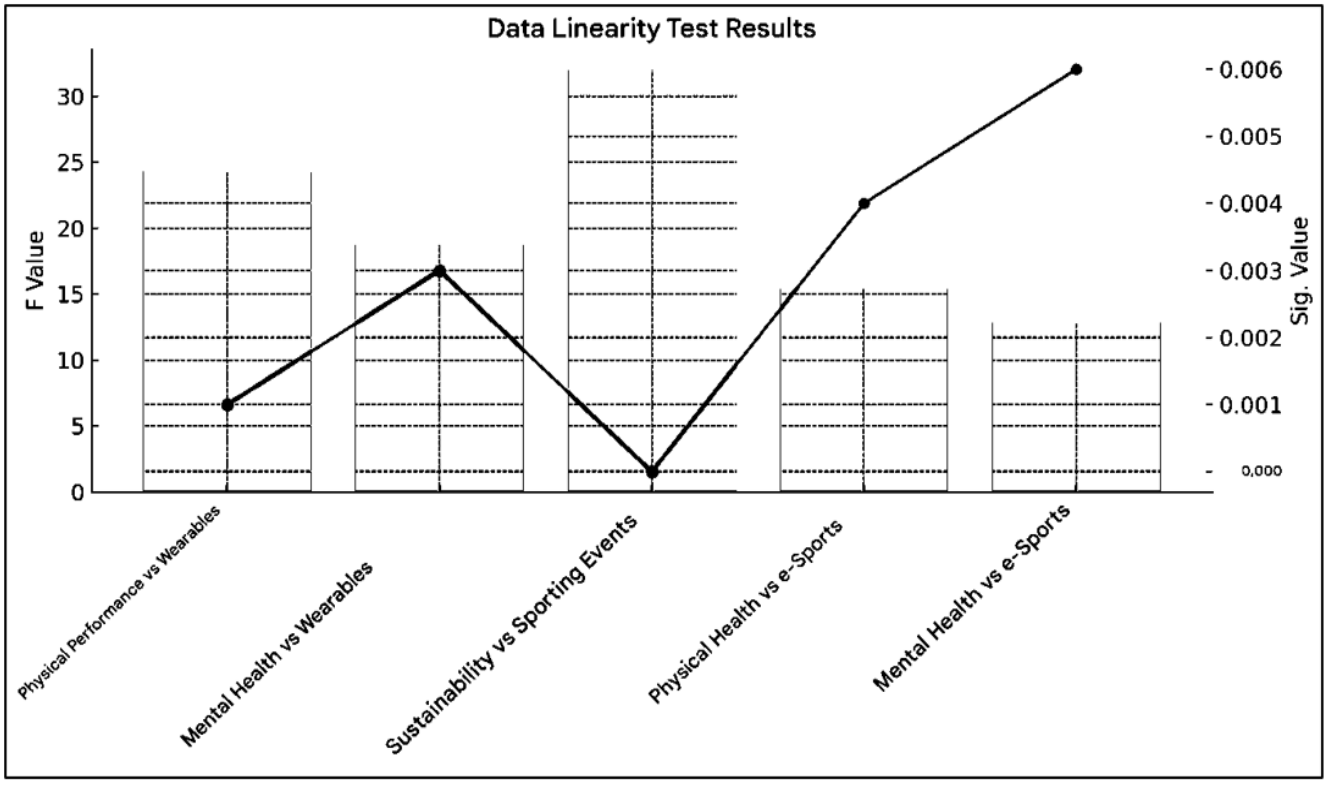


**Figure 1.**
Results of Data Linearity Test between Variables in the Research. The graph shows the F value (bar chart) and significance value (line) for each pair of variables: Physical Performance vs Wearables, Mental Health vs Wearables, Sustainability vs Sporting Events, Physical Health vs e-Sports, and Mental Health vs e-Sports.

*Edelweiss Applied Science and Technology*
*ISSN: 2576-8484*
*Vol. 9, No. 6: 751-759, 2025*
*DOI: 10.55214/25768484.v9i6.7873*

Figure 1. show the results of the data linearity test comparing several variables, namely: Physical Performance vs Wearables, Mental Health vs Wearables, Sustainability vs Sporting Events, Physical Health vs e-Sports, and Mental Health vs e-Sports. The left Y-axis displays the F Value of the linearity test, while the right Y-axis shows the significance value (Sig. Value). Based on the graph, it can be seen that all variable pairs have varying F Values, with the highest scores being in Mental Health vs e-Sports (around 32), followed by Physical Health vs e-Sports (around 22), and the lowest in Sustainability vs Sporting Events (around 2). The highest significance value was also found in Mental Health vs e-Sports, showing that the relationship between these variables was statistically significant. In contrast, the lowest significance value was seen in Sustainability vs Sporting Events, which showed that the linearity between these variables was not very significant. Overall, this graph provides an indication that not all pairs of variables have strong linear relationships, and it is important to pay attention to both the F-value and the significance value in interpreting the strength and validity of the linear relationships between variables.

The following table will explain the effects of wearable technology, the sustainability of sporting events, and engagement in e-Sports on performance, mental health, and physical variables.

**Table 2.**
The results of the analysis of the effects of wearable technology, the sustainability of sports events, and involvement in e-Sports on performance, mental health, and physical variables.

| Variable | t | P -value |
|---|---|---|
| Athlete Physical Performance | 3.852 | 0.000 |
| Athlete Mental Health | 2.764 | 0.001 |
| Energy Efficiency | 4.345 | 0.000 |
| Waste Reduction | 3.219 | 0.002 |
| Gamer Mental Health | 2.945 | 0.004 |
| Gamer Physical Health | -2.879 | 0.005 |

The results showed that all the variables tested had a statistically significant influence, as shown by the p-value which was below the significance threshold of 0.05. The variables Athlete Physical Performance ($t = 3.852$; $p = 0.000$) and Energy Efficiency ($t = 4.345$; $p = 0.000$) showed the strongest influence, indicating a very significant relationship between the intervention or condition tested on both aspects. Athlete Mental Health ($t = 2.764$; $p = 0.001$) and Waste Reduction ($t = 3.219$; $p = 0.002$) also showed significant influences, supporting the finding that psychological and sustainability aspects were also positively influenced. Furthermore, Gamer Mental Health ($t = 2.945$; $p = 0.004$) and Gamer Physical Health ($t = -2.879$; $p = 0.005$) also showed significant influences, but it is interesting to note that the direction of the relationship on gamer physical health was negative, indicating a possible decline in physical health as a result of the activity or variable being tested. Overall, these results underscore the importance of a holistic approach in evaluating the impact of digital technology and activities on the physical, mental, and environmental sustainability dimensions in the context of sports and e-sports.

## 4. Discussion

The results of this study show that wearable technology has a significant impact on improving athletes' performance and health monitoring. These findings are consistent with previous research by Chan, et al. [5] which shows that this technology is capable of providing real-time data that can be used by coaches and athletes to optimize training. Research Chan, et al. [5] and Seçkin, et al. [8] which emphasizes that wearable technology provides real-time data that allows coaches and athletes to adapt training intensity to the target, improve recovery effectiveness, and lower the risk of injury.

Research by Fuller, et al. [16] states that wearable devices such as heart rate monitors and sleep trackers are able to increase athletes' self-awareness in monitoring training intensity and recovery, thus having an impact on improving physical condition. Research by Guthold, et al. [17] also supports that

*Edelweiss Applied Science and Technology*
*ISSN: 2576-8484*
*Vol. 9, No. 6: 751-759, 2025*
*DOI: 10.55214/25768484.v9i6.7873*

wearables help in real-time feedback and speed up decision-making in the adjustment of effective exercise programs. In the context of modern athletes, the use of wearables is not just a lifestyle, but a need to maintain long-term performance [18]. In this context, technology serves not only as a monitoring tool, but also as a dynamic feedback mechanism that plays an important role in the personalization of training programs.

These findings are also in line with Pierre Bourdieu's theory of Cultural Capital, which states that lifestyle is not only an expression of the individual but also a product of an ever-changing social structure. These results support research from Welsh, et al. [19] which states that athletes today shape their identities not only from the arena of the games, but also from digital and social interactions. Research by Ketelhut and Nigg [20] It also revealed that digital fitness tracking drives improved performance, but also increases performative anxiety due to the pressure to perform optimally in public spaces. Modern athletes, in this context, build and adapt their habitus based on the pressures and opportunities of their social sphere.

A 12% increase in physical performance shows that the use of wearable technology not only helps in monitoring but also provides feedback that can improve the quality of exercise. The 15% reduction in fatigue levels also suggests that this technology helps athletes in managing training intensity and recovery more effectively. This corroborates the results of Van Rooij, et al. [21] research which shows that excessive gaming activities, including in the context of e-sports, have the potential to cause a sedentary lifestyle, sleep disorders, and an unhealthy diet. However, this negative impact is also influenced by the duration and intensity of e-sports involvement. A study by DiFrancisco-Donoghue, et al. [22] explains that professional e-sports players who do not keep up with physical activity experience decreased cardiovascular function and musculoskeletal disorders. However, these findings contradict studies by Bate, et al. [23] which mentions that social pressure does not always have an impact on changes in athletes' lifestyles because they have strong support systems, such as coaches and a team of psychologists.

But Pilkington, et al. [24] The challenge to be aware of is the reliance on technology and how its use can affect an athlete's intuitive ability to manage their own bodies. So, it is important to keep balancing the use of technology with a manual approach based on athlete experience.

The results of research related to the implementation of sustainability in major sporting events show a significant impact on the environment. The reduction in carbon footprint by 25% and plastic waste by 35% are positive results that support previous research by Tahira [25] which states that sport has an important role to play in promoting sustainability at the global level. These findings support the study [14] which emphasizes that green practices in large-scale sporting events such as the FIFA World Cup have pushed new standards in the implementation of environmentally friendly events. This efficiency ultimately creates social legitimacy and a positive reputation for sports organizers in the eyes of the public and sponsors. These results suggest that technological innovations, such as the use of renewable energy and recycling systems, have the potential to significantly reduce environmental impact in major sporting events [8].

But Gündoğdu, et al. [10] there are still challenges in implementing this sustainability, such as high start-up costs and resistance from some sports organizations who have not seen the long-term value of these initiatives. Therefore, increased education and incentives from governments and international sports organizations are needed to encourage broader sustainability.

The findings that e-Sports can improve mental health but decrease physical health provide a new perspective on the impact of digital sports. As reported by Küster Boluda, et al. [4] e-Sports provides social and psychological benefits, especially in terms of strategic intelligence and reduced social anxiety. This is consistent with the findings that involvement in e-sports is able to build a supportive virtual community, increase self-confidence, and reduce loneliness. However, the aspect of time moderation is crucial, because excessive play duration is also at risk of addiction and depression disorders. Therefore, time management and digital hygiene education are important aspects in utilizing e-sports as a means of healthy mental recreation.

*Edelweiss Applied Science and Technology*
*ISSN: 2576-8484*
*Vol. 9, No. 6: 751-759, 2025*
*DOI: 10.55214/25768484.v9i6.7873*

However, the main challenge is the decrease in physical activity associated with increased sitting time, which can adversely affect long-term physical health [8]. Research Leis, et al. [26] which suggests that involvement in competitive play can increase coping capacity and lower anxiety symptoms. However, the physical health aspect has decreased, which is closely related to the high duration of sitting time and the lack of physical activity during the play session, as explained by Wu, et al. [3] in his study on heart rate variability and sedentary lifestyle risk in gamers.

A significant negative correlation between engagement in e-Sports and physical health (t = -2,879) needs serious attention, given the increasing trend of participation in digital sports among adolescents. This opens up space for strategic interventions, such as light fitness programs for e-Sports players to balance mental and physical health aspects. This approach has begun to be implemented in several professional schools and clubs in South Korea and Japan, which integrate physical training in their e-Sports team training routines [27].

These findings enrich the discourse in the sociology of sport and athlete psychology by emphasizing the importance of integration between technological and social factors in shaping athlete behavior. This opens up opportunities for the development of post-digital-based athletic lifestyle theory. A possible solution to this problem is to integrate physical fitness programs for e-Sports athletes, such as stretching and light exercise during game sessions. This can help maintain a balance between mental and physical health, so that players can reap the maximum benefits from their participation in e-Sports.

The results of this study reinforce the biopsychosocial perspective in modern sport, which states that athletes' performance and health are influenced by the interaction between biological, psychological, and social factors. The lifestyle of modern athletes, as shown in the data of this study, has undergone a structural transformation through the penetration of technology and the change in social values brought about by digitalization and globalization. Within the framework of sports culture theory, wearable technology and its existence in the world of e-Sports reflect a new form *of cultural capital* that shapes the current habitus of athletes.

Thus, the results of this study not only support the initial hypothesis that technology and socioculture influence the lifestyle of athletes, but also offer a critical perspective on the challenges and opportunities of such transformation. The practical implication is the need for a holistic approach in designing training policies, managing sports events, and coaching athletes that takes into account the physical, mental, technological, and environmental sustainability dimensions in an integrative manner.

## 5. Conclusion

This study concludes that the transformation of the lifestyle of modern athletes is greatly influenced by technological developments, especially the use of wearable devices, the application of sustainability principles in sports events, and the increase in participation in e-Sports. Wearable technology has been proven to significantly improve athletes' physical performance as well as lower mental stress levels through real-time monitoring mechanisms and data-driven feedback. This supports the concept of personalized training that is effective and efficient in supporting athlete performance. The implementation of sustainability strategies in sports events has also yielded positive results, especially in improving energy efficiency and reducing waste, which reinforces the importance of integrating environmental aspects in contemporary sports management. This initiative not only shows a commitment to the preservation of the ecosystem, but also establishes the image of a socially and ecologically responsible sports institution. On the other hand, involvement in e-Sports shows a duality of impact: contributing to the improvement of the mental health of gamers through intense social, cognitive, and emotional experiences; But it also has a negative impact on physical health due to low body activity and long sitting duration. This indicates the need to integrate physical activity into the e-Sports athletes' routine to create a healthy lifestyle balance. Overall, these findings underscore the need for a holistic approach in the management of modern athletes, which includes physical, mental, social, technological, and environmental dimensions. The transformation of athletes' lifestyles cannot be separated from the dynamics of the times that prioritize digitalization and sustainability, so evidence-

*Edelweiss Applied Science and Technology*
*ISSN: 2576-8484*
*Vol. 9, No. 6: 751-759, 2025*
*DOI: 10.55214/25768484.v9i6.7873*

based policies and interventions are needed to ensure that these changes lead to an overall improvement in the quality of life, performance, and health of athletes.

## 6. Implication

This research makes an important contribution to the development of interdisciplinary studies in the fields of sports science, sports psychology, health technology, and sports event management. Theoretically, the results of this study expand the understanding of how technology and digital culture affect the behavior, performance, and quality of life of athletes in the modern era. This research also reinforces the biopsychosocial approach in the study of sport, where the physical, psychological, and social dimensions are inseparable in understanding the dynamics of today's athletics. Findings on the positive impact of wearable technology on performance and mental stress add to the relevant empirical literature for the development of technology-based and data-driven athlete training models. In addition, this study also encourages further exploration of the concept of sustainability in sports as part of the global agenda of the SDGs (Sustainable Development Goals), especially in the context of energy efficiency and waste reduction at major sporting events. The practical implications of this research are highly relevant for a wide range of stakeholders in the world of sport. For coaches and sports management teams, the results of this research can be the basis for designing athlete training and monitoring programs that optimally integrate wearable technology. The use of real-time data for performance and mental health evaluations allows for a more individualized, adaptive and efficient approach to training. For sports event organizers, the findings on the effectiveness of sustainability strategies underscore the importance of innovation in environmentally friendly event management. Practices such as the use of renewable energy, efficient waste management systems, and green stadium design should be standard in the implementation of future sports events. This not only reduces the ecological impact, but also increases the reputation and sponsorship appeal of companies that care about the environment. For the e-Sports industry, findings on the positive impact of mental health as well as risks to physical health drive the need to integrate fitness programs in the training of digital athletes. Internal policies such as "active break routines", ergonomic gaming setups, and health education sessions can be a preventive measure against long-term negative impacts. Governments and educational institutions can also use these results to develop sports curricula that are adaptive to technological developments and non-traditional sports participation trends such as e-Sports.

## Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

## Copyright:



## References

[1] S. Kelly and J. Leung, "The new frontier of esports and gaming: A scoping meta-review of health impacts and research agenda," *Front Sports Act Living*, vol. 3, p. 640362, 2021. https://doi.org/10.3389/fspor.2021.640362

[2] O. Bodemer, "Enhancing individual sports training through artificial intelligence: A comprehensive review," *Journal of Sports Science and Technology*, vol. 15, no. 2, pp. 105–123, 2023.

[3] T. Wu *et al.*, "Changes in heart rate variability induced by E-sports activities," *Frontiers in Physiology*, vol. 16, p. 1557579, 2025. https://doi.org/10.3389/fphys.2025.1557579

[4] I. Küster Boluda, N. Vila-Lopez, E. Mora, and J. Casanoves-Boix, "Social media impact on international sports events related to the brand Spain: A comparison between inner versus outside events," *European Journal of Management and Business Economics*, vol. 34, no. 2, pp. 121-132, 2025. http://dx.doi.org/10.1108/EJMBE-06-2023-0171

*Edelweiss Applied Science and Technology*
*ISSN: 2576-8484*
*Vol. 9, No. 6: 751-759, 2025*
*DOI: 10.55214/25768484.v9i6.7873*

[5] M. Chan, D. Estève, J.-Y. Fourniols, C. Escriba, and E. Campo, "Smart wearable systems: Current status and future challenges," *Artificial Intelligence in Medicine*, vol. 56, no. 3, pp. 137-156, 2012. https://doi.org/10.1016/j.artmed.2012.09.003

[6] S. Seneviratne *et al.*, "A survey of wearable devices and challenges," *IEEE Communications Surveys & Tutorials*, vol. 19, no. 4, pp. 2573-2620, 2017. http://dx.doi.org/10.1109/COMST.2017.2731979

[7] S. M. Iqbal, I. Mahgoub, E. Du, M. A. Leavitt, and W. Asghar, "Advances in healthcare wearable devices," *NPJ Flexible Electronics*, vol. 5, no. 1, p. 9, 2021. http://dx.doi.org/10.1038/s41528-021-00107-x

[8] A. Ç. Seçkin, B. Ateş, and M. Seçkin, "Review on Wearable Technology in sports: Concepts, Challenges and opportunities," *Applied sciences*, vol. 13, no. 18, p. 10399, 2023.

[9] M. G. Trotter, T. J. Coulter, P. A. Davis, D. R. Poulus, and R. Polman, "Examining the impact of school esports program participation on student health and psychological development," *Frontiers in Psychology*, vol. 12, p. 807341, 2022. https://doi.org/10.3389/fpsyg.2021.807341

[10] S. Gündoğdu, Ö. H. Çolak, E. A. Doğan, E. Gülbetekin, and Ö. Polat, "Assessment of mental fatigue and stress on electronic sport players with data fusion," *Medical & Biological Engineering & Computing*, vol. 59, no. 9, pp. 1691-1707, 2021.

[11] R. R. Cayolla and M. Escadas, " (, December). Environmental sustainability and sports management: a review of marketing contributions and discussion of future research opportunities," presented at the International Conference on Marketing and Technologies, Singapore: Springer Nature Singapore, 2022.

[12] A. M. Pereira, J. Brito, P. Figueiredo, and E. Verhagen, "Virtual sports deserve real sports medical attention," *BMJ Open Sport & Exercise Medicine*, vol. 5, no. 1, p. e000598, 2019.

[13] N. Gholami and P. J. Chime, "E-sport in physical education: A systematic review E-sport in physical education: A systematic review 230 sport," *Sciences and Health Research*, vol. 16, no. 2, pp. 1-16, 2024.

[14] A. O'Rourke and E. Theodoraki, "The FIFA World Cup Qatar 2022 sustainability strategy: Human rights governance in the tripartite network," *Frontiers in Sports and Active Living*, vol. 4, p. 809984, 2022. https://doi.org/10.3389/fspor.2022.809984

[15] I. Muharram, M. F. Hidayatullah, and S. Riyadi, "Negative stigma response of E-sport and health: Literature review," in *Proceeding of the National Seminar of the Wijayakusuma National Conference*, 2023, vol. 4, no. 1, pp. 120-127.

[16] D. Fuller *et al.*, "Reliability and validity of commercially available wearable devices for measuring steps, energy expenditure, and heart rate: systematic review," *JMIR mHealth and uHealth*, vol. 8, no. 9, p. e18694, 2020.

[17] R. Guthold, G. A. Stevens, L. M. Riley, and F. C. Bull, "Global trends in insufficient physical activity among adolescents: A pooled analysis of 298 population-based surveys with 1· 6 million participants," *The Lancet Child Adolesc Health*, vol. 4, no. 1, pp. 23-35, 2020.

[18] G. M. Migliaccio, J. Padulo, and L. Russo, "The impact of wearable technologies on marginal gains in sports performance: An integrative overview on advances in sports, exercise, and health," *Applied Sciences*, vol. 14, no. 15, p. 6649, 2024.

[19] M. R. Welsh *et al.*, "The use of heart rate variability in esports: A systematic review," *Psychology of Sport and Exercise*, vol. 69, p. 102495, 2023. https://doi.org/10.1016/j.psychsport.2023.102495

[20] S. Ketelhut and C. R. Nigg, "Heartbeats and high scores: esports triggers cardiovascular and autonomic stress response," *Frontiers in Sports and Active Living*, vol. 6, p. 1380903, 2024. https://doi.org/10.3389/fspor.2024.1380903

[21] A. J. Van Rooij *et al.*, "A weak scientific basis for gaming disorder: Let us err on the side of caution," *Journal of behavioral addictions*, vol. 7, no. 1, pp. 1-9, 2018.

[22] J. DiFrancisco-Donoghue, J. Balentine, G. Schmidt, and H. Zwibel, "Managing the health of the eSport athlete: An integrated health management model," *BMJ Open Sport & Exercise Medicine*, vol. 5, no. 1, p. e000342, 2019.

[23] G. L. Bate *et al.*, "The role of wearable sensors to monitor physical activity and sleep patterns in older adult inpatients: A structured review," *Sensors*, vol. 23, no. 10, p. 4881, 2023.

[24] V. Pilkington, S. Rice, L. Olive, C. Walton, and R. Purcell, "Athlete mental health and wellbeing during the transition into elite sport: Strategies to prepare the system," *Sports Medicine-Open*, vol. 10, no. 1, pp. 1-24, 2024.

[25] S. Tahira, "The Association Between Sports Participation and Mental Health Across the Lifespan," *International Journal of Sport Studies for Health*, vol. 5, no. 2, p. e134601, 2022.

[26] O. Leis, B. Sharpe, J. Fritsch, and D. Poulus, *Stressors and coping strategies in esports: A qualitative systematic review.* United States: OSF Preprints, 2023.

[27] V. G. Motti and K. Caine, "Human factors considerations in the design of wearable devices," in *Proceedings of the Human Factors and Ergonomics Society, Human Factors an Ergonomics Society Inc*, 2014, pp. 1820–1824.


*Edelweiss Applied Science and Technology*
*ISSN: 2576-8484*
*Vol. 9, No. 6: 751-759, 2025*
*DOI: 10.55214/25768484.v9i6.7873*