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İÇİNDEKİLER

CHAPTER 1

THE RELATIONSHIP BETWEEN SLEEP QUALITY AND SPORTIVE PERFORMANCE OF ADOLESCENT BASKETBALL PLAYERS IN THE U13-U14 AGE GROUP

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INTRODUCTION

Sleep is defined as a state in which sensory-motor interactions with the environment are temporarily interrupted in an easily reversible manner and is generally associated with inactivity. It is emphasized that sleep is a process that gives the opportunity to recover after physical activities, gain new energy, and also internalize our feelings and impressions (Bathory, & Tomopoulos, 2017). Deterioration of sleep quality can cause negative consequences such as decreased performance ability, affected daily activities, decreased energy level and daytime sleepiness (Çölbay et al. 2007).

Sleep patterns are affected depending on age and developmental process (Shaffer, 1993). While defining adolescence, the American Psychiatric Association has included expressions as a chronological period caused by physical and emotional processes, starting with sexual and psychosocial maturation, and characterized by rapid physical, psychological and emotional development (Edgerton, & Campbell, 1994). Adolescence is roughly the transition period of the individual from childhood to adulthood, and it is natural for the individual to undergo changes in sleep physiology as well as physical, psychological and hormonal changes during this period (Bülbül et al. 2010). The daily need for sleep in adolescence is 8.5-9.3 hours, which is higher than that of children and adults (Cars Kadon et al. 1980). Despite the increased need for sleep, the daily sleep duration may be shortened and many problems may occur with the effect of some factors specific to this period (Chervin et al. 2003). One of these problems is that the low sleep quality of the athletes can negatively affect their performance.

There are many studies examining the relationship between sleep and exercise and it seems that different results are obtained (Brandt et al. 2017; Driver, & Taylor, 2000; Youngstedt et al. 2003; Vuori et al. 1988; Julıff et al. 2018; Uezu et al. 2000; O'Connor, & Youngstedt, 1995; Andrew, & Watson, 2017; Singh et al. 1997). Basketball is a sport that involves changes of direction, high-intensity repetitive accelerations and decelerations, and jumping and landing. It is emphasized that players must have high physical and cognitive capacity (Stojanovic et al. 2018). In basketball, which is a team sport, acceleration-deceleration, direction changes and vertical jumps are performance determinants (Svilar, 2019). High levels of anaerobic power and high anaerobic capacity are required for performance in basketball (Çobanoğlu et al.2012). In order to reveal this power and capacity, it is necessary to provide the right rest and load periods. One of the most important factors in the resting process is sleep. It is thought that the performance of adolescent athletes with poor sleep quality may also be adversely affected. In this respect, it is thought to be important to examine the relationship between sleep, which is the most important phase of rest in adolescent basketball players and sportive performance. Therefore, the aim of the study is to investigate the relationship between sleep quality and sportive performance in U13-U14 age group adolescent basketball players.

METHODS

Participants

Basketball players living in İzmir, participating in the 2023 İzmir DSİ Sports Traditional Victory Cup Tournament and competing in the 13-14 age category participated in the research. The sample size was determined with the G-Power 3.1.9.4 program (Heinrich Heine University Düsseldorf, Germany). It was planned to include 91 participants in the study, based on 95% power with an alpha (error) rate of 5% and a large effect size for repeated measurements. Before the research started, basketball players and their parents signed a voluntary consent form stating that they participated in the research voluntarily.

Procedure

Pittsburgh Sleep Quality Index (PSQI) was applied to the participants at the beginning of the tournament. Buysse et al. 1989 developed PSQI in 1989 (Buysse et al. 1989). The Turkish validity and reliability study of PSQI was conducted by Ağargün et al. 1996. The sensitivity of the index for diagnostic purposes is 89.6%, while its specificity is 86.5% (Ağargün et al. 1996). PSQI is a self-reported screening and evaluation test that provides information about sleep quality deterioration and the type and severity of sleep problems. A reliable distinction can be made between "those with good sleep" and "those with bad sleep". The score of each question is between 0-3. A score of 0-21, which is the sum of 7 component scores, is obtained for the total PSQI score. The high PSQI total score of the participants is a result indicating that their sleep quality is poor. According to this measurement method, if the total PSQI score is ≤5, it is concluded that the participant has good sleep quality, and if >5, it is concluded that the participant has poor sleep quality (Ağargün et al. 1996).

Statistics of all matches attended by basketball players were recorded by the researchers and performance data (number of played game, playing time, points, free throws made, two point made, three point made, total rebounds, offensive rebounds, defensive rebounds, assists, faul) were created.

The height of the participants was measured with an ultrasonic height meter (Langen Messstab 5003, Germany). Body weight and body mass index were determined with a body analysis scale (Tanita BC 401, Japan). The ethical suitability of the study was approved by the decision numbered 2023/25-03 of the Non-Interventional Ethics Committee of Dokuz Eylül University (İzmir / TÜRKİYE).

Statistical Analysis

SPSS 24.0 program (SPSS Inc., Chicago, IL) was used for statistical analyses. Descriptive statistical analyzes were used to determine the mean±standard deviation values of the data [age, physical data (height, body weight, body mass index), PSQI and performance data (number of played game, playing time, points, free throws made, two point made, three point made, total rebounds, offensive rebounds, defensive rebounds, assists, faul)]. The relationships between age, body weight, height, performance data and PSQI results were evaluated with Pearson Correlation analysis. Those with a total PSQI score of ≤5 were classified as Group 1, and those with >5 were classified as Group 2. The relationship between the Independent T-test and performance data was analyzed. The significance level was accepted as $p<0.05$.

RESULTS

Table 1. *Statistical analysis of descriptive and performance data of basketball players.*

N=91	Min Value	Max Value	Mean±SD
Age (y)	13,00	14,00	13,64±0,48
Height (cm)	145,00	196,00	166,80±9,76
Weight (kg)	32,00	80,00	54,87±9,91
BMI	15,10	27,50	19,69±2,72
PSQI	0,00	9,00	3,99±2,02
Number of played game	1,00	5,00	3,77±1,09
Playing time (sec)	18,00	2400,00	1011,33±505,76
Points	0,00	18,80	4,18±4,18
Free throws made	0,00	3,60	0,36±0,56
Two point made	0,00	8,00	1,63±1,70
Three point made	0,00	1,40	0,20±0,32
Total rebounds	0,00	13,80	2,60±2,79
Offensive rebounds	0,00	4,20	0,67±0,94
Defensive rebounds	0,00	10,60	1,91±2,21
Assists	0,00	3,40	0,44±0,60
Faul	0,00	4,00	1,11±0,90

N:*Number of basketball players;* ***Min:*** *Minimum; Max: Maximum;* ***SD:*** *Standart Deviation;* ***y:*** *year;* ***cm****: centimeter;* ***kg:****kilogram;* ***sec:****second;* ***BMI:*** *Body Mass Index;* ***PSQI:*** *Pittsburgh Sleep Quality Index.*

Table 2. *Correlations between variables.*

	Age	H	W	BMI	PSQI	NPG	PT	Points	FTM	TPM	ThPM	TR	OR	DR	Assist	Faul
Age	1	,289**	,106	-,110	-,073	,029	-,060	,129	,109	,062	,290**	,101	,034	,124	,105	,112
H		1	,661**	,033	,035	,058	,325**	,381**	,222*	,391**	,140	,595**	,484**	,561**	,045	,303**
W			1	,765**	,033	-,056	,238*	,144	,188	,135	,043	,433**	,299**	,436**	-,157	,172
BMI				1	,016	-,104	,041	-,130	,022	-,147	-,052	,049	-,023	,077	-,247*	-,036
PSQI					1	,146	,023	,028	-,037	,064	-,089	,048	,067	,037	,009	,036
NPG						1	,390**	,442**	,250*	,416**	,315**	,263*	,415**	,143	,397**	,499**
PT							1	,670**	,399**	,663**	,352**	,608**	,510**	,556**	,371**	,474**
Points								1	,708**	,973**	,491**	,582**	,628**	,473**	,443**	,597**
FTM									1	,656**	,193	,499**	,568**	,384**	,234*	,434**
TPM										1	,301**	,571**	,655**	,452**	,400**	,569**
ThPM											1	,221*	,080	,234*	,380**	,325**
TR												1	,730**	,954**	,372**	,468**
OR													1	,510**	,273**	,508**
DR														1	,343**	,368**
Assist															1	,396**
Faul																1

H: Height; W: Weight; BMI: Body Mass Index; PSQI: Pittsburgh Sleep Quality Index; NPG: Number of played game; PT: Playing time; FTM: Free throws made; TPM: Two point made; ThPM: Three point made; TR: Total rebounds; OR: Offensive rebounds; DR: Defensive rebounds. **. Correlation is significant at the 0.01 level (2-tailed).*. Correlation is significant at the 0.05 level (2-tailed).

H: *Height;* ***W:*** *Weight;* ***BMI:*** *Body Mass Index;* ***PSQI:*** *Pittsburgh Sleep Quality Index;* ***NPG:*** *Number of played game;* ***PT:*** *Playing time;* ***FTM:*** *Free throws made;* ***TPM:*** *Two point made;* ***ThPM:*** *Three point made;* ***TR:*** *Total rebounds;* ***OR:*** *Offensive rebounds;* ***DR:*** *Defensive rebounds.* **. Correlation is significant at the 0.01 level (2-tailed).*. Correlation is significant at the 0.05 level (2-tailed).

Table 3. *Independent T test analysis results of groups according to PSQI results.*

	n1=72; n2=18	Mean±SD	t	p
Two point made	*n1*	1,54±1,70	-,896	,373
	n2	1,94±1,74		
Three point made	*n1*	0,22±0,35	2,498	**,015***
	n2	0,10±0,12		
Total rebounds	*n1*	2,44±2,72	-,797	,428
	n2	3,02±2,96		
Offensive rebounds	*n1*	0,65±0,92	-,495	,622
	n2	0,77±1,05		
Defensive rebounds	*n1*	1,75±2,10	-,906	,367
	n2	2,26±2,35		
Assists	*n1*	0,45±0,65	,312	,756
	n2	0,40±0,40		
Faul	*n1*	1,10±0,91	-,412	,681
	n2	1,19±0,91		

n1: *Number of basketball players with PSQI total score ≤5;* ***n2:*** *Number of basketball players with PSQI total score >5;* ***SD:*** *Standart Deviation.* **p<0.05.**

DISCUSSION AND CONCLUSION

In this study, which aimed to investigate the relationship between sleep quality and sports performance in adolescent basketball players in the U13-U14 age group, the mean age of the participants was determined as 13,64±0,48 years. The means number of matches played by the participants in the tournament was 3,77±1,09, the time they stayed in the match was 1011,33±505,76 seconds, and the total points they received in the matches was 4,18±4,18. PSQI means results, which were applied to determine sleep quality, were found to be 3,99±2,02. Participants' PSQI mean data were below 5 points, indicating good sleep quality (Table 1).

Considered an essential process for athletes, sleep aids recovery after strenuous physical and mental activities (Samuels, 2008; Venter, 2012). It is also emphasized that failure to provide adequate regeneration may lead to loss of performance as it will cause overall stress accumulation in athletes (Jones, & Tenembaum, 2009). Consistent with the literature, this study found that basketball players had good sleep quality (Samuels, 2008; Venter, 2012; Jones, & Tenembaum, 2009). There are also publications associating injuries with the negative effects of sleep deprivation on physical-cognitive performance (Charest, & Grandner, 2020). It is reported that the effects of sleep disturbance on the physical and technical performance of athletes are significant (Simpson et al. 2017). It was stated that this situation is of critical importance, especially in sports where decision-making ability, coordination and aerobic capacity are forefront (Halson, 2013; Kirschen et al. 2020; Singh et al. 2021; Thun et al. 2015; Chennaoui et al. 2015). Reyner & Horne (2013) found that sleep restriction (5-hour restriction) impaired tennis serve skill even if caffeine was consumed before exercise (Reyner, & Horne, 2013). Mah et al. (2011) found in their study with 11 male basketball players that optimum sleep could help reaching peak performance (Mah et al. 2011). It is mentioned in the literature that elite basketball players may not be able to get enough sleep every night due to various factors such as travel, late training, games and use of electronic devices (Ochoa-Lácar et al. 2022). Jones et al. (2019) emphasized in their research with 112 NBA players that social media activity late at night negatively affects performance (Jones et al. 2019). Another study with 13 male weightlifters observed negative mood disturbances following acute (24-hour) sleep loss compared to normal nightly sleep (Blumert et al. 2007). In another study, sleep quality status, assessed using the Pittsburgh sleep quality index (PSQI), was found to be pooper in national-level athletes compared to a non-athlete control group (Bender et al. 2018). In their study to investigate the effect of sports on the amount of nightly sleep, Anderson and Reale (2020) found that sports did not have a significant effect on the amount of nightly sleep in adolescent athletes, who were largely team sports athletes (Anderson, & Reale, 2020). It is emphasized that heavy training loads during the day negatively affect the sleep quality of the same night (Facer-Childs et al. 2021) and this is reflected in the performance the next day (Clemente et al. 2019; Conte et al. 2021; Doeven et al. 2020). Therefore, it has been stated that it is important for coaches to take this into consideration when planning and deciding on training intensities and programs (Ochoa-Lácar et al. 2022).

In this study, no significant correlation was found between PSQI and research variables (Table 2). In this study method, the performance data of basketball players who received ≤5 points according to the PSQI total results were compared with those who received >5 points. Only the free throws made scores of basketball players with good sleep quality during the tournament were significantly higher than those of basketball players without good sleep quality (Table 3). In this study, consistent with the literature (Jones, & Tenembaum, 2009, Halson, 2013; Kirschen et al. 2020; Singh et al. 2021; Thun et al. 2015; Chennaoui et al. 2015), it is thought that poor sleep quality negatively affects free throws made. However, considering that this study was conducted with adolescent basketball players in the 13-14 age group, it is possible that the technical development process may also be effective for free throws made. Unlike the literature (Reyner, & Horne, 2013) there were no significant differences between basketball players with poor sleep quality and basketball players with good sleep quality in performance parameters other than the free throws made. The fact that PSQI results are not correlated with any research variable indicates that sleep has no effect on performance for this study results. Considering the high interest of adolescents in games and social media in today's conditions, this study also suggests that the participants are more disciplined about sleep.

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CHAPTER 2

THE IMPORTANCE AND BENEFITS OF PHYSICAL ACTIVITIES FOR INDIVIDUALS RECEIVING INCLUSIVE EDUCATION

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Abstract

Physical activities are crucial in the holistic development and well-being of individuals receiving inclusive education. Engaging in regular physical activities not only promotes physical health but also contributes to cognitive, social, and emotional development. This paper explores the importance and benefits of physical activities for individuals receiving inclusive education, drawing upon relevant literature to provide an academic perspective. The findings highlight the positive impact of physical activities on various aspects of individuals' lives, including physical fitness, motor skills, social interaction, self-esteem, and overall academic performance. The paper also discusses practical strategies and considerations for promoting and incorporating physical activities in inclusive educational settings.

Inclusive Education

Inclusive education is a concept that has gained significant attention and recognition in education. It refers to a system of education that aims to provide equitable opportunities and access to education for all learners, regardless of their abilities, backgrounds, or characteristics. Inclusive education emphasizes the importance of diversity, acceptance, and equal participation in learning. Inclusive education is an educational approach that addresses the diverse learning needs of all students, including those with disabilities or special needs, within mainstream educational settings. It promotes an inclusive culture and ethos that values and respects every learner's differences and strengths (Schuelka, 2018; Miller et al., 2022).

Several foundational principles support the concept of inclusive education. It underscores the fundamental right to education for all individuals, regardless of their abilities or disabilities, as articulated in international conventions and declarations (UNESCO, 1994). Inclusive education promotes all learners' full and active engagement within mainstream classrooms, acknowledging the advantages of diversity and the significance of social integration (Ainscow, 2005). Additionally, inclusive education promotes individualized support and accommodations to ensure all students can access the curriculum and achieve their full potential (Booth & Ainscow, 2011).

Inclusive classrooms provide opportunities for social interaction and peer learning, which can enhance the social skills and self-esteem of students with and without disabilities. Also, inclusive education fosters a sense of belonging and acceptance among all learners, promoting a positive school climate and reducing the risk of stigmatization (Avramidis & Norwich, 2002). Moreover, inclusive education has been linked to improved academic outcomes, as it provides appropriate support and differentiated instruction tailored to individual student needs (Friend & Bursuck, 2018).

Implementing inclusive education requires collaborative efforts and support from various stakeholders. It involves collaboration among teachers, specialists, support staff, parents, and the community to create inclusive environments, develop individualized support plans, and implement effective instructional strategies (Rieser, 2012; Rose & Doveston, 2015). Collaboration encourages a holistic approach to education and enhances comprehensive support for students with diverse needs. Inclusive education is guided by legal and policy frameworks at both national and international levels. Many countries have enacted legislation and developed policies to promote inclusive education and ensure equal educational opportunities for all learners (Yell & Christle, 2017; Demchenko et al., 2021). International organizations, such as UNESCO, have also provided guidelines and recommendations for implementing inclusive education practices worldwide (UNESCO, 2017).

In conclusion, inclusive education is an educational approach that aims to provide equitable opportunities, access, and support for all learners, regardless of their abilities or disabilities. It is based on inclusivity, individualized support, social integration, and stakeholder collaboration. Inclusive education offers numerous benefits, including enhanced social interaction, improved academic outcomes, and a sense of belonging for all learners. Legal and policy frameworks support the implementation of inclusive education at various levels. By embracing inclusive education, educational systems can create environments that value diversity, promote equal opportunities, and ensure the success of all learners.

Needs and Difficulties of Individuals Receiving Inclusive Education

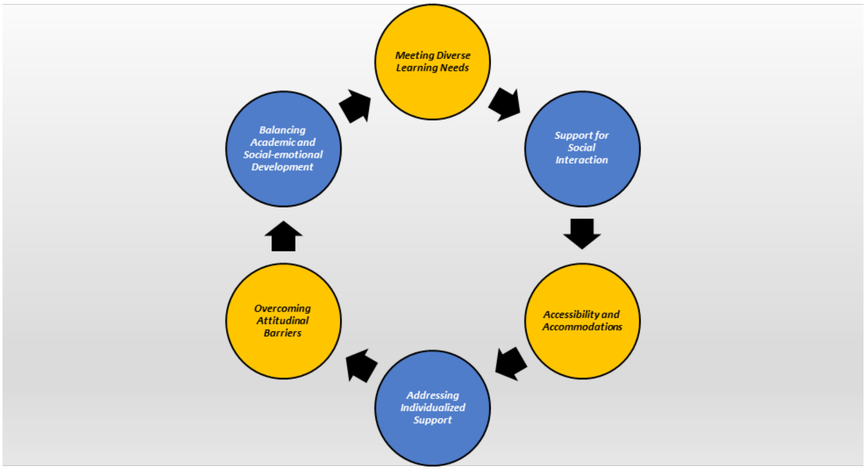
Inclusive education, which aims to provide equal educational opportunities for all learners, including those with disabilities or special needs, has gained significant attention and importance in recent years. While inclusive education promises to encourage social integration, personal growth, and improved academic outcomes, it is crucial to recognize and address the specific needs and difficulties that individuals receiving inclusive education may encounter.

One of the primary needs of individuals in inclusive education is the supply of appropriate instructional strategies and supports tailored to their diverse learning needs. Individualized instruction and differentiated teaching approaches are essential to accommodate varying abilities, learning styles, and preferences (Sousa & Tomlinson, 2011). By recognizing and addressing these diverse learning needs, educators can enhance students' educational experiences and outcomes in inclusive settings. Individuals in inclusive education may face challenges in developing and maintaining social relationships due to differences in communication styles, social skills, or physical abilities. Social interaction difficulties are commonly reported by students with disabilities in inclusive classrooms. Providing social skills training, promoting peer support, and facilitating inclusive activities can help foster positive social interactions and promote a sense of belonging among students (Carter et al., 2008; Strain & Bovey, 2011; Odom et al., 2012).

Accessibility is crucial in ensuring that individuals with disabilities can fully participate in inclusive education. This includes physical accessibility of school buildings and classrooms and the availability of assistive technologies, adapted materials, and accommodations such as sign language interpreters, captioning, or assistive listening devices (WHO, 2011). Adequate accessibility measures are essential to support the inclusion and active participation of individuals with diverse needs. Inclusive education requires a comprehensive approach that addresses the individualized support needs of learners. This may involve specialized interventions, therapies, or additional support services, such as speech and language therapy, occupational therapy, or counselling (Friend & Bursuck, 2018). Collaborative teamwork among educators, specialists, and families is crucial in identifying and implementing effective support strategies tailored to the unique needs of each learner (Murawski, 2009; Turnbull, 1995).

Attitudes and perceptions of educators, peers, and the broader community can significantly impact the experiences of individuals in inclusive education. Negative attitudes, stereotypes, or stigmatization towards individuals with disabilities can create barriers to full participation and hinder the establishment of inclusive environments (Avramidis & Norwich, 2002). Promoting awareness, fostering positive attitudes, and providing disability awareness training can create a more inclusive and accepting educational culture. Individuals in inclusive education may face challenges balancing their academic and social-emotional development. Students with disabilities may experience higher emotional and behavioural difficulties, impacting their overall well-being and engagement in the learning process (Avramidis & Norwich, 2002; Kart & Kart, 2021). Creating supportive and inclusive learning environments that address academic and social-emotional needs is crucial for the holistic development of individuals in inclusive education.

Figure 1. *Needs and Difficulties of Individuals Receiving Inclusive Education*

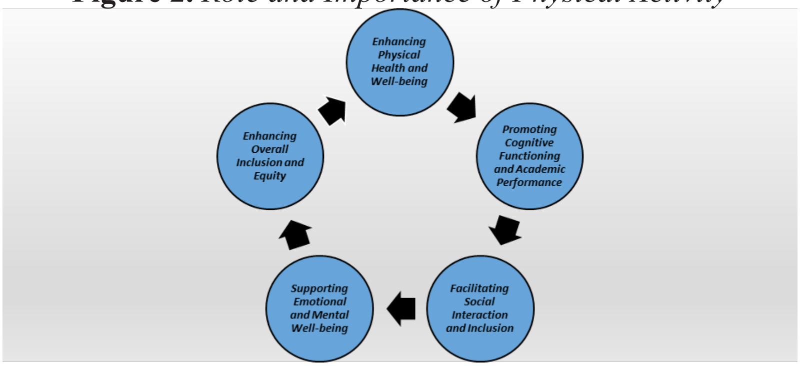


In conclusion, individuals receiving inclusive education have diverse needs and may encounter difficulties requiring targeted support and interventions. Recognizing the importance of individualized instruction, fostering social interactions, ensuring accessibility, providing appropriate accommodations, addressing attitudinal barriers, and balancing academic and social-emotional development are critical for promoting successful, inclusive educational experiences. By addressing these needs and difficulties, educators and stakeholders can work towards creating inclusive environments that empower all learners to thrive and reach their full potential.

Role and Importance of Physical Activity in Successful Inclusive Education Programs

Physical activity is pivotal in successful inclusive education programs, contributing to all learners' overall well-being, social integration, and academic achievement.

Figure 2. *Role and Importance of Physical Activity*



Regular physical activity has consistently improved physical health and well-being among learners in inclusive education programs. Activity promotes cardiovascular fitness, muscular strength, and flexibility while reducing the risk of chronic diseases. It encourages a sense of well-being, boosts self-esteem, and contributes to the overall quality of life for learners of all abilities (Kasser & Lytle, 2013; Hinckson et al., 2013). Physical activity positively influences learners' cognitive functioning and academic performance in inclusive education settings (Donnelly et al., 2016). Regular physical activity improves attention, memory, and information processing, enhancing learning outcomes. It also supports the development of executive functions, such as problem-solving, decision-making, and self-regulation, which are crucial for academic success (Hillman et al., 2019). Also, Physical activity provides valuable opportunities for social interaction, fostering inclusive and supportive relationships among learners with diverse abilities. Participating in shared physical activities promotes teamwork, cooperation, and communication skills. It breaks down barriers, encourages peer support, and creates a sense of belonging and acceptance within the inclusive education community (Watkins et al., 2015; Taheri & Minnes, 2016). Physical activity is closely associated with improved emotional and mental well-being in learners receiving inclusive education (Yager et al., 2021). Physical activity relieves stress, reduces anxiety and depressive symptoms, and enhances mood and self-confidence. It provides an outlet for emotional expression, promotes resilience, and supports the development of positive mental health (Ruotsalainen et al., 2018).

Inclusive education programs strive to ensure equal opportunities for all learners, and incorporating physical activity into the curriculum emerges as a vital catalyst in achieving this overarching goal. By integrating physical activity into the educational framework, educators enable all learners to participate actively, facilitating equal chances for physical development, skill acquisition, and enjoyment. Inclusive education practices that encompass physical activity have been shown to promote fairness and equality. When students of different abilities engage in physical activities together, it enhances their physical well-being, helps dismantle barriers, and dispels preconceived notions about varying capabilities. Collaborative participation in physical activities reinforces the principles of inclusion and equity in the educational setting, promoting a sense of belonging among all students (Block & Obrusnikova, 2007; Kasser & Lytle, 2013; Block & Obrusnikova, 2007 Ainscow, 2020). Inclusive education focusing on physical activity empowers learners to build empathy and understanding towards their peers, fostering an inclusive and supportive learning environment.

Furthermore, inclusive physical activity programs contribute to increased self-esteem and self-confidence among students with diverse abilities, which, in turn, positively impacts their overall academic performance. Incorporation of physical activity within the curriculum is a crucial step towards enhancing overall inclusion and equity in education. It ensures that all learners can actively participate, promotes fairness, breaks down barriers, and fosters a culture of inclusivity and acceptance. By adhering to the principles of inclusive education and recognizing the significance of physical activity, educators can create an environment where every student feels valued and empowered to achieve their full potential.

The role and importance of physical activity in successful inclusive education programs are multifaceted, encompassing physical health, cognitive functioning, social interaction, emotional well-being, and overall inclusion. By recognizing and integrating physical activity within inclusive education settings, academics and educators can create an inclusive and supportive environment that fosters holistic development and maximizes the potential of all learners.

Individualized Education Programs and Physical Activities

It is crucial to recognize the significance of IEPs in the context of inclusive education and their integration with physical activities. IEPs, as mandated by the Individuals with Disabilities Education Act (IDEA, 2004), are personalized plans designed to meet the unique needs and goals of learners with disabilities. Within the inclusive education framework, incorporating physical activities tailored to individualized goals and abilities is essential for promoting holistic development and participation (Block & Obrusnikova, 2007). By aligning physical activities with the objectives outlined in learners' IEPs, educators can provide targeted interventions to address specific areas of need, such as motor skill development, sensory integration (Ayres, 1979), and social interaction, supporting their overall growth and progress. Winnick and Porretta (2016) emphasize the importance of providing necessary adaptations and accommodations to ensure equitable participation for all learners with disabilities in physical education. Furthermore, educators' collaboration with other professionals, like physical and occupational therapists, is essential for successfully implementing these programs (LaMaster et al., 1998). In conclusion, IEPs are pivotal in integrating physical activities within inclusive education settings, fostering holistic development, and ensuring equity for all learners with disabilities.

Integration of Physical Activities into Individualized Education Programs

Integrating physical activities within IEPs is crucial for promoting inclusive and holistic education for learners with diverse needs (Individuals with Disabilities Education Act [IDEA], 2004). Physical activities are vital in promoting the physical, cognitive, social, and emotional development of learners with disabilities (Winnick & Porretta, 2016). Including physical activities within IEPs ensures that learners with diverse needs have equitable active participation and skill development opportunities (Block, 1994).

IEPs are comprehensive plans that outline goals, accommodations, and instructional strategies for learners with disabilities (IDEA, 2004). By incorporating physical activity goals and objectives into IEPs, educators can provide targeted support and promote learners' meaningful engagement in physical activities (Winnick & Porretta, 2016). When integrating physical activities into IEPs, align them with learners' individualized goals and objectives. This alignment ensures that physical activities address specific needs, promote skill development, and support learners' growth and progress (Sherrill, 2004). Physical activities within IEPs are essential to ensure the inclusivity and active participation of learners with disabilities (Rimmer et al., 2004). Adaptations may include modifying equipment, adjusting rules, providing additional support, or offering alternative activities catering to each learner's unique abilities and needs (Obrusnikova & Cavalier, 2011). Effective collaboration and communication among educators, related service providers, and families are critical for successfully integrating physical activities into IEPs (Standal & Jespersen, 2008). Collaborative efforts promote shared decision-making, exchange of expertise, and the development of comprehensive physical activity plans that align with learners' individualized needs (Whitehead, 2010). Regular assessment and monitoring of learners' progress in physical activities within IEPs are essential for evaluating the effectiveness and making necessary adjustments.

Challenges Encountered in the Relationship Between Inclusive Education and Physical Activity

It sheds light on the barriers and obstacles that hinder the successful integration of physical activity within inclusive education settings. By examining these challenges, educators and policymakers can gain insights to develop effective strategies and interventions for promoting physical activity and inclusion for all learners.

Inclusive education aims to provide equal opportunities for all students in various educational domains, irrespective of their abilities (Block, 2007; Kudláček & Ješina, 2008). One significant concern is the lack of accessibility in physical activity programs for students with disabilities. Physical barriers, such as inadequate facilities and resources, impede the active participation of these students in physical activities (Rimmer et al., 2004). Consequently, students with disabilities often experience feelings of exclusion and frustration (Haegele & Sutherland, 2015; Goodwin & Watkinson, 2000). It is essential to adapt physical education programs to suit the diverse needs of students with disabilities, ensuring their meaningful engagement in physical activities with their peers (Sherrill, 2004).

The Importance of Adaptive Physical Education: The limited availability of adaptive physical education initiatives in schools poses a significant obstacle to inclusivity. Adaptive physical education, as defined by the National Association for Sport and Physical Education (2011), involves tailoring activities, equipment, and instructional strategies to accommodate the unique abilities of individual students. Kasser and Lytle (2005) highlight that this personalized approach can help create an inclusive environment where all students can actively participate in physical activities and benefit from them. However, despite its benefits, the lack of such initiatives often leads to excluding students with disabilities from physical activity programs, further echoed by the findings of Rimmer et al. (2004) and Block & Obrusnikova (2007).

Challenges Faced by Educators: One of the significant challenges in promoting inclusivity in physical activity programs is the educators' lack of preparedness to modify activities and materials to cater to the needs of students with disabilities (Block, 2007). Many educators feel they must be equipped to make the necessary adaptations, a sentiment echoed in observations of general physical education teachers (Hodge et al., 2004). These challenges can perpetuate barriers to inclusivity (Lieberman et al., 2002). The complex nature of these challenges underscores the importance of crossdisciplinary approaches to address these barriers (Rizzo & Lavay, 2001). Proper training and professional development opportunities for educators are crucial to empower them to create accessible and inclusive physical activity programs for all students, regardless of their abilities (Grenier & Yeaton, 2013; Goodwin & Watkinson, 2000).

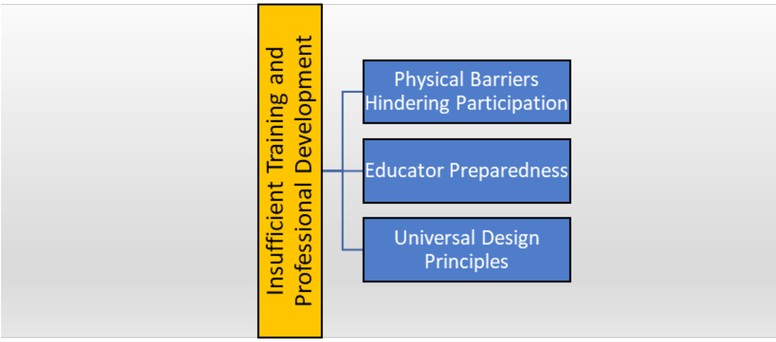
The concept of universal design emphasizes creating barrier-free environments and practices, ensuring participation from all individuals, irrespective of their abilities (Mace et al., 1991). By focusing on universal design principles, educational institutions can work towards fostering greater inclusivity. Such design principles, when applied to education, highlight the importance of creating learning environments that cater to the diverse needs of all students (Burgstahler, 2007). Especially in physical activity, facilities must be designed to be fully accessible (Steinfeld & Maisel, 2012). Furthermore, studies like those by Block and Obrusnikova (2007) have highlighted the significance of inclusion in physical education, suggesting that students with disabilities should have equal opportunities to engage in physical activities alongside their peers. Embracing these principles in physical activity and recreational domains ensures that students are included (Sherrill, 2004).

Conclusion inclusive education's success in fostering holistic development and overall well-being among students with disabilities is contingent on addressing the accessibility and adaptation barriers in physical activity programs.

Insufficient Training and Professional Development

Inclusive education aims to provide equitable opportunities for all students, but one significant challenge lies in the relationship between inclusive education and physical activity. Smith et al. (2018) highlight the issue of inadequate accessibility in physical activity programs stemming from the lack of inclusive facilities, equipment, and resources catering to the diverse needs of students with disabilities.

Figure 3. *Insufficient Training and Professional Development*



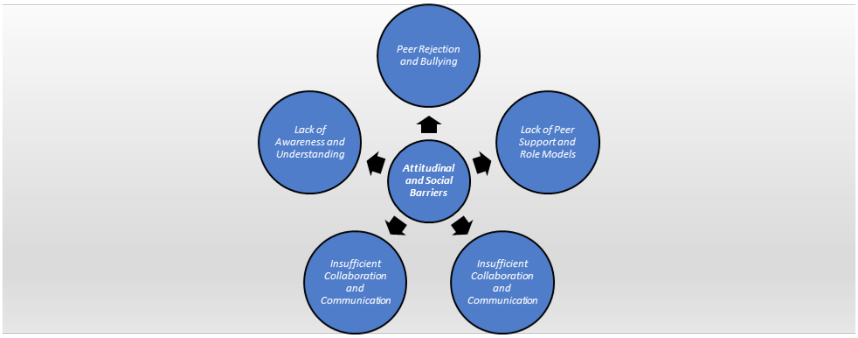
Physical barriers hindering participation identify physical barriers as a significant obstacle, hindering the active participation of students with disabilities in physical activities. These barriers include the absence of accessible facilities and equipment, limiting the engagement of students with disabilities in physical education classes (Block & Obrusnikova, 2007). Lack of adaptive physical education initiatives is critical to inclusive education (Sherrill, 2004). Emphasizing the need for more adaptive physical education initiatives in schools creates obstacles for students with diverse abilities to engage meaningfully in physical activities with their peers. The importance of individualized adaptations stresses the significance of such modifications in physical education to accommodate the diverse needs of students with disabilities (Winnick & Porretta, 2016). Implementing personalized approaches can promote inclusivity. Educator preparedness reveals challenges in modifying physical activity programs for students with disabilities, indicating a need for more training and resources (Hutzler & Sherrill, 2007). To foster inclusive education in physical activity programs, the World Health Organization recommends the adoption of universal design principles (World Health Organization, 2011).

Conclusion: The challenges in inclusive education and physical activity are multifaceted, including accessibility, adaptation, and educator preparedness (Fitzgerald, 2005). Collaborative strategies can address these challenges, promoting holistic student development.

Attitudinal and Social Barriers

Attitudinal barriers often pose significant challenges in promoting inclusive education and physical activity. Negative attitudes towards disability and inclusion can lead to stigmatization and marginalization of students with disabilities in the context of physical activity programs (Rillotta & Nettelbeck, 2007). Inclusive education's success in fostering meaningful social interactions among students can be hindered by peer rejection and bullying towards students with disabilities (Rose et al., 2011). Such social barriers may discourage the participation of students with disabilities in physical activities, limiting their overall engagement. A lack of awareness and understanding among educators, students, and parents about the benefits and importance of inclusive physical activity programs can also contribute to the persistence of social barriers (Block & Obrusnikova, 2007). Adequate knowledge about adaptive physical education and inclusive practices may help efforts to create an inclusive environment. Effective collaboration and communication between educators, parents, and students are essential in ensuring the success of inclusive physical activity programs (Sharma et al., 2008). However, barriers to communication and collaboration can impede the smooth implementation of inclusive practices. Without effective partnerships, addressing the unique needs of students with disabilities becomes challenging. Optimistic peer support and the presence of role models can significantly influence the participation of students with disabilities in physical activities (Martin, 2010). However, the absence of peer support and role models can act as social barriers, isolating students with disabilities from active engagement. Societal norms and expectations regarding disability and physical activity can perpetuate social barriers in inclusive education (Hughes & Paterson, 1997). These norms may inadvertently reinforce segregation and exclusion, making creating an inclusive physical activity environment challenging. Educators, policymakers, and stakeholders can develop comprehensive strategies to foster inclusivity in physical activity programs within the inclusive education framework by understanding and addressing these attitudinal and social barriers (Hodge et al., 2002). Encouraging positive attitudes, promoting social awareness, and fostering collaborative efforts can lead to a more inclusive and supportive environment for all students, ensuring their active participation and holistic development.

Figure 4. *Attitudinal and Social Barriers*



Resource Constraints

One of the primary challenges in the relationship between inclusive education and physical activity is the presence of resource constraints, minimal funding, and budget allocations (U.S. Department of Education, 2010). More financial resources can help develop and maintain inclusive physical activity programs. Resource constraints often result in inadequate access to specialized equipment necessary to cater to the diverse needs of students with disabilities in physical activity settings (Block, 2007). The lack of appropriate adaptive equipment can impede the active participation of students with disabilities (Rimmer et al., 2004).

An essential resource challenge in inclusive physical activity programs is the need for more qualified personnel, such as adapted physical education specialists, therapists, and aides (Winnick, 2011). The absence of trained professionals can limit the implementation of individualized adaptations and support for students with disabilities (Smith & Green, 2004). Resource constraints often lead to limited inclusive facilities within educational institutions (Lepore & Gayle, 2007). Insufficient accessible spaces and adapted environments can restrict the opportunities for students with disabilities to engage in physical activities alongside their peers. Educators and staff require ongoing professional development to enhance their skills in creating inclusive physical activity programs (Whitehead, 2001). However, resource constraints may result in a need for more professional development opportunities and training for educators.

Transportation can be a significant barrier to inclusive physical activity participation for students with disabilities (Rimmer et al., 2004). Resource constraints may limit accessible transportation options, making it challenging for students to access physical activity facilities. Collaborating with community organizations and stakeholders can enhance inclusive physical activity initiatives. However, resource constraints may hinder the establishment of partnerships, reducing the opportunities for inclusive engagement beyond the school environment. Adequate data collection and evaluation are essential for evidence-based decision-making in inclusive physical activity programs (Winnick, 2011). However, resource constraints may limit the capacity to gather comprehensive data and conduct thorough evaluations.

Figure 5. *Constraints*

Educators, policymakers, and stakeholders can work together to develop creative solutions and secure necessary resources for inclusive education and physical activity by recognizing and addressing these resource constraints. Collaborative efforts and advocacy for increased funding and support are crucial in creating an inclusive environment that empowers all students to participate fully in physical activities, fostering their overall well-being and development.

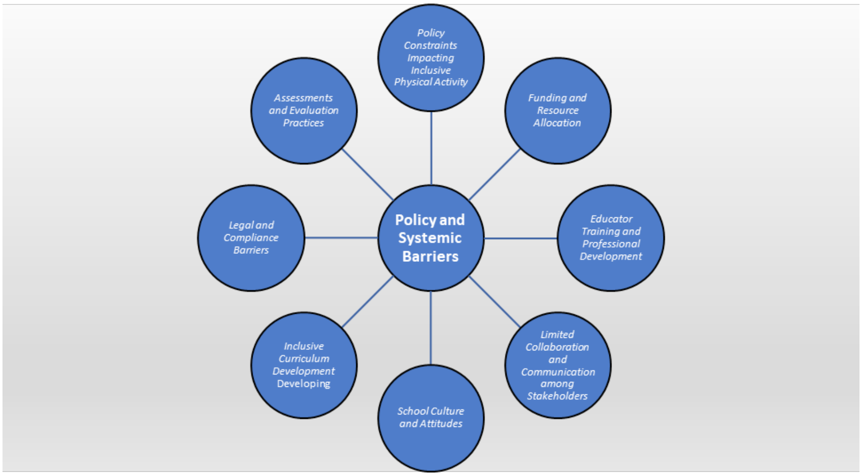
Policy and Systemic Barriers

Policy and systemic barriers significantly impact the relationship between inclusive education and physical activity (Slee, 2011). Emphasize that specific policies may lack clear guidelines on accommodating students with disabilities in physical education, leading to ambiguity and inconsistency in practice (Florian, 2014). Argue that insufficient funding and resource allocation can hinder schools from providing adequate accessibility and support in physical activity programs for students with disabilities (Armstrong et al., 2011). The lack of necessary resources can create a disparity in the quality of physical education experiences, impacting students' overall engagement and participation.

Highlight the need for comprehensive training and professional development programs for educators to support students with disabilities in physical activity effectively (Sharma et al., 2008). Lack of proper training can make educators ill-prepared to accommodate diverse needs, perpetuating barriers to inclusive physical education. Effective collaboration and communication among stakeholders, including teachers, parents, administrators, and support staff, are essential for creating an inclusive physical activity environment (Ainscow et al., 2006).

The prevailing school culture and attitudes towards disability can significantly impact the implementing of inclusive physical activity programs (Avramidis & Norwich, 2002). Fostering a positive and accepting school culture can create an environment where students with disabilities feel welcomed and included in physical education. Legal and compliance barriers, such as ambiguous disability policies or inadequate adherence to accessibility standards, can pose obstacles to inclusive physical activity (Hehir & Katzman, 2012). Stress the need for comprehensive legal frameworks that explicitly support including students with disabilities in physical education programs. Evaluating and assessing students' physical activity progress can also present inclusivity challenges (Black & Wiliam, 1998). Advocate for using flexible and individualized assessment methods that consider the diverse abilities of students with disabilities. Developing an inclusive curriculum that accommodates the needs of all students is crucial for promoting inclusivity in physical activity (Udvari-Solner & Kluth, 2007).

Figure 6. *Policy and Systemic Barriers*



Policy and systemic barriers significantly impact the relationship between inclusive education and physical activity. By addressing these challenges, policymakers, educators, and stakeholders can create an inclusive environment where all students can actively participate and thrive in physical activity programs, regardless of their abilities. Implementing evidence-based policies, providing adequate resources, and investing in comprehensive training for educators are essential steps towards fostering inclusivity in physical education within educational institutions.

Individualization and Differentiated Instruction

The relationship between inclusive education and physical activity presents several challenges that require careful consideration. One critical aspect that contributes to addressing these challenges is the implementation of individualization and differentiated instruction. Tomlinson (2017) asserts that personalizing educational strategies to cater to the unique needs of students with disabilities is vital to fostering inclusivity. As Winnick (2011) discussed, individualized approaches in physical activity programs can significantly impact the engagement and participation of students with diverse abilities. Block (2007) emphasizes the importance of designing tailored physical activity plans to break down physical barriers hindering the involvement of students with disabilities in sports and exercise.

Inclusive physical education necessitates adopting differentiated instruction techniques to accommodate diverse learners effectively. Conderman & Hedin (2012) stress that educators should modify the content, process, and product of physical activity lessons to ensure all students can actively participate and achieve meaningful learning outcomes. Furthermore, Winnick (2011) underscores the significance of adapting physical activities to suit the specific needs of students with disabilities. Educators should have the knowledge and skills to customize exercises, equipment, and facilities to create an inclusive and empowering environment for all students. Addressing the challenges encountered in the relationship between inclusive education and physical activity requires adequate educator preparedness. The National Center for Inclusive Education highlights the need for comprehensive professional development and training programs, which are further supported by the findings of Conderman and Hedin (2012), to empower educators with the tools to individualize physical activity instruction effectively. Adopting universal design principles is crucial in promoting inclusive physical activity, as outlined by CAST (2018). The World Health Organization (2010) advocates for creating barrier-free environments and practices that cater to the needs of all students, ensuring their active participation and engagement.

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CHAPTER 3

THE RELATIONSHIP OF PLASMA LEPTIN LEVELS WITH EATING ATTITUDES, MENSTRUAL CYCLES REGULATIONS AND ENDOCRINE FACTORS IN BALLET DANCERS[1]

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1 The Relationship Of Plasma Leptin Levels With Eating Attitudes, Menstrual Cycles Regulations And Endocrine Factors In Ballet Dancers başlıklı bu çalışma Dr. Öğr. Üyesi Pınar TATLIBAL'ın Yüksek Lisans Tez çalışmasıdır. Celal Bayar Üniversitesi BAP birimi tarafından desteklenmiştir (Celal Bayar Üniversitesi Sağlık Bilimleri Enstitüsü, 2009. Danışman: Prof Dr. Hayriye Selda Yücel, Ulusal Tez Merkezi No: 455943).

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Introduction

It is emphasized that energy storage and use are very important for life in the formation of the homeostatic system. Regulation of energy balance is provided by a complex physiological system. Leptin and its receptor are secreted from adipose tissue and are very important for this system (1). Leptin regulates feeding behavior as a potent food intake suppressor and energy expenditure stimulator (2). Suppression of reproductive function to adapt to caloric deprivation may be a situation that female athletes may face for high performance in sports where low body weight is required. (3). Leptin hormone may be an important mediator of reproductive function (4). It has been reported that leptin levels may vary depending on fat stores and energy availability. While it has been determined that leptin levels may be low when energy restriction is applied, leptin levels have been associated with body mass index (BMI) in humans (5, 6). In a study (7), serum leptin concentrations were found to be high in the vast majority of obese people and it was stated that it decreased again with weight loss. While some studies (8, 9) show that rodents in which leptin is not active tend to be amenoric and infertile, other studies (10, 11) show that women with no menstrual period may have chronically low leptin levels. Leptin receptors have been found in hypothalamic neurons associated with gonadotropin-releasing hormone (GnRH). It is thought that it may signal the presence of low energy to the reproductive axis. For this reason, it is emphasized that leptin may be a critical factor (12).

It has been reported that observed exercise-related reproductive disorders can often result from dysfunction at the hypothalamic level. The hormonal profile of women who face high intensity or scope in branches that require low body weight, such as gymnastics, ballet, ice skating, is characterized by hypoestrogenism resulting from the disruption of the hypothalamic-pituitary-ovarian axis. In particular, the GnRH suppression that occurs every 60–90 minutes limits LH secretion and, to a lesser extent, FSH secretion, which ultimately limits ovarian stimulation and estradiol production. This continuation of the follicular phase or the lack of LH and estradiol may cause suppression of menstrual periods in the aforementioned female athletes. It has been reported that Inadequate LH levels may be among the causes of menarche, primary and secondary amenorrhea. The course of pubertal growth and the activity level of the onset of menarche have been associated in young ballet dancers (3).

Negative energy balance may be seen in female athletes for whom aesthetic appearance is important and who need to have a low body weight for high performance. Additionally, pathological eating habits are also common. It is stated that the reproductive and metabolic hormonal profiles of female athletes in these sports branches are compatible with the profiles of aneroxic (AN) women. Therefore, adaptations due to dietary restriction in these athletes may be important causes of menstrual disorders (3). The aim of this study is to investigate the relationships between plasma leptin levels in female ballet dancers, eating attitudes, menstrual cycle patterns and the hormones insulin, LH, FSH, IGF-1, IGFBP-3, prolactin, estradiol, cortisol, progesterone.

Methods

Participants

A total of 49 voluntary participants, 22 female ballet dancers (mean age 21.32±4.64 years) and 27 female sedentary (mean age 19.48±1.09 years) participated in the study. Ballet dancers group (BDG) are 22 volunteer ballet dancers with at least 5 years of ballet back ground, who work at Izmir State Opera and Ballet (Izmir / Turkey) and are students of the Ballet Department of Dokuz Eylül University State Conservatory. The sedentary group (SG) consists of 27 volunteer students who are students of Dokuz Eylul University Vocational School of Health Services (Izmir / Turkey) and Dokuz Eylul University Vocational School of Nursing (Izmir / Turkey), who have never done regular physical activity before. Supported by Celal Bayar University Scientific Research Projects (BAP).

Procedure

Before starting the study, the participants signed the consent form describing the purpose and content of the study, indicating that they participated in the study voluntarily. Physical profiles and anthropometric measurements of the all participants were made. All participants completed the Menstrual Cycle Form and the EAT–26 Test. BDG also filled the Training Information Form. Blood samples of all participants were taken once, from forearm venous blood, between 08:00 and 10:00 in the morning after fasting for 10 hours.

Body height and circumference measurements were measured with an anthropometric set (Holtain, USA). Body weight, BMI, body fat ratio (BFR), lean body mass (LBM) and BFP (%) were measured with the body analyzer device (Tanita Bioelectric Impedance, 300 MA, C.O. Tokyo – Japan). In addition, skinfold thickness measurements were taken with the skinfold-caliper (Holtain, USA). Subcutaneous fat thickness measurement with Skinfold was made according to Jackson – Pollock – Ward (1980) formula (13). Body density was calculated by making triceps, suprailiac and anterior thigh skinfold measurements, and BFR was calculated with the Siri equation 1961 (14).

With the Menstrual Cycle Form, the menstrual patterns of the participants and whether they had any gynecological disorders were determined. With the Training Information Form, their training history, whether they had an injury, if so, the interrupted time and temporal training intensities were determined.

The EAT-26 test was performed in 1982 by Garner et al. It is a scale that determines eating attitudes developed by (15). It was adapted into Turkish by Devran in 2014 (16). It was applied to the participants in this study. Scores below 20 points indicate normal eating attitudes. Scores above 20 points indicate abnormal eating attitudes. It is not possible to make a specific diagnosis with EAT-26 alone but recommends investigating scores above 20.

Venous blood samples of the participants were taken between 18-24 days of menstruation (luteal phase). Straight blood was collected in tubes via brachial veins in the morning after all-night fasting. Plain blood was centrifuged in tubes at 1200 g for 15 minutes. The upper serum portion was placed in Eppandorf tubes for biochemical measurements. It was stored at -80°C until analysis. Serum leptin levels were measured by solid phase sandwich ELISA. Samples and standards containing recombinant leptin; It was incubated with rabbit polyclonal IgG-type antibodies raised against human recombinant leptin immobilized to the solid phase. Captured leptin binds with the biotinylated rabbit anti-leptin IgG-peroxidase complex, and the conversion of the added chromogenic substrate was measured by detecting its optical density at 450 nm in a plate reader. Serum insulin, LH, FSH, IGF-1, IGFBP-3, prolactin, estradiol, cortisol and progesterone levels were measured by immunoturbidimetric method using original commercial reagent kits on Immulite 2500 (Siemens Healthcare Diagnostics, USA) analyzer.

Statistical Analysis

While LH, FSH, IGF-1, IGFBP-3, prolactin, estradiol, cortisol, and progesterone hormones were used as dependent variables, the independent variables of the study were the eating attitudes, menstrual cycle patterns and physical activity levels of BDG and SG. The SPSS 22.0 program (SPSS Inc., Chicago, IL) running under Windows was used for statistical analysis.

After the data were collected, descriptive statistics were calculated for the determination and separation of "off-means values" for all variables. Values below ± 3 values of the standard deviation according to descriptive statistics were excluded from the statistical analysis of the study. The comparison of the values of BDG and SG for all variables was then analyzed by Independent Sample T-Test. The relationship between the hormonal profiles, menstrual cycle levels, eating attitudes and physical activity levels of BDG and SG were revealed by Pearson Correlation Analysis. It was accepted as the level of significance ($p<0.005$).

Results

Descriptive statistics regarding the age and physical profiles of BDG and SG are shown in Table 1. BFR of the research groups were measured by two different methods. In the first measurement, BFP, BFR and LBM data were obtained as a result of bioelectrical impedance analyzes taken with tanita. In the second measurement method with the Skinfold caliper, regional measurements were made and calculations were made in the Siri equation 1961 (14) and the BFR was reached. Descriptive statistics for age, body weight, body height, BMI, BFP, BFR and LBM of BDG and SG are shown in Table 1.

Table 1. *Descriptive statistics regarding the age and physical profiles of BDG and SG.*

	BDG (N= 22)			SG (N= 27)			Total (N= 49)		
	Mean±SD	Min	Max	Mean±SD	Min	Max	Mean±SD	Min	Max
Age (years)	21.32±4.64	17.00	31.00	19.48±1.09	18.00	23.00	23.31±3.31	17.00	31.00
Body Weight (kg)	51.91±8.44	38.40	70.80	57.73±7.87	42.90	75.40	55.11±8.56	38.40	75.40
Body Height (cm)	164.86±7.13	152.00	176.00	166.74±5.22	159.00	180.00	165.90±6.16	152.00	180.00
BMI (kg/m²)	18.88±1.93	16.60	23.10	20.77±2.72	16.80	27.70	19.92±2.55	16.60	27.70
BFP (%)	12.11±5.14	1.00	20.70	23.34±6.33	7.40	34.80	18.30±8.06	1.00	34.80
BFR (kg)	6.60±3.58	0.50	14.70	13.92±5.40	3.20	26.20	10.63±5.91	0.50	26.20
LBM (kg)	45.00±5.16	70.00	95.00	43.80±2.97	38.20	49.20	44.34±4.09	37.80	56.10

N; *Number of participant,* ***BDG;*** *Ballet Dancers Group,* ***SG;*** *Sedentary Group,* ***SD;*** *Standart Deviation,* ***Min;*** *Minimum Value,* ***Max;*** *Maximum Value,* ***BMI;*** *Body Mass Index,* ***BFP;*** *Body Fat Percentage,* ***BFR;*** *Body Fat Ratio,* ***LBM;*** *Lean Body Mass.*

Descriptive statistics on the anthropometric characteristics of BDG and SG are shown in Table 2.

Table 2. *Descriptive statistics on the anthropometric characteristics of BDG and SG.*

	BDG (N= 22)			SG (N= 27)			Total (N= 49)		
	Mean±SD	Min	Max	Mean±SD	Min	Max	Mean±SD	Min	Max
Shoulder (cm)	95.36±5.65	86.00	109.00	98.26±5.85	87.00	116.00	96.97±5.89	86.00	116.00
Chest (cm)	78.41±5.73	70.00	95.00	86.44±5.29	79.00	102.00	82.84±6.77	70.00	102.00
Waist (cm)	63.73±4.86	56.00	75.00	71.11±5.76	59.00	87.00	67.80±6.49	56.00	87.00
Abdomen (cm)	77.14±6.50	67.00	91.00	86.78±6.61	76.00	101.00	82.45±8.10	67.00	101.00
Hip (cm)	89.91±6.34	79.00	101.00	97.22±6.34	82.00	110.00	93.94±7.27	79.00	110.00
Thigh (cm)	52.05±5.09	40.00	62.00	55.78±4.83	46.00	65.00	54.10±5.25	40.00	60.00
Calf (cm)	34.45±2.72	30.00	40.00	35.00±2.73	30.00	41.00	34.76±2.71	30.00	41.00
Arm (cm)	23.32±1.94	20.00	28.00	26.33±2.43	22.00	30.00	24.98±2.67	20.00	30.00

N; *Number of participant,* ***BDG;*** *Ballet Dancers Group,* ***SG;*** *Sedentary Group,* ***SD;*** *Standart Deviation,* ***Min;*** *Minimum Value,* ***Max;*** *Maximum Value.*

Descriptive statistics regarding the hormonal values measured in the luteal phase calculated for each of the participants according to their statements on the Menstrual Cycle Form are shown in Table 3.

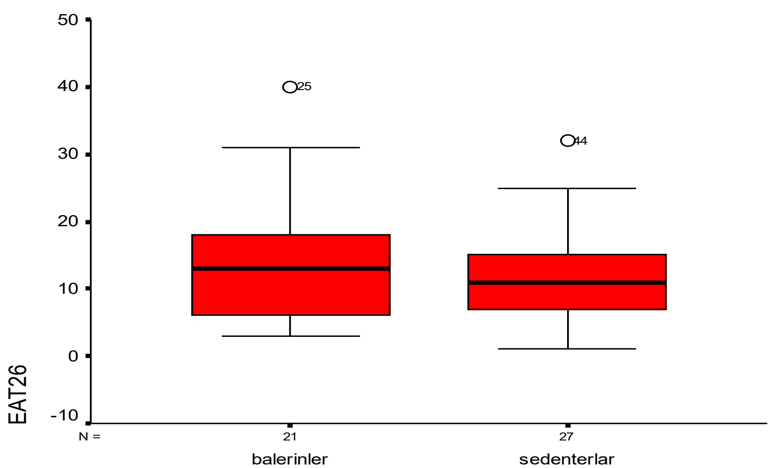
Table 3. *Descriptive statistics on the hormonal values of BDG and SG in the luteal phase.*

	BDG (N= 22)			SG (N= 27)			Total (N= 49)		
	Mean±SD	Min	Max	Mean±SD	Min	Max	Mean±SD	Min	Max
PRL	15.56±8.25	5.10	33.80	14.16±8.33	4.11	44.40	14.76±8.23	4.11	44.40
FSH	5.90±2.95	1.84	12.70	5.57±2.75	2.23	11.80	5.71±2.80	1.84	12.70
LH	13.47±16.21	1.20	72.40	7.96±7.95	1.03	23.10	10.34±12.36	1.03	72.40
E	122.34±78.58	31.20	272.00	100.18±52.51	23.10	198.00	109.75±65.17	23.10	272.00
PRG	3.32±4.24	0.25	14.40	5.63±5.64	0.50	22.70	4.36±5.16	0.25	22.70
COR	17.14±4.94	9.79	28.20	14.13±4.59	6.79	23.60	15.43±4.93	6.79	28.20
INS	3.54±3.00	2.00	14.70	6.31±3.26	2.00	15.20	5.12±3.41	2.00	15.20
IGF-1	256.68±76.47	141.00	458.00	275.36±74.55	184.00	473.00	267.30±75.08	141.00	473.00
IGFBP-3	4.78±0.65	3.35	5.98	4.92±0.49	3.97	5.69	4.86±0.56	3.35	5.98
LEPTIN	13.44±13.96	2.01	53.94	45.51±29.11	4.32	91.05	31.66±28.51	2.01	91.05

N; *Number of participant,* ***BDG;*** *Ballet Dancers Group,* ***SG;*** *Sedentary Group,****SD;*** *Standart Deviation,* ***Min;*** *Minimum Value,* ***Max;*** *Maximum Value,* ***PRL;*** *Prolactine,* ***FSH;*** *Follicle Stimulating Hormone,* ***LH;*** *Luteal Hormone,* ***E;*** *Estrogen,* ***PRG;*** *Progesterone,* ***COR;*** *Cortizol,* ***INS;*** *Insuline,* ***IGF-1;*** *Insulin-Like Growth Factor-1,* ***IGFBP-3;*** *Insulin-Like Growth Factor Binding Protein-3.*

The participants' Eat-26 Test data means are shown in Figure 1.

Figure 1. *Mean results of the participants on the EAT-26 Test.*



Ballet Dancers Group **Sedantary Group**

(N=22) ***(N=27)***

According to the analysis results, the mean values of BDG and SG from the Eat-26 test are below "20 points", which is the indicator of healthy nutrition. In the Independent Sample-T Test analysis, it was found that the mean values of the two groups from the Eat-26 Test were not statistically different from each other (t= 1.19; p>0.005).

The Independent Sample-T Test summary table of the anthropometric and physical profiles of BDG and SG is shown in Table 4.

Table 4. *Independent Sample-T Test summary table of anthropometric and physical profiles of BDG and SG.*

(N=49)	t	p
Body Weight (kg)	-2,491	,646
Body Height (cm)	-1,063	,128
BMI (kg/m²)	-2,736	,121
BFP (%)	-6,700	,218
BFR (kg)	-5,445	**,004***
LBM (kg)	1,016	**,001***
Shoulder (cm)	-1,749	,849
Chest (cm)	-5,097	,813
Waist (cm)	-4,781	,577
Abdomen (cm)	-5,114	,794
Hip (cm)	-4,017	,533
Thigh (cm)	-2,625	,943
Calf (cm)	-,696	,871
Arm (cm)	-4,717	,196

N; *Number of participant,* ***BDG;*** *Ballet Dancers Group,* ***SG;*** *Sedentary Group,* ***BMI;*** *Body Mass Index,* ***BFP;*** *Body Fat Percentage,* ***BFR;*** *Body Fat Ratio,* ***LBM;*** *Lean Body Mass.*
p*<0.005.

Among the independent variables evaluated according to Independent Sample-T Test analysis, only BFR and LBM differed statistically between the two groups (p<0.005). While the BFR of BDG was statistically lower than SG, their LBM was also statistically higher than SG (Table 4).

The Independent Sample-T Test summary table of the hormonal values of BDG and SG is shown in Table 5.

Table 5. *Independent Sample-T Test summary table of the hormonal values of BDG and SG.*

(N=49)	t	p
PRL	,551	,668
FSH	,383	,883
LH	1,484	,115
E	1,121	,113
PRG	-1,484	,247
COR	2,081	,957
INS	-2,884	,283
IGF-1	-,789	,160
IGFBP-3	-,814	,985
LEPTIN	-4,422	**,002***

N; *Number of participant,* ***BDG;*** *Ballet Dancers Group,* ***SG;*** *Sedentary Group,* ***PRL;*** *Prolactine,* ***FSH;*** *Follicle Stimulating Hormone,* ***LH;*** *Luteal Hormone,* ***E;*** *Estrogen,* ***PRG;*** *Progesterone,* ***COR;*** *Cortizol,* ***INS;*** *Insuline,* ***IGF-1;*** *Insulin-Like Growth Factor-1,* ***IGFBP-3;*** *Insulin-Like Growth Factor Binding Protein-3.* ***p*<0.005.***

When the hormonal profiles of the participants were examined, only leptin levels differed statistically between BDG and SG. The leptin levels of SGs measured in the luteal phase were statistically higher than the leptin levels of BDG measured in the same period (Table 5). Two different linear regression models were designed to analyze the relationships of BDG and SG with the variables affecting leptin levels.

The independent variables entered into this model with the Stepwise Method are respectively anthropometric characteristics, physical profile values, training levels, eating attitudes, menstrual patterns and hormones. The dependent variable is the leptin levels of the participants. Tables 6 and 7 show the leptin levels in two different models of BDG and SG, respectively, and the variables that have a statistically significant relationship.

Table 6. *BDG Stepwise Linear Regression analysis summary table.*

Model	R Square	Standard Error of the Estimate	R Square Change	F Change	df1	df2	p
1	.42	11.20	.42	11.75	1	16	.003*
2	.70	8.33	.27	13.92	1	15	.002*

a Predictors: *(Constant), Progesterone****, b Predictors:*** *(Constant), EAT-26.* ***p*<0.005.***

According to the Linear Regression analysis data explained in Table 6, leptin levels in the luteal phase of BDG and only 2 of the independent variables explained above; A statistically significant relationship was found between eating attitudes and progesterone levels (p<0.005). These two independent variables explain 70% of the variation in leptin levels.

Table 7. *SG Stepwise Linear Regression analysis summary table.*

Model	R Square	Standard Error of the Estimate	R Square Change	F Change	df1	df2	p
1	.63	17.99	.61	39.81	17.99	23	.000*
2	.75	14.94	.73	11.37	14.94	22	.003*

a Predictors: *(Constant), Body Fat Percentage****, b Predictors:*** *(Constant), Body Fat Percentage, Progesterone.* ***p*<0.005.***

The regression analysis model table explained in Table 7 draws a different picture from the table of BDG. According to the data described in this table, only two of the independent variables entered in the Stepwise Regression analysis, BFP and progesterone levels show a statistically significant relationship with the leptin values of SG measured in the luteal phase (p<0.005). These two variables explain 75% of the changes in leptin.

Discussion

In the findings of this study, BFR and LBM different statistically between BDG and SG. While the BFR of BDG were found to be significantly lower than those of SG, LBM of BDG was found to be significantly higher (Table 4; p<0.004, p<0.001). The first reason for the significant difference in these two independent variables is thought to be due to the long-term training of the BDG. Although not statistically significant, the BMI values and body weights of BDG were found to be lower than those of SG. In addition, the mean height of the BDG, which was not statistically significant, was shorter than the SG, and their BFP, shoulder, chest, waist, abdomen, hip, thigh, calf and arm circumference measurements were lower than the SG.

In a study conducted by Stokic et al. (2005) with similar independent variables, they found the BMI and BFP values of ballet dancers to be significantly lower than those of the sedentary group (17). Soric et al. (2008) found that their body weights, BMI values and BFP values were significantly lower than the control group in their study with artistic gymnastics, rhythmic gymnastics and ballet dancers (18). In another study, Van Marken Lichtenbelt et al. (1995) found no significant difference between the body compositions, age and height of ballet dancers with eumenoric and menstrual disorders and the control group. However, body weight and BMI values were found to be significantly lower in dancers than in the control group. While there was no significant difference between the LBM values of the ballet dancers and the control group, the BFR of the ballet dancers was found to be significantly lower than the values of the control group (19). Lauhlin et al. (1997) conducted a study between athletes with eumenoric and menstrual cycle disorders and sedentary people, and when the groups were compared for BMI, they observed that cycling and amenoric athletes had significantly lower BFM than the control group (20). The findings in the literature described above (17-20) emphasize that BFP is significantly lower in ballet dancers and sports branches. This is also consistent with our study. BMI values were also found to be low, although it was not significant also in our study, which was in line with the study of Lauhlin et al. 1997 (20). In this study, low BFR and high LBM in BDG compared to SG are important in terms of the flexibility-performance relationship in ballet, which is an aesthetic art activity. The science of training emphasizes the importance of physical factors such as strength and speed and the flexibility parameter in the development of technique, especially in order to provide an optimal development in gymnastics and ballet (21). Providing hyperextension angles in the joints, performing jumps, pivots and balances with the right technique and with the desired proficiency, can only be achieved with low body fat values in aesthetic branches that dominate these artistic aspects. Since the control group of this study did not do any exercise, it is thought that BDG gave the opposite anthropometric results.

Another explanation for LBM and BFR, which were statistically different between SG and BDG, was thought to be the dietary habits of the participants. However, according to the results of the analysis, the mean values of BDG and SG from the Eat-26 test in this study were below “20 points”, which is the indicator of healthy nutrition, and it was found that they were not statistically different from each other. No malnutrition was found in the BDG in our study. This situation can be explained by the fact that the participants eat regularly or do not have weight problems or negative energy balance at a level that does not create compelling and psychological pressure. Beals et al. (2000, 2002) showed that eating disorders in athletes are no different from those in sedentary people. However, they emphasized that the rate of eating disorders may be higher in athletes who require a low fat percentage (22, 23).

In studies comparing the energy intake of athletes with menstrual cycle disorders (24-27), it was found that all active women with menstrual cycle disorders had a negative energy balance. Garner et al. (1980) diagnosed 6.5% of ballet dancers with anorexia nervosa (AN) in their study (28). While Le Grange et al. (1994) found AN in 4.1% of the ballet dancers in their study, they found partial AN syndrome in 8.2% of them (29). The rate of malnutrition among ballet dancers was found to be 33% in America and 47% in Europe (30). These results are not compatible with the results of eating attitudes in SG and BDG in our study.

Laughlin et al. (1997) compared the relationship between IGF-1, leptin, BFP and nutritional variables in their study with AN and normal control groups. As a result, it has been shown that factors other than BFP, such as irregular eating habits, low fat consumption and low IGF-1 levels, can control leptin secretion. While low leptin levels were found in young amenoric athletes who did not have an increase in nighttime serum leptin levels, nighttime serum leptin levels were found to be higher in athletes with regular menstrual cycles and similar BMI values who consumed more fat (20). The results of Laughlin et al. (20) are consistent with the results of our study.

There are several mechanisms that explain athletic menstrual disorders, such as negative energy balance and intensive physical activity. In the literature (31-33) it has been found that LH, FSH and prolactin hormone secretions are decreased but cortisol, IGFBP-1 and growth hormone secretions are increased in women with functional hypothalamic amenorrhea (FHA). In the study of Andrico et al. (2002) conducted with FHA and control group, the participants were classified as overweight and normal weight according to their BMI levels. While the levels of gononadotropins, prolactin, insulin, free tri-iodothyronine and leptin hormone levels of each of the participants with FHA were significantly lower than the control group, cortisol, IGF and IGFBP-1 levels were found to be significantly higher. While there was a linear positive correlation between leptin and body weight, BMI, LH, peptide-C, insulin, and IGF-1 values, there was a negative correlation between cortisol and IGFBP-1 (34). Farah et al. (2000) found leptin levels to be significantly lower in amenoric elite athletes than in athletes with normal cycling. While leptin was associated with tri-iodothyronine and insulin, estrogen was not associated with energy intake or exercise energy expenditure (35).

When the hormonal profiles of BDG and SG were examined in our study, leptin hormone levels of SG were found to be statistically higher than leptin hormone levels of BDG, but there was no significant difference between prolactin, FSH, LH, estrogen, progesterone, cortisol, insulin, IGF 1 and IGFBP-3 values of the two groups. In studies (20, 34-37) the leptin levels of female athletes were found to be significantly lower than the control groups, which is consistent with our study. In addition, in studies (26, 31-34) cortisol levels of athletes were found to be higher than control groups. In our study, cortisol levels were also found to be higher in BDG than in SG, although it was not significant. Some studies (31-34) found that the LH levels of the athletes were lower than the control groups. In our study, no significant difference was found between LH levels of BDG and SG values. In studies that found the prolactin levels of the athletes lower than the control groups (31-33) IGFBP-1 levels were found to be higher than the control groups, while FSH levels were found to be lower (31-33). While Andrico et al. (2002) found that the insulin levels of the athletes were lower than the control group (34), in our study, the insulin levels of the BDG were lower than the SG and the estrogen levels were not statistically significant. In our study, eating attitudes and progesterone levels of BDG were associated with changes in leptin levels, while BFP and progesterone levels were associated with changes in leptin levels in SG. Andrico et al. (2002) found the relationship between leptin and LH, insulin, and IGF-1 significant, but not IGFBP-1 and cortisol with leptin (34). While Farah et al. (2000) associated leptin with insulin, they did not find a relationship between plasma leptin and estrogen and progesterone in the luteal or follicular phase, and changes in leptin levels were not associated with changes in estrogen and progesterone levels (35). These results are not compatible with our study. Laughlin et al. (1997) associated the leptin levels of the sedentary group with BFP (20) and Andrico et al. (2002) found that there was a positive correlation between leptin in the control group and body weight and BMI values (34), and these results support our study.

In our study, BFP, which was found to be significantly lower in BDG compared to SG, makes us think that BDG performs long-term, regular, high-intensity exercise and as a result, they have low BFP. Because the low fat ratio suppresses the reproductive system. Again, low BFP associated with the reproductive system mechanism suppresses reproductive hormones in conjunction with low leptin levels. This can be explained by the fact that BDG pay attention to their eating habits even though they have low BFP, while leptin levels are high because SG have a high BFP can explain this relationship. While some studies (8, 9) show that rodents in which leptin is not active tend to be amenoric and infertile, other studies (10, 11) support that there may be a chronic low leptin in women with no menstruation. Low leptin levels have been observed in amenoric women while controlling body fat, and these women do not have the typical daily pattern of leptin concentration (20, 38). On the other hand, in our study, no significant relationship was found between low leptin levels in BDG and menstrual cycle patterns.

Castelo-Branco et al. (2006) found that regular menstrual cycles were 58% in ballet dancers and 75% in the control group. While they found the rate of oligomenorrhea to be 43% in ballet dancers, they found amenorrhea to be 8%. In the control group, 14% oligomenorrhea, 11% polymenorrhea and menorrhagia rates were detected. It was determined that the rates of oligamenorea and amenorrhea of menstrual disorders were higher in ballerinas compared to the control group. ((39). In our study, however, no menstrual cycle disorders were found in BDG. In studies (8-11, 20, 38) it was found that women with low leptin levels did not have menstruation. In our study, leptin levels and BFP, which were found to be significantly lower in BDG compared to the SG, were not significantly associated with menstrual cycle patterns and leptin values, which differed from the literature findings.

Conclusion

In conclusion, in our study, leptin levels and BFR, were found to be lower in BDG compared to SG. LBM was higher in BDG. It was an expected result for BDG in ballet where regular training and aesthetic appearance are important. However, it was concluded that eating attitudes or menstrual cycle patterns of BDG and SG were normal results. Changes in leptin levels were associated with eating attitudes and progesterone levels in BDG and with BFP and progesterone levels in SG.

Limitations

The blood sample, which was planned to be collected only once (in the luteal phase) in our study, is recommended for more comprehensive results about the menstrual cycle patterns of the participants, by being taken in different phases in different studies. It is thought that the studies to be carried out with mostly ballet dancers or aesthetic branch athletes will be beneficial.

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