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F. NACHTEGALL AND GYMNASTICS IN DENMARK: ASCERTAINMENT HISTORY IN THE EDUCATIONAL SYSTEM

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Abstract The relevance of the study is due to the need to improve the quality of training of future physical education (PE) specialists. Knowledge of the legacy of outstanding teachers is the basis for the formation of professional competencies of PE specialists. The experience of F. Nachtegall, the Scandinavian educator of New Times, the main stages of his activity on the introduction of PE in education, their content and results became an impulse to recognize the importance of physical and moral health of young people as the main object of attention of authorities, benefactors and society during the period under study. The educational reforms initiated by him ensured the availability of PE to all young people, promoted the education of healthy, industrious, useful citizens and led to the institutionalisation of PE. Founding Europe's first gymnastics club and a private gymnastics school for different classes, organising and running a school for training civic gymnastics teachers, and founding a gymnastics college - these are just a small part of Nachtegall's multifaceted activities. Nachtegall's practical experience had an enormous influence on the creation of the organisational, programme, control and methodological foundations for the formation of didactic knowledge on the teaching process of PE.

Key words: humanist, New Time, system of gymnastics, schools, physical exercises

Introduction

Globalization and informatization of the modern world have increased the role and importance of the personality of the teacher, the necessity of continuity and success of their personal professional development and intensified the search for ways to modernize professional education. The study of the historical experience of the development of physical education (PE) and sports can effectively contribute to the optimization of the training of future specialists in PE and sports, the formation of their professional knowledge and the mastery of socio-historical experience. A deep understanding of history helps in learning methodological skills in the field of methods of knowledge formation, sets of techniques and methods aimed at instilling value attitudes towards PE and sport. Currently, PE is an integral component of the compulsory school syllabus, is naturally recognized as a regular school subject. Although not overtly contested as a subject of the curriculum, it is unfortunately not considered a core school subject, a performance not prioritized by students unlike mathematics, physics or the native language. Underestimating the importance of physical education in the minds of modern society leads to an unsatisfactory state of physical, spiritual and moral health of the society (Shephard, 2015). The reasons for this are insufficient awareness of graduates of higher educational institutions of physical culture about the cultural and historical

foundations of physical culture and sports, their readiness for the implementation of educational activities. It is important to teach students in their future professional activities, meaningful use of the accumulated pedagogical experience, which provides an opportunity to rationally solve modern problems of school PE.

Publications in recent years illuminate various aspects of European PE and sports history. Thus, studies have recently been published that highlight and describe the characteristic features of various concepts of PE that emerged in the 19th century (Soltyk, 2017). The evolution of national gymnastics systems, their mutual influence and competition is discussed (Cochet, 2012; Roper, 2021). There is a cause-and-effect relationship between politics, ideology, religion, and particularities of the introduction of organized PE in the 19th century (Bonde, 2017; Roper, 2021; Tröhler, Westberg, 2017).

PE as a new school subject in the nineteenth century, the creation of PE institutions, concepts and theories that influenced modern physical culture is covered in the works of Krüger, Hofmann (2015), Roper (2021). As previously reported in the literature, gymnastics was important for almost all social groups and genders in Europe during the 19th century (Ottosson, 2010; Wikström-Grotell et al., 2013). Most of the early studies and current work focus on the detailed study of the characteristics of the creation and development of the Swedish and German gymnastics systems, as well as the development of the sport (Melnick, 2016; Naul, Scheuer, 2020; Pfister, 2003). Characteristics and history of the formation of Turnen's gymnastics by F.L. Yan has been demonstrated by many authors (Kaimakanis et al., 2008; Krüger, R. Hofmann, 2015; Pfister, 2003; Reicher, 2020). P. H. Ling's genesis and evolution of gymnastics and his contribution to the development of kinesiology and physiotherapy are comprehensively considered (Lundquist Wanneberg, 2018; Melnick, 2016; Pfister, 2003). The educational methods of Swedish gymnastics for girls in the mid-nineteenth century have been analyzed in terms of the influence of gender representations (Leonard, 1904a; Westberg, 2018; Wikström-Grotell et al., 2013; Živanović, Milošević, 2017). The development of an educational ideology of athleticism in the late nineteenth century is discussed in terms of British interest in sport as an imperial tool ('Physical Education in State and Private Schools in Britain in the Late-Nineteenth and Early-Twentieth Centuries', 2010). A series of recent studies have covered the principle ideas of British teachers T. Arnold and E. Tring in 'context of school physical education ('Physical Education in State and Private Schools in Britain in the Late-Nineteenth and Early-Twentieth Centuries', 2010; 'Public Schools in Britain in the Nineteenth Century', 2010).

At the beginning of the 20th century, an American historian of physical education Fred Eugene Leonard analyzed the main milestones of F. Nachtegall's pedagogical activity, noted its importance for Denmark and Europe and characterized him as a leader in the field of national gymnastic education in the 19th century (Leonard, 1904b, 1918, 1923). In 1920-1930, the outstanding Polish scientist Eugeniusz Witold Piasecki wrote about the successful experience of F. Nachtegall in the organization of university physical education (Piasecki, 1929; Piasecki, 1930). Nonetheless, subsequent publications of the second half of the 20th century covered F. Nachtegall's activities in the field of education mainly in connection with his role in the creation of Europe's first military and civilian gymnastic institute (Boigey, 1932; Kun, 1984; Ljunggren, 1996). In the 1990s Scandinavian scientists studied in more detail aspects of the integration of F. Nachtegall's gymnastics in the school curriculum, emphasizing its influence on the formation of patriotism and Danish national identity (Eichberg, 1993, 1995; Hoffmann, 1993; Trangbæk, 1996a). The publications drew attention to the innovative nature of F. Nachtegall's gymnastics, the humanistic orientation towards the development of the bodily and moral potential of young people (Eichberg, 1993; Møller, 1996; Naul, 1998).

However, his activities in the early 19th century were of particular interest in promoting physical education at all levels of learning and in different types of educational establishments. This issue, in the context of the cultivation of physical education in education, is underexplored and requires further research.

We assume that studying the legacy of the outstanding Scandinavian teachers of the 19th century on the introduction of physical education into education will reveal the continuity of generations in this area and contribute to a deeper understanding of the trends in the development of modern physical culture.

The purpose of the research is to analyze, generalize and systematize the experience of Scandinavian New Time educator F. Nachtegall, to characterize the main stages of his activity regarding the introduction of physical education into education, their content, and results.

Research material and methods

Analysis, synthesis, generalization and interpretation of scientific, archival literature and Internet materials on this issue were carried out. An axiological methodological approach was used, which made it possible to highlight the valuable content in the object under study, namely, the activity of F. Nachtegall was analyzed. The research tasks were: the introduction into scientific circulation of previously little-known facts of the facet of life and practical activities of F. Nachtegall, the study of his social and professional ties, ethic and worldview that influenced the establishment of physical education in the educational system of Denmark. The main source for the topic of our study was the archival collection of the Royal Danish Library. Old historical texts, in particular those by F. Nachtegall, are digitized and searchable. Since the texts taken as the basis were written in nineteenth-century Danish, the English translation was made as faithful as possible to the original. Materials from several leading scientific and pedagogical periodicals were used, including The International Journal of the History of Sport, Nordic Journal of Educational History, Scandinavian Journal of History, etc., as well as the work of leading researchers Leonard, Piasecki, Kun (Kun, 1984; Leonard, 1904b, 1918, 1923; Piasecki, 1929).

Results and discussion

The inspiration for the educational reform in Europe, which united the physical and cognitive education of children, was Jean-Jacques Rousseau's novel «Emile, or On Education». Educational reformers in Germany, inspired by the novel, created schools for different grades of children in the late 18th century called Philanthropinum (Eichberg, 1995; Ljunggren, 1996). In these schools, various outdoor activities including gymnastics were organized as a compulsory part of the school curriculum. It should be noted that the concept of «gymnastics» in the New Time combined exercises with and without apparatus, such as running, jumping, wrestling, skiing, skating, defense and attack techniques, vaulting (exercises and jumps) on table and horse, pole and wall climbing, maintaining balance on ropes and trees (Leonard, 1923).

Enthusiasts-philanthropists saw gymnastic exercises as a means of physical education, the purpose of which was to form the character and intellect of future citizens.

In the future, the difficult political conditions in Europe in the 19th century, due to important historical events (the emergence of the Austro-Hungarian monarchy, the Napoleonic wars, and the strengthening of the German states) also forced the governments of Western European countries to positively change their attitude towards the idea of organizing PE for the younger generation (Cochet, 2012; Krüger, Hofmann, 2015).

The most widespread, in the first decades of the 19th century, was the humanistic concept of physical activity (PA) outlined in the works of Johann Christoph Friedrich Gutsmuths. J.C.F. Gutsmuths (1759–1839), a prominent teacher at the Philanthropist's School in Schnepfenthal, Germany, in «Gymnastik für die Jugend» (Gymnastics for Youth), presented a system of exercises based on natural science such as games, climbing, balancing, jumping, running, throwing, swimming, skating, exercises aimed at improving perception (Lundquist Wanneberg, 2018; Živanović, Milošević, 2017). He identified two main areas of gymnastics: natural, intended for healing, and artificial, whose movements aim at beauty and performance and not at function (utilitarian and non-utilitarian gymnastics) (Leonard, 1923).

The socio-political events taking place in Europe had a huge impact on Denmark, and the national and philanthropic inspirations of education were the vital prerequisites for the introduction and establishment of school gymnastics. The goal of educational reform became the government's desire to educate good Christians, patriots, and useful citizens of the kingdom (Hoffmann, 1993).

The outstanding European academic Vivat Victorius Franciscus (Franz) Nachtegall (1777–1847) became one of the disciples of J.C.F. Gutsmuths (Eichberg, 1993; Hoffmann, 1993; Leonard, 1923). From childhood, Franz Nachtegall was interested in various physical activities and engaged in fencing and vaulting. Gutsmuth's study of «Gymnastik für die Jugend» determined his life's work (Kun, 1984; Leonard, 1918).

Passion for gymnastics and understanding of its importance for the formation of a system of values through the development of bodily organization prompted F. Nachtegall to found the world's first gymnastic club («Gymnastische Gesellschaft») in Copenhagen in 1798 and a private gymnasium in 1799, the first institution at that time where students were engaged exclusively in physical training in open space. Demand for gymnastic classes increased, and between 1799 and 1803, the number of Nachtegall's students increased from 5 to 150 (Nachtegall, 1831). One of them was P. H. Ling, who later began to develop in Sweden what he had learned from F. Nachtegal (Boigey, 1932; Leonard, 1904a; White, 1887). Public sympathy and the popularity of practical classes among the young prompted him to promote physical education with great zeal. In December 1800, F. Nachtegall created The Society for the Propagation of the Art of Swimming, whose numerous members organized annual swimming competitions and encouraged the best swimmers with cash prizes (Leonard, 1918; Nachtegall, 1831).

Pedagogical career F. Nachtegall continued as a teacher of gymnastics at the private school Copenhagen Philanthropin in 1799. In parallel with practical activities, F. Nachtegall from 1802 to 1804 lectured on the history and methods of physical education for everyone to awaken more interest in this part of pedagogy (Nachtegall & Mønster, 1802). Most of the students at Blagaard Seminary attended Nachtegal's lectures, and undergraduate students participated in practical exercises with exercise equipment on the school premises. The Crown Prince Regent (the future King Christian VII) personally attended the classes several times and, recognizing F. Nachtegall's ability, appointed him professor of gymnastics at the university in 1804 (Nachtegall, 1831). We believe that his painstaking work began from this moment with the aim of legislatively fixing the obligatory nature of physical education in the form of gymnastics in all types of educational institutions.

According to the royal decree in 1804, F. Nachtegal established a military gymnastics institute (for the training of gymnastics instructors in the army and navy). At first, gymnastics was taught for two hours a day and the number of students ranged from 60 to 70. The three-year course included the study of theory and practical exercises and ended with an exam (Nachtegall, 1831).

In 1805, F. Nachtegall published the book «Instruction i Gymnastikken for de Lehrere som er ansatte ved Kavalleriets og Infanteriets Unterofficer - og Exerceerskolen» (Nachtegall, 1831). The book is structured in a question-and-answer format and includes sections on exercises to develop balance, flexibility and agility, as well as specific running and swimming exercises. It is interesting that in the book, for the first time for pedagogical gymnastics, it was proposed to perform individual and group acrobatic exercises, their types, and equipment necessary for classes are described. The definition of gymnastics in the Introduction is given as the art of exercising and training the body to make it fitter, stronger, more flexible, lighter, faster and stronger. In addition, F. Nachtegall emphasized the significance of gymnastics as a remedy of healing and hygiene. Typical mistakes made by students were explained with ways to correct them and recommendations regarding the order in which the exercises are performed. The final chapter of the book describes the responsibilities of a gymnastics teacher. For example, a teacher should set an example for students, be being physically fit, considerate about the students' abilities and health, and by being polite and tactful (Nachtegall, 1805).

A little later, in 1806, Nachtegall developed a plan for the mandatory teaching of the theory and practice of gymnastics, followed by an examination at the end of the course, thus laying the foundation for the educational method of teaching this discipline.

In March 1807, together with the seminary director, he submitted to the Commission to Improve the Management of Danish Schools («Den Store Skolekommission») a proposal to introduce physical exercise as compulsory education at Blagaard Seminary. To meet the needs of primary and general schools, a school was established in 1808 to train civilian gymnastics teachers. The established department was neither exclusive nor independent, as civilians were simply allowed to study gymnastics in a military institution. From 1809, on his initiative, gymnastics became compulsory in gymnasiums and secondary schools (Leonard, 1918; V. V. F. Nachtegall, 1831). Nachtegall organized the training of students sent from non-resident teachers' colleges («Seminarier»), who showed special inclination and ability towards gymnastics, for methodology of teaching gymnastics and various recreational exercises (Eichberg, 1993; Leonard, 1918; Nachtegall, 1831). During six years of operation of this civic institute, 31 students received diplomas as gymnastics teachers and 10 of them began teaching gymnastics in Danish teachers' colleges (Leonard, 1923; Piasecki, 1929).

It should be noted that in the first decade of the 19th century, in Danish society, a large number of prominent representatives of the bourgeoisie and authorities, physical education was regarded as a tool for reproducing national identity and patriotism, forming unity and rallying the nation, a tool for forming the military- applied physical readiness of young people to defend the fatherland. The catastrophic consequences of Denmark's participation in the war between France and England, the economic difficulties caused by the loss of Norway in 1814, and the overall experience of the war showed the army to use gymnastics to adapt to changes in military technology and strategy (Hoffmann, 1993). Accordingly, the expediency of universal military training for youth as an essential part of education pushed philanthropic considerations into the background and contributed to the introduction of military applied gymnastics in schools and physical training in the Danish army became a major force in implementation of gymnastic education. During these difficult times for Denmark, F. Nachtegall sought to support the gymnastic movement in all available ways. Probably, supplementing school gymnastics with military applied exercises, he fulfilled the requirements of the king and the government. At the same time, the Danish government followed a systematic approach of introducing gymnastics into the school curriculum and not limited to the training of gymnastics teachers.

An ordinance on the general school system in Denmark on 29 July 1814 legalized the introduction of school gymnastics (Nachtegall, 1831). Gymnastics was made compulsory for both boys and girls. Every teacher was supposed to give daily lessons to his students about gymnastic exercises like running, jumping, swimming and military exercises outside school hours and every school was supposed to have necessary equipment and an area of 3200–4800 square feet (Leonard, 1923). Students of elementary classes had to study 3 hours a week, senior classes – 2 times a week, every year from June 1 until the beginning of autumn vacation. In summer, the children had to perform swimming exercises. The regulation suggests that gymnastic exercises should be selected which could contribute most to the development of strength, coordination and ability needed by an individual in general and the working class in particular. During these years, F. Nachtegal conducted practical classes with students. To popularize swimming, according to his suggestion, classes were organized with military instructors who taught long distance swimming, diving, rescue techniques for drowning and swimming in uniform and with weapons. It was F. Nachtegall who suggested the use of cork belts as an aid in teaching swimming to beginners. He arranged for the provision of bathing suits for the learners as well (Nachtegall, 1831).

Foreign policy and economic conditions led to the expansion of the purpose of gymnastics to the training of future soldiers. F. Nachtegal supported the idea of a national educational function of gymnastics and included military-applied exercises in pedagogical (and especially school) gymnastics, the reason why the teaching of this discipline was legally restricted to boys only, the future recruits. As F. Nachtegal wrote its main objective was to correct the bodily posture of the farmer, to develop skill and physical skills that will fit him, with desire, skill and courage to fulfill his future destiny as a defender of the fatherland (Nachtegall, 1831). Let us emphasize that it was the political situation in Denmark that forced Nachtegall to focus more on the military content of school gymnastics and changed the main vector of his initiative for the physical education of students.

However, the results of the implementation of this law were much as expected. Many schools in Copenhagen introduced physical exercise into the curriculum, but military gymnastics met with resistance in rural schools. The reluctance of Denmark's rural population to take up gymnastics was probably due to the fear that gymnastics could replace traditional, folk physical education with military-applied exercises.

In 1816 the Civilian Institute almost ceased to function due to economic depression, but the Military Institute continued to provide higher gymnastic education until 1898. Gymnastics became a required subject in Seminaries (teachers' colleges) in 1818, and in 1821 Nachtegall was appointed to the position of «Gymnastikdirector» (Director of Gymnastics) and commanded both civil and military gymnastics throughout the country.

In 1827, at Nachtegall's suggestion, the king ordered the establishment of a gymnastic college («Normalskole für Gymnasticken») where teachers from public and private schools could study gymnastics. A gymnastics school for teachers was opened in January 1828 and 200 teachers were trained there that year (Leonard, 1923).

It should be noted that Nachtegal's operations took place under rather difficult circumstances. On one hand, the state saw the potential of gymnastics as physical training for peasants for the defense of the country. On the other, peasants hated military service and did not give up their own physical culture, which was a symbol of their freedom. At the same time, economic difficulties prevented the setting up of sites and the purchase of equipment everywhere, and a general understanding of the importance of school gymnastics as an educational program was not yet established among the majority of the population.

According to the Royal Decree of June 25, 1828, the introduction of three lessons a week for the teaching of gymnastics to boys and youth in all schools of the country began immediately. In the same year, «Lærebog

i gymnastik for almue- og borger-skolerne i Danmark» was published for use in secondary and comprehensive schools, one of whose authors was F. Nachtegall (Hoffmann, 1993; Nachtegall, 1828). Thus, the Danish was the first European government to allow the publication of a school textbook on gymnastics. 4000 copies of the textbook were sent to all Danish schools at the King's expense. Teachers were given the responsibility of conducting gymnastics classes in government schools and the school authorities were given the information about the degree of difficulty of exercises, the standard of gymnastic grounds, the possibilities of swimming lessons and instructions were given to ensure necessary qualifications of teachers. The rules of gymnastics formulated by F. Nachtegall, indicated that a gradual transition from lighter to more complex and from less to more strenuous exercises should always be observed, it was proposed to widely use exercises to develop agility and flexibility, jumping, and acrobatic exercises. Therefore, gymnastics was included in the practice of educating bourgeois youth and peasant youth, who were to acquire the necessary military-applied skills in state institutions – general education and recruiting schools.

In 1934, F. Nachtegall prepared and published «Regulativ for den gymnastiske Undervisning ved de lærde Skoler i Danmark». In particular, paragraph 4 suggests that, if suitable facilities are available, at least two hours a week should be devoted to physical exercise throughout the year. However, it was added that certain exercises should not be performed during winter and hot summer days (Nachtegall, 1834). In 1836, F. Nachtegall inspected the seminaries and found a lack of sports equipment and some incorrect teaching methods, prompting him to organize a summer course for gymnastics teachers in 1837.

In 1838, at the suggestion of F. Nachtegall, an experimental school for girls was established, in which thirty pupils, aged six to fifteen, began to study three lessons a week. The success of this experiment made it possible to create a regular gymnastics school for women. In the summer of 1839, gymnastics classes with girls were opened in Royal Navy schools, and many other schools in Copenhagen took similar action (Leonard, 1918; Trangbaek, 1996b).

In 1842, F. Nachtegall handed over the leadership of the Military Gymnastics Institute to Niels Georg La Cour, but remained the director of gymnastics in Denmark until his death. After the death of F. Nachtegall, the development of physical education in Denmark slowed down. Unfortunately, La Cour could not effectively continue the work of F. Nachtegall, starting in 1859, the military began to be mainly involved in the teaching of gymnastics, who sought only to achieve the correctness of the exercises, so students began to perceive gymnastics as a means of punishment. According to Leonard (1918), his harshness and tactlessness during inspections caused a feeling of irritation and indignation among the school authorities.

After the defeat of the Danes in the 1864 war with Prussia and Austria, measures were again taken to revive general interest in national physical education. In shooting clubs, young men in military service had the opportunity to learn how to handle weapons and do gymnastics. Initially, exercise was done outdoors and with little or no equipment, but in 1871 the first dedicated gymnasium was built in Riesling (Fyn). By 1897, there were about 300 such buildings and 10,000 young people were engaged in gymnastics. Traditional classes were supplemented with exercises from Swedish and German gymnastic systems, exercises on horizontal bars and parallel bars, rings and trapeziums were introduced, and teacher training was reorganized (Eichberg, 1995; Hoffmann, 1993). As for women's gymnastics, the work of F. Nachtegall was continued by Professor A. G. Drachman, who believed that exercises for girls should be aesthetic and different from exercises for boys, and P. Petersenf, who did not adhere to any naturalistic principles for exercises, except for their external forms (Leonard, 1918).

As part of the revival of physical culture in Europe, this study demonstrates that the gymnastic movement in Denmark was not an isolated phenomenon. The main ideas of physical education were developed in Europe in the 19th century by teachers of different countries, and each of them, with their contribution to the field of education, influenced the views and activities of others, contributing to mutual enrichment and development.

These results go beyond previous reports and show that Nachtegall's activities have had an impact on democratic education, specifically in the areas of physical culture within the learning process, the creation of school curricula, and the establishment of guidelines and standards for PE. The gymnastics institutes designed by Nachtegall became the first centers in the world for the training of professionals in PE, and gymnastics became one of the elements of the rationalization of the lifestyle and the strengthening the place of PE in society.

Conclusions

Our results shed new light on the state-political, socio-economic, and cultural-historical prerequisites for the introduction of physical education in the Danish education system during the study period. The theoretical and practical experience of F. Nachtegall is generalized and systematized, the main stages of his activities on the introduction of physical education into practice, their content and results are analyzed, and their humanistic orientation is proved. Expressing the national aspiration for unity and independence of the Danes, F. Nachtegall, as a supporter of the idea of harmonic development of personality, including mental, physical, and moral education, considered gymnastics an integral part of education, was convinced of the necessity of rational combination and searching for integrative forms of physical and military-applied exercises for the education of youth. The practical work of Nachtegall on the introduction of gymnastic exercises in obligatory educational programs promoted the fixation of physical training in the national school program of Denmark, became the impulse for the institutionalization of physical education and had a significant influence on the development of school physical training in many countries. While progress has been gradual, it has not been inconsiderable. A legal basis was created that established physical education as a school subject and gymnastic institutions were founded. Furthermore, it was Nachtegall who initiated the methodological and normative provision of school physical education.

Denmark was the first European country to introduce physical education as an indispensable part of the school studies and to train teachers in this subject, offering systematic training in gymnastics theory and methodology.

The results of the study can be used in the educational process of higher educational institutions that provide training, retraining, and professional development of specialists in physical education. Further research will focus on the historical record of the progression of school physical education in the 20th century in Europe and the world.

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STUDENT ATTITUDES 2015–2023 TOWARDS THE USE OF MODERN TECHNOLOGY TO MEASURE THEIR OWN PHYSICAL ACTIVITY

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Abstract Physical activity is one of the important pillars helping to maintain well-being and health. The aim of the article was to try to identify the directions of changes in students' attitudes towards physical activity between 2015 and 2023, including the aspect of monitoring movement and exercise using modern technologies. The article presents research conducted on a group of 180 students of physical education and tourism and recreation. The declared physical activity of the students was analysed, along with the need to monitor movement using electronic devices. A shortened version of the International Physical Activity Questionnaire (IPAQ) was used as the research tool. The questionnaire was modified by adding questions on monitoring physical activity. Analysis of the results shows that the declared physical activity has changed over the analysed time period. In 2015, an average of 74.5% of the students in the studied faculties declared their activity as high, while in 2023, 38.5% of the students did so. In 2015, an average of 25.5% of the students surveyed declared their physical activity, while in 2023, an average activity was declared by 20% of the students surveyed. Low activity was declared by 1% in 2015 and by an average of 41.5% of students in 2023. There was no determinant effect of the gender of the surveyed students on the level of physical activity. An increase in the number of students using modern technology to monitor their own physical activity was found over the analysed time period.

Key words: physical activity, IPAQ, modern technology, sports students, tourism and leisure students

Introduction

Physical activity is an activity that should accompany a person throughout life. Movement and activity also have their place in situations of illness, e.g. as one element of rehabilitation. It helps to maintain and even improve health. An important aspect of physical activity is also its relation to the education of children, adolescents and, more broadly, society as a whole by accompanying it throughout its life with a hedonistic effect on humans (Nowak et al., 2019).

In recent years, there have been significant changes in the way people live. We are witnessing changing social and economic patterns around the world (Boon et al., 2010). In terms of physical activity, sedentary lifestyles have become dominant and this is a worldwide phenomenon (Knuth, et al., 2010). These changes are due, among other things, to the development of technology. The pandemic has significantly affected many aspects of life, including lifestyle and physical activity habits. In view of the negative trends also observed in the health status of students, it seems necessary to pay attention to their lifestyle, including physical activity levels. Research on physical activity undertaken by students was conducted, among others, at Lviv University in Ukraine. There, it was found that better

results in terms of physical activity undertaking were observed in male students than in female students (Bergier et al., 2017). Other authors found that male and female students with higher levels of physical activity declared higher levels of quality of life (Pavlova et al., 2017). On the other hand, a Turkish researcher found that students studying physical education at T.C. Hitit University declared a higher quality of life, taking into account, among other things, the physical sphere, than students of other majors studying at this university (Çiçek, 2018). Further research in this regard therefore seems justified (Gruzieva et al., 2018).

Research on physical activity takes on particular importance after the long period associated with the pandemic, which introduced various restrictions including mobility and social isolation. Young people, who have always been one of the most active groups in society, have been negatively affected by the social isolation associated with the pandemic. Children and young people are spending more and more time in front of computer screens, mobile phones without leaving home in their free time (Ridley, 2018). This behaviour leads to a reduction in physical activity and thus has a negative impact on health. This trend has affected all active people including students.

There are now many ways to monitor physical activity. For this reason, children and young people are increasingly turning to modern technology to help them measure their own physical activity. One of the most popular is the use of mobile apps to track workout results, calories burned during exercise and other physical activity-related parameters. Apps installed on phones allow people to monitor their progress and communicate with other app users, which can help keep them motivated to be active. Their popularity is due to the fact that smartphones are very common among young people. Another way to monitor physical activity is by using dedicated devices such as smartwatches or fitness bands (Nadobnik, 2018). These devices can function independently and can also be used to monitor sleep quality. In recent years, interest in healthy lifestyles and physical activity has increased (Villas-Boas, 2019). This phenomenon has been particularly evident among young people, who have become increasingly aware of the benefits of regular exercise and taking care of their bodies and, therefore, their well-being (Núñez-Rocha, et al., 2020). In this context, the post-pandemic studies, which have certainly left a strong mark on social behaviour, may seem interesting.

Purpose of the research

The aim of the research conducted was to attempt to determine the attitudes of University of Szczecin students of physical education and tourism and recreation towards physical activity over the period 2015–2023. An interesting aspect of the research was to determine the influence of the type of major and gender on the level of activity and the respondents' willingness to use electronic devices to monitor their own physical activity.

A hypothesis was formulated, pandemic time adversely affected students' physical activity levels. It was considered that physical education students would be more likely to undertake physical activity than tourism and recreation students. The time of the pandemic forced students, among other things, to study remotely, so modern technologies became essential for functioning in the spheres of learning, culture, socialising, etc. For this reason, students regardless of their field of study will also be interested in technological opportunities after the pandemic, including those for monitoring physical activity.

Material and Methods

Several instruments are available to measure physical activity, including different versions of self-report questionnaires, direct observation, telemetry heart rate measurement, motion sensors and others (Montoye, et al.,

1996). Unfortunately, each of these methods has its limitations (Welk, 2002). There is currently no ideal or best solution (Terwee, et al., 2010). Recently, motion sensors for measuring physical activity have been strongly gaining popularity (Freedson & Miller, 2000), mainly due to their measurement accuracy, relatively low price and small size.

The International Physical Activity Questionnaire (IPAQ) was developed in 1998 to standardise and develop a global standard for measuring human physical activity (Craig, et al., 2003). Since then, the IPAQ has become the most widely used physical activity questionnaire (van Poppel MNM, at.al., 2010), with two versions: The 31-item form (IPAQ-LF) and the 9-item short form (IPAQ-SF). The short form records activity of four levels of intensity: 1) high-intensity activity such as aerobics, 2) moderate-intensity activity such as cycling, 3) walking and 4) sitting.

The study used the Polish version of the IPAQ (Biernat et al., 2007, 2008). The questionnaire was supplemented by adding questions on the issue of monitoring physical activity using modern technology. This article presents the results of a study conducted in 2015 and in 2023 on a group of students of physical education and tourism and recreation at the University of Szczecin. In 2015, the study group consisted of 80 students, while in 2023 the study group consisted of 100 students. The limited size of the respondents was due to the relatively small number of students studying these subjects. It was assumed that the need for physical activity of students undertaking the above-mentioned majors may be more related to the choice of profession and interests of the future job, in which physical activity will play a dominant role. The information obtained was statistically analysed using Excel 2010 spreadsheet and STATISTICA 12.

Results

Self-assessment of physical activity refers to how an individual assesses their own level of physical activity. It is a subjective assessment made by the individual based on their own experiences and observations. The IPAQ scale divides physical activity into three categories, depending on duration and intensity (Biernat, 2007): low-intensity activities, such as walking, which last at least 10 minutes per day; moderate-intensity activities, such as brisk walking, cycling, dancing, fitness, which last at least 10 minutes per day; and high-intensity activities, such as running, jumping, aerobics, which last at least 10 minutes per day.

A total of 180 people participated in the surveys. The first survey took place in 2015, while the second survey took place in 2023. Basic information on the students surveyed is presented in Table 1.

Table 1. Basic information on surveyed students - descriptive statistics

Year of research	N	M	Me	σ	SKE	K	Min	Max
2015	80	23.92	22	5.68	2.92	11.49	18	55
2023	100	21.97	21	3.42	2.83	10.39	18	40

Legend: N – number of subjects, M – mean , Me – median, σ – standard deviation, SKE – skewness, K – kurtosis, Min – minimum, Max – maximum

Source: own study.

The average age of the students surveyed in 2015 was 23.92 years, while in 2023 the average age was 21.97 years. The median age of the students surveyed in 2015 was 22 years, while in 2023 the median age was 21 years. The standard deviation of the students' ages in 2015 was 5.68 and in 2023 the standard deviation was 3.42, indicating greater age variability for the 2015 group than for the latter group (2023). The calculated SKE and K

indicate a larger number of younger students in 2023 compared to the students surveyed in 2015. Basic information related to the gender breakdown of the study subjects is presented in Table 2.

Table 2. Table of N numbers by gender of the surveyed students of physical education (PE) and tourism and recreation (TR)

	Year of research			Year of research	
Gender and field of study	2015	2023	Gender and field of study	2015	2023
F P.E.	15	25	F T.R.	24	23
M P.E.	27	38	M T.R.	14	14

Legend: F P.E. – female P.E. students, M P.E. – male P.E. students, F T.R. – female TR students, M T.R. – male TR students, K – female, M – male

Source: own elaboration.

The 2015 study group consisted of 39 females and 41 males, while in 2023, 48 females and 52 males participated in the study. The distribution of numbers (N) of the different age groups of students surveyed is shown in Table 3.

Table 3. Numbers of students surveyed in 2015 and in 2023

Year of survey	2015		2023	
Age of respondents (years)	N	Percentage of respondents [%]	N	Percentage of respondents [%]
x ≤ 20	15	18.75	34	34.00
20 < x ≤ 25	49	61.25	58	58.00
25 < x ≤ 30	8	10.00	5	5.00
30 < x ≤ 35	4	5.00	1	1.00
x > 35	4	5.00	2	2.00
	K-S d = 0.257, p < 0.01; Lilliefors p < 0.01; Shapiro-Wilk W = 0.702, p = 0.000		K-S d = 0.241, p < 0.01; Lilliefors p < 0.01; Shapiro-Wilk W = 0.720, p = 0.000	

Source: own elaboration.

The research found that the largest group was students aged 20–25. In 2015, this age group comprised 61.25% (N = 49) while in 2023, 58% (N = 58) of respondents were in this age group. The second group in terms of numbers were students under the age of 20. In 2015, they accounted for 18.75% of the respondents (N = 15), while in 2023, the group of students under 20 years of age accounted for 34% (N = 34). The age distributions of the students surveyed do not follow a near normal distribution (2015 Shapiro-Wilk W = 0.702, p = 0.000; 2023 Shapiro-Wilk W = 0.720, p = 0.000).

Basic information on the declared physical activity of physical education and tourism and recreation students is presented in Figure 1.

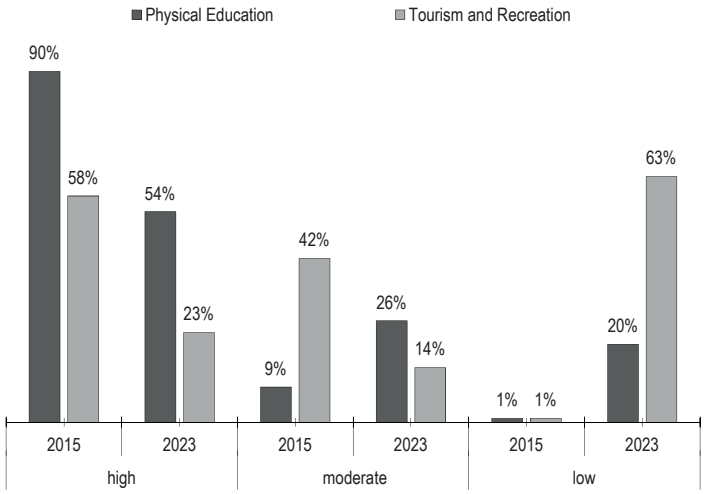

Figure 1. Students [%] declaring physical activity levels in 2015 and in 2023.
Source: own elaboration.

In the 2015, an average of 73.5% of the students in the studied subjects declared their physical activity at a high intensity level, while in 2023, 38.5% of students indicated such activity. In the 2015, medium physical activity was declared on average by 25.5% of the students surveyed, while in 2023, medium activity was declared by 20% of the students. Low activity in 2015 was declared by 1% and in 2023 by an average of 41.5% of respondents. The detailed data obtained shows a high rate of change. In 2015, 90% of the surveyed physical education students declared high activity, while the value of this activity decreased to 54% in 2023. A decrease in the number of students declaring high physical activity was also recorded for tourism and recreation students – here a change was observed from 58% to 23% of respondents. A change was also noted in the case of students describing their activity as low. In 2015, 1% of both physical education and tourism and recreation students described their physical activity as low. However, in 2023, analysis of the survey information indicated that 20% of physical education students and 63% of tourism and recreation students described their physical activity as low.

For those declaring moderate physical activity, the number of physical education students increased from 9% in 2015 to 26% in 2023. For tourism and recreation students declaring a moderate level of physical activity, it decreased from 42% in 2015 to 14% in 2023.

Analysis of the study variables was performed using the Independence χ^2 Test for p-value with an assumed $p < 0.05$. The results of these analyses are presented in Table 4.

Table 4. Independence χ^2 test for variables: field of study, gender, year of study, level of declared physical activity, use of physical activity monitoring devices.

Year of research	P.E. course of study	Variables tested	The result of independence χ^2 test
2015	Women Men	Gender and level of physical activity	The result is not significant at $p < 0.05$
2023	Women Men	Gender and level of physical activity	The result is not significant at $p < 0.05$
Year of research	T.R. course of study	Variables tested	The result of independence χ^2 test
2015	Women Men	Gender and level of physical activity	The result is not significant at $p < 0.05$
2023	Women Men	Gender and level of physical activity	The result is not significant at $p < 0.05$
Year of research	P.E. course of study	Variables tested	The result of independence χ^2 test
2015	Women Men	Gender and the use of physical activity monitoring devices	The result is not significant at $p < 0.05$
2023	Women Men	Gender and the use of physical activity monitoring devices	The result is not significant at $p < 0.05$
Year of research	T.R. course of study	Variables tested	The result of independence χ^2 test
2015	Women Men	Gender and the use of physical activity monitoring devices	The result is not significant at $p < 0.05$
2023	Women Men	Gender and the use of physical activity monitoring devices	The result is not significant at $p < 0.05$
Year of research	Course of study	Variables tested	The result of independence χ^2 test
2015	P.E. T.R.	Course of study and physical activity levels	**The result is significant at $p < 0.05$**
2023	P.E. T.R.	Course of study and physical activity levels	**The result is significant at $p < 0.05$**

Source: own elaboration.

The Independence χ^2 test showed that the gender of the physical education students did not determine the respondents' declaration of physical activity levels in both 2015 (p-value = 0.500) and 2023 (p-value = 0.381). A similar lack of gender determination when declaring physical activity levels was observed for tourism and recreation students in both 2015 (p-value = 0.984) and 2023 (p-value = 0.249). For physical education students, gender did not determine the use of self-monitoring devices for physical activity in both 2015 (p-value = 0.340) and 2023 (p-value = 0.758). A lack of gender determination for activity monitoring was also observed for tourism and recreation students in 2015 (p-value = 0.723) and in 2023 (p-value = 0.443). The Independence χ^2 test showed the determination of the field of study on the declared level of physical activity in both 2015 (p-value < 0.000) and 2023 (p-value < 0.000).

Discussion

The study has shown that over the last few years, there have been significant changes in students' attitudes towards physical activity, recreation, and active leisure time. Students of Physical Education and Tourism and Recreation, due to the specificity of their chosen educational profile, should be characterised by high physical activity, while due to their young age – also openness to new technologies, especially electronic and IT technologies (Nadobnik & Eider, 2015). The study conducted showed that most participants had positive attitudes towards

physical activity. However, many of them stated that they did not have enough time for regular physical activity due to their workload, studies and other responsibilities. The literature suggests that the use of modern technology is associated with more positive attitudes towards physical activity (Mynarski et al., 2013). Nowadays, young people spend more and more time in front of screens, which often leads to a lack of movement and low physical activity. Fear of failure or criticism - some young people fear failure or criticism from others - can lead to a reluctance to try new forms of activity.

The research conducted indicates that among the students surveyed who declared their activity level to be low, interest in monitoring their activity was as high as that of more active students. The analyses of the results showed that the use of modern technology to monitor their own physical activity by students in the study fields analysed increased on average from 16 per cent in comparison with 2015 to 100 per cent in 2023. In 2015, 22 per cent of the surveyed Physical Education students used modern technologies to monitor their own physical activity, while at the same time 10 per cent of the surveyed tourism and recreation students used electronic devices. In 2023, 100% of the students in the surveyed majors declared using technology during their physical activity.

The pandemic resulted in the closure of schools, sports clubs and fitness centres, which affected young people's access to places where they could play sport. Due to the closure of schools, young people have been forced to study remotely, which has involved long periods of time spent in front of a computer or smartphone screen. This, among other things, has resulted in a decrease in physical activity for young people and an increase in time spent sitting. The analysis of the data obtained also showed a change in the declared level of physical activity among the students of the studied faculties. This change consisted largely of a significant decrease in the number declaring a high level of physical activity. An increase in the number of modern technology users using physical activity monitoring devices was found. This increase was also observed among those declaring their own physical activity at a low level.

The pandemic and the associated restrictions have reminded people of the importance of looking after their health and fitness. Many people are beginning to realise that physical activity doesn't have to be about working out in a gym or doing a strenuous workout. There are many other ways to keep fit, such as jogging, yoga, swimming or dancing (Ridley, 2018). It is worth remembering that regular physical activity is important for maintaining physical and mental health, so it is worth making it a regular part of your lifestyle (Richard et al., 2021).

Changes in students' attitudes towards physical activity before and after the pandemic are still under investigation, but trends in young people's appreciation of the importance of physical activity for physical and mental health and general well-being, among other things, have already been described (Kotarska et al., 2021). The time between the studies coincided with a period associated with pandemic restrictions, which is likely to have had a direct and strong impact on young people's physical activity.

The advantages of physical activity monitoring are numerous. They allow you to determine your progress in your sport and achieve your goals. In this way, you can effectively adapt your training and diet to your needs, which can lead to better results. Monitoring physical activity can help reduce the risk of injury, as you can avoid overloading your body and plan for adequate recovery, and can help maintain motivation and prevent energy dips during training.

Monitoring physical activity is just one of many ways to look after health and fitness. Adequate nutrition, regular check-ups and rest and recovery are equally important. All these elements together form a holistic approach to health and ensure a long and healthy life (Salahuddin, 2012). Excessive use of modern technology, especially

video games and social media, can lead to a sedentary lifestyle and reduced time spent on physical activity. This can lead to health problems such as obesity, heart disease and diabetes. It is important that young people learn to use modern technology in a healthy and moderate way, while encouraging physical activity. This can be done through the use of fitness apps that motivate regular workouts while also setting a limit on the amount of time they can use electronic devices. It is also worth encouraging young people to engage in outdoor physical activity, such as cycling, running or playing football, in order to avoid a sedentary lifestyle and enrich their lives with movement and physical activity. The results of the study suggest that pandemic time may have an impact on the reduction of physical activity in the study group of students, with an increased interest in monitoring physical activity.

Monitoring your own physical activity can have many benefits for your health and fitness. It can have a positive impact on maintaining motivation, adapting training and diet to one's needs and reducing the risk of injury. With a variety of ways to monitor physical activity, everyone can find the best way to control their training (Nadobnik, 2019). The results of the study indicate significant changes over the last few years in students' attitudes towards spending time actively and changes towards the use of modern technology to measure their own physical activity. Those declaring themselves to be inactive were also keen to monitor their progress regarding activity and movement.

Conclusions

1. The number of students declaring low levels of physical activity increased.
2. Statistically significant differences were found between the field of study and declared physical activity.
3. There was no significant effect of gender on the declared level of physical activity.
4. The number of students using technological devices to monitor their own physical activity increased.
5. There was no significant effect of gender and field of study on willingness to use devices to monitor physical activity levels.

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DESIGN AND VALIDATION OF A TOOL TO COLLECT STUDENT-ATHLETES' PERCEPTION OF THEIR SATISFACTION

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Abstract The purpose of this study was to design and validate a tool to collect the student-athletes' perception of their satisfaction. The instrument collects information regarding student-athlete characteristics, self-perception, perception of training, perception of team/teammates, perception of the program organization, and perception of the support received. The design and validation, of the questionnaire were done in two phases: a) design and development of the instrument, and b) content validation by experts. The results show that the tool is suitable for obtaining information about student-athletes' perception of their satisfaction. The implementation of the tool involves two phases: a) student-athletes completion of a survey, and b) student-athletes and moderator carry out a group discussion regarding the causes behind their answers, things to maintain, and things that could change or improve. The tool developed and validated could contribute to increase the information of student-athletes about their experience and generate communication channels.

Key words: college, sport, tool, student-athlete, perception

Introduction

Higher education plays a vital role in our society by developing individual's knowledge and critical thinking (Miller, 2003). The inclusion of athletics in this equation can enhance the student-athlete's higher education

experience, allowing them to become well-rounded citizens. The practice of sport enables students to develop their character, motivation, endurance, loyalty, and other skills (Duderstadt, 2000). Intercollegiate athletics is regulated by organizations that establishes the rules, policy of eligibility standards, administrative policy, etc. (Renick, 1974). The largest regulating organization in the United States is the National Collegiate Athletic Association (NCAA). In 1989, the NCAA instituted a Student-Athlete Advisory Committee (SAAC). The role of this committee is to provide student-athlete input regarding the issues that affect the student-athlete welfare (NCAA, 2015). Each NCAA member institution is required to implement this committee. This committee allows for athletic departments and the NCAA to obtain immediate feedback regarding the effects of the regulation. From a broad perspective, the NCAA has developed tools to assess the student-athletes' satisfaction and experiences. The goal of these assessments, done every five years, is to obtain the student-athletes' perspective to evaluate the effect of the regulation and procedures implemented. There are also research tools to assess the student-athletes' perception that try to generalize the findings and help establish the effect of the regulation on the student-athletes and on the athletic programs. To our knowledge, there is not a universal tool that focuses on obtaining the perceptions of the student-athletes from a qualitative and quantitative perspective to improve their experiences in a specific athletic program. Every history has different perspectives and missing the perspective of the student-athletes can affect the proper evaluation of how education and athletics interact in higher education institutions.

At the institutional level, the NCAA administers studies to gauge student-athlete satisfaction and their athletics, academic, and social experiences while in college, as well as their health and well-being. One assesses recent classes of athletes while the other focuses on former players. These studies are called Growth, Opportunities, Aspirations, and Learning of Students in College (GOALS) and the Study of College Outcomes and Recent Experiences (SCORE), respectively. The SCORE assessment has only been conducted once since its existence in 1994. The results were published in 2005–2006. The GOALS study is conducted approximately every five years, administered in 2006, 2010, 2015, and 2020. For the most recent iteration of the GOALS study there were over 22,000 student-athletes' responses (Durham, 2020) The goal of these assessments is to impart information about the general trends regarding college academic experience, college athletics experience, college social experience, recruitment, health and well-being, time commitments, on-campus support, and finances.

At the research level, there are several valid and reliable tools. The Athlete Satisfaction Questionnaire (ASQ), developed by Riemer and Chelladurai (1998), provides a psychometric scale of the facets that affect student-athletes' satisfaction. This tool is based on the authors' theoretical framework and facets (Chelladurai & Riemer, 1997). The following criteria classify a facet: whether it (a) is task- or social-related, (b) is an outcome or a process, and (c) affects the individual or team. This tool differentiates seven categories of facets: individual task outcomes, team task outcomes, individual social outcomes, team social outcomes, individual task processes, team task processes, team social processes, and individual social processes. Examples of other tools available are the "Satisfaction Scale for Athlete" (SSA) (Caliskan & Baydar, 2016), the Adaptation of the "Athlete Satisfaction Questionnaire" (Smith, 2010), the "Student Athletes' Motivation toward Sports and Academics Questionnaire" (SAMSAQ) (Gatson-Gayles, 2005), and "Student-Athlete Experiences Inventory" (SAEI) and "Student-Athlete Gains Inventory" (SAGI) (Cox et al., 2004). All these research tools intend to collect valid and reliable information that generalizes the athletes' perceptions.

The approach of the available tools is focused on analyzing general trends or doing research. This paper describes the process of developing a tool that allows specific athletic departments to collect information regarding

their student-athletes' perceptions. The goal of the tool is to elicit their perception as critical starting points that prompt a positive analysis and discussion panel about student-athlete experiences. Student-athletes are key members of a college athletics program. Their perspective of the student-athlete experience is unique. It is crucial to collect data about their experience that provides athletic administrators with actionable data. Currently, within college athletics, the main metrics that are used to measure student-athlete progress are winning/losing percentages, graduation rates, team Grade Point Average (GPA), or Academic Progress Rate (APR) scores. These quantitative metrics do not provide insight into the day-to-day experience of the athletes. The tool intends to combine data from a survey and discussion panel as a starting point to gauge student-athletes' experience at their respective college or university. These combinations of quantitative and qualitative data have the intention to uncover a more in-depth understanding of the athletes' responses. The implication of athletes in the process will augment their involvement and provide perspectives and solutions closer to their realities. The use of this data would allow athletic programs to make necessary improvements to the athletic department's regulations to enhance the student-athlete experience. This study aimed to design and validate a tool to collect the student-athlete's perceptions and satisfaction.

Material and Methods

The design and validation of the questionnaire were done in two stages: a) design and development of the instrument, and b) content validation (Trochim & Donnelly, 2007). The design and development of the instrument involved the use of specific literature about student-athlete satisfaction. Reviews in the following databases were done: ISI Web of Knowledge, Medline, SPORTDiscus, Google Scholar, and EBSCO. The key word searches included: "student-athlete", "satisfaction", "perception", and "evaluation". A review of abstracts was done to select the papers related to the instrument topic. Questionnaires found in the literature (Caliskan & Baydar, 2016; Cox et al., 2004; Chelladurai & Riemer, 1997; Gatson-Gayles, 2005; Smith, 2010), specific literature (Chelladurai & Riemer, 1997; Gatson-Gayles, 2005), and literature about creating an original instrument (Hague et al., 2004; Thomas, 2004) were used as guides. In the process of designing the first draft of the survey, the researchers, two student-athletes, and two college coaches participated in the process of selecting the questions, adapting or wording the questions, and clarifying them.

The structure of the tool followed the facets of athlete satisfaction established by Chelladurai & Riemer (1997). The facets differentiate between outcomes and process: self, coaches, team, administration and family/community. Questions were grouped into: student-athletes' characteristics (four questions), student-athlete's self-perception (eight questions), training-perception (fifteen questions), team/teammates-perception (fourteen questions), administration perception (seven questions), and support perception (three questions). For the questions related to socio-demographics of the athletes, open and closed-ended questions were used. For the questions related to student-athlete's self-perception about the facets, the Likert scale (0–10) was used.

In the second stage, the instrument was sent to four experts in fields related to coaching, sociology, and sport management; to 14 college students-athletes of individual and collective sports; and four college coaches of individual and collective sports. They were asked to evaluate qualitative (open questions) and quantitative questions (scale 1–10) from the survey regarding: clarity of the survey's questions; adequacy of the survey's questions; and the necessity to include/exclude questions. The cohorts' suggestions were considered, and appropriate alterations were made. A descriptive analysis of their responses (i.e. mean, median, and mode) was also recorded. Following the framework of Bulger and Housner (2007), questions with values lower than 7.0 were eliminated, questions with

values between 7.1 and 8.0 were modified, and questions with values greater than 8.1 were accepted or accepted with modifications. With the reported values from the quantitative evaluations done by the experts, the Aiken's (V) was calculated (Penfield & Giacobbi, 2004).

Result

The draft of the survey had 56 questions after the first stage. The questions were divided into six groups about student-athletes characteristics and facets of satisfaction. The experts' and student-athletes' observations were related to the options of the questions, vocabulary used, the need to clarify the terminology or questions, etc.

Table 1. Evaluation by expert judges, student-athletes, and sport coaches (second stage).

VARIABLES	AIKEN'S V		VARIABLES	AIKEN'S V	
	definition	pertinence		definition	pertinence
Sociodemographic questions			**Self-perception questions about team/teammates**		
Sport	1.00	1.00	Team task achievement	0.96	1.00
Athletic year	1.00	1.00	Goals achieved	1.00	1.00
Scholarship	1.00	1.00	Team growth	0.89	0.95
Residence hall	1.00	1.00	Solidarity and integration	0.91	0.98
Self-perception questions about satisfaction			Principles of right and wrong	1.00	1.00
Performance	1.00	1.00	Effort teammates	1.00	1.00
Goals	1.00	0.98	Contribution team	1.00	1.00
Personal development	1.00	1.00	Friendships	1.00	1.00
Personal growth	0.89	0.95	Belonging	0.98	0.95
Effort	0.91	0.98	Support each other	0.99	1.00
Contribution	1.00	1.00	Recognition received	0.90	0.95
Structure	0.90	0.95	Support received	0.91	0.95
Self-perception questions about coaches & trainers			Level of loyalty	1.00	1.00
Use your abilities	1.00	1.00	**Self-perception questions about administration**		
Level of engagement	0.99	1.00	Facilities	0.89	0.95
Communication and information	0.90	0.95	Budget	0.89	0.95
Structure and process	0.98	0.95	Support received trainers	0.90	0.95
Recruiting and selection process	0.99	1.00	Housing facilities	0.91	0.95
Use of available athletic talent	0.90	0.95	Financial support/scholarship	1.00	0.98
Usefulness of practice	1.00	1.00	Level of loyalty	0.98	0.95
Tactic	1.00	0.95	Academic support	0.91	0.95
Equitable treatment	0.89	0.98	**Self-perception questions about support & recognition**		
Principles of right and wrong	0.83	0.92	Community support	1.00	1.00
Participation in decision-making	0.87	0.95	Family/friends (non-team)	1.00	1.00
Recognition	1.00	1.00	Media coverage	1.00	1.00
Support received	0.99	1.00			
Level of loyalty (individual)	1.00	1.00			
Level of loyalty (team)	1.00	1.00			

At this stage, all questions from the draft of the survey had an average score >7.0. The Aiken's V was pertinent (>0.81 for the lowest value). Some of the questions' terminology and style were changed after reviewing the experts' evaluation of the draft of the survey. After the first review of the experts and student-athletes, the second draft was reviewed following the same procedures. All the questions from the reviewed draft of the survey had an average score >7.0. The Aiken's V was pertinent (>0.81 for the lowest value) (Table 1). The survey had 49 questions after the revision process.

Discussion

This paper describes the process done to design and validate a tool to assess student-athlete satisfaction. The whole process of the design was influenced by the idea of developing a tool that allows bringing the voices of student-athletes to their programs. The first step of the process involved a review of the literature and a review of similar questionnaires (Trochim & Donnelly, 2007). The second step was content validation; and between these two steps a testable iteration of the survey was created. This tool could be used as first step in a group or panel discussion about the student-athlete's perception. The questionnaire could help student-athletes organize their thoughts as a starting point of the process.

Researches developed the pre-draft of the survey. The final draft was completed through internal reviews and meetings with athletes and coaches. Students in an exercise science program helped in the establishment of the process of application of the survey and group discussion (panel discussion). After this process, the experts' review contributed to increasing the clarity, understanding, and proper vocabulary and structure of the survey. In this phase, the experts' evaluation helped to establish the pertinence of the sections and questions of the survey (Bulger & Housner, 2007; Escurra, 1989; Padilla et al., 2007; Zhu et al., 1998). The levels of content validity found are higher than the proposed minimum (Penfield & Giacobbi, 2004).

Most of the tools available that collect athlete's satisfaction are research tools or are focused on specific aspects of athlete satisfaction. The tool developed has the intention to help coaches and administrators to improve athlete's environment and satisfaction at a specific college or university. The goal was to create a tool that can be manipulated, altered, or adapted to the needs of an individual athletic program. The process of collecting data combines qualitative and quantitative data through the implementation of two phases: 1) The student's athletes fill-out the Likert-scale questions of one of the blocks (or the whole survey), and 2) A moderator generates a discussion between the athletes (e.g., panel group) regarding the causes behind their answers, things to maintain, and things that could change or improve related to one or several aspects of the facets. After finishing the second phase, the process is repeated with the rest of the tool's parts (if necessary). Each part involves a different number of questions. The approximate time of implementation of the tool will depend on the level of discussion generated by athletes. As a reference, each block could involve around 15–30 minutes. The tool can be adapted to include the questions and parts in which the program is interested in getting information. The tool can be implemented with a representative group of athletes or with the whole group.

The moderator's role is critical in creating the proper flow and tracking the observations provided for the athletes during the discussion. At the end of the discussion, the moderator summarizes the information shared with the group to make sure he/she collected the ideas/comments appropriately and if some clarification is needed. Our experience showed us how this approach could help student-athletes to share information about aspects that affect their life but might not be perceived as a problem. For example, regarding housing (administration facet),

the discussion allowed student-athletes to express their opinions about the meal plans and aspects related to this topic: the lack of variability of the food options after living on campus for several years, the problem of acquiring fresh fruit and vegetables for campus residents, information about how to eat appropriately for training or to prepare for competition and recovery with the options available on campus, manage residence problems, or balance academics and athletics. The implementation of this tool could be an alternative approach for athletic administrators to obtain the perspectives of their student-athletes. It has the purpose to retrieve a more in-depth scope of the athlete's opinions, intending to make them feel more included during the process. Student-athletes' experiences are influenced by multi-disciplinary factors, making them part of a large dynamics complex system. Gathering their insight could ascertain better information regarding the life of a student-athlete.

This tool could be useful to obtain information about student-athletes' satisfaction perception. The tool has a structure that allows for the flexibility of it being divided into questions, several parts, or as a whole survey, which lends to it being a practical tool that could be adapted depending on the goals and needs of an athletic department. The tool is intended to be the first step of the process of knowing the opinions about the student-athletes' experiences. The following steps of the process will be established after collecting the information. The combination of information from questionnaires and group discussions could help to establish student-athletes' experiences, their needs, and possible strategies to improve their experience. This combination will allow student-athletes to increase their involvement in the running of an athletic department and help them to feel heard. The implementation of the tools could be carried out for the Student-Athlete Advisory Committee, the athletic department, coaches, etc. Future studies are needed about reference values and normative profiles for different sports, genders, and divisions to interpret appropriately the quantitative data provided by the survey.

Conclusions

The tool created for this project is suitable for collecting athletes' perceptions regarding their satisfaction with their teammates, team, and athletic department. By involving student-athletes, coaches, and administrators to enhance the student-athlete experience. The adaptability of the tool and the combination of different approaches allow the users of the tool to manipulate it according to their context and needs. The tool has some limitations. The authors only assessed the content validity of the instrument (expert evaluation). The proper implementation of the group discussion depends on the experience of the moderator. The implementation of this tool requires a learning curve to the context, program, needs, etc. This tool could allow coaches and administrators to include in their source of information the voice and opinions of the student-athlete experience.

Questionnaire to collect student-athletes' perception of their satisfaction

This questionnaire is part of a process that aims to collect information about your experience as a student-athlete. This is the first of the process. After filling out the survey, you will participate in a group discussion. Since the questionnaire is anonymous, we ask that you respond as sincerely as possible. The survey intent that you think about your experience as a starting point of more in-depth discussion about your experience and how it could be improved. To complete the questionnaire, mark an X under the response that best corresponds to your answer, keeping in mind that there should only be one answer unless otherwise indicated. When necessary, print clearly on the lines provided.

Socio-demographic questions

1. What sport(s) do you currently compete in? _____
2. What is your athletic year? ( ) Freshman ( ) Sophomore ( ) Junior ( ) Senior ( ) 5th year-Senior / Graduate
3. Scholarship ( ) Full ( ) Partial ( ) Non-scholarship ( ) Walk-on
4. Do you in live in the residence hall? ( ) Yes ( ) No

Self-perception questions about satisfaction

	Less satisfied										More satisfied
How satisfied are you with your performance as a student-athlete?	0	1	2	3	4	5	6	7	8	9	10
How satisfied are you with the goals that you have achieved regarding your sport, your education, and your personal development?											
– Sport	0	1	2	3	4	5	6	7	8	9	10
– Education	0	1	2	3	4	5	6	7	8	9	10
– Personal development	0	1	2	3	4	5	6	7	8	9	10
How satisfied are you with your personal involvement being a student-athlete in the athletic program of your university?	0	1	2	3	4	5	6	7	8	9	10
How satisfied are you with your personal growth as an athlete regarding technical and tactical skills, strategies and tactics of the sport, physical capacities, psychological skills, social skills and personal mental growth?											
– Technical and tactical skills	0	1	2	3	4	5	6	7	8	9	10
– Strategies and tactics of the sport	0	1	2	3	4	5	6	7	8	9	10
– Physical capacities	0	1	2	3	4	5	6	7	8	9	10
– Psychological skills	0	1	2	3	4	5	6	7	8	9	10
– Social skills	0	1	2	3	4	5	6	7	8	9	10
– Personal mental growth	0	1	2	3	4	5	6	7	8	9	10
How satisfied are you with the effort you give during practice sessions and in competition?											
– Physical (in-season practices)	0	1	2	3	4	5	6	7	8	9	10
– Physical (in-season games)	0	1	2	3	4	5	6	7	8	9	10
– Physical (out of- season)	0	1	2	3	4	5	6	7	8	9	10
– Mental (in-season practices)	0	1	2	3	4	5	6	7	8	9	10
– Mental (in-season games)	0	1	2	3	4	5	6	7	8	9	10
– Mental (out of-season)	0	1	2	3	4	5	6	7	8	9	10
How satisfied are you with your contribution to your program and team?											
– Program	0	1	2	3	4	5	6	7	8	9	10
– Team	0	1	2	3	4	5	6	7	8	9	10
How satisfied are you with the structure of the athletic program?											
– Structure of athletic program	0	1	2	3	4	5	6	7	8	9	10

Self-perception questions about coaches and trainers

	Less satisfied										More satisfied
How satisfied are you with how your coaches use your abilities as an athlete and the abilities of the rest of their athletes in the program/team?											
– Yourself	0	1	2	3	4	5	6	7	8	9	10
– Teammates	0	1	2	3	4	5	6	7	8	9	10
How satisfied are you about the level of engagement by your coach involving training and practice?											
– Physical training	0	1	2	3	4	5	6	7	8	9	10
– Practice	0	1	2	3	4	5	6	7	8	9	10
How satisfied are you about the communication and information provided by your coach(es)?											
– Communication & information	0	1	2	3	4	5	6	7	8	9	10
How satisfied are you with the structure and process within the team regarding technical and tactical training, physical training, and health aspect/athletic training (physical therapy)?											
– Technical and tactical training	0	1	2	3	4	5	6	7	8	9	10
– Physical training	0	1	2	3	4	5	6	7	8	9	10
– Health aspects / athletic training	0	1	2	3	4	5	6	7	8	9	10
How satisfied are you with the recruiting and/or selecting the players for the team?											
– Recruiting/Selection	0	1	2	3	4	5	6	7	8	9	10
How satisfied are you with the use of the available athletic talent of the team in a coordinated manner to achieve success in athletic competition?											
– Use of athletic talent	0	1	2	3	4	5	6	7	8	9	10
How satisfied are you with the usefulness of practice to achieve success in athletic competition?											
– Usefulness	0	1	2	3	4	5	6	7	8	9	10
How satisfied are you with the tactics adopted by the coaches and processes within the team regarding technical and tactical training, and competition?											
– Technical and tactical training	0	1	2	3	4	5	6	7	8	9	10
– Competition	0	1	2	3	4	5	6	7	8	9	10
How satisfied are you with equitable treatment received for yourself/team members by the coaching staff, athletic trainers, and athletic department?											
– Coaching staff	0	1	2	3	4	5	6	7	8	9	10
– Athletic trainers	0	1	2	3	4	5	6	7	8	9	10
– Athletic department	0	1	2	3	4	5	6	7	8	9	10
Being in accordance with the accepted principles of right and wrong that govern the conduct of a profession (coach)											
– Ethical conduct coach	0	1	2	3	4	5	6	7	8	9	10
How satisfied are you with the level of athlete participation in decision-making in situation contingencies that the coach allows?											
– Participation	0	1	2	3	4	5	6	7	8	9	10
How satisfied are you with the recognition received by coaches, teammates, and others?											
– Coaches											
– Teammates											
– Others	0	1	2	3	4	5	6	7	8	9	10
How satisfied are you with the support received by the athletic department regarding training and competition?											
– Support by athletic department	0	1	2	3	4	5	6	7	8	9	10

	Less satisfied										More satisfied
How satisfied are you with the level of loyalty that the coach(s) demonstrates towards yourself as an individual?											
– Level of loyalty towards yourself	0	1	2	3	4	5	6	7	8	9	10
How satisfied are you with the level of loyalty that the coach demonstrates towards the team?											
– Level of loyalty towards team	0	1	2	3	4	5	6	7	8	9	10

Self-perception questions about team/teammates

	Less satisfied										More satisfied
How satisfied are you with your team performance (team task achievement)?											
– Team performance	0	1	2	3	4	5	6	7	8	9	10
How satisfied are you with the goals achieved by your team regarding sport, education, and personal development?											
– Sport	0	1	2	3	4	5	6	7	8	9	10
– Education	0	1	2	3	4	5	6	7	8	9	10
– Personal development	0	1	2	3	4	5	6	7	8	9	10
How satisfied are you with the team growth in terms of sport aspects regarding technical and tactical skills, strategies and tactics of the sport, physical capacities, psychological skills, social skills and personal mental growth?											
– Technical and tactical skills	0	1	2	3	4	5	6	7	8	9	10
– Strategies and tactics of the sport	0	1	2	3	4	5	6	7	8	9	10
– Physical capacities	0	1	2	3	4	5	6	7	8	9	10
– Psychological skills	0	1	2	3	4	5	6	7	8	9	10
– Social skills	0	1	2	3	4	5	6	7	8	9	10
– Personal mental growth	0	1	2	3	4	5	6	7	8	9	10
How satisfied are you with solidarity and integration of the team members in the program?											
– Solidarity and integration	0	1	2	3	4	5	6	7	8	9	10
Being in accordance with the accepted principles of right and wrong that govern the conduct of a profession (student-athlete)											
– Ethical conduct	0	1	2	3	4	5	6	7	8	9	10
How satisfied are you with the effort put forth by your teammates during practices and competitions?											
– Practices	0	1	2	3	4	5	6	7	8	9	10
– Competitions	0	1	2	3	4	5	6	7	8	9	10
How satisfied are you with the contribution of your team helping towards you as a teammate?											
– Team help	0	1	2	3	4	5	6	7	8	9	10
How satisfied are with your friendships with the rest of the members of the team and program (athletes and coaches)?											
– Teammates	0	1	2	3	4	5	6	7	8	9	10
– Coaches	0	1	2	3	4	5	6	7	8	9	10
How satisfied are you with your level of belonging in the team and program?											
– Teammates	0	1	2	3	4	5	6	7	8	9	10
– Program	0	1	2	3	4	5	6	7	8	9	10
How satisfied are you with how the team members get along as a group as well as providing support to each other?											
– Team cohesion	0	1	2	3	4	5	6	7	8	9	10
– Support to each other	0	1	2	3	4	5	6	7	8	9	10

	Less satisfied										More satisfied
How satisfied are you with the recognition received from your teammates, coach(es), administration and media?											
– Teammates	0	1	2	3	4	5	6	7	8	9	10
– Coach(es)	0	1	2	3	4	5	6	7	8	9	10
– Administration	0	1	2	3	4	5	6	7	8	9	10
– Media	0	1	2	3	4	5	6	7	8	9	10
How satisfied are you with the support received by your teammates?											
– Support by teammates	0	1	2	3	4	5	6	7	8	9	10
How satisfied are you with the level of loyalty that your teammates demonstrate towards you?											
– Level of loyalty	0	1	2	3	4	5	6	7	8	9	10

Self-perception questions about administration

	Less satisfied										More satisfied
How satisfied are you with the facilities and equipment provided to the team?											
– Practice facilities	0	1	2	3	4	5	6	7	8	9	10
– Game facilities	0	1	2	3	4	5	6	7	8	9	10
– Equipment	0	1	2	3	4	5	6	7	8	9	10
– Locker rooms	0	1	2	3	4	5	6	7	8	9	10
How satisfied are you with the total budget allotted to your team regarding the budget for travel (meals, hotels, transportation), equipment, practice/game apparel, strength & conditioning/weight room facilities, film/video?											
– Travel-meals	0	1	2	3	4	5	6	7	8	9	10
– Travel-hotels	0	1	2	3	4	5	6	7	8	9	10
– Travel-transportation	0	1	2	3	4	5	6	7	8	9	10
– Equipment	0	1	2	3	4	5	6	7	8	9	10
– Practice apparel	0	1	2	3	4	5	6	7	8	9	10
– Game apparel	0	1	2	3	4	5	6	7	8	9	10
– Strength & conditioning/weight room facilities	0	1	2	3	4	5	6	7	8	9	10
– Film/video	0	1	2	3	4	5	6	7	8	9	10
How satisfied are you with the support received by your athletic trainers, medical staff, and personal trainers?											
– Athletic trainers	0	1	2	3	4	5	6	7	8	9	10
– Medical staff	0	1	2	3	4	5	6	7	8	9	10
– Strength and conditioning coaches	0	1	2	3	4	5	6	7	8	9	10
– Others (_____)	0	1	2	3	4	5	6	7	8	9	10
How satisfied are you with the housing facilities provided to you as an athlete and your team (housing, study areas, and meal plans)?											
– Housing	0	1	2	3	4	5	6	7	8	9	10
– Study areas	0	1	2	3	4	5	6	7	8	9	10
– Meal plans	0	1	2	3	4	5	6	7	8	9	10
– Others (_____)	0	1	2	3	4	5	6	7	8	9	10
How satisfied are you with the financial support/scholarship opportunities provided by the athletic department/university to the athlete?											
– Financial support/scholarships	0	1	2	3	4	5	6	7	8	9	10
How satisfied are you with the level of loyalty that the athletic department and university demonstrates toward your team?											
– Level of loyalty-athletic department	0	1	2	3	4	5	6	7	8	9	10
– Level of loyalty-university	0	1	2	3	4	5	6	7	8	9	10

	Less satisfied										More satisfied
How satisfied are you with the academic support received by your professors, academic advisers, tutoring help, study tables, and grade reports?											
– Professors	0	1	2	3	4	5	6	7	8	9	10
– Academic advisers	0	1	2	3	4	5	6	7	8	9	10
– Tutoring help	0	1	2	3	4	5	6	7	8	9	10
– Study tables	0	1	2	3	4	5	6	7	8	9	10
– Grade reports	0	1	2	3	4	5	6	7	8	9	10

Self-perception questions about support and recognition

	Less satisfied										More satisfied
How satisfied are you with the community support received for your team and yourself for the involvement in your athletic endeavors?											
– Team	0	1	2	3	4	5	6	7	8	9	10
– Yourself	0	1	2	3	4	5	6	7	8	9	10
	Less satisfied										More satisfied
How satisfied are you with your family/friends (non-teammates) support for the involvement in your athletic endeavor?											
– Family	0	1	2	3	4	5	6	7	8	9	10
– Friends	0	1	2	3	4	5	6	7	8	9	10
How satisfied are you with the media coverage or the support yourself, your team, and your program receives?											
– Yourself	0	1	2	3	4	5	6	7	8	9	10
– Team	0	1	2	3	4	5	6	7	8	9	10
– Program	0	1	2	3	4	5	6	7	8	9	10

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ACUTE EFFECTS OF LONG DISTANCE RUNNING ON PLANTAR FOOT PRESSURE DISTRIBUTION

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Abstract Twenty-six healthy men and women participated in this study in which 14 were long distance runners and remaining were control subjects. Following the initial assessment of foot pressure distribution, the runners were asked to complete the regular training program. Immediately after the run, foot pressure distribution was again assessed using the Zebris FDM-Treadmill. The parameters were analysed and compared with the pre-training data. The same parameters were also assessed for the control group at rest. Paired t-test was used to compare the foot pressure distribution before and after the run. Independent t-test was used to compare the same parameters between runners and control group. No significant changes were observed in runners post run whereas the control group showed significant changes in the foot pressure distribution of right forefoot and backfoot when compared to long distance runners at rest. The findings of the study suggest that the foot pressure distribution is not affected acutely after the long distance running. The future studies could analyse the plantar pressure measurement throughout the training programs to detect the time and nature of the deviations linked to long distance run, which would help in injury prevention.

Key words: runners, backfoot, forefoot, stance, plantar pressure

1. Introduction

In human locomotion, the foot serves as the last link in the kinematic chain. The foot aids in the management of the delicate muscle activity required to maintain balance while standing. Walking requires the foot to perform two roles, a passive role that cushions the impact forces that the human body is exposed to during walking and running, and an active function that transfers the internal forces created by the muscles to the ground in order to accelerate the body during push-off (Rosenbaum & Becker, 1997).

In recent years, health-focused activities as well as competitively oriented events, such as road races with distances ranging from 5 km to the traditional marathon distance of 42.2 km, have become popular. However, it is

unsurprising that, as a result of these changes, the number of running-related and overload injuries has increased (Nagel et al., 2008).

Running for an extended period of time puts a lot of pressure on the lower body, particularly the knees, ankles, and feet (Hong et al., 2012; García-Pérez et al., 2013). Long-distance runners' plantar pressure may be affected by accumulating loads on the foot. Plantar pressure is a biomechanical metric that coaches and players can use to manage or prevent foot injuries such as skin issues and stress fractures (Willems et al., 2012; Bisiaux & Moretto, 2008). As a result, understanding the impact of running on plantar pressure can aid in the prevention of foot ailments such as stress fractures.

Therefore, the aim of this study is to assess the acute effects of long distance running on plantar pressure weight distribution.

2. Material and Methods

26 healthy men and women (14 long distance runners and 12 control group) were involved in this study and were informed about the testing procedures and written informed consent was obtained. Runners were included if they had completed at least half/one full marathon and they were excluded based on any recent history of neurological diseases, surgery, trauma, any neuromuscular or cardiovascular pathology. The control group was selected under the same age group as runners and were excluded if they were involved in any sporting activity.

2.1. Ethics Approval

This study was conducted upon the prior consent of Ethical Committee of Guru Nanak Dev University, Amritsar (752/HG) and it was consistent with the provisions of the Declaration of Helsinki.

2.2. Experimental procedure

2.2.1. Pre run analysis

The runners filled a subjective data form including their name, age, height, weight etc. and they were asked to fill an injury history questionnaire which included questions related to their running history, injuries related to running, their weekly average duration and speed etc (Hespanhol Junior et al., 2012).

The plantar foot weight distribution was assessed using the Zebris-FDM treadmill. The participants stood in their relaxed stance position with double-limb support, their arms relaxed at their sides, and looking straight ahead; they were required to stand still in that position for approximately 30 sec, and they were instructed to take several steps, marching on the spot, prior to setting into a comfortable stance position. The system was calibrated each time with a new participant. Weight distribution of both left and right foot was taken (left forefoot %, backfoot %, and total %; right forefoot %, backfoot %, and total %). The control group under the same age were also recruited and were asked to follow the similar procedure. These results were compared with the pre run data of the runners.

2.2.2. Post run analysis

After the initial assessment of the pre run analysis for runners, the runners were asked to complete their regular training of running for different distances according to their experience. Immediately following the run, foot pressure distribution was again recorded and analysed and compared to the pre run data. The runners were given general cool down stretches by the trained physiotherapist

3. Statistical Analysis

The data was analysed using Statistical Package for Social Sciences (IBM SPSS Statistics version 28.0) software. Results were considered statistically significant if p value was less than 0.05. Independent t-test was used to compare the foot pressure distribution of runners and control group at rest followed by paired t-test used to compare the gait parameters pre and post the run.

4. Results

The anthropometric data of all the participants is shown in table 1 with mean age (39.62), mean height (165.31), mean weight (73.50) and mean BMI (24.281).

Table 1. Summary of anthropometric data of the participants

Characteristics	Mean (N = 26)	SD
Age	39.620	6.1390
Height	165.310	20.0470
Weight	73.500	23.0900
BMI	24.281	2.7287

Table 2 & figure 1 show the comparison of the foot pressure distribution in long distance runners pre and post run. There were no significant changes observed between the left and right foot of the runners before and after the run.

Table 2. Comparison of static foot pressure distribution in runners pre and post run

Parameter	Pre		Post		t value	p value	Cohen's d
	Mean (n = 9)	SD	Mean (n = 9)	SD			
Left forefoot pressure (%)	41.78	11.649	40.33	15.596	0.435	0.675	0.145
Left backfoot pressure (%)	58.22	11.649	61.89	11.591	–1.301	0.230	–0.434
Total (%)	53.78	12.696	50.56	3.167	0.789	0.453	0.263
Right forefoot pressure (%)	45.14	9.512	45.43	12.150	–0.073	0.944	–0.028
Right backfoot pressure (%)	54.86	9.512	54.57	12.150	0.073	0.944	0.028
Total (%)	49.57	3.994	49.14	3.288	0.817	0.817	0.091

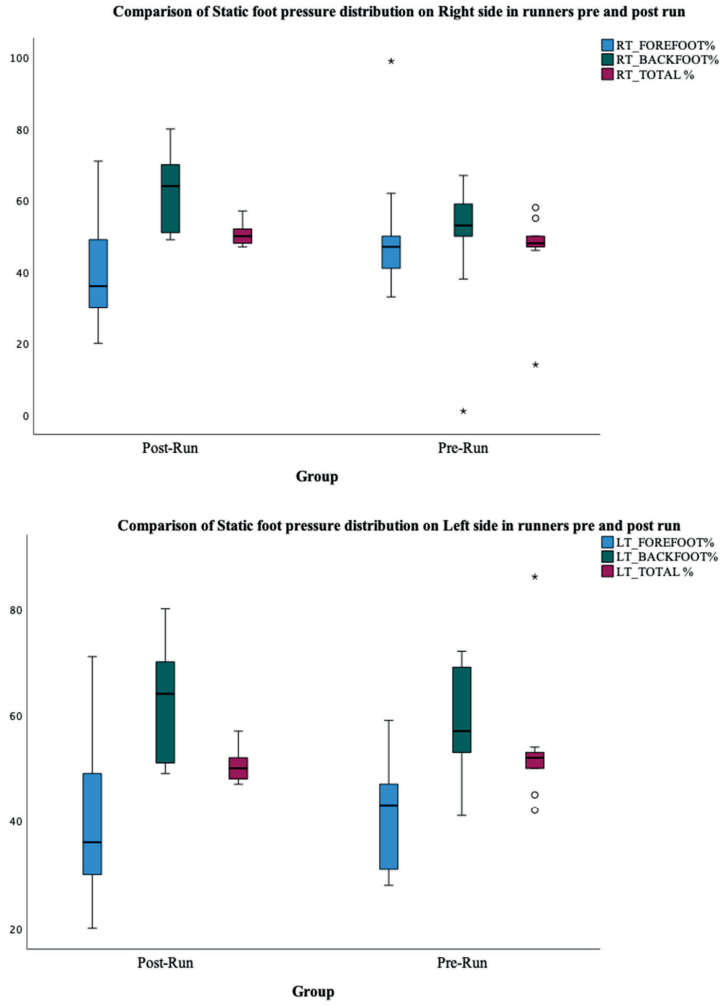

Figure 1. Comparison of Static foot Pressure Distribution in Runners Pre and Post Run

Table 3 & figure 2 show the foot pressure distribution during static stance between the left and right foot of the runners and control group at rest which shows significant difference in right forefoot and backfoot pressure.

Table 3. Comparison of static foot pressure distribution between runners and control group at rest

Parameter	Runners		Control		t value	p value	Cohen's d
	Mean (n = 14)	SD	Mean (n = 12)	SD			
Left forefoot pressure (%)	40.93	11.855	38.42	6.947	0.644	0.526	0.253
Left backfoot pressure (%)	59.07	11.855	61.58	6.947	–0.644	0.526	–0.253

Parameter	Runners		Control		t value	p value	Cohen's d
	Mean (n = 14)	SD	Mean (n = 12)	SD			
Total (%)	52.64	10.360	48.83	6.132	1.115	0.276	0.439
Right forefoot pressure (%)	53.07	16.936	40.45	11.827	2.097	**0.047***	0.845
Right backfoot pressure (%)	46.93	16.936	59.55	11.827	–2.097	**0.047***	–0.845
Total (%)	48.07	10.528	52.09	5.486	–1.146	0.263	–0.462

* statistically significant at $p < 0.05$

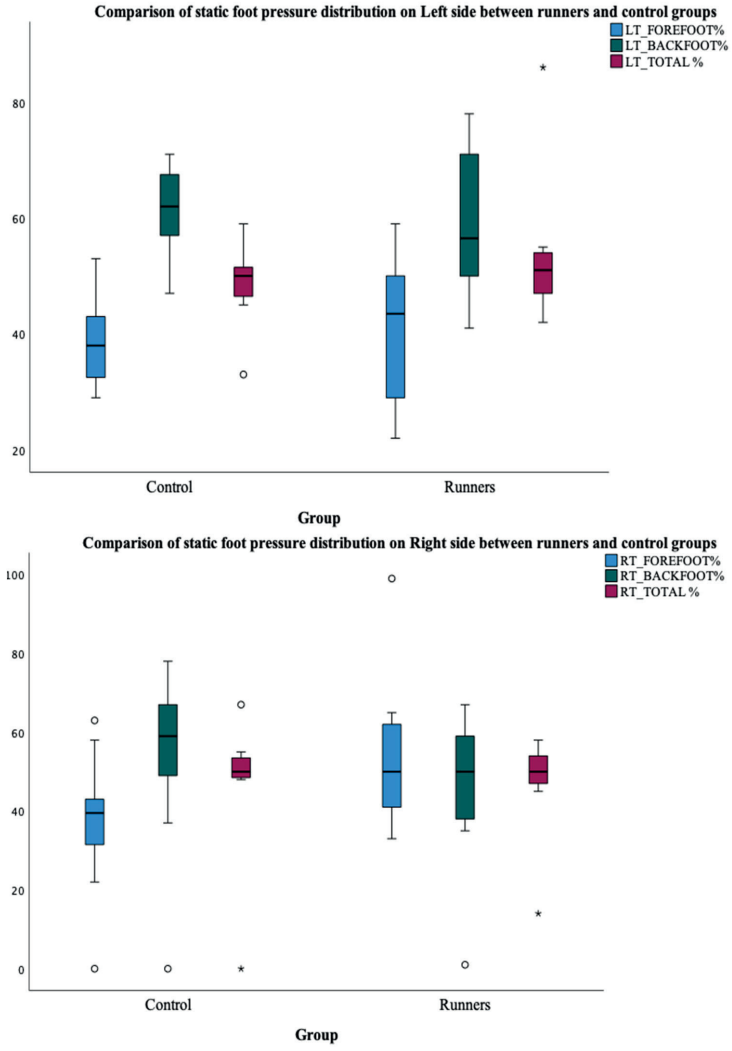

Figure 2. Comparison of Static foot Pressure Distribution between Runners and Control Groups Fig.1 Comparison of Static foot Pressure Distribution in Runners Pre and Post Run

5. Discussion

The purpose of the present study was to assess the acute effects of long distribution on plantar foot pressure weight distribution. In this study, there were no significant changes observed among runners pre and post run whereas on the other hand, comparing the runners with control group, there were significant differences observed in the right forefoot and backfoot pressure.

5.1. Static foot pressure distribution of the long distance runners pre and post training:

There were no significant changes found in the foot pressure distribution pre and post training which is similar to the results found by Rocha et al. (2014), where they concluded that static assessment of plantar pressure are less sensitive after 21 km and more sensitive after 10 km. Thus, as the runners in the current study ran more than 30 km, this could be the reason behind the non-significant change in foot pressure distribution after training.

5.2. Static foot pressure distribution between runners and control group:

In the current study, static foot pressure distribution among the control group was analysed and compared to the runners. According to our knowledge, this is the first study which compared the static foot pressure distribution between long distance runners and non-runners. There were significant changes found in the weight distribution of the right forefoot and backfoot ($p < 0.05$) when comparing the runners with the control group. The reason behind this significant variation can be due to habituation of the runners to strike their foot with the forefoot (forefoot strikers) or rearfoot (rearfoot strikers) and hence tends to bear more weight on that region of the foot. Also, as the BMI increases with age in adults, it leads to less stance stability and less motor response and hence, the variation can be seen in the runners and control group as runners tend to maintain their healthy BMI and therefore have better stability (Salsabili et al., 2011; Ku et al., 2012).

6. Conclusion

The present results show that the long distance running didn't influence the Plantar foot pressure distribution but the control group showed significant changes in foot pressure distribution when compared to runners. This explains that the runners adapt to these characteristics to enhance their running economy and hence, tend to adopt a pattern of striking their foot in a certain manner. The future studies could analyse the plantar pressure measurement throughout the training programs to detect the time and nature of the deviations linked to long distance run, which would help in injury prevention.

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EIGHT-WEEK ZUMBA TRAINING FOR WOMEN IN THE NEW NORMAL PERIOD

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Abstract Zumba shares similarities with other aerobic exercises such as dancing and cycling, as it enhances cardiovascular health and facilitates calorie burning. However, what distinguishes Zumba is its emphasis on enjoyment and the incorporation of dance movements from various music genres. This form of aerobic exercise involves sustained moderate to high-intensity activity without excessive fatigue. It strengthens the heart muscle and promotes efficient blood circulation. Furthermore, aerobics can effectively reduce blood pressure in individuals with hypertension. This positive effect is attributed to the improvement of blood vessel function, facilitating better blood flow and alleviating strain on the heart. Regular aerobic exercise also contributes to weight loss, which further aids in lowering blood pressure. Nevertheless, the impact of Zumba on VO_2max ability remains to be explored. In this study, a pre-experimental design was employed, involving one-hour Zumba sessions conducted over eight weeks, comprising approximately 12 tracks prepared by the instructor. The study sample consisted of 30 participants engaged in Zumba classes. Prior to Zumba, the Jackson non-exercise test formula was employed to assess VO_2max fitness. Post-Zumba, the 1-mile jog test formula was utilized to measure VO_2max fitness. The study findings indicate a significant increase in the mean VO_2max value after treatment, compared to the lower mean value observed before treatment. Specifically, the mean value of VO_2max increased from 38.46 ml/kg/minute before treatment to 47.83 ml/kg/minute after treatment. These results suggest that

Zumba exercise enhances aerobic fitness by positively impacting cardiovascular biological mechanisms in young women during the transition to the new normal period.

Key words: Zumba training, aerobic fitness, young adult women, COVID-19, the new normal period

Introduction

Sport plays a crucial role during the COVID-19 pandemic by helping to prevent mental disorders caused by quarantine, isolation, and physical distancing measures. Engaging in physical activities at home can enhance the immune and cardiovascular systems (Ahmadi Hekmatikar & Molanouri Shamsi, 2020). Furthermore, light exercises are generally safe and carry a low risk of injury. Zumba and high-impact aerobic activities are particularly popular among teenagers and adult women (Kusnanik et al., 2020), with Zumba being one of the favored sports in Singaraja City. Exercise activities have been recognized as a top priority for maintaining health during the pandemic. Notably, Zumba is recommended in various references due to its enjoyable nature and the physical and mental health benefits it provides (Domene et al., 2016). To ensure cardiovascular, metabolic, and musculoskeletal fitness, it is advisable to engage in Zumba dancing, audio-visual-directed gymnastics, and aerobic exercise training (Hammami et al., 2022).

The COVID-19 pandemic has significant and wide-ranging effects on humans and society, although many of the effects are still not fully understood. Consequently, people have to adapt their daily routines, and there has been a growing interest in understanding how COVID-19 affects the body's physiological systems (Alves et al., 2021). The virus responsible for COVID-19, known as SARS-CoV-2, belongs to the beta coronavirus group and shares similarities with SARS-CoV and MERS-CoV, but it is not identical to them (Wang et al., 2020). The virus has the potential to cause damage to multiple organs in the body. It primarily targets the lungs, entering respiratory cells and causing damage to lung tissue. This damage impairs the lungs' ability to oxygenate the blood, resulting in breathing difficulties or shortness of breath. Consequently, the respiratory system is the most affected by COVID-19, and patients face various complications once infected with SARS-CoV-2. The virus can also impact other organs, such as the heart. It may lead to inflammation of the heart muscle or heart failure. In severe cases, insufficient oxygen supply to the heart can even cause it to stop functioning properly. Additionally, COVID-19 can have a significant impact on the brain, potentially leading to severe brain infections. Inflammation caused by blood clots can result in neurological symptoms. Musculoskeletal symptoms, including joint and muscle pain, as well as fatigue, have also been reported in COVID-19 patients. Despite lacking a history of kidney disease, individuals with COVID-19 have exhibited signs of kidney damage. Moreover, the disease can affect the digestive system, with reported cases of diarrhea and infections in the lower digestive tract. COVID-19 has shown its ability to affect multiple physiological systems within the body, with the lungs, heart, brain, musculoskeletal system, kidneys, and digestive system all being susceptible to damage and complications.

Zumba is highly popular among communities in Indonesia, even during the COVID-19 pandemic. People are willing to invest money in this form of exercise. A study showed that Zumba is a suitable physical activity for women to improve their cardiovascular fitness without experiencing excessive strain on the heart (Delextrat et al., 2016). Zumba Tumbling, an aerobic exercise inspired by American dance movements used in physical therapy exercises, is particularly favored (Barranco-Ruiz & Villa-González, 2020). In a study where women engaged in Zumba workouts twice a week for eight weeks, it was found that their cardiovascular endurance increased by 21%

compared to the control group. Additionally, another study reported that women who followed a Zumba exercise regimen for 12 to 40 weeks, with 2 or 3 sessions per week, experienced a significant improvement in maximal oxygen utilization (VO_2max) relative to body mass, ranging from 4.7% to 6.9% (Delextrat et al., 2016).

The Zumba class is designed to provide a workout that incorporates a range of intensities, from low to high. This exercise format, known as a dance fitness party, not only aims to burn calories in an enjoyable manner but also offers mental health benefits. The Zumba movement draws inspiration from energetic exercise styles, which contribute to its impact on physical fitness. Despite its simplicity in terms of steps, it has a significant effect on overall physical fitness. By engaging in Zumba, individuals can activate their entire body through hip movements alone. Physical activity and exercise are essential for enhancing social functioning and daily productivity. The World Health Organization (WHO) recommends engaging in physical exercise at least three times per week, with each session lasting 60 minutes. The exercise should be of medium to high intensity, with a focus on aerobic activities. Moderate-intensity exercise is also a crucial component of cardiovascular training.

The fitness level of young women in the Zumba Kanaya club is currently at the low level. When Zumba was performed for a duration of 1 hour over eight weeks, it resulted in only a slight increase in VO_2max for inactive women with limited or no prior experience with Zumba exercises (Domene et al., 2016). Various factors can influence VO_2max levels, including gender, age, genetics, altitude, exercise, and nutrition (Indrayana & Yuliawan, 2019). The main focus of this study is to enhance cardiovascular capacity through Zumba and ultimately reduce mortality by promoting lifestyle changes.

Zumba is widely recognized as an effective form of aerobic exercise, as it involves moderate to high intensity movements performed for an extended duration without significant fatigue. However, the extent to which Zumba can improve VO_2max, a measure of aerobic endurance, is still unknown. While several studies have demonstrated the positive impact of Zumba on overall fitness when adhering to aerobic exercise principles, there remains a scarcity of research investigating its specific influence on VO_2max in young women. Thus, to expand knowledge in this field, the objective of this study was to evaluate the long-term effects of a Zumba physical activity program on the outdoor fitness of young women during the transition from the COVID-19 pandemic to the “new normal.” This research aimed to explore the cognitive benefits of Zumba as a positive avenue for enhancing academic performance, especially considering the mandatory periods of rest imposed on adolescents due to the COVID-19 restrictions (Latino et al., 2021).

Material and Method

This study employed a pre-experimental design and was conducted between May 2020 and July 2020, during the “new normal” situation. In this context, the fitness community in Kanaya engaged in their regular activities while implementing health protocols to prevent the transmission of COVID-19. The selection of respondents was based on age, height, weight, and body mass index. The respondent group consisted of individuals with prior experience in Zumba exercise and who were physically active. The Zumba sessions lasted for one hour and included approximately 12 tracks prepared by the instructor. Before commencing the study, an initial test was conducted to determine the initial fitness level of the sample. The population and sample of this study comprised 30 individuals who participated in Zumba at the Kanaya Club in Indonesia’s Bali Singaraja. The research spanned eight weeks, with three sessions held each week. The measurement of VO_2max fitness was carried out before the Zumba exercise using the Jackson non-exercise test formula, and after the Zumba exercise using the 1-mile jog

test formula. After the 60-minute Zumba session, the subjects jogged for one mile. All subjects were required to provide informed consent as evidence of their willingness to participate in the Zumba program, as recommended by the researcher.

Results

Data presented in Table 1 provides a distribution of pulse rates based on research conducted by the Kanaya Zumba Club. Statistical analysis revealed that the average pulse rate before engaging in Zumba exercise was 78.20 beats per minute. After completing the Zumba workout, the average pulse rate was measured and found to be 140.09 beats per minute.

Table 1. Characteristics of Subjects

	Value Range	Average
Age	20–22	21
height (cm)	157–174	159.20
weight (Pound)	30.15–45.89	33.40
IMT (kg/m2)	28.57–44.93	30.32

The age range observed in the study was 20–22 years, with an average age of 21 years. Body height ranged from 157–174 cm, with an average height of 159.20 cm. The participants' body weight varied from 30.15–45.89 pound, with an average weight of 33.40 pound. IMT ranged from 28.57–44.93 kg, and the average IMT was 30.32 kg. Significant correlations were found between changes in physical fitness and various anthropometric and psychological parameters over the eight-week intervention (Delextrat et al., 2016).

As Table 2 shows, the mean VO_2max value was initially lower, but after the treatment, there was a significant increase in the mean VO_2max value. Comparing the mean VO_2max values before treatment (38.46 ml/kg/minute) and after treatment (47.83 ml/kg/minute) reveals the positive impact of the intervention. The changes in VO_2max values are presented in Table 2 for further examination.

Table 2. Average value VO_2max

VO2max	Value Range	Average
Before	34.56–46.80	38.46
After	42.64–54.74	47.83

Discussion

Zumba fitness is a popular high-impact workout and is sometimes considered suitable for weight management (Vassilopoulou et al., 2017). Zumba exercises can improve aerobic fitness in natural settings due to the balanced interaction between the body's stress-responsive systems, including the hypothalamic-pituitary-adrenal (HPA) axis, autonomic nervous system, and immune system. An eight-week Zumba fitness program has been found to significantly reduce body fat percentage in young females (Haghjoo et al., 2016). Aerobic high-impact exercises, which include strength training and routine stretching, aim to enhance various aspects of fitness such as flexibility,

muscle strength, and cardiovascular health (Kusnanik et al., 2020). The results of this study demonstrated that a home-based Zumba intervention led to positive changes in maximal aerobic fitness and mental well-being, including improved self-perception of physical strength, muscle development, increased independence, and a sense of purpose in life (Delextrat et al., 2016). When performing Zumba exercises, the activation of the hypothalamic-pituitary-adrenal (HPA) axis and sympathetic nervous system depends on the intensity of the workout. Low-intensity workouts (at 50% of maximum capacity) result in minimal HPA axis activation, while moderate to high-intensity workouts (>70% of maximum capacity) activate both the HPA axis and sympathetic nerves simultaneously. The American College of Sports Medicine (ACSM) suggests that exercise intensity should range from 40–85% of VO_2max or 64–94% of maximum heart rate for optimal cardiovascular benefits (Luettgen et al., 2012).

Zumba workouts have been found to be associated with improved cardiovascular fitness, anthropometric profiles, and body composition in healthy women, making it a highly attractive and popular physical activity among women (Barranco-Ruiz & Villa-González, 2020). Zumba workouts have also been shown to reduce skinfold thickness more effectively than aerobic exercise alone (Suminar et al., 2018). Dance-based exercises, audio-visual-guided gymnastics, and high-impact aerobics are often recommended for maintaining cardiovascular, metabolic, and musculoskeletal fitness, as well as reducing the severity of symptoms of depression and anxiety (Teferi, 2020). A study by Barene et al. (2014) demonstrated that the increase in aerobic fitness in the Zumba group was more significant than that in the soccer group during a 40-week training period. This study recommends engaging in Zumba workouts 2–3 times per week, with an average exercise intensity of 75% of maximum heart rate, and a duration of 60 minutes. These findings support the results of this study, indicating that aerobic exercise brings about various benefits including weight management, improved health, and endurance. Therefore, engaging in regular aerobic exercise not only enhances overall fitness but also helps reduce subcutaneous fat deposits beneath the skin.

Zumba gymnastics can be performed at different intensities, ranging from low to moderate to high. If done for more than 30 minutes, it requires good aerobic endurance. A higher aerobic endurance capacity has a positive impact on the body's metabolism, facilitating the conversion of food into energy required for physical activity. Zumba serves as a beneficial exercise to enhance overall fitness. To achieve maximum aerobic fitness, it is recommended to engage in Zumba workouts for a minimum of 8 weeks. In a recent study, significant increases in VO_2max relative to body mass were observed after eight weeks of Zumba training, with a substantial effect size (Delextrat et al., 2016). Many women are motivated to exercise with the goal of losing body weight, and Zumba is an excellent choice for achieving this objective (Delextrat et al., 2016). Sports practice environments have existed for a long time and have become increasingly vibrant with the development of various types and forms of gymnastics. Zumba workouts are enjoyed by people of all ages, genders, and backgrounds, particularly among young women, making it highly popular (Vassilopoulou et al., 2017). The appeal of Zumba gymnastics lies in the fact that the movements are accompanied by music, bringing joy and excitement. The ease of performing various movements adds to the enjoyment and enthusiasm for Zumba gymnastics.

Zumba utilizes the fundamental principles of aerobic exercise to achieve calorie expenditure, improve the cardiovascular system, and enhance overall body strength. It has been found that Zumba can burn approximately 369 calories, which is around 9.5 kcal per minute (Kusnanik et al., 2020). Engaging in Zumba workouts significantly enhances health-related quality of life factors and improves cardiovascular and metabolic capacities. It has also been demonstrated that Zumba can contribute to reducing body fat in overweight and physically inactive women

(Domene et al., 2016). Similar to other forms of aerobic exercise, Zumba involves dynamic movements that stimulate muscle contractions. A 60-minute aerobic workout can help reduce subcutaneous fat and body mass (Mustedanagić et al., 2016). Additionally, maintaining moderate to high cardiorespiratory fitness has been shown to significantly reduce the risk of COVID-19 mortality, with higher cardiorespiratory fitness providing even greater risk reduction compared to moderate fitness levels, suggesting a dose-response relationship (Christensen et al., 2021). The energetic movements in Zumba also contribute to calorie and fat burning while promoting heart health. It is estimated that Zumba workouts can burn 500–800 calories per session. To ensure the effectiveness of a Zumba training program, it is essential to tailor it according to the appropriate level of exercise intensity. Aerobic exercise has a positive and significant impact on lifestyle, as suggested by this study (Latino et al., 2021).

The present study revealed that Zumba workouts conducted over an eight-week period can enhance cardiovascular fitness and physiological mechanisms related to aerobic endurance in young women during the new normal phase. The results indicated a significant increase in VO_2max, with values of 38.46 ml/kg/minute before the intervention and 47.83 ml/kg/minute after the treatment. These findings underscore the positive impact of Zumba on the fitness and well-being of healthy young women. Further investigations could extend the study duration to explore long-term effects on aerobic fitness. Additionally, future research could consider examining other variables associated with Zumba exercises. It is recommended that instructors or practitioners follow the prescribed Zumba program for eight weeks while carefully considering the recommended intensity levels.

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PRACTICING SPORT IN THE AGE GROUP 21–34 AND THE RISK OF BREAST CANCER – ANALYSIS OF THE RESULTS OF A RETROSPECTIVE STUDY

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Abstract Breast cancer is the most common malignant tumor in women, so it is important to study the factors that can protect against it. One of them is physical activity, which has become the area of our interest, especially the practice of sports by women aged between 21 and 34.

The aim of this retrospective study was to check how practice of sport in the age group of 21–34 in women from the research group diagnosed with breast cancer and in the control group (healthy women from families burdened with this cancer) influences the risk of developing breast cancer.

The study showed that healthy women from families with a burden of breast cancer practiced sports in the age range 21–34 more frequently and intensively than women who had a history of breast cancer. (Sport 1 – highest intensity $P = 0.002$ Sport 2 – medium intensity $P < 0.001$ Sport 3 – the lowest intensity $P < 0.001$).

It can be concluded that practicing sport in the age group of 21–34 is an important factor in the prevention of breast cancer, although the influence of other protective factors in women from the control group cannot be ruled out.

Key words: breast cancer, retrospective study, physical activity, prevention

Introduction

Breast cancer is the most common malignant tumor among women in Poland, accounting for approximately 25% of all malignant tumours (Stec et al., 2021) In 2016, over 18,000 cases and over 6,000 deaths were reported in Poland (Jassem et al., 2019). This disease is also a significant problem in countries with a higher Human Development Index than Poland, for example in the United States in 2023, 297,790 new cases of invasive breast cancer are forecast, with 43,170 deaths. (*Cancer Facts & Figures 2023*, n.d.) This cancer is a problem so significant that a number of actions have been taken to prevent the disease - for example, October is internationally recognized as "Breast Cancer Awareness Month", while in Poland in women aged 50–69, every 24 months The National Health Fund reimburses mammography. One of the goals of this program is to reduce the mortality rate to the level of European Union countries, which shows the scale of the problem and is an important area of clinical interest for Polish researchers.

Over the years of research on breast cancer, many factors predisposing to the occurrence of this cancer have been identified (Kashyap et al., 2022). Some of them, such as sex, age or genetic predisposition, are of course unmodifiable, but many of them are directly influenced by the patient. One of such factors is physical activity, because as early as 1985, Robert Frisch's team noticed that in women who practice competitive sports in college (college athletes), the prevalence of breast cancer, as well as other cancers of the reproductive system, was lower than in women who did not practice sports (Frisch et al., 1985). As physical activity in the form of sports is one of the simplest, financially undemanding and most pleasant factors of cancer prevention for a woman, it has become the subject of research by our scientific team. To this end, we examined how the practice of sports was shaped in women who were patients of the International Hereditary Cancer Center – Department of Genetics and Pathomorphology of the Pomeranian Medical University in Szczecin in the years 2001–2021 during the age range between 21 and 34 years of age. The study compared the activity of 384 women who were diagnosed with cancer with the control group, i.e. healthy women from families burdened with breast cancer who were under the care of the Centre, 226. Thus, a total of 610 women's sports activities were examined, which allows for a statistically and clinically significant analysis.

As other studies have shown, coming from family with breast cancer history is a very important risk factor (Brody & Biesecker, 1998), so we decided to check whether the preventive factor in the control group was practicing sports. In this study, we chose the age range 21–34 because estrogen levels peak in women in the mid to late 20s (Lephart, 2018), and physical activity is a known factor in lowering estrogen levels (Ennour-Idrissi et al., 2015) whose high levels, both in form of early menarche and late menopause as well as hormone replacement therapy is a risk factor (Kashyap et al., 2022).

Materials and Methods

The correspondence survey was conducted for the study group from December 2020 to December 2022, and for the control group from June 2021 to December 2022, after obtaining a positive opinion on the purpose of the research and the method of its implementation, issued by the Bioethics Committee of the Pomeranian Medical Academy in Szczecin/Pomeranian Medical University in Szczecin – Resolution No. BN-001/254/02 of December 9, 2002, resolution No. BN001/254/02-A of June 29, 2020, resolution No. BN-001 /254/02-A of November 16, 2020, resolution No. BN-001/254/02-A of April 26, 2021. The study group consisted of women with an average age

of onset of 52.15 years from the West Pomeranian Voivodeship with histopathologically confirmed breast cancer – identified on the basis of data from the International Center for Hereditary Cancer of the Department of Genetics and Pathomorphology of the Pomeranian Medical University in Szczecin in the period from January 1, 2001 to September 30 2021. The control group consisted of healthy women from families with breast cancer history with an average age of 55.8 years from the West Pomeranian Voivodeship, matched to the study group in terms of place of residence and age range - identified on the basis of data from the International Hereditary Cancer Center of the Department of Genetics and Pathomorphology of the Pomeranian Medical University in Szczecin in the period from January 1, 2001 to September 30, 2021.

Invitation to participate in the study, the purpose of which was given, as well as consent to participate in the study - "Declaration of informed consent of the respondent" along with "Consent to the processing of personal data in a scientific study with an information clause" was sent by post in the first stage of research for the group of the study group and the control group via the Information Security Administrator of the International Hereditary Cancer Center of the Department of Genetics and Pathomorphology of the Pomeranian Medical University in Szczecin to 3,379 women with breast cancer and to 3,379 healthy women from families with breast cancer history. The materials were sent in two stages. By return mail, the Information Security Administrator of the International Hereditary Cancer Center of the Department of Genetics and Pathomorphology of the Pomeranian Medical University in Szczecin received 1516 questionnaires in the study group, of which 888 questionnaires were completed and confirmed in writing "Declarations" and "Consents" to participate in scientific research, and 628 surveys are unfilled and unsigned "Declarations" and "Consents" to participate in scientific research – without giving a reason. 1,861 women did not engage in any correspondence in the research study.

In the control group, the Information Security Administrator of the International Hereditary Cancer Center of the Department of Genetics and Pathomorphology of the Pomeranian Medical University in Szczecin received 473 questionnaires completed and confirmed in writing, "Declarations" and "Consents" for participation in scientific research. 2906 women did not engage in any correspondence in the research study without giving a reason.

The Information Security Administrator of the International Hereditary Cancer Center of the Department of Genetics and Pathomorphology of the Pomeranian Medical University in Szczecin provided personal data with the address of 888 women suffering from breast cancer in the study group and personal data with the address of 473 healthy women from families burdened with breast cancer, which constituted the control group, to the researchers in order to start the second phase of the study.

Questionnaires, together with instructions on how to answer the questions included in the survey, were sent by the researchers to 888 women diagnosed with breast cancer as the study group and 473 healthy women from families with breast cancer as the control group. By return mail, the researchers in the study group received 421 questionnaires, of which 2 questionnaires were not completed and without any information, in 35 cases the questionnaire was not fully completed. 467 women did not initiate any correspondence despite prior written consent to the research. The group of 421 ill women examined was reduced by 37 people questionnaires.

By return mail, the researchers in the control group received 228 questionnaires, of which 2 questionnaires were unfilled and without any information, 245 women did not undertake any correspondence despite their prior written consent to the research. The control group of healthy women was reduced by 2 people-questionnaires.

Finally, the data of 384 patients with breast cancer from the study group and 226 healthy women from families with breast cancer history in the control group were included in the statistical analysis. The course and aggregate

data of the survey process in the first and second stages for the research group and the control group are presented in Table 1 and Table 2.

Table 1. Characteristics of the study group

Number of women	Women with breast cancer identified on the basis of data from the International Hereditary Cancer Center - Department of Genetics and Pathomorphology of the Pomeranian Medical University in Szczecin, in the period from January 1, 2001 to September 30, 2021.
	I stage of research
3379	The Information Security Administrator of the International Hereditary Cancer Center - Department of Genetics and Pathomorphology of the Pomeranian Medical University in Szczecin sent by post, "Declarations" and "Consents"
888	By return mail, the Information Security Administrator of the International Hereditary Cancer Center - Department of Genetics and Pathomorphology of the Pomeranian Medical University in Szczecin received completed and confirmed in writing "Declarations" and "Consents" for participation in scientific research
628	By return mail, the Information Security Administrator of the International Hereditary Cancer Center - Department of Genetics and Pathomorphology of the Pomeranian Medical University in Szczecin received unfilled and unsigned "Declarations" and Consents "for participation in scientific research - without giving a reason
1863	Has not undertaken any correspondence in scientific research
Total: 3379	
	II stage of research
888	Surveys sent by researchers
467	No correspondence was undertaken - despite prior written consent for the study
2	By return, the researchers received blank questionnaires and no information
35	By return mail, the researchers received incomplete questionnaires
384	By return, the researchers received fully completed questionnaires
Total: 888	
384	Total surveys qualified for statistical analysis

Table 2. Characteristics of the control group

Number of women	Healthy women from families with breast cancer identified on the basis of data from the International Hereditary Cancer Center - Department of Genetics and Pathomorphology of the Pomeranian Medical University in Szczecin, in the period from January 1, 2001 to September 30, 2021.
	I stage of research
3379	The Information Security Administrator of the International Hereditary Cancer Center - Department of Genetics and Pathomorphology of the Pomeranian Medical University in Szczecin sent by post, "Declarations" and "Consents"
473	By return mail, the Information Security Administrator of the International Hereditary Cancer Center - Department of Genetics and Pathomorphology of the Pomeranian Medical University in Szczecin received completed and confirmed in writing "Declarations" and "Consents" for participation in scientific research
2906	Has not undertaken any correspondence in scientific research
Total: 3379	
	II stage of research
473	Surveys sent by researchers
245	No correspondence was undertaken - despite prior written consent for the study
2	By return, the researchers received blank questionnaires and no information
226	By return, the researchers received fully completed questionnaires
Total: 473	
226	Total surveys qualified for statistical analysis

Results

a) Study characteristics

The study involved 384 women from the research group diagnosed with breast cancer and 226 healthy control women from families burdened with breast cancer. The study was conducted in the form of questionnaires, the questions of which were formulated on the basis of sources [(Friedenreich et al., 1998), (Kriska et al., 1990), (Bergier et al., 2019), (Ainsworth et al., 1993), (Kośmicki, 1999)].

In the study group, the average age of breast cancer onset was 52.15 years. Among the respondents, 262 are or were married, which is 68.2%, and 121 declared their marital status as single, which is 31.5%. 1 person did not answer this question (0.3%). 206 (53.6%) respondents described their education as secondary, 123 (32%) as higher, and 48 (12.5%) declared primary education. 7 people (1.8%) did not answer. The mean body weight was 71.37 kg with the extreme values being 45 kg and 125 kg, with a median of 70 kg. The shortest woman measured 146 cm, the highest 181 cm, with a median of 162 cm.

In the control group, the mean age of the patient is 55.8. Among the surveyed women, 182 are or were married (80.5%), 41 were not married (18.1%), and 3 did not answer (1.3%). 139 respondents (61.5%) defined their education as higher, 69 as secondary (30.5%), and 17 as primary (7.5%), 1 person did not answer. The lowest weight of a woman was 45 kg, the highest 120 kg, with a median of 68.4 kg. The lowest height was 150 cm and the highest 179 cm, the median was 164.4 cm.

In the surveys, women were given the opportunity to enter three sports practiced by them in the age group of 21–34. For each of these sports, the respondent could assign the intensity of effort on a scale of 1 to 3, and each of these points was described as follows:

- little effort
- moderate exertion causing a slight increase in heart rate and light sweating
- strenuous exertion causing a strong increase in heart rate and heavy sweating

The collected data from women was analyzed and then the sports they practiced were sorted, so that sport no. 1 was always the sport for which the respondent indicated the highest intensity, no.

b) Description of the results

The first step taken by the team was to demonstrate the existence of a statistical relationship between practicing sports by women aged 21–34 and the age of breast cancer in women from the research group. As shown in Table 3, for each of the three sports practiced, a statistically significant relationship was demonstrated, because the "p" coefficient was many times lower than 0.05. The occurrence of this dependence showed that further analyzes made sense.

Table 3. Relationship between the age of breast cancer onset and sports practiced by women aged 21–34

Sport	P = chi square of independence
Sport 1 – highest intensity	P = 0.002
Sport 2 – medium intensity	P < 0.001
Sport 3 – the lowest intensity	P < 0.001

Another activity was to compare the percentage of women practicing sports in the age group 21–34, which is shown in Table 4 . In the research group, only 33.1% of women declared it, while in the control group it was 44.6%,

which gives a difference of 11.5 percentage points. The differences are even greater in the case of the second and third sport, where not only the percentage of women in the control group exceeds that of the study group, but they also gain an advantage in absolute numbers, despite the fact that the study group is 1.7 times larger. And so, in the case of the second sport, almost twice as many women from the control group practice it than women from the research group, and in the case of the third sport, this percentage increases as much as 2.6 times.

Table 4. Practicing sports in the age group 21–34

Sports/Group	research group	control group
All women	384	226
Not practicing sports	66.9% (257)	54.4% (123)
Playing sports	33.1% (127)	44.6% (103)
Doing another sport	13.3% (51)	25.2% (57)
Practicing a third sport	4.9% (19)	12.8% (29)

The next issue investigated by the team was to check how the intensity of the sport practiced by the subjects is distributed. As Table 5 shows, in the case of the highest intensity sport, the number of women declaring them in the case of sport 1 and sport 2 is higher both in percentage and absolute numbers in favor of the control group. In the case of sport 3, only the percentage is higher, although the number of women meeting this criterion is so small that one may have doubts as to the statistical significance of this result. According to Table 6, women from the research group scored 1.5% higher in practicing sport no. 1 with moderate intensity, compared to women from the control group. However, this is most likely due to the fact that in the case of women from the control group, most of them declared the sport of the highest intensity as their most exhausting, while those from the research group declared the sport of medium intensity. This thesis is confirmed by the result for sport no. 2 and 3, where the control group again prevails over the research group, both in percentages and in absolute numbers. Only in the case of sports with the lowest intensity in table 7, women from the research group get a better percentage result in the case of sports 2 and 3, but this is due to the fact that women from the control group declared practicing sports with higher intensity than those from the research group.

Table 5. Practicing sports with the highest intensity in the age group 21–34

Sports/Group	research group	control group
All women	384	226
sports 1	11.2% (43)	24.8% (56)
sports 2	3.6% (14)	8.4% (19)
sports 3	0.8% (3)	1.3% (3)

Table 6. Practicing sport of medium intensity in the age group 21–34

Sports/Group	research group	control group
All women	384	226
sports 1	18.8% (72)	17.3% (39)
sports 2	8.1% (31)	16.4% (37)
sports 3	3.1% (12)	10.6% (24)

Table 7. Practicing sports with the lowest intensity in the 21–34 age group

Sports/Group	research group	control group
All women	384	226
sports 1	3.1% (12)	3.5% (8)
sports 2	1.6% (6)	0.4% (1)
sports 3	1.0% (4)	0.9% (2)

Discussion

As a result of a retrospective survey study, we showed that practicing sports in women aged 21–34 may be associated with avoiding or at least delaying the age of breast cancer development. Women from the control group practiced sports much more often than those from the research group, moreover, while in the control group all women are patients of the International Center for Hereditary Cancer – Department of Genetics and Pathomorphology of the Pomeranian Medical University in Szczecin, they are healthy but from families burdened with breast cancer, in the case of the research group, this burden for the majority of patients has not been established, so it may even more indicate the preventive role of practicing sport in the age group of 21–34. Similar conclusions were drawn in a study (Boraka et al., 2022) showing that a high level of physical activity over 1 hour per day each week correlated with a 23% lower risk of developing breast cancer. This work, however, showed that physical activity as the only factor does not affect the risk of disease in premenopausal women. In the case of our project, however, we focused strictly on practicing sports, not physical activity, which could cause variability of results. In turn, a study (Matthews et al., 2020) showed that meeting the standard of physical activity (7.5–15 MET/h per week) can reduce the risk of getting sick by 6–10%. The result of our study also agrees with the observations of the RE team Frisch (Frisch et al., 1985), who showed that subjects who were involved in organized college sports developed breast and reproductive organ cancers less frequently than their peers who did not display similar activities. On the other hand, a study (Wu et al., 2012) showed that the risk of breast cancer decreases by 2% for each increase of 25 MET-h/week in recreational activity and by 5% for each increase of 2 hours per week for moderate and brisk activities. Thus, it can be assumed that for practicing sport, which by its nature has a higher intensity than recreational activity, these percentages may increase even more. A study that came to similar conclusions was (Guo et al., 2020), which showed that premenopausal women who confirmed at least 58.3 MET hours/week had a 23% reduced risk of developing breast cancer, compared to those with the lowest levels of activity. In contrast, for postmenopausal women, those in the top quartile of physical activity showed a 17% reduced risk compared to women in the lowest quartile. As study (Kruk, 2007) has shown, lifetime total physical activity among women was associated with a reduced breast cancer

risk. It is not contradictory to our results, because healthy women from families burdened with breast cancer were practicing sports more often than females with diagnosed malignancy.

The advantage of our work is the control and research group including over 600 women who are patients of the International Center for Hereditary Cancer – Department of Genetics and Pathomorphology of the Pomeranian Medical University in Szczecin, which takes care of patients from the entire West Pomeranian Voivodeship, covering about 1.7 million inhabitants. The disadvantage is that the assessment of physical activity by patients is subjective, and it is not possible to check whether the declared practice of sports by the patient actually took place. The study is retrospective, the advantage of this is that you can compare how the practice of sport and its intensity in the age range selected by us can be compared. The disadvantage of this type of study is the inability to control the patients' activity in real time, and on this basis calculate the percentage of breast cancer incidence depending on the declared sport activity. It cannot be ruled out that factors other than activity also influenced the incidence of the patients, although the lack of incidence of statistically active women from the control group, despite the fact that they come from families burdened with breast cancer, shows that isolated practicing of sports in the age group 21–34 affects the incidence of cancer.

Conclusions

Practicing sports in 21–34 age range may reduce risk of a breast cancer. We motivate this conclusion because our research has shown that women from the control group, healthy from families burdened with breast cancer, but without a diagnosis of this cancer, statistically more often practiced sports in the age group of 21–34, and their activity was higher than those from the research group with diagnosed cancer.

These findings could be important especially for adolescent women from families with breast cancer prevalence. Practicing sports for them could be an easy way to reduce risk of getting diagnosis of breast cancer, and also prevent most of civilization diseases like diabetes, ischemis heart disease or arterial hypertension.

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ASSESSMENT OF MAXIMUM VELOCITY: A CASE STUDY OF POGOŃ SZCZECIN FOOTBALL PLAYERS IN POLISH EKSTRAKLASA

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Abstract The aim of this study was to assess the maximum velocity achieved by professional soccer players. The study involved 20 professional football players. The analysis of the achieved velocities during the season was based on individual maximum velocity values obtained in a preseason period test using the GPS monitoring device Catapult Vector S7. The study covered 20 match units and 77 training units.

A velocity equal to or greater than 100% of the maximum velocity was achieved 24 times - 21 times (accounting for 88%) during a competitive match (MD 0), 1 time (accounting for 4%) two days before (MD-2), and two times (accounting for 8%) three days before (MD-3). A velocity in the range of 90-99% of the maximum velocity was achieved 207 times.

The results confirm that football players can achieve values equal to or greater than 100% of their maximum velocities; however, this occurrence is rare. Due to the low probability of high maximum velocity values during a training microcycle, it is recommended to incorporate specific training methods that allow for achieving high maximum velocities to reduce the risk of hamstring muscle injuries among players, especially among reserve players (who rarely participate in competitive matches).

Key words: soccer, training load monitoring, GPS, maximum velocity, speed training

Introduction

The study was conducted to gain a better understanding of the topic of individualization of training loads, aimed at improving the athletic performance of soccer players and assisting in reducing the incidence of injuries resulting from mismanagement of training loads.

Speed is one of the most sought-after physical skills in most team and individual sports. It is defined as the highest velocity at which a player can perform a sprint (Williams, 2005). Sprint, a very fast run, is considered the most frequently occurring action leading to goal scoring, performed by either the shooting or assisting player (Faude, 2012). Faude (2012) analyzed 360 video materials that included goal-scoring situations in the German Bundesliga and highlighted the actions preceding each goal. Sprint preceded 161 (45%) of all analyzed goals, out of which 109 were executed without pressure from opponents, and 121 without the ball. The assisting player sprinted in a straight line 137 times (38%), with most sprints being performed with the ball – 93 out of 360 goal-scoring situations.

Sprinting in a straight line is the most frequently performed action by players assisting or scoring goals in direct match situations. The intensity of work performed by professional footballers in top leagues appears to be relatively consistent (Barros, 2007). The distances covered by players at high speeds are usually short and dependent on the tactical setup of the team. The players' positions on the field also directly determine the volume of work they can accomplish. It is worth noting that players in positions with limited space on the field may face challenges in developing high-speed abilities over longer distances, and a specific training approach should be considered to address this (Owen, 2013).

In football, players rarely reach their maximum velocity during a sprint; the initial start and acceleration phases are deemed more critical (Jovanović, 2011). Unlike sprinters who reach their maximum speed between 50 and 70 meters, football players rarely have such open spaces on the field, with distances typically ranging from 30 to 40 meters at most. A high level of overall physical fitness is crucial for players competing at the highest levels, regardless of the league (Arnason, 2004). It has been observed that the most common speed values among footballers are around 32 km/h (Rampinini, 2007). A player's speed capabilities depend on various factors, including their training level and age (Buchheit, 2015). Depending on their position on the field, players achieve different values of their maximum speeds. Maximum values for central midfielders from one team were as low as 85% of their maximum velocity, central defenders 89%, full-backs 90%, wingers 92%, and forwards 93% (Al Haddad, 2015). These results indicate that players only approach their maximum speeds and that the position on the field plays a crucial role in these values. External load measurement in football, which often focuses on fixed speed zones, is widespread (Weston, 2018). However, this approach does not consider individual speed capabilities and predispositions of the player (Lovell, 2009).

Increasingly, research and scientific reports in football suggest interpreting player loads individually and tailoring training loads based on their physical predispositions (Abbott, 2018). Individualized training loads can help better match training and match demands among players, consequently reducing the risk of injury while maintaining high performance during competitions (Hunter, 2014). Since speed zones in football are classified and fixed for individual monitoring devices, conducting tests to determine the player's individual measures is necessary to obtain detailed data regarding their speed capabilities (Scott, 2018).

The aim of the study is to provide answers to the following research questions:

1. Can players achieve values equal to or greater than 100% of their individual maximum velocity?
2. Are velocities equal to or greater than 100% of maximum velocity achieved more frequently by professional footballers during matches compared to training sessions?
3. Which players most frequently achieve values equal to or greater than 100% of their maximum velocity?
4. Does a player's position on the field influence their ability to reach values equal to or greater than 100% of their maximum velocity?

Materials and Methods

The study involved 20 players aged between 19 and 34 years old. The players were divided based on their positions on the field into five groups (forwards – 1 player, wingers – 4 players, central midfielders – 7 players, full-backs – 4 players, central defenders – 4 players). Data from 17 matches in the Polish PKO Ekstraklasa, 1 match in the Fortuna Polish Cup, and 2 matches in the UEFA Europe Conference League were utilized, along with 77 training sessions. These data were used for the percentage analysis of individual maximum speed values achieved by the players. Individual maximum speed values were obtained through speed tests over 100 meters using the CATAPULT VECTOR S7 GPS system, which is used for monitoring training loads. Based on the obtained results – the maximum speed values, an individual analysis of maximum speed values during both training sessions and matches was conducted.

For the study, the GPS monitoring devices Catapult Vector S7 were used, which employ two systems – GPS and GLONASS. The transmitters are placed in a specialized vest on the player's back. The GPS transmitter determines the player's position by measuring the time of signals emitted by satellites. Catapult devices are equipped with inertial sensors that allow for detailed measurements. These sensors include an accelerometer, gyroscope, and magnetometer. The accelerometer identifies specific movements such as jumps and accelerations. The gyroscope is used for measuring rotations around three axes. The magnetometer acts as an electronic compass, providing information about the direction and orientation of individual movements.

Results

The highest speed achieved was 34.88 km/h by player number 3 (Group II – winger), while the lowest speed of 29.84 km/h was recorded by player number 17 (Group V – central defender) (Figure 1).

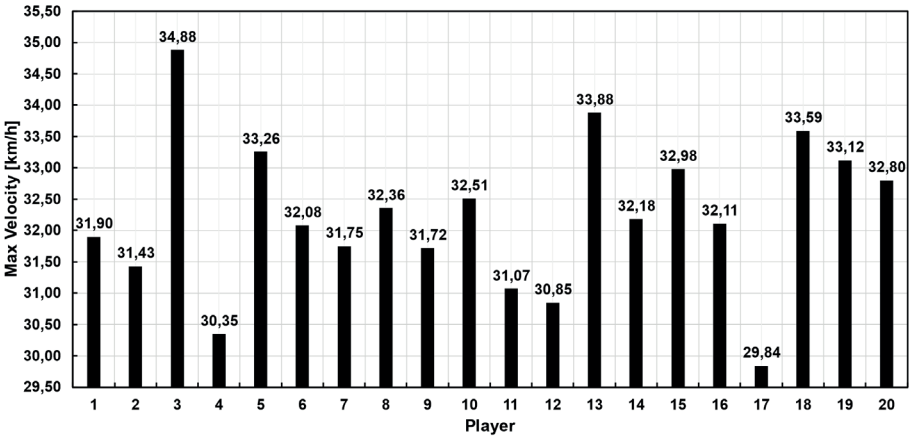

Figure 1. Maximum speed values attained by each player during the study

Figures 2 and 3 present the player groups and the number of occurrences where players achieved specific values of maximum velocity – values equal to or greater than 100% of maximum velocity (Figure 2) and values in the range of 90–99% of maximum velocity (Figure 3).

The group with the highest number of repetitions of maximum velocity equal to or greater than 100% was Group II – the wingers, while Group III – the central midfielders achieved the highest number of repetitions with velocities in the range of 90–99% of maximum velocity.

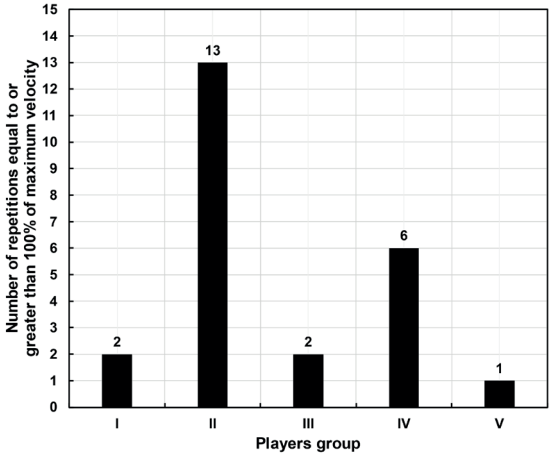

Figure 2. Repetitions equal to or greater than 100% of maximum velocity achieved by each player *group*

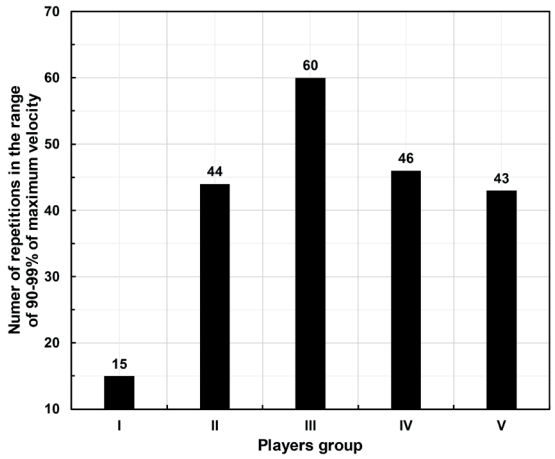

Figure 3. Repetitions in the range of 90–99% of maximum velocity achieved by each player group

Figure 4 illustrates individual days during the microcycle and the number of recorded occurrences of values equal to or greater than 100% of maximum velocity. Values equal to or greater than 100% of maximum velocity were most frequently achieved by the players during competitive matches (21 repetitions). One repetition was recorded two days before the match (MD-2), and two repetitions were recorded three days before the match (MD-3).

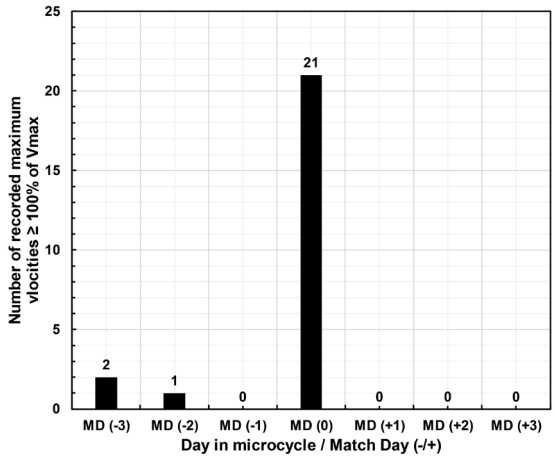

Figure 4. Repetitions equal to or greater than 100% of maximum velocity on each day of the microcycle

The group with the highest number of repetitions of maximum velocity equal to or greater than 100% was Group 2 – the wingers, while Group 3 – the central midfielders achieved 59 repetitions with velocities in the range of 90–99% of maximum velocity.

Table 1. Groups and the number of recorded individual values of maximum velocity

GROUP	90–99% of Maximum Velocity	≥ 100% of Maximum Velocity
I	15	2
II	44	13
III	59	2
IV	46	6
V	43	1
SUM	**207**	**24**

Table 2. *The number of recorded individual maximum speed values in each of the 17 microcycles*

MICROCYCLE	90–99% of Maximum Velocity	≥ 100% of Maximum Velocity
1	19	3
2	16	1
3	12	1
4	12	2
5	13	2
6	11	1
7	14	2
8	12	4
9	9	1
10	11	2
11	10	1
12	14	0
13	14	3
14	13	1
15	14	0
16	5	0
17	8	0
SUM	**207**	**24**

Discussion

The conducted study confirms that football players can achieve values equal to or greater than 100% of their maximum speed, but this occurrence is rare. During 17 league matches, 3 cup matches, and 77 training sessions, maximum speed equal to or greater than 100% of maximum speed was achieved only 24 times, with this event happening 21 times during match sessions and only 3 times during training sessions. Matches involving a live audience may result in higher arousal of the nervous system among players. Fans and the awareness of a competitive match are external factors positively influencing the physical capabilities of the players.

It can be observed that fatigue increases among players due to the frequency of occurrences of maximum speed values during the first and last microcycle (Table 2).

As shown in the study (Djaoui et al., 2017) on a group of professional football players from the French first division, similarities were noticed, indicating that maximum speeds among football players are much more frequently achieved during matches than during training sessions. Similarly, it was observed that wingers achieve their maximum speed values more frequently than players in other positions.

The obtained results from the conducted study indicate a low probability of achieving maximum speeds among the players. Similarly, in a study encompassing two 21-day training microcycles conducted by Gualtieri et al. on a group of 20 professional players competing in the top-tier Italian league (Serie A), it was found that players who regularly start competitive matches from the first minute exhibit significantly higher internal and external loads compared to reserve players, considering both match and training loads (Gualtieri, 2020). The study emphasizes the importance of individualizing speed thresholds for load optimization. These findings are of paramount importance in football due to the continually emerging evidence supporting the use of high-intensity runs as a preventive measure against injury occurrences (Buckthorpe, 2019). The research confirms that football matches are a pivotal component during the microcycle, where players engage in more very high-intensity runs and football-specific activities, which can be challenging to replicate during training sessions (Morgans, 2018). During training units, coaches may struggle to reproduce match-equivalent running conditions, especially high-intensity runs. Individualized speed thresholds (runs exceeding 80% of maximum speed) for players not regularly participating in matches can serve as a crucial preventive tool throughout the season (Gualtieri, 2020).

It should be noted that developing maximum speed in players can serve as a preventive measure, reducing the risk of injury due to the specific work of the hamstring muscles, which are highly active during maximal intensity sprints (Edouard, 2019).

Additionally, players who serve as substitutes for the starting lineup may find themselves in situations where they do not reach their maximum speed for days, weeks, or even months, exposing themselves to the risk of injury if they are required to perform sprints at maximal or submaximal speed during matches.

Based on our own research, it can be concluded that continuous monitoring and control of players are crucial aspects, along with creating conditions during training sessions that enable players to engage in specific exercises aimed at achieving speeds close to maximum.

Conclusions

1. Professional football players can achieve values equal to or greater than 100% of their maximum speed.
2. Velocity equal to or greater than 100% of maximum speed are significantly more frequently achieved by players during competitive matches than during training sessions.
3. Football is a sport in which players rarely reach values equal to or greater than 100% of their maximum speed.
4. Wingers achieve values equal to or greater than 100% of maximum speed most frequently, indicating that the player's position on the field plays an important role.

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