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Analyzing the in-Game Movement of Players at the World Cup and Asian Cup

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Abstract

Purpose: This study aims to analyze the movement of players at the 2022 World Cup in Qatar and the 2023 Asian Cup in Qatar, with the aim of analyzing movement across tournaments and continents.

Method: To do this, we collected and analyzed official match reports from the tournament and came up with the following results.

Results: First, the Asian Cup had higher movement than the World Cup in Total Distance, Zone 1 (walk), and Zone 3 (run). Second, the World Cup had higher movement than the Asian Cup in the High Speed Runs and Sprints factors. Third, in Total distance, the Asian Cup has higher movement and South America has lower movement. In Zone 2 and Zone 3, the movement of South America is lower than the other continents. Fourth, High Speed Runs is dominated by Europe. Sprints were lower for the Asian Cup. This study compares soccer styles and playing strategies across continents and races in the World Cup and Asian Cup.

Conclusion: This study was able to diagnose the performance of Asian soccer and identify areas that need to be improved in the future. We hope that this research will help Asian countries develop their training programs and tactics.

Keywords: Soccer, World Cup, Asian Cup, Movement, Distance Traveled

1. Introduction

The speed of play in modern soccer has increased in recent years, and players must run faster and perform skills at higher speeds to achieve good results. A typical tactical feature of modern soccer is the narrow offensive and defensive spacing, which requires faster transitions from offense to defense or from defense to offense [1]. This requires soccer players to perform a wide range of movements and a high level of physical fitness.

In most sports, there is a score to win. In soccer, points are scored, and you need to score to win, and you need to keep the ball away from your opponent to win the game. Sprinting occurs in scoring situations, and it has been found that sprinting occurs in every second scoring situation in the German National League [2]. During a soccer match, players sprint an average distance of 10.6-12 km, with a total distance of 340-380 m depending on the player's position [3]. Analyzing soccer matches can be done with high-tech equipment such as GPS, which can provide basic data on the distance traveled by players during the match [4]. GPS can also be used to measure player fitness before, during, and after a game and provide insight into player characteristics. Video analytics and GPS systems can be used to analyze training and matches to better analyze team and individual performance.

Different positions in soccer require different distances, sprints, skills, physicality, and stamina. The distance traveled during a match is different for each position, and this is due to the different tactical roles that each position plays during a match[5]. Mohr et al reported that an elite soccer player ran 10 km per game and had an energy expenditure of 61 kj/kg [6]. Soccer players perform sprints every 90 seconds during a game, lasting on average 2-4 seconds and accounting for 0.5%-3% of the total game time[7]. Typically, sprints are less than 30 meters 96% of the time and less than 10 meters 50% of the time[8].

Soccer players reported the highest total distance traveled during a match by position, with flankers reporting the highest total distance traveled than any other position, and midfielders reporting the highest total distance traveled than forwards and center backs[9]. Elite soccer players have an average sprint speed of 20-25 km/h[10].

In the field of domestic soccer, a comparative analysis of the distance traveled and movement intensity during the 2014 World Cup in Brazil has been conducted to determine the extent to which a soccer player's position affects cardiorespiratory function, movement intensity, and distance traveled during a match[11]. In particular, there is a lack of research on the performance and excellence of players in different positions.

The Asian Football Confederation is providing various information about the teams and players at the Qatar AFC Asian Cup 2023. In particular, the data analyzing the players' movements is presented in a scientific way, including the distance, activity distribution, and sprint of each player through 3D video analysis. Through these data, it is possible to analyze various verification and performance indicators such as continental comparisons, and it is judged that in-depth research is needed in this area in the future.

Therefore, the purpose of this study is to collect data on team travel and movement for the 2022 FIFA World Cup Qatar and the 2023 Asian Cup Qatar and use it to analyze the differences in total travel and movement by qualifying continent.

2. Research Method

2.1. Research subjects

For the purpose of this study, 84 matches were selected, including three group stage matches from each of the 32 teams that participated in the 2022 World Cup in Qatar and 24 teams that participated in the 2023 Asian Cup. The independent variables were categorized by Asian Cup and continent as shown in <Table 1>. Players were limited to those who played at least one match and played at least 90 minutes. Goalkeepers (GKs) were excluded because they have very different characteristics than field players.

Table 1. Research subjects.

Target				Frequency
Asian cup		Japan, Iran, South Korea, Australia, Saudi Arabia, Qatar, Iraq, United Arab Emirates, Uzbekistan, Oman, China, Bahrain, Syria, Vietnam, Jordan, India, Kyrgyzstan, Palestine, Tajikistan, Lebanon, Thailand, Malaysia, Indonesia, Hong Kong		24
World cup	By continent	Asia	10 Qatar, Iran, South Korea, Saudi Arabia, Japan, and Australia	6
		Africa	99Senegal, Cameroon, Ghana, Morocco, Tunisia, Tunisia	5
		North and Central America	Canada, Mexico, United States, Costa Rica	4

		South America	Brazil, Argentina, Uruguay, and Ecuador	4
		Europe	Germany, Denmark, France, Belgium, Serbia, Spain, Croatia, England, Switzerland, Netherlands, Poland, Portugal, Wales	13
Total				56

2.2. Researching resources

The official website of the Federation Internationale de Football Association (www.fifa.com) will provide a Post Match Summary Report for the 2022 FIFA World Cup Qatar. Official Documents in PDF (Portable Document Format) format are available in 52 match reports. The official website of the Asian Football Confederation (www.the-afc.com) will provide match results and official analysis of the 2023 Asian Cup Qatar. The Post Match Summary Report is available in PDF (Portable Document Format) format, and a total of 36 Official Documents are available as match reports. A total of 88 match reports were collected. For example, after the opening match between Qatar and Lebanon, a report like <Table 2> is submitted.

Table 2. Analytics reports and their types and contents.

Report types	Factors
In possession	Possession
Out of possession	No ownership
Goalkeeping	Goalkeepers
Set plays	Set play
Individual data in possession	Personally owned data
Individual data out of possession	Non-personally identifiable data
Individual data physical	Personalized fitness data

2.3. Research variables

We reviewed the analytical reports provided by FIFA and AFC and borrowed the information we wanted to use in this study. We derived the contents related to player movements. The following factors are reported in the individual physical fitness data, and the specific factors are shown in <Table 3>.

Table 3. Personal fitness factors.

Factors	Contents
Distance(m)	Total distance traveled
Zone 1 (walk): 0-7 Km/h (m)	Distance traveled between 0-7 miles per hour
Zone 2 (jog): 7-15 Km/h (m)	Travel between 7-15 miles per hour
Zone 3 (run): 15-20 Km/h (m)	Travel between 15-20 miles per hour
Zone 4 (HIR): 20-25 Km/h (m)	Travel between 20-25 miles per hour
Zone 5 (Sprint): 25+Km/h (m)	Traveling over 25 miles per hour
High Speed Run(n)	High-intensity run recovery
Sprints(n)	Recovering strategy runs
Top speed(Km/h)	Maximum speed

2.4. Data processing method

Microsoft Office Excel 2023 was used primarily for record keeping to organize the official reports available for the 2022 World Cup Qatar and 2023 Asian Cup Qatar. To statistically process the data, PASW statistics 18.0 was used to perform independent t-tests for qualification to the round of 16 (successful and unsuccessful) and one-way ANOVA to test for differences in behavior across continents. LSD was used as a post hoc test with a significance level of $\alpha=.05$. As for the educational satisfaction, 3 factors were extracted from 26 items to 11 items, excluding the items with low factor loadings. They explain 82.246% of the total factor variance. The inter-factor loadings between each item were .50 or greater.

3. Results

3.1. Analyzing the difference in overall movement between the World cup and Asian cup

The results of the overall movement differences between the 2022 World Cup in Qatar and the 2023 Asian Cup in Qatar are shown in <Table 3>. Differences were found in all areas except Zone 2(jog) ($P=.371$), Zone 5(sprint) ($P=.418$), and Top Speed ($P=.497$). Total Distance ($P<.000$, $1M=10453.12$, $2M=10839.65$), Zone 1(walk) ($P<.000$, $1M=3801.71$, $2M=4051.56$), Zone 3(Run) ($P<.000$, $1M=1361.66$, $2M=1482.65$), while countries participating in the Asian Cup were higher in High Speed Runs ($P=.000$, $1M=120.83$, $2M=73.16$) and Sprints ($P=.000$ $1M=46.45$, $2M=15.40$).

Table 4. World cup-Asian cup overall movement difference analysis.

Contents		N	Mean	SD	t	p
Total distance (m)	1	533	10454.12	1033.77	-5.821	0.000
	2	463	10839.65	1072.16		
Zone 1 (Walk): 0-7 km/h (m)	1	533	.3801.71	366.42	-9.762	0.000
	2	463	4051.56	449.35		
Zone 2 (Jog): 7-15 km/h (m)	1	533	4480.74	815.22	-0.894	0.371
	2	463	4524.76	739.04		
Zone 3 (Run): 15-20 km/h (m)	1	533	1361.66	412.59	-4.741	0.000
	2	463	1482.65	395.94		
Zone 4 (HIR): 20-25 km/h (m)	1	533	600.38	204.74	2.143	0.032
	2	463	574.06	182.60		
Zone 5 (Sprint): 25+ km/h (m)	1	533	212.34	136.78	0.811	0.418
	2	463	205.80	116.74		
High speed runs (n)	1	533	120.83	28.75	29.556	0.000
	2	463	73.16	21.24		
Sprints (n)	1	533	46.45	14.12	42.710	0.000
	2	463	15.40	7.36		
Top speed	1	533	31.29	2.00	-0.679	0.497
	2	463	31.66	12.66		

Note: 1: Qatar 2022 world cup, 2: Qatar 2023 asian cup.

3.2. Analyze the difference between World cup continental and Asian cup movements

The results of the analysis of the difference in movement between the World Cup continent and the Asian Cup are shown in <Table 4>. Total Distance($F=12.026$ $P<.001$), Zone 1($F=19.175$ $P<.001$), Zone 2($F=3.901$ $P<.01$), Zone 3($F=7.090$ $P<.001$), High Speed Runs($F=179.855$ $P<.001$), Sprints($F=366.907$ $P<.001$), and no significant difference in Zone 4 ($F=1.810$), Zone 5 ($F=1.504$), and Top Speed ($F=0.116$).

The post hoc test (LSD) results show that Total Distance is highest in the Asian Cup (10839.65m), followed by Europe (10632.09m), North and Central America (10486.1m), Asia (10438.29m), Africa (10422.54m), and South America (9915m), and lowest in Africa and South America. In particular, the Asian Cup is the most running continent with about 10.8 kilometers, which is at least 0.4 kilometers more than Africa and South America. Zone 1 (walk) is highest in the Asian Cup (4051.56 meters), followed by Africa (3830.57 meters), Asia (3809.31 meters), Europe (3798.21 meters), North and Central America (3788.74 meters), and South America (3776.11 meters). Zone 2 (jog) is highest in Europe (4594.94 meters), North America (4531.13 meters), and the Asian Cup (4524.76 meters), and lowest in South America (4146.54 meters). Zone 3 (run) is highest in Asian Cup (1482.65 meters) and Europe (1418.91 meters), and lowest in South America (1228.41 meters). High Speed Runs were highest in Europe (123.8n), North and Central America (121.54n), Africa (119.42n), and Asia (119.27n), with South America (111.44n) higher than the Asian Cup (73.16n). Sprints were highest in Asia (48.58n), Africa (47.37n), Europe (46.04n), North and Central America (45.26n), and South America (44.80n), with the Asian Cup being the lowest.

Table 5. Analyzing the difference between world cup continental and asian cup movement.

		N	Mean	SD	F	Hoc
Total distance (m)	1	70	9915.30	874.95	12.026	1<5,3,4,2,6
	2	225	10632.09	1053.56	***	
	3	95	10438.29	990.00		
	4	68	10486.10	1114.32		
	5	95	10422.54	953.62		
	6	463	10839.65	1072.16		
	Total	1016	10629.81	1068.33		
Zone 1: 0-7 km/h (m)	1	70	3776.11	411.84	19.175	1,4,2,3,5<6
	2	225	3798.21	397.41		
	3	95	3809.31	360.93		
	4	68	3788.74	281.65		
	5	95	3830.57	314.99		
	6	463	4051.56	449.35		
	Total	1016	3915.57	424.76		
Zone 2: 7-15 km/h (m)	1	70	4146.54	822.40	3.901	1<6,4,2
	2	225	4594.94	836.12	**	
	3	95	4479.06	851.54		
	4	68	4531.13	717.15		
	5	95	4422.13	727.24		
	6	463	4524.76	739.04		
	Total	1016	4500.80	781.36		
Zone 3: 15-20 km/h (m)	1	70	1228.41	308.32	7.090	6,2>1
	2	225	1418.91	418.45	***	
	3	95	1335.55	466.26		
	4	68	1370.25	448.06		
	5	95	1344.21	360.60		

	6	463	1482.65	395.94		
	Total	1016	1416.79	409.36		
Zone 4: 20-25 km/h (m)	1	70	549.11	175.81	1.810	
	2	225	613.92	215.34		
	3	95	604.87	188.94		
	4	68	583.50	219.52		
	5	95	613.68	200.31		
	6	463	574.06	182.60		
	Total	1016	588.39	195.61		
Zone 5: 25+ km/h (m)	1	70	214.27	140.98	1.504	
	2	225	200.06	122.11		
	3	95	240.97	154.02		
	4	68	212.32	172.97		
	5	95	211.40	116.19		
	6	463	205.80	116.74		
	Total	1016	209.36	128.02		
High speed runs(n)	1	70	111.44	23.49	179.855	6<1<3,5,4,2
	2	225	124.80	30.04	***	
	3	95	119.27	26.65		
	4	68	121.54	34.07		
	5	95	119.42	25.57		
	6	463	73.16	21.24		
	Total	1016	99.11	34.92		
Sprints(n)	1	70	44.80	13.27	366.907	6<1,4,2,5,3
	2	225	46.04	13.45	***	
	3	95	48.58	14.50		
	4	68	45.26	17.07		
	5	95	45.26	13.55		
	6	463	47.37	7.36		
	Total	1016	15.40	19.30	0.116	
Top Speed(km/h)	1	70	31.34	1.81		
	2	225	31.20	2.02		
	3	95	31.34	1.90		
	4	68	31.13	2.42		
	5	95	31.53	1.91		
	6	463	31.66	12.66		
	Total	1016	31.46	8.67		

Note: *** p<.001, ** p<.01, * p<.05.

1: South America, 2: Europe, 3: Asia, 4: North and Central America, 5: Africa, 6: Asian Cup.

4. Discussions

The purpose of this study is to analyze the movements of players who competed in the 2022 World Cup in Qatar and the 2023 Qatar Asian Cup in order to analyze their movements by tournament and continent. Collectively, we will analyze the results and discuss them as follows.

When analyzing the movement of players who competed in the 2022 World Cup in Qatar and the 2023 Asian Cup in Qatar, we found differences in Total Distance , Zone 1 (walk) and Zone 3 (run). The total distance of the World Cup was 10.4 kilometers, which is similar to Hong's study (10.2 kilometers)[11]. The Asian Cup is 10.8 kilometers, which is about 0.4-0.6 kilometers more than the World Cup. Meanwhile, professional soccer players move an average of more

than 10 kilometers per game[12]. This means that players in international competitions and professional team games average a total distance of more than 10 kilometers, but the efficiency of their movements seems to have a significant impact on their performance. Compared to the Asian Cup, the World Cup is a higher-level event, which means that players play more efficiently while traveling less distance.

Zone 1 (walk) and Zone 3 (run) movements were higher in the Asian Cup than in the World Cup. Asian nations participating in the 2018 World Cup in Russia also showed high levels of Zone 1 and Zone 3[13], which is consistent with the results of this study. The reason why Asian players in the World Cup have more walks and runs is likely due to the high level of defensive activity in the World Cup compared to other continents.

High Speed Runs and Sprints factors were higher for countries participating in the World Cup than the Asian Cup. High speed runs are a recurring phenomenon during soccer matches and are one of the most important factors in match performance[14]. In addition, found that English Premier League and La Liga players perform a much higher percentage of high-speed runs than players in other leagues[15][16][17][18][19][20]. This proves that this factor is very important in world-class competition. Sprint was higher in the World Cup than in the Asian Cup. Sprints support the findings of this study which found that players in European and South American leagues compete more often than in Asia or other parts of the world[21][22]. On the other hand, the 2018 World Cup in Russia did not show a difference in the number of sprints[23][24], which contradicts the results of this study, and can be attributed to differences in climatic factors between Qatar and Russia[25].

When analyzing the difference between the continents that participated in the World Cup and the Asian Cup, we found that the Asian Cup (10.8 kilometers) travels the most distance in total distance, while South America (9.9 kilometers) travels the least, meaning that South America plays efficient soccer with about 1 kilometer less distance than Asia[26][27]. The 2018 World Cup in Russia also showed the lowest total distance traveled by South American countries, supporting the results of this study

In Zones 2 and 3, the movement of South America is lower than other continents. South America was also underrepresented at the 2018 World Cup in Russia, which is consistent with this study. South America has higher recoveries in other Sprints and high-intensity movements than in Zone 2. This is likely due to the fact that South American nations play a quick space penetration style of tactics with short passes.

High Speed Runs (m) were highest in Europe and lowest in South America and the Asian Cup. found that soccer players made more high-speed runs in the first 15 minutes of the game and the last 15 minutes of the game, and that the higher the pressure and tempo of the game, the higher the number of high-speed runs[28]. European teams tend to favor straightforward and quick attacking transitions, which is why they need High Speed Runs. Asian teams tend to play a more controlled game, emphasizing body distribution, positioning, and stability over high-speed runs. They also tend to have more gradual buildups and defensive moves rather than quick transitions, which may explain why they have fewer high-speed runs[29].

Sprinting is a high-intensity movement, and players at the Asian Cup performed it at a much lower rate than their continental counterparts at the World Cup. Sprints are most often repeated at distances of 1-5 meters during a match, and at distances of 6-10 meters, they are more common in the attacking positions[24][30]. This difference is likely due to the higher quality of the teams at the World Cup compared to those at the Asian Cup. This means that players from Asian countries train a lot of high-intensity movements and play in such a way that these movements are more likely to be seen in actual matches[27].

5. Conclusion and Recommendations

The study collected official match analysis reports from the 2022 World Cup in Qatar and the Asian Cup in Qatar in 2023 to identify differences in the factors that drove the behavior.

The analysis shows that the Asian Cup has higher movement than the World Cup in Total Distance, Zone 1 (walk), and Zone 3 (run). This suggests that Asian soccer has a higher total distance traveled and more low-intensity movements during matches compared to global soccer. High Speed Runs and Sprints factors were higher in the World Cup compared to the Asian Cup. This suggests that most of the players in the World Cup play in the world's top leagues and use a lot of high-speed runs and sprints, which means they need to increase the frequency of these movements to perform well.

When analyzing the differences between the continents that participated in the World Cup and the Asian Cup, we found that the Asian Cup had higher movement in Total distance and South America had lower movement. In Zone 2 and Zone 3, South America's movement is lower than the other continents. This is likely due to the fact that South American nations play a quick, space-penetrating style of play with short passes. High Speed Runs (m) is highest in Europe. European teams favor straightforward and quick attacking transitions, resulting in a higher distance for High Speed Runs. Sprints are high-intensity movements, and Asian Cup players performed very low in them compared to the continents that competed in the World Cup. This suggests that players from Asian nations need to change their movements through high-intensity related training.

The study compared soccer styles and game strategies across continents and races in the World Cup and Asian Cup. This allowed us to diagnose the performance of Asian soccer and identify areas for future improvement. Future studies should include data from a wider range of competitions and time periods for a more comprehensive analysis. It is hoped that this study will help Asian nations develop their training programs and tactics.

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7. Appendix

7.1. Author's contribution

	Initial name	Contribution
Lead Author	SH	<ul style="list-style-type: none">-Set of concepts <input checked="" type="checkbox"/>-Design <input checked="" type="checkbox"/>-Getting results <input checked="" type="checkbox"/>-Analysis <input checked="" type="checkbox"/>-Make a significant contribution to collection <input checked="" type="checkbox"/>-Final approval of the paper <input checked="" type="checkbox"/>-Corresponding <input checked="" type="checkbox"/>-Play a decisive role in modification <input checked="" type="checkbox"/>
Corresponding Author*	TK	<ul style="list-style-type: none">-Significant contributions to concepts, designs, practices, analysis and interpretation of data <input checked="" type="checkbox"/>-Participants in Drafting and Revising Papers <input checked="" type="checkbox"/>-Someone who can explain all aspects of the paper <input checked="" type="checkbox"/>

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Breaking Silence: LGBTQ+ Athletes in the Evolving Chinese Sports Landscape

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Abstract

Purpose: The purpose of the study was to provide a critical review of existing research and explore the unique context of LGBTQ+ athletes in China. This study closes a significant gap in the literature, which is mainly concentrated in Western countries, and explores the sociocultural and political dynamics that influence the experiences of LGBTQ+ athletes in China. Through this research, we will further understand the difficulties faced by Chinese LGBTQ+ athletes and propose evidence-based strategies and policies to foster a more inclusive and supportive sports environment. We aim to contribute to the global debate on diversity and inclusion in sports, and strive to have the demands inherent in China's LGBTQ+ recognized and addressed.

Method: This study employed a literature review method to analyze international inclusion of LGBTQ+ athletes, and focuses on Chinese inclusion of LGBTQ+ athletes. It explored the social, cultural, legal and political background that affects LGBTQ+ athletes in China. This study combines research results from different sources such as academic journals, policy reports, and media analysis to provide an overall perspective on the current status of Chinese LGBTQ+ athletes.

Results: The results of the study show that LGBTQ+ athletes in China face severe discrimination and exclusion due to social prejudice, insufficient legal protection, and lack of policy support within sports organizations. They often face barriers such as homophobia, heterosexism, and participation. The study highlights the role of traditional cultural values, media representation and political factors in continuing to address these issues. Despite some progress, there are still significant gaps in support and awareness of LGBTQ+ athletes in China.

Conclusion: Creating a more inclusive and supportive environment for Chinese LGBTQ+ athletes require legal reform, policy advocacy, and cultural change. The study highlights the importance of developing and training tailored educational programs for sports administrators, promoting positive media expression, and fostering community-based initiatives. The study calls on academics, policymakers and practitioners to work together to address the unique issues facing LGBTQ+ athletes in China and promote diversity and inclusion in sport worldwide.

Keywords: LGBTQ+, Chinese Sports, Discrimination, Inclusion, Socio-Cultural Dynamics

1. Introduction

Over the past two decades, sport policymakers have encountered significant challenges in promoting demographic diversity within professional sports [1][2]. Efforts have been made to ensure that traditionally underrepresented or marginalized groups can access the psychosocial and health benefits associated with sport participation [3][4].

Despite these efforts, professional athletes, particularly those identifying as lesbian, gay, bisexual, transgender, and queer (LGBTQ+), often face hostile environments within sports organizations, encountering discrimination from teammates, leaders, and fans [5][6]. This persistent

discrimination can be attributed to several factors, including leaders' lack of expertise in diversity policy creation and individual prejudicial attitudes[7][8][9]. These factors lead to the slow pace of change within sports organizations, resulting in significant resistance at the micro level.

This resistance manifests in practices that silence LGBTQ+ athletes, such as the denial of homophobic actions by clubs and teams[10]. This situation is particularly pronounced in China, where the lack of national protective laws and political discourse addressing LGBTQ+ issues further exacerbates the challenges faced by LGBTQ+ athletes.

China lacks legal and political support for LGBTQ+ individuals, in contrast to Western societies, where laws prohibit discrimination based on sexual orientation or gender identity, ensuring equal treatment in similar circumstances[11]. Additionally, no specific ministry or government department is responsible for matters related to sexual orientation and gender identity[12]. This absence of support, combined with political controls on civil sector organizations and media censorship of sex-related content, has significantly hindered the development of LGBTQ+ culture, expression, and public advocacy on LGBTQ+ matters, especially in sport settings[13][14].

The impact of these challenges in the social and participation context of sport is evident in the stressors faced by LGBTQ+ athletes. These stressors include discrimination such as sexism, homophobia, and heterosexism, which is defined as prejudice against homosexuals by heterosexuals on a cultural, institutional, and personal level [15][16][17]. It is important to understand that social pressures since these stressors have a significant impact on participants' sporting experiences.

Furthermore, sport environments often reflect broader social attitudes and sometimes exacerbate social prejudice. For LGBTQ+ individuals, participating in sport can mean dealing with a complex environment of both acceptance and discrimination. In this environment, a variety of negative behaviors such as sexism, homophobic epithets, physical violence, and organizational discrimination may also occur[18]. In addition, proximal stressors such as fear of rejection, hiding sexual identity, and internalized homophobia also play an important role, leading to chronic stress, anxiety, and burnout.

In order to effectively address these issues, a deeper understanding of homophobia is essential. Weinberg (1972) originally defined homophobia as the fear of being close to homosexuals, but the term has expanded to include broader societal prejudice against a variety of sexual orientations[19][20]. These changes reflect not only fear but also a more comprehensive understanding of discrimination against LGBTQ+, including disgust, exclusion, and institutional inequality.

The adverse effects of these social pressures extend beyond the sports environment, reflecting larger societal issues. They can lead to poor health outcomes for LGBTQ+ individuals, such as anxiety, depression, self-harm, and suicidal behaviors, driven by heteronormative and homophobic prejudice[21][22]. This stress is further exacerbated by a lack of social support and the necessity to hide one's sexual orientation[23][24]. Meyer's (2003) model of LGBTQ+ stress highlights the disproportionate pressures on stigmatized groups due to their marginalized status, underscoring the need for systemic change and supportive environments.

Furthermore, research on LGBTQ+ discrimination in sport emphasizes the broader sociocultural context and the reinforcement of sexism and homophobia[25][26]. Sports often mirror societal values, reinforcing traditional gender roles and heteronormativity. As a result, male athletes who do not conform to traditional masculinity face pejorative labeling, which reinforces negative gender stereotypes and homophobia[27].

Despite progress in some areas, such as professional athletes' coming out and increased acceptance, homophobia remains a significant stressor for LGBTQ+ individuals in sports[28]. The

continued relevance of these issues highlights the ongoing challenges faced by LGBTQ+ athletes and underscores the necessity for sustained efforts to create safer, more inclusive environments.

Given China's unique socio-cultural and political context, it is imperative to explore how these factors influence the experience of LGBTQ+ athletes in Chinese sports. Unlike many Western countries, where legal and social acceptance of LGBTQ+ has greatly increased, China has a different environment and faces unique challenges and dynamics. The combined effects of traditional values, political control, and media censorship in China, LGBTQ+ athletes face a complex environment that is very different from that in the West[29][30].

Therefore, the purpose of this study was to critically review existing research and explore the unique context of LGBTQ+ athletes in China. This study explored the socio-cultural and political dynamics that affect the experiences of LGBTQ+ athletes in China based on the current situation and existing literature in Western countries. Through this investigation, this study aimed to deepen the understanding of the difficulties faced by LGBTQ+ athletes in China and proposed evidence-based strategies and policies to create a more inclusive and supportive sporting environment. It will contribute to the global discourse on diversity and inclusion in sport and strive to understand and address the inherent requirements of LGBTQ+ athletes in China.

2. A Historical Review of the Global LGBTQ+ Rights Movement

In the mid-20th century, the LGBTQ+ rights movement began to emerge in Western countries, striving to decriminalize and depathologize homosexuality. Legalizing gay sex was one of the early goals of the movement. The Stonewall Riots in 1969 were an important milestone in the LGBTQ+ rights movement in the United States, demonstrations and advocacy activities around the world. Since then, many countries have decriminalized homosexual behavior and gradually depathologized homosexuality in the 1980s and 1990s[31]. In the 2000s, many countries passed anti-discrimination laws to protect the rights of LGBTQ+ in employment, education, and public services. In 2001, the Netherlands became the first country to allow same-sex marriage, and many other countries followed suit. In addition to the growing recognition of gender identity and transgender rights, increasing attention has been directed towards the rights of transgender individuals[32].

Based on this evidence, the global LGBTQ+ human rights movement has made significant progress. Since the mid-20th century, society has continued to develop acceptance and respect for diversity in gender and sexual orientation. The impact of this movement is gradually becoming evident in the field of sports as well, breaking long-standing heterosexual norms and gender discrimination. Individuals are emerging, fighting for greater causes, including the rights and recognition of LGBTQ+ athletes.

With the support of the LGBTQ+ human rights movement, international sports organizations have gradually adopted inclusive policies. For example, the International Olympic Committee (IOC) adopted a gender identity policy in 2003, allowing transgender athletes to participate as long as they meet certain conditions. In 2015, the IOC updated the policy on transgender athletes, marking an important milestone in sports policy[33]. The 2016 U.S. Supreme Court ruling on the legalization of same-sex marriage provides legal protection for the social acceptance of LGBTQ+ athletes. During this period, research indicated that policy adjustments aimed at increasing inclusiveness also faced significant challenges and controversies[34].

There are also sports events for the LGBTQ+ community, such as the Gay Games, which began in 1982[35]. These events provide a safe and inclusive competitive environment for LGBTQ+ athletes, showcase their diversity and competitive abilities, and promote social acceptance of

the LGBTQ+ community. The global LGBTQ+ rights movement has achieved remarkable results in the field of sports, promoting a number of policy reforms and changing social attitudes.

In 2016, the IOC further relaxed the competition conditions for transgender athletes, no longer requiring gender reassignment surgery, but mandating certain hormone level requirements[36]. Multiple openly LGBTQ+ athletes have become pioneers in the sports world, inspiring more athletes to be open about their sexual orientation or gender identity. Billie Jean King, who came out as gay in 1981, set a role model for LGBTQ+ athletes and promoted social acceptance[37]. Similarly, the public status and success of athletes like Greg Louganis and Matthew Mitcham have increased the visibility and recognition of the LGBTQ+ community in sports[38][39]. These openly identified and successful LGBTQ+ athletes earn respect through their courageous actions and exceptional performances, paving the way for future LGBTQ+ athletes and pushing the sports world towards greater inclusion and equality.

Moreover, the Tokyo 2021 Olympics marked the first time in history that the event featured a significant number of LGBTQ+ athletes. The success of these Games indicated widespread acceptance of LGBTQ+ athletes in sports. The Paris 2024 Olympic Games were expected to continue promoting inclusion, particularly with the participation of transgender and non-binary athletes, further enhancing diversity and inclusion in sports[40]. As society's recognition of LGBTQ+ rights increases, more athletes are able to enjoy widespread support and recognition even after coming out. Social media and modern communication tools are helping these athletes spread their stories, increasing the influence of the LGBTQ+ community in sports[41].

3. The Status Quo of LGBTQ+ Attitudes in China and in Sports

Historically, homosexuality was outlawed in China until the 1950s[42]. It was not until 1997 that China's Criminal Law removed the criminal penalty for homosexual acts, marking a key step in the decriminalization of homosexuality. In contemporary China, LGBTQ+ are often tolerated as long as they keep their sexual orientation private and refrain from demanding equality[43]. Despite a gradual increase in societal acceptance, prejudice and discrimination remain prevalent. A 2016 national survey indicated that 55% of respondents held neutral or negative attitudes toward homosexuality[44]. A 2020 study highlighted that while younger generations are more accepting of the LGBTQ+ community, traditional attitudes persist among older and conservative families[45].

This persistence is also reflected in media coverage of LGBTQ+ in China, which tends to focus on events that provoke discussion and controversy, rather than systemic rights and protection issues. This pattern of reporting can reinforce stereotypes and discrimination[43]. On social media platforms, discussions about LGBTQ+ topics show a mix of support and advocacy alongside negative and discriminatory comments, reflecting the complex societal attitudes toward LGBTQ+ individuals[46].

Attitudes towards the LGBTQ+ community in Chinese sports are still evolving. Despite some progress at the legal and policy levels, explicit protections for LGBTQ+ athletes are lacking. In some universities and sports organizations, such as Beijing Sport University, supportive activities for the LGBTQ+ community are emerging. These initiatives include LGBTQ+ friendly sporting events and lectures aimed at promoting understanding and support[47].

Meanwhile, some Chinese athletes have shown support for the LGBTQ+ community through personal actions, such as sharing their support on social media. Although these actions are relatively rare, they have helped raise awareness of LGBTQ+ athletes in society[48]. However, negative incidents still highlight the challenges faced by LGBTQ+ athletes. For example, after Guan

Yingnan came out as a lesbian in 2017, she faced severe online harassment and threats, reflecting the widespread prejudice and hostility toward LGBTQ+ individuals in Chinese society [49].

Additionally, sports media in China often display bias in their coverage of LGBTQ+ athletes, using derogatory terms or ridiculing athletes' sexual orientation, which harms individual athletes and perpetuates negative societal perceptions [50]. The organizers of the 2019 Beijing Gay and Lesbian Sports Games faced significant challenges, including venue rental cancellations and administrative obstacles, due to the nature of the event. Some women's soccer players have faced workplace discrimination and reduced playing opportunities after coming out as lesbians, affecting their career development and mental health [51].

In conclusion, while the social environment in China is improving, the LGBTQ+ community still faces substantial prejudice and oppression in sports. For example, transgender athletes often encounter obstacles in entry qualifications, and sports institutions have unclear policies, resulting in unfair treatment in competitions and daily training [52]. These negative incidents not only harm the individual rights and interests of LGBTQ+ athletes but also hinder the development of diversity and inclusion in China's sports community.

4. Social and Cultural Influences: Cultural Attitudes, Media Representation

In western countries, reflecting widespread social values and laws, there is evidence that social attitudes have also improved in sports, with increased inclusion, increased acceptance of LGBTQ+ identity, and decreased cultural homosexuality [53][54]. However, heterosexuality is still prevalent in sports and acts as a mechanism of social exclusion. Menzel et. al (2019) conducted quantitative research to recruit LGBTQ+ (N=5524), and 16.7% of participants are transgender. They found out that over the past six months, 82% of participants reported witnessing expressions of homophobia or transphobia in sport, and 90% believed homophobia and transphobia were ongoing issues in sport environments. Among respondents, transgender people (46.2%) were most likely to have experienced direct discrimination in the past year.

In the case of China, the lack of a national Protection law and national political discussion addressing the issue of LGBTQ+, especially in a sports setting, has significantly hindered the development of LGBTQ+ culture and performance. The lack of legal and political assistance limits political control over civic groups and media censorship of sexual content, as well as public discussion and advocacy of LGBTQ+ issues [55]. Although the Chinese government accepted the recommendation of the UN Human Rights Council to enact a law on the Prohibition of Discrimination, its implementation has been slow and difficulties persist [56]. Moreover, China's cultural attitude towards LGBTQ+ is formed by the combination of traditional values and modern social dynamics. China is influenced by the Confucian culture of family and lineage, which emphasizes social harmony. These values often foster expectations of the opposite sex and discourage behaviors that are perceived as impeding social cohesion. As a result, non-heterosexual sexual orientation and sense of sexual identity have been branded throughout history [57][58].

The dynamics of modern society are changing this traditional attitude. With globalization through the media, travel, the Internet and increased exposure to international perspectives on the human rights of LGBTQ+, traditional norms are being challenged [59][60][61]. Younger generations, in particular, are more susceptible to global cultural trends that embrace LGBTQ+ identity. Additionally, due to urbanization and modernization, the urban social environment is more diverse and liberalized compared to the countryside, and attitudes are gradually changing. A significant factor affecting these changing attitudes is media representation.

Media representation in China plays an important role in shaping public perception and attitudes of LGBTQ+ individuals. Historically, mainstream media have portrayed LGBTQ+ in ways

that stigmatize LGBTQ+, and have often associated homosexuality with deviance and disease[12]. The State Administration of Press, Publication, Radio, Film and Television (SARFT) has restricted positive representations of LGBTQ+, further solidifying social prejudices and limiting the scope of public discussion[55]. Despite efforts to control this narrative, negative reporting on LGBTQ+, perpetuating negative public attitudes and impeding progress towards public acceptance and inclusion. These persistent negative reports have a long-term impact on public perception and social acceptance of LGBTQ+ in the country.

For LGBTQ+ athletes, negative media portrayals help reinforce stereotypes and create a culture of silent exclusion within the sporting environment. Such portrayals can lead to homophobia, and athletes may feel compelled to hide their sexual orientation, further isolating themselves from potential support networks[62][63]. Prior research has shown that media portrayals of LGBTQ+ athletes often emphasize deviance rather than normalization, further exacerbating the difficulties these athletes face[64][65]. The ongoing stigma perpetuated by such media portrayals creates significant barriers for LGBTQ+ athletes, adversely affecting their mental health and overall well-being[66][67].

However, the media has consistently questioned these norms. In 2015, the landmark event of independent filmmaker Bobo Fan challenging the removal of the trailer for an LGB-themed documentary highlighted the potential of media and legal measures to promote visibility and competition regulation[55]. These efforts highlighted a changing landscape of media representation, suggesting a gradual shift toward acceptance and inclusion as visibility of LGBTQ+ issues and individuals in China increases.

Additionally, international media and global sporting events have a significant impact on domestic cultural attitudes towards LGBTQ+ individuals. The participation of openly LGBTQ+ athletes in international competitions and the media coverage of these events serve as a powerful symbol of acceptance and inclusion. This international exposure can inject vitality into local sports and shift public perceptions towards LGBTQ+ athletes to a more positive one. For example, the visibility of LGBTQ+ athletes at events such as the Olympics can challenge existing prejudices and provide inspiration for an inclusive sporting culture around the world, including in China[68][69]. Research has demonstrated that positive media representation and international visibility are critical to changing public attitudes and increasing acceptance[70][71].

Despite these incremental changes, significant obstacles remain. The interplay between media representation and cultural attitudes continues to present challenges for LGBTQ+ athletes in China. For example, stigma and lack of positive representation in the media contribute to the persistence of discriminatory behavior in sports environments, which discourages participation by LGBTQ+ athletes and exacerbates physical and mental health issues[72].

5. Implications

The evidence discussed highlighted the urgent need for research collaboration and to look at solutions to address the discrimination and exclusion faced by LGBTQ+ athletes in the country. Despite ample evidence of discrimination, resistance from sports administrators and policymakers remains an important barrier to progress. These obstacles often stem from a lack of expertise and resources needed to develop effective diversity initiatives[8][10][73].

Theoretically, this study highlighted the gaps in existing domestic research on LGBTQ+ athletes. The lack of comprehensive data and a customized theoretical framework for China's unique socio-cultural environment hinders development. In order to consider the interaction between Confucian values that shape attitudes toward LGBTQ+ and modern social dynamics, existing theories need to be modified. Additionally, the study underscored the need to integrate

intersectionality theories to understand the multifaceted experiences of discrimination and exclusion faced by LGBTQ+ athletes in China[74]. Developing these theoretical frameworks would lay the foundation for effective intervention and policy formulation.

In fact, to promote LGBTQ+ inclusion in Chinese athletes, there is an urgent need to develop and implement evidence-based programs and policies. Based on the expertise and accessibility of the sports environment, sports management scholars in China are uniquely positioned to lead these efforts. Joint research with public health academics and practitioners can draw on a variety of expertise to develop integrated interventions[75][76].

Meanwhile, it is imperative to implement educational resources and training programs that conform to Chinese cultural and political background. These programs must be rigorously evaluated to effectively address discrimination and promote inclusion[8][77]. The development of comprehensive teaching materials and the holding of seminars equip sports managers with the necessary skills to create an inclusive environment within the unique constraints of Chinese society.

Policy advocacy is also important. Promoting the introduction and implementation of anti-discrimination and gender equality legislation in China is critical to creating a supportive environment for LGBTQ+ athletes. This includes advocating positive media representation of LGBTQ+ athletes and guaranteeing equal rights for LGBTQ+ athletes in areas such as common property, hospital access, adoption, inheritance, etc[12]. By engaging with Chinese policymakers and advocating for legislative changes, a supportive legal framework can be built.

6. Future Research Directions

Future research should prioritize identifying the specific barriers faced by sports administrators and policymakers in addressing LGBTQ+ diversity issues within Chinese sports. A deeper understanding of these challenges could lead to the development of targeted strategies that promote more inclusive practices and meaningful support[78]. In addition, research should explore sociopolitical dynamics that influence resistance and develop targeted interventions to address these factors.

Additionally, future research is needed to develop and test interventions to reduce discrimination and improve the experiences of LGBTQ+ athletes in Chinese sports. This includes evaluating existing teaching materials, creating new culturally sensitive materials tailored to the unique tasks of the Chinese sports environment[79]. Pilot and longitudinal studies can assess the effectiveness of these interventions and promote good practices.

To fully understand the issues facing LGBTQ+ athletes, it is imperative to use different quantitative and qualitative research methods. Quantitative research can provide extensive data on the prevalence and types of discrimination, and qualitative research can provide insights into individual experiences and the effectiveness of interventions. Combining this approach can provide a richer and more nuanced understanding of the problems and potential solutions[80]. Research should investigate the intersections of multiple forms of discrimination such as homophobia, fection, sexism, and how this intersectional identity affects the experience of LGBTQ+ athletes in China[74]. Understanding the subtle experiences of players with multiple identities can lead to a more comprehensive and inclusive diversity strategy.

Finally, expanding research into the benefits of LGBTQ+ diversity on the overall success of sports teams and the experience of all participants could underscore the value of inclusive practices. Demonstrating the commercial and social benefits of diversity can motivate Chinese sports administrators to embrace inclusive practices[81][82].

By covering these areas, future research could create a more inclusive and supportive environment for LGBTQ+ athletes in our sports community, ultimately helping to improve their health, well-being, and participation in sports activities. To this end, scholars, policymakers, and staff need to work together to develop and implement evidence-based strategies to promote diversity and inclusion in China's unique cultural and political environment.

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8. Appendix

8.1. Author's contribution

	Initial name	Contribution
Lead Author	XJ	-Set of concepts <input checked="" type="checkbox"/>
		-Design <input checked="" type="checkbox"/>
		-Getting results <input checked="" type="checkbox"/>
		-Analysis <input checked="" type="checkbox"/>
		-Make a significant contribution to collection <input checked="" type="checkbox"/>
		-Final approval of the paper <input checked="" type="checkbox"/>
Corresponding Author*	HX	-Corresponding <input checked="" type="checkbox"/>
		-Play a decisive role in modification <input checked="" type="checkbox"/>
		-Significant contributions to concepts, designs, practices, analysis and interpretation of data <input checked="" type="checkbox"/>
		-Participants in Drafting and Revising Papers <input checked="" type="checkbox"/>
		-Someone who can explain all aspects of the paper <input checked="" type="checkbox"/>

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Activating Forest Trail Hiking Programs

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Abstract

Purpose: Forest hiking programs have positive effects on health improvement, stress relief, and local economic revitalization. However, addressing issues such as inadequate accessibility and lack of program diversity requires systematic analysis and evaluation. This study aims to analyze the current operational status and explore ways to improve participation rates and program quality. By proposing practical improvement measures, the study intends to provide foundational data for the sustainable development of the program.

Method: This study aims to analyze the status of forest hiking programs based on reports from 2015 to 2023. It will evaluate visitor numbers, participation rates, operational status, and facility conditions to develop strategies for program revitalization. Research questions are focused on changes in visitor numbers, participation rates, operating hours and frequency, and facility conditions. Data were collected from various reports, and key findings were derived through meta-analysis.

Results: From 2015 to 2023, the number of visitors and participation rates for forest hiking programs increased, and the number of programs and operating hours also expanded. Following a temporary decline due to the COVID-19 pandemic, there was a recovery trend. The increase in participation rates was attributed to program diversification, the addition of meditation and family programs. Additionally, facility conditions continuously improved, significantly reducing the need for further improvements by 2023.

Conclusion: Forest hiking programs have increased in visitor numbers and participation rates from 2014 to 2023. Program diversification, quality improvements, facility upgrades, and the introduction of online and hybrid options have boosted satisfaction and accessibility. Enhanced collaboration with the local community has further supported the program's sustainability. These strategies are crucial for the successful operation and development of the programs.

Keywords: Forest Road, Program Quality, Facility Maintenance, Community Involvement, Program Diversification

1. Introduction

Forest hiking programs can bring various positive effects such as health improvement, stress relief, and local economic revitalization through interaction with nature [1]. However, in recent years, there has been increased attention to participation rates and operational efficiency, leading to a heightened awareness of the need for qualitative improvements in the program and an increase in the number of participants [2][3]. The success of such programs is largely dependent on accessibility, diversity of content, and participation from local residents [4]. However, current forest hiking programs face several issues, including insufficient accessibility and lack of program diversity, and there is a need for concrete solutions to address these issues. Systematic analysis and evaluation are essential for resolving these problems [5][6].

This study will thoroughly analyze the current operational status of forest hiking programs and seek ways to increase participation rates and enhance program quality. The analysis will cover visitor numbers, participation rates, program operation status, and facility conditions. Based on the research results, strategies will be developed to improve the operational efficiency of forest hiking programs, enhance participant satisfaction, and strengthen ties with local communities[7][8].

To increase participation rates, it is necessary to improve program accessibility and develop programs that reflect diverse age groups and interests. This includes collaboration with local residents, providing customized programs, and strengthening promotion efforts[9]. To improve program quality, a systematic evaluation and feedback system is required, and it is crucial to actively incorporate participant feedback and continuously update the program content[9]. Additionally, to strengthen ties with local communities, it is necessary to establish communication and cooperation mechanisms with local residents and utilize community resources to enhance the quality of the programs[10][11]. This approach will contribute to increasing the sustainability of the program and improving the local economy and quality of life for residents.

To achieve these goals, this study will collect and analyze various data to diagnose the current status of forest hiking programs and propose practical improvement measures to resolve identified issues. The research results will serve as important foundational data for the successful operation and sustainable development of forest hiking programs[12][13].

2. Research Methods

2.1. Research objectives

To assess the status of forest hiking programs, we will focus on annual reports from local tourism associations, research reports from the Korea Tourism Organization, annual operation plans from the Korea National Park Service, maintenance records from the Korea Forest Service, and facility maintenance management reports from 2015 to 2023. By analyzing visitor numbers, program participation rates, program operation status, and facility conditions, we aim to identify strategies for revitalizing the program.

2.2. Research questions

- 1) How have visitor numbers changed annually?
- 2) How have program participation rates evolved, and what factors have influenced these changes?
- 3) How have program operation hours and annual operation frequency changed, and what changes have occurred in program types?
- 4) How has the condition of facilities changed, and what areas need improvement?

2.3. Data collection

Data on visitor numbers from 2015 to 2023 were collected from official reports of local tourism offices and operating agencies. Program participation rates were obtained from institutional databases and survey results. Program operation status was gathered from annual operation plans and records, while facility conditions were assessed through maintenance records and on-site inspection reports.

2.4. Meta-analysis

The collected data were comprehensively analyzed to derive overall trends and developmental directions for forest hiking programs. This involved creating a meta-analysis table by inte-

grating annual data on visitor numbers, participation rates, operational status, and facility conditions. Patterns and correlations observed in the data were analyzed to identify key findings. The changes in facility conditions over the years were analyzed to determine areas requiring improvement, and trends in facility condition improvements were visualized graphically.

3. Current Status of Forest Trail Hiking Programs by Region(2024)

The status of forest trail hiking programs across various regions in 2024 is detailed in <Table 1>, which provides information on the number of programs, annual total participation, participation rate, main program types, and key landmarks and features in each region.

Table 1. Forest trail hiking program regional status (2024).

Region	Programs	Annual total participation (People)	Participation rate (%)	Key program types	Major attractions and features
Seoul	70	15,000	11.5%	Basic walks, Nature exploration, Historical tours, Experiential activities, Meditation programs, Family programs	Bukhansan, Namsan, Seoul forest
Busan	45	7,500	15.0%	Basic walks, Historical tours, Experiential activities, Meditation programs, Family programs	Geumjeongsan, Haeundae beach, Busan bridge
Daegu	30	5,500	15.0%	Nature exploration, Wildflower observation, Family programs	Palgongsan, Daedeok mountain, Donghwas temple
Incheon	25	4,000	12.0%	Basic walks, Nature exploration, Historical tours	Gyeyangsan, Songdo central park, Incheon port
Gwangju	20	3,500	10.0%	Nature exploration, Wildflower observation, Experiential activities	Mudeungsan, Gwangju lake park, Cheonbyeonsan
Daejeon	18	3,000	11.5%	Basic walks, Nature exploration, Historical tours	Gyeryongsan, Daejeon expo science park, Gapcheon
Ulsan	15	2,500	10.0%	Nature exploration, Experiential activities	Taehwagang, Ganjeolgot, Ulsan grand park
Gyeonggi-do	85	20,000	12.5%	Basic walks, Nature exploration, Historical tours, Experiential activities, Meditation programs	Hwaseong fortress, Gapyung lake, Yangpyeong dumulmeori
Gangwon-do	60	12,000	14.0%	Nature exploration, Wildflower observation, Family programs, Experiential activities	Seoraksan, Odaesan, Pyeongchang trout festival
Chungcheong buk-do	22	4,000	11.0%	Nature exploration, Wildflower observation, Experiential activities	Sobaeksan, Cheongnamdae, Jecheon uirimji
Chungcheong nam-do	28	5,000	12.5%	Basic walks, Historical tours, Experiential activities	Gyeryongsan, Asan hot springs, King muryeong's tomb, Naepo forest trail

Jeolla buk-do	25	4,500	13.0%	Nature exploration, Wildflower observation, Experiential activities	Jirisan, Naejangsan, Jeonju hanok village
Jeolla nam-do	30	6,000	14.5%	Basic walks, Nature exploration, Experiential activities, Meditation programs	Byeonsanbando, Yeosu odongdo, Suncheon bay
Gyeongsangbuk-do	35	7,000	15.0%	Nature exploration, Wildflower observation, Historical tours	Palgongsan, Gyeongju bulguksa temple, Yeongju sosuseowon
Gyeongsangnam-do	32	6,500	14.0%	Basic walks, Nature exploration, Historical tours, Family programs	Jirisan, Tongyeong hallyeo maritime national park, Changnyeong wawangsan
Jeju	12	2,000	10.0%	Nature exploration, Experiential activities	Hallasan, Seongsan ilchulbong, Manjanggul cave

3.1. Regions

Seoul Special City operates the highest number of programs, utilizing various forest trails and hiking routes within the city. Gyeonggi-do and Gangwon-do also have a significant number of programs, reflecting their extensive forest areas and tourism resources.

3.2. Annual total participation

Seoul Special City records the highest annual total participation, attributable to its population density and extensive network of forest trails. Gyeonggi-do and Gangwon-do also exhibit relatively high participation figures due to their abundant natural resources and tourist attractions. Busan Metropolitan City and Daegu Metropolitan City show relatively lower participation numbers but still reflect local interest in forest trail

3.3. Participation rates

Busan Metropolitan City and Daegu Metropolitan City have the highest participation rates, indicating a strong local interest and engagement. These regions primarily offer nature and historical tours, where program quality positively impacts participation rates. Gyeongsangbuk-do and Jeollanam-do also record high participation rates, demonstrating the popularity of forest trail programs in these areas.

3.4. Key program types

To assess the status of forest hiking programs, we will focus on annual reports from local tourism associations, research reports from the Korea Tourism Organization, annual operation plans from the Korea National Park Service, maintenance records from the Korea Forest Service, and facility maintenance management reports from 2015 to 2023. By analyzing visitor numbers, program participation rates, program operation status, and facility conditions, we aim to identify strategies for revitalizing the program.

4. Forest Trail Hiking Program Meta-analysis Table (2015-2023)

The analysis table for forest trail hiking programs from 2015 to 2023 is as shown in <Table 2>.

4.1. Visitor numbers and annual growth rate

In 2015, the number of visitors was 15,000, and by 2023, it had increased to 25,000. Although the annual growth rate showed an overall decreasing trend, it still demonstrated positive

growth. From 2015 to 2019, the annual growth rate was decreasing. In 2020, there was a decline due to the COVID-19 pandemic, but a recovery trend was observed afterward, with the annual growth rate reaching 6.4% in 2023.

4.2. Total number of programs and participants

In 2015, there were 50 programs and 5,000 participants. By 2023, these numbers had increased to 85 programs and 10,000 participants, indicating a continuous growth in both the total number of programs and the number of participants. Notably, in 2020, online programs were introduced, and from 2021 to 2023, both the number of programs and participants showed a stable growth trend.

4.3. Participation rate

The participation rate was 10.0% in 2015 and increased to 11.8% in 2023. This shows an overall upward trend in participation rates, which can be attributed to the diversification of programs, as well as the introduction of meditation and family programs.

Table 2. Forest trail hiking program analysis table (2015-2023).

Year	Number of Visitors	Annual Growth Rate (%)	Total Number of Programs	Number of Participants	Participation Rate (%)	Operating Hours (hours/week)	Annual Frequency (times)	Major Program Types	Need for Facility Improvement (%)
2015	15,000		50	5,000	10.0%	20	200	Basic walks, Nature Exploration	30%
2016	16,500	10.0%	55	5,750	10.5%	22	210	Basic walks, Nature exploration, Wildflower observation	28%
2017	18,000	9.1%	60	6,500	10.8%	24	220	Basic walks, Nature exploration, Historical exploration	25%
2018	19,500	8.3%	65	7,000	10.8%	26	230	Basic walks, Nature exploration, Historical exploration, Experiential activities	20%
2019	21,000	7.7%	70	8,000	11.4%	28	240	Basic walks, Nature exploration, Historical exploration, Experiential Activities	18%
2020	20,000	-4.8%	60	6,000	10.0%	24	220	Online Programs Added	22%
2021	22,000	10.0%	75	8,500	11.3%	26	230	Basic Walks, Nature Exploration, Historical Exploration, Experiential Activities	20%

2022	23,500	6.8%	80	9,200	11.5%	28	240	Basic Walks, Nature Exploration, Historical Exploration, Experiential Activities, Meditation Programs	15%
2023	25,000	6.4%	85	10,000	11.8%	30	250	Basic Walks, Nature Exploration, Historical Exploration, Experiential Activities, Meditation Programs, Family Programs	10%

4.4. Operating hours and annual frequency

Operating hours increased from 20 hours per week in 2015 to 30 hours per week in 2023. The annual frequency of operations also rose from 200 times in 2015 to 250 times in 2023. This indicates that both operating hours and annual frequency have increased, reflecting an expansion in program operations and variety.

4.5. Major program types

From 2015 to 2019, the main programs were basic walks and nature exploration. Starting from 2019, historical exploration and experiential activities were added. In 2022, meditation programs were introduced, and by 2023, family programs were also added, leading to greater program diversification. This expansion aligns with participant demands and current trends.

4.6. Need for facility improvement

The need for facility improvement was 30% in 2015, but this had decreased to 10% by 2023. This reduction indicates that improvements in facility management and maintenance have been achieved

5. Discussion of Issues in Forest Trail Hiking Programs

5.1. Low participation rates

Low participation rates are one of the most common issues in forest trail hiking programs. The primary reasons for low participation are the lack of accessibility and insufficient promotion of the programs[14]. It has been pointed out that inadequate accessibility and promotion negatively impact participation rates, emphasizing the need to enhance accessibility and promotion strategies[15]. Additionally, the diversity of the programs and tailored services are reported to be important in increasing participation rates[16].

5.2. Imbalance in program quality

When the quality of the programs is inconsistent or low, participant satisfaction may decrease, leading to lower re-participation rates[17]. It has been argued that a systematic evaluation and feedback system is necessary to improve program quality, and actively incorporating participant feedback and continuously updating program content are crucial[18]. The involvement of professional staff and regular updates to program content contribute to improving program quality[19].

5.3. Dissatisfaction with facility conditions

Poor facility conditions can cause discomfort among participants and decrease overall program satisfaction. The importance of facility maintenance and safety inspections is emphasized, with regular facility checks and improvements being necessary [20]. Analyzing the impact of facility conditions on program success and noting that improvements in facility conditions contribute to enhancing program quality [21].

5.4. Lack of community engagement

The lack of engagement with the local community negatively affects the sustainability of the programs [22]. It has been noted that insufficient cooperation with local residents can reduce the effectiveness of the programs, highlighting the need to develop communication and collaboration strategies with the community [23]. Additionally, utilizing local resources and encouraging resident participation are reported to play a crucial role in enhancing program sustainability [24].

To address these issues, it is essential to improve program accessibility and promotion, implement systematic evaluations and improvements in program quality, regularly inspect and maintain facilities, and actively engage with the local community. Such approaches will contribute to the overall success and sustainability of forest trail hiking programs.

6. Strategies for Enhancing Forest Trail Hiking Programs

6.1. Increasing participant numbers and participation rates

The number of participants in forest trail hiking programs has steadily increased in recent years, and participation rates are also gradually rising [25]. To sustain this trend and further increase both participant numbers and rates, it is crucial to enhance the accessibility and appeal of the programs. Improving accessibility involves collaborating with local communities to enhance transportation options and providing various participation options [26]. Additionally, increasing participation rates can be achieved through customized programs and events tailored to the interests of the local community [23][27].

6.2. Diversification and improvement of program quality

Recent efforts to diversify programs, including the addition of meditation and family programs, have contributed to increased participant satisfaction [28]. To continuously improve program quality, it is essential to actively incorporate participant feedback and regularly evaluate and update program content [29][30]. Particularly, incorporating additional program elements such as experiential activities and historical tours can provide participants with richer experiences. Developing tailored programs that reflect various age groups and interests is also important [31].

6.3. Facility improvement and maintenance

Initially, facility conditions required improvement, but they have significantly improved recently [32]. Ongoing maintenance and improvements are necessary to keep facilities in optimal condition. Regular inspections and repairs are essential [33]. According to recent studies, well-maintained facilities positively impact overall program success and participant satisfaction, making continuous improvement and upkeep essential [34][35].

6.4. Expansion of online and hybrid programs

As online programs were introduced during the COVID-19 pandemic, expanding online and hybrid programs in the future is necessary [36]. Enhancing program accessibility through online

platforms will allow participants of various ages and locations to easily join, contributing to a broader participant base and increased program flexibility[37].

6.5. Strengthening sustainable community engagement

To strengthen community engagement, collaboration with local residents and utilization of local resources are required[38]. Close cooperation with the community can enhance program sustainability, improve program quality by actively utilizing local resources, and encourage local resident participation[39][40]. This approach will help gain community support and contribute to the successful operation of the programs.

These strategies aim to build on the current success factors of forest trail hiking programs, promote future-oriented development, and play a crucial role in revitalizing the programs through enhanced community collaboration and improved program quality.

7. Conclusion and Future Research Directions

7.1. Conclusion

Forest trail hiking programs have demonstrated successful growth from 2014 to 2023, with continuous increases in both visitor numbers and participation rates. Notably, the diversification of programs, improvement in quality, enhancement of facility conditions, and the introduction of online and hybrid programs have contributed significantly to increasing participant satisfaction and improving program accessibility.

Firstly, the increase in participant numbers and rates is expected to continue as a result of strategies aimed at enhancing program accessibility and appeal. Collaborating with local communities to improve transportation and provide customized programs is likely to further boost these metrics. The diversification and improvement in program quality have played a crucial role in increasing participant satisfaction, with continuous feedback and quality assessments being essential for ongoing content improvements.

Secondly, the increase in operational hours and annual program frequency reflects effective responses to the expansion of programs and participant demands. Recent additions of meditation and family programs have broadened the program's scope, catering to a wider range of age groups and interests.

Thirdly, while facility conditions initially required improvement, recent continuous maintenance and enhancements have positively impacted program success. Ongoing regular inspections and maintenance will remain crucial for sustaining these positive effects.

Fourthly, the expansion of online and hybrid programs has maintained accessibility during the pandemic and will be important for providing flexible participation options for diverse age groups and locations in the future.

Fifthly, strengthening community engagement contributes to the sustainability of the programs. Utilizing local resources and encouraging resident participation are key factors in the successful operation of the programs. Collaboration with the community will be an essential strategy for shaping the future direction of the programs.

In summary, key strategies for revitalizing forest trail hiking programs include diversifying and improving program quality, maintaining continuous facility improvements, expanding online and hybrid options, and strengthening community collaboration. These strategies are expected to contribute to the successful operation and development of the programs, positively impacting local communities and the environment.

7.2. Future research directions

Future research should focus on developing programs and marketing strategies based on various minority statistics, conducting multidimensional evaluations of programs, and establishing systems for improvement. Research should also include developing facility management solutions, analyzing the effectiveness of online and hybrid models, and enhancing program quality. Additionally, developing community cooperation models to encourage local resident participation and utilizing these to improve programs will be essential. These suggestions and research directions will provide foundational data for the successful operation and sustainable development of forest trail hiking programs, serving as a crucial basis for future research and policy development.

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9. Appendix

9.1. Author's contribution

	Initial name	Contribution
Lead Author	SP	-Set of concepts <input checked="" type="checkbox"/> -Design <input checked="" type="checkbox"/> -Getting results <input checked="" type="checkbox"/> -Analysis <input checked="" type="checkbox"/> -Make a significant contribution to collection <input checked="" type="checkbox"/> -Final approval of the paper <input checked="" type="checkbox"/> -Corresponding <input checked="" type="checkbox"/>
Corresponding Author*	XC	-Play a decisive role in modification <input checked="" type="checkbox"/> -Significant contributions to concepts, designs, practices, analysis and interpretation of data <input checked="" type="checkbox"/> -Participants in Drafting and Revising Papers <input checked="" type="checkbox"/> -Someone who can explain all aspects of the paper <input checked="" type="checkbox"/>

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The Influence of Sports Star Image on Sports Engagement among Chinese Adolescents

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Abstract

Purpose: Adolescence is a crucial period for value formation, with sports playing a key role in socialization and adherence to norms. Modern sports convey societal values and influence youth behavior. While there is extensive research on sports stars in Korea, studies on their impact on Chinese youth are limited. This research aims to analyze the images of sports stars to understand their effects on Chinese youths' attitudes and participation, and to provide foundational data for improving sports policies and programs.

Method: The study used a 26-item questionnaire divided into personal characteristics (3 items), sports interest (8 items), and sports star images (15 items). Reliability was between .580 and .796, with an overall .792. Data collection involved direct school visits and self-administered surveys. SPSS 27.0 was used for t-tests, ANOVA, and multiple regression analysis to examine the impact of sports star images on sports interest among Chinese adolescents.

Results: Based on gender, male adolescents showed higher perceptions of sports stars' appearance, evaluation, and sensory images. There were no differences based on school year. The appearance, evaluation, and sensory images of sports stars significantly impacted sports interest. Additionally, differences in sports interest were observed based on gender and interest in sports stars, with a higher interest in sports stars correlating with increased sports interest.

Conclusion: Firstly, male adolescents showed higher perceptions of sports star images in appearance, evaluation, and sensory aspects compared to females, with no significant differences in athletic performance images. No differences were found based on school year. Secondly, sports stars' appearance, evaluation, and sensory images significantly impact sports interest, highlighting these factors as key to increasing adolescents' engagement in sports.

Keywords: Adolescent Value Formation, Sports Star Image, Youth Sports Engagement, Gender Differences in Sports Perception, Impact of Sports Stars on Youth Attitudes

1. Introduction

Adolescence is a crucial period for the formation of personal values, significantly influencing all aspects of human behavior. During this stage, sports play a key role in socialization and in developing the ability to adapt to groups and adhere to societal norms[1]. Sports have a considerable impact on shaping adolescents' values, playing an essential role in instilling proper values in youth, who will be the leaders of future society[2]. In modern society, sports have evolved beyond mere recreation to become a vital institution for transmitting societal values. As part of a highly industrialized society, sports internalize and convey social norms and values[3]. This demonstrates that sports play a role in reflecting and transmitting dominant values across society[4][5][6].

The development of mass media and the professionalization of sports in the 1980s and 1990s highlighted the image of sports stars and their influence[7]. Sports stars have become central figures in popular culture, serving as important role models for adolescents[8][9]. Adolescents' enthusiasm for sports stars often stems from their financial rewards, social prestige, and the potential for upward mobility[10][11]. By achieving success, sports stars become symbols through which adolescents aspire to improve their own social status and position[12].

The relationship between sports stars and adolescents is also important from the perspective of value socialization. Adolescents internalize norms, values, attitudes, and behavioral patterns through sports stars[13], which can have either positive or negative effects on their behavioral and emotional development[14]. Therefore, the influence of sports stars' behavior and attitudes on adolescents is significant for society as a whole[15].

In South Korea, research on sports stars has been active in marketing and socio-cultural aspects, but studies focused on adolescents are relatively scarce[16][17]. While there is growing research on the impact of sports stars on adolescents' value formation, studies in China are limited[18][19][20]. Since China's reform and opening-up, there have been rapid social changes and significant growth in the sports sector. However, research on the relationship between sports stars and Chinese youth is still insufficient. Recent studies explore how Chinese adolescents form their identities and values through sports stars and their sports participation[21][22]. Thus, this study aims to analyze the image of sports stars to clarify their impact on adolescents' attitudes and participation in sports, and to provide a basis for improving sports policies and programs, thereby contributing to the understanding of sports participation and value formation among Chinese youth.

2. Research Questions and Hypotheses

2.1. Research questions

This study sets forth the following research questions:

- 1) How do Chinese adolescents perceive sports star images based on their personal characteristics?
- 2) Are there differences in sports interest among Chinese adolescents based on their personal characteristics?
- 3) What impact does the sports star image have on sports participation among Chinese adolescents?

2.2. Research hypotheses

To identify the effects of sports star images on sports participation among Chinese adolescents, the following specific hypotheses were formulated:

Hypothesis 1: There will be differences in sports star images based on the personal characteristics of Chinese adolescents.

- 1-1. There will be differences in sports star images based on gender.
- 1-2. There will be differences in sports star images based on grade level.
- 1-3. There will be differences in sports interest based on the level of interest in sports stars.

Hypothesis 2: There will be differences in sports interest among Chinese adolescents based on their personal characteristics.

- 2-1. There will be differences in sports interest based on gender.
- 2-2. There will be differences in sports interest based on grade level.

2-3. There will be differences in sports interest based on the level of interest in sports stars.

Hypothesis 3: Sports star images will influence sports participation among Chinese adolescents.

3. Research Methods

3.1. Research participants

The participants in this study were students from D High School located in Jinhuangdao City, Hebei Province, China, in 2009. The school comprises three classes each for 1st, 2nd, and 3rd-year students, totaling nine classes with 520 students enrolled. Students were selected using a systematic stratified cluster random sampling method. Out of 520 distributed questionnaires, 500 were used for final analysis after excluding 20 invalid ones. Jinhuangdao City, a significant northern port city known for its tourist attractions, has a population of approximately 3 million. The general characteristics of the study participants are summarized in <Table 1>.

Table 1. Personal characteristics of the research participants.

Category	Level	N	%
Gender	Male	200	40
	Female	300	60
Grade	1st Year	240	48
	2nd Year	120	24
	3rd Year	140	28
Interest in Sports Stars	Interested	315	63
	Not Interested	185	37

According to <Table 1>, the study participants consisted of 200 male students and 300 female students. The distribution by grade included 240 first-year students, 120 second-year students, and 140 third-year students. In the survey on interest in sports stars, 315 participants, representing 63%, reported having an interest, while 185 participants, representing 37%, indicated no interest.

3.2. Measurement tools

3.2.1. Survey structure and content

This study used a questionnaire to analyze the impact of sports star images on Chinese adolescents' sports interest and image. The questionnaire is divided into three areas: personal characteristics, sports interest, and sports star image, and consists of a total of 26 items. The personal characteristics section includes 3 items related to gender, grade, and interest in sports stars. The sports interest section comprises 8 items, while the sports star image section is divided into four areas—appearance, athletic performance, evaluation, and sensory—with a total of 15 items. The detailed structure and number of items in the questionnaire are shown in <Table 2>.

Table 2. Personal characteristics of the research participants.

Indicator	Content	Number of items	Total
Personal characteristics	Age, Gender, Interest in sports stars	3	3
Sports interest	Interest in exercise	1	8
	Knowledge of rules	1	
	Planning Exercise Time	1	
	Discussion of skills and information	1	
	Anticipation of exercise time	1	
	Cancellation of other activities for sports	1	
	Interest in sports stars	1	
	Impact of sports stars on self	1	
Sports star image	Appearance	4	15
	Athletic performance	4	
	Evaluation	4	
	Sensory	3	
Total			26

3.2.2. Reliability and validity of the questionnaire

The questions related to sports star image were revised and supplemented to fit the research by referencing questionnaires from [23][24][25]. These questions were organized into four areas with a total of 15 items, and their reliability was established in prior research. The sports interest items were modified based on studies from [26][27][28], resulting in a total of 8 items. The reliability of the questionnaire was evaluated using the commonly applied threshold of 0.6 in social sciences. The reliability assessment results for each section of the questionnaire are shown in <Table 3>.

Table 3. Composition and reliability of sports star image.

Composition indicator	Number of items	Reliability coefficient	
Appearance image	4	.796	.792
Performance image	3	.580	
Evaluation image	4	.688	
Sensory image	3	.673	

<Table 3> shows the number of items and reliability coefficients for each indicator. The number of items for the appearance image is 4, with a reliability coefficient of .796. The performance image consists of 3 items, with a reliability coefficient of .580. The evaluation image includes 4 items, with a reliability coefficient of .688. The sensory image comprises 3 items, with a reliability coefficient of .673. The overall reliability coefficient is .792.

3.3. Research procedures and data processing

3.3.1. Research procedures

The survey was conducted by the researcher, who contacted the school officials in China in advance, visited the schools personally to explain the purpose of the study, and distributed the questionnaires. The students completed the surveys using the self-administered method and the completed questionnaires were then collected.

3.3.2. Data processing

First, any questionnaires with incomplete or unreliable responses were excluded from the analysis. The study utilized SPSS 27.0 software to perform t-tests, one-way ANOVA, and multiple regression analyses. To examine differences in sports star images and sports interest among Chinese adolescents based on personal characteristics, t-tests and one-way ANOVA were conducted. Subsequently, multiple regression analysis was applied to analyze the impact of sports star images on sports interest.

4. Results and Discussion

In order to determine the safety, consistency, and predictability of each item in the collected questionnaire, this study measured the reliability coefficient. The reliability evaluation standard used was 0.6, which is generally used in social sciences. The composition and reliability of each questionnaire are as shown in <Table 4> below.

Table 4. The composition and reliability of sports star images.

Composition index	Number of items	Reliability coefficient	
Appearance	4	.796	.792
Performance	3	.580	
Evaluation	4	.688	
Sensation	3	.673	

4.1. Perception of sports star images among Chinese adolescents

4.1.1 Differences in perception of sports star images based on gender

The differences in Chinese adolescents' perceptions of sports star images based on gender were analyzed, and the results are presented in <Table 5>.

Table 5. Differences in perception of sports star images by gender.

	Gender	N	M	SD	t	p
Appearance	Male	200	3.070	.951	5.649	.000
	Female	300	2.617	.828		
Performance	Male	200	3.983	.847	-.967	.334
	Female	300	4.053	.705		
Evaluation	Male	200	3.594	.806	2.645	.008
	Female	300	3.400	.800		
Sensation	Male	200	3.363	.800	3.253	.001
	Female	300	3.108	.899		

According to the results in <Table 5>, there are significant differences in the perception of sports star images by gender in terms of appearance ($t = 5.649$; $p < .001$), evaluation ($t = 2.645$; $p < .01$), and sensation ($t = 3.253$; $p < .01$), with the exception of performance. Males reported higher scores than females in appearance, evaluation, and sensation, which may be related to a stronger overall interest in sports among males. Studies by suggest that higher interest in sports among males may lead to a stronger perception of sports star images among them[29][30][31].

In recent years, the well-being culture has gained significant popularity across mainland China, with the "handsome" (Eol-jjang) and "fit" (Mom-jjang) culture rapidly spreading. This cultural trend has made men more interested in appearance and physique than before, which may explain why they focus more on the appearance and sensation aspects of sports stars.

In Chinese society, even under the socialist system, there is a high level of popularity and social and economic recognition for male sports stars. This social context provides a backdrop for the higher evaluation scores that male sports stars receive compared to their female counterparts. Such findings illustrate how the social status of sports stars and public perceptions of them differ by gender, offering important insights into these dynamics.

4.1.2. Research questions

Based on the analysis of <Table 6>, there were no significant differences in perceptions of sports star images among Chinese adolescents across different school grades, including appearance image, athletic performance image, evaluation image, and sensory image. This indicates that there is no substantial variation in the perception of sports star images based on the students' grade levels. This result is consistent with the findings of studies [32][33][34], and it was also reported in this study that there are no significant differences in sports star image perceptions across grades. This suggests that adolescents, regardless of their school grade, have a consistent level of understanding regarding the image of sports stars.

Table 6. Differences in perception of sports star images by gender.

	Grade	N	M	SD	SS	df	MS	F	Sig.
Appearance	1st grade	240	2.838	.925	.749	2	.375	.456	.634
	2nd grade	120	2.738	.820	408.724	497	.822		
	3rd grade	140	2.782	.945	409.473	499			
Athletic performance	1st grade	240	3.954	.814	2.582	2	1.291	2.203	.112
	2nd grade	120	4.111	.695	291.225	497	.586		
	3rd grade	140	4.074	.728	293.807	499			
Evaluation	1st Grade	240	3.549	.801	2.709	2	1.354	2.088	.125
	2nd Grade	120	3.365	.756	322.351	497	.649		
	3rd Grade	140	3.452	.852	325.059	499			
Sensory	1st Grade	240	3.258	.877	2.266	2	1.133	1.504	.223
	2nd Grade	120	3.100	.794	374.297	497	.753		
	3rd Grade	140	3.221	.913	376.562	499			

4.1.3. Differences in perceptions of sports star images based on interest in sports stars

The differences in perceptions of sports star images based on the level of interest in sports stars were analyzed, and the results are shown in <Table 7>.

Table 7. Differences in perceptions of sports star images based on interest in sports stars.

	Interest in sports stars	N	M	SD	<i>t</i>	<i>p</i>
Appearance	Yes	315	2.828	.900	.959	.338
	No	185	2.747	.916		
Athletic performance	Yes	315	4.081	.755	2.168	.031
	No	185	3.928	.781		
Evaluation	Yes	315	3.557	.793	2.900	.004
	No	185	3.342	.816		
Sensory	Yes	315	3.246	.875	1.238	.216
	No	185	3.146	.857		

The analysis of Table 6 revealed significant differences in perceptions of sports star images based on the level of interest in sports stars, specifically in athletic performance ($t=2.168$; $p<.05$) and evaluation ($t=2.900$; $p<.01$). In other words, individuals with higher interest in sports stars had more positive perceptions of the sports stars' athletic performance image and evaluation image. This suggests that those with an interest in sports stars place greater importance on athletic performance rather than appearance. Athletic performance is directly related to game outcomes, and athletes with exceptional performance are likely to achieve good results, attract media and societal attention, and receive higher public evaluations.

4.2. Chinese adolescents' perceptions of sports interest

4.2.1. Differences in sports interest by gender

To investigate differences in sports interest by gender, a *t*-test was conducted. The results are shown in <Table 8>.

Table 8. Differences in sports interest by gender.

	Gender	N	M	SD	<i>t</i>	<i>p</i>
Sports interest	Male	200	3.568	.700	6.749	.000
	Female	300	3.111	.758		

The analysis of <Table 8> showed a significant difference in sports interest by gender ($t=6.749$; $p<.001$). In the past, the lower participation of women in sports compared to men was due to the underdevelopment of women's sports. However, recent advancements in China's political and economic spheres, the successful hosting of the 2008 Beijing Olympics, and the activation of women's professional sports have led to a rapid increase in women's interest in sports and sports stars. Despite these improvements, opportunities for women to participate in sports are still fewer compared to men, resulting in generally lower interest in sports among women. Nonetheless, if policies are implemented to increase women's sports participation and interest, it is expected that women's interest in sports will continue to improve.

4.2.2. Differences in sports interest by school grade

To investigate differences in sports interest by school grade, a one-way ANOVA was conducted. The results are shown in <Table 9>.

Table 9. Differences in sports interest by school grade.

	Grade	N	M	SD	SS	df	MS	F	Sig.	Post hot
Sports interest	1st grade	240	3.334	0.760	3.981	2	1.990	3.408	.034	
	2nd grade	120	3.137	0.730	290.273	497	0.584			3, 1>2
	3rd grade	140	3.364	0.799	294.254	499				

According to the results in <Table 9>, a significant difference in sports interest by school grade was found ($t=3.408$; $p<.05$). Post-hoc analysis revealed that 3rd-year and 1st-year students showed higher levels of sports interest compared to 2nd-year students. However, other studies have not found differences in perceptions across school grades.

4.2.3. Research questions

To analyze the differences in sports interest based on interest in sports stars, a t-test was conducted. The results are shown in <Table 10>.

Table 10. Differences in sports interest based on interest in sports stars.

	Interest in sports stars	N	M	SD	t	p
Sports interest	Yes	315	3.444	.728	5.919	.000
	No	185	3.037	.768		

According to the results in <Table 10>, a significant difference in sports interest based on interest in sports stars was observed ($t=5.919$; $p<.001$). Students who are interested in sports stars had higher levels of sports interest compared to those who are not interested. This may be because students who follow sports stars have more opportunities to encounter them through sports broadcasts and programs. With the development of media, it is now easier to access and follow the performances of sports stars, which suggests that interest in sports stars can translate into greater interest in sports. Studies. Also suggest that sports viewing provides vicarious experiences of sports, indicating that increased interest in sports stars may lead to higher overall interest in sports[35][36].

5. The Impact of Sports Star Images on Chinese Adolescents' Sports Interest

To analyze the impact of sports star images on sports interest, a regression analysis was conducted. The results are shown in <Table 11>.

Table 11. The Impact of sports star images on sports interest.

	B	S.E	β	t	Sig
(Constant)	1.725	.208		8.309	.000
Appearance	.199	.039	.235	5.077	.000

Athletic performance	.052	.046	.051	1.131	.259
Evaluation	.118	.048	.124	2.457	.014
Sensory	.123	.044	.139	2.820	.005

Note: $F=35.469^{***}$, $R^2=.223$.

The analysis of <Table 11> revealed that the images of sports stars' appearance ($\beta=.235$; $p<.001$), evaluation ($\beta=.124$; $p<.005$), and sensory qualities ($\beta=.139$; $p<.01$) significantly impacted sports interest, with an overall explanatory power of 22.3%. This indicates that the appearance, social image, and sensory abilities of sports stars are key factors in increasing sports interest among Chinese adolescents. Specifically, the importance of appearance and social evaluation is highlighted, and the results suggest that the diverse sensory abilities of sports stars also influence adolescents' interest in sports.

6. Conclusion and Recommendations

6.1. Results

This study primarily aimed to examine the impact of sports star images on the sports interest of Chinese adolescents. The study focused on 520 students from grades 1, 2, and 3 at D High School in Qinhuangdao, China. Data were collected through surveys and analyzed using the SPSS-WIN 27.0 program, employing factor analysis, t-tests, one-way ANOVA, and multiple regression methods.

The study yielded the following conclusions:

First, significant differences were found in adolescents' perceptions of sports star images based on gender, specifically in appearance, evaluation, and sensory images. Male adolescents had higher perceptions in all these areas compared to female adolescents. However, no significant gender differences were found in athletic performance image. Additionally, there were no significant differences in sports star image perceptions based on school grade. Significant differences were observed in perceptions of athletic performance and evaluation images based on interest in sports stars, with males showing higher perceptions.

Second, the analysis of the impact of sports star images on sports interest revealed that appearance, evaluation, and sensory images all significantly influenced sports interest. This suggests that the appearance, social evaluation, and sensory abilities of sports stars are key factors in increasing adolescents' sports interest.

This study highlights the significant impact of sports star images on adolescents' sports interest and suggests that future research should further examine interactions with other factors.

6.2. Recommendations

The limitations of this study and suggestions for future research are as follows. First, expanding the scope of the study to include youth from all over China, including areas with active professional sports such as Shanghai and Guangzhou and economically underdeveloped areas, will provide a more comprehensive and professional study. Second, although previous studies have focused on the positive aspects, objective research that also considers the negative impacts on youth is needed. Third, since the current study focuses on qualitative research, in-depth research using quantitative methods such as surveys, developing questionnaires suitable for the Chinese context, and analyzing internal experiences and perceptions through interviews is needed. In addition, it is judged that the basic analysis of the impact of the image of Chinese sports stars on youth suggested various possibilities, and follow-up research based on this study

is needed. In addition, the results of the study could include more actionable recommendations for policymakers and educators, and follow-up research is needed to explore these aspects in more detail.

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8. Appendix

8.1. Author's contribution

	Initial name	Contribution
Author	XC	<ul style="list-style-type: none">-Set of concepts <input checked="" type="checkbox"/>-Design <input checked="" type="checkbox"/>-Getting results <input checked="" type="checkbox"/>-Analysis <input checked="" type="checkbox"/>-Make a significant contribution to collection <input checked="" type="checkbox"/>-Final approval of the paper <input checked="" type="checkbox"/>-Corresponding <input checked="" type="checkbox"/>-Play a decisive role in modification <input checked="" type="checkbox"/>-Significant contributions to concepts, designs, practices, analysis and interpretation of data <input checked="" type="checkbox"/>-Participants in Drafting and Revising Papers <input checked="" type="checkbox"/>-Someone who can explain all aspects of the paper <input checked="" type="checkbox"/>

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TERA-PD: Therapeutic Exercise for Respiratory Function and Autonomic Balance in Parkinson's Disease

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Abstract

Purpose: Patients with Parkinson's disease (PD) often experience postural instability, respiratory muscle weakness, diaphragm weakness, and autonomic nervous system imbalance. To address these issues, we designed a therapeutic exercise routine that PD patients may easily incorporate into their daily lives.

Method: The Therapeutic Exercise for Respiratory function and Autonomic balance in Parkinson's Disease (TERA-PD) was designed to improve axial postural instability, respiratory muscle strength, and heart rate variability in PD patients. The exercise was formulated based on our previous study, a review of the literature, and guidance from experts.

Results: The warm-up exercises are (1) stretching the neck, and (2) massaging the scalene muscles. The main exercises are (1) torso stretch with breathing, (2) torso rotation with breathing, (3) holding the breath at the maximum inhalation, and (4) inhaling and exhaling in a steady rhythm while changing spinal posture accordingly.

Conclusion: Given that PD patients experience both postural instability and autonomic nervous system imbalance, targeted treatment is necessary. In the future, we plan to implement TERA-PD in clinical settings to evaluate its effectiveness. With further research, we aim for TERA-PD to become an effective method for alleviating the symptoms and improving the quality of life of PD patients.

Keywords: Parkinson's Disease, Respiration, Autonomic Nervous System, Therapeutic Exercise, Routine

1. Introduction

Parkinson's disease (PD) is a multisystem neurodegenerative disease involving the central, enteric, and autonomic nervous system. PD clinically manifests as both motor and non-motor symptoms[1]. PD necessitates individualized, patient-centered care because the symptoms differ from person to person. The drug industry has begun to shift toward a patient-centric culture, and patient-focused drug development for PD is likewise evolving. However, there is still no disease-modifying medication for PD, so the patients must live with a variety of symptoms that steadily exacerbate. Polypharmacy, wearing-off, and dyskinesia are other issues that advanced-stage PD patients face[2].

PD patients, especially those with severe non-motor symptoms have various unmet therapeutic needs. Non-motor symptoms, however, are frequently given less priority in treatment than motor symptoms[3]. Although PD is often characterized by the presence of motor symptoms, non-motor symptoms such as autonomic dysfunction, neuropsychiatric dysfunction, and sleep disorders appear several years before the onset of overt motor symptoms[4]. The most troublesome non-motor symptoms perceived by the patients are constipation, fatigue, leg problems, and daytime sleepiness[5].

Although it is less acknowledged, dysfunction of the respiratory system is also one of the hallmarks of PD[6]. Baille et al. discovered that inspiratory muscle weakness is frequent in early-stage PD patients, even when their pulmonary function testing is within the normal range[7]. Santos et al. also observed that respiratory muscle strength and other lung function indices have been compromised since the early stages of PD[8]. Furthermore, diaphragm thickness and excursion declined as PD advanced, and compromised diaphragm function was associated with respiratory and voice function, postural instability, constipation, and urological function in PD patients, according to Yu et al.'s study[9].

There are currently no disease-modifying medications for PD. Nonetheless, physical exercise is most likely a legitimate disease-modifying treatment for PD[10]. According to a network meta-analysis based on 154 randomized controlled trials with 7,837 participants, most types of physical exercise were relatively safe. They could relieve motor symptoms and improve the quality of life of PD patients[11]. Meanwhile, there is less data regarding the effect of exercise on non-motor symptoms of PD patients[12][13]. Although we had previously verified the ability of physical exercise to alleviate non-motor symptoms in PD patients[14][15], we believed it was necessary to develop more specialized exercise therapy in considering respiratory muscle weakness and autonomic nervous system imbalance in PD patients. As a result, we designed a therapeutic exercise program, Therapeutic Exercise for Respiratory function and Autonomic balance in Parkinson's Disease (TERA-PD), that PD patients may readily carry out in their daily lives.

2. Methods

According to the studies, typical PD symptoms include postural instability[16][17], autonomic nervous system dysfunction[4][5][18], and respiratory muscle weakness[6][7][8][9]. Rather than presenting individually or independently, these symptoms may appear concurrently and in conjunction. Recent research has looked into the relationship between postural instability and autonomic dysfunction[17], the relationship between respiratory muscle strength and cardiovascular autonomic function[19], and the relationship between diaphragm function and postural stability in PD[9]. In particular, Huang et al. confirmed that respiratory muscle training simultaneously improved pulmonary function and autonomic function in PD patients[19]. Symptoms such as postural instability and autonomic dysfunction in PD are also typical symptoms that do not respond well to dopaminergic treatment[20]. It is also unclear whether respiratory dysfunction is improved by levodopa treatment[21]. In this context, we aimed to develop an exercise therapy to correct postural instability, autonomic dysfunction, and respiratory muscle weakness in PD.

The TERA-PD was designed to improve axial postural instability (i.e., dropped head/bent spine posture), respiratory muscle strength, and heart rate variability in PD patients. We structured TERA-PD into two parts: warm-up exercise and main exercise. The warm-up exercises involve relaxing the respiratory muscles. The main exercises, which involved (1) torso stretch with breathing, (2) torso rotation with breathing (3) holding breath at maximal inhalation, and (4) inhaling and exhaling at a steady rhythm and changing the spinal posture accordingly, was designed based on our previous study[22], a review of the literature, and guidance from experts.

In particular, we referred to heart rate variability (HRV) biofeedback studies and protocols when determining inhalation and exhalation rates. HRV signifies variations in the time intervals between consecutive heartbeats. A heart with good health has complicated nonlinear oscillations that reflect mathematical chaos[23]. The HRV biofeedback aims to maximize the amplitude of the blood pressure and heart rate oscillations by breathing at rates close to the resonance frequency, which in turn stimulates respiratory sinus arrhythmia and maximizes the cardiovascular system's baroreflex[24]. A typical resonance frequency is between 4.5 and 6.5 breaths per

minute, with an average of around 5.5. The resonance frequency is thought to be influenced by a person's height and blood volume[25].

Although classical HRV biofeedback protocols and studies recommend breathing at an individual's unique resonance frequency, more recently, standardized HRV biofeedback at fixed rates, such as 6 breaths per minute or 5.5 breaths per minute, has been shown to have similar effects to traditional protocols[26][27][28]. In general, longer exhalations than inhalations (for example, a 4:6 ratio of inhalation/exhalation) are recommended[29]. While Lin et al. found out that a 5:5 ratio of inhalation/exhalation produced greater HRV compared to a 4:6 ratio[28], Van Diest et al. found out (by comparing a 3:7 and 7:3 ratio of inhalation/exhalation) that longer exhalations could produce greater relaxation by increasing the high-frequency component of HRV[30]. Since our primary aim is to maximize the HRV and thus stimulate the baroreflex of the cardiovascular system of PD patients, we will use a 5:5 ratio of inhalation/exhalation in this protocol.

3. Results

3.1. Warm-up exercise

Begin the session by instructing the patients to stretch their necks in four directions. Then, instruct the patients to lightly massage their scalene muscles using their fingers. Inform the patients that it is okay to cough, as massaging their scalene muscles may cause a cough <Figure 1>.

Figure 1. Warm-up exercise: (a) neck stretch (b) scalene muscle massage.

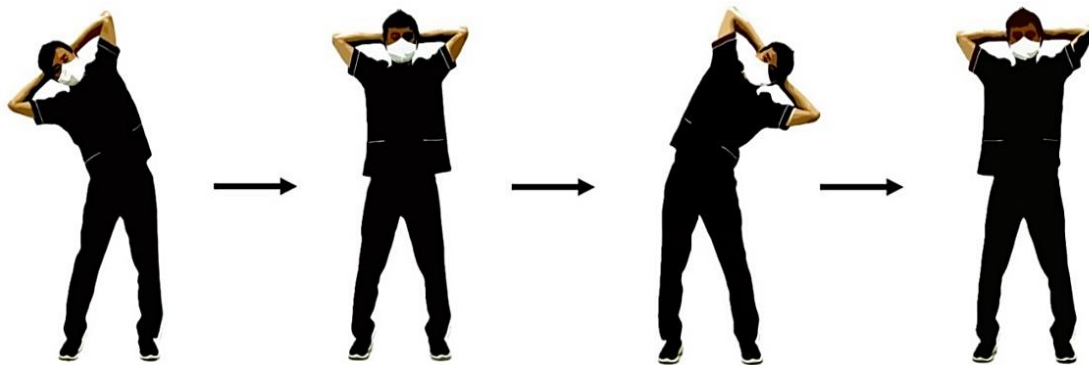


3.2. Main exercise

3.2.1. Torso stretch with breathing

The goal of this exercise is to activate the respiratory muscles, specifically the intercostal muscles and diaphragm. Instruct the patients to stand with both hands interlaced over the back of the head, elbows open as wide as possible. Instruct the patients to extend their torso to the left with an inhalation, return to the vertical position with an exhale, stretch to the right with an inhale, and then back to the vertical position with an exhale. This exercise can be performed while playing music or sound with a beat of 30 beats per minute (bpm). If performed at the speed, this movement will let the patients inhale and exhale at a pace of 15 breaths per minute <Figure 2>.

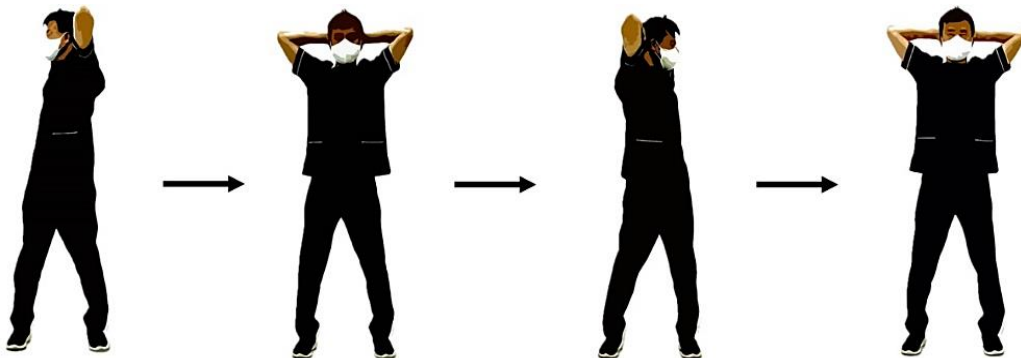
Figure 2. Main exercise (1) torso stretch with breathing.



3.2.2. Torso rotation with breathing

The goal of this exercise is to stimulate the respiratory muscles, particularly the pectoralis major, intercostal muscles, and diaphragm. Instruct the patients to stand again with both hands interlaced on the back of the head, elbows open as wide as possible. Instruct the patients to rotate their torso to the left with an inhale, return to the front position with an exhale, rotate to the right with an inhale, and then back to the front position with an exhale at 30 bpm. This exercise can also be performed while playing 30 bpm music or sound. Again, if performed appropriately, this movement will enable the patients to inhale and exhale at a pace of 15 breaths per minute <Figure 3>.

Figure 3. Main exercise (2) torso rotation with breathing.



3.2.3. Holding the breath at maximal inhalation

The goal of this exercise is to strengthen the patients' diaphragm and increase their lung capacity. Have the patients sit upright on a chair with a backrest. First, instruct the patients to place both hands on their thighs or knees, relax their arms, and inhale through their noses as deeply as possible. Then, instruct the patients to raise both arms and inhale as deeply as possible. Explain that elevating their arms will expand the thoracic cavity, allowing them to breathe more air. After inhaling as much air as possible, hold it for as long as possible, and then exhale slowly through slightly parted lips, as if exhaling through a straw. If a straw are available, have the patients exhale through it <Figure 4>.

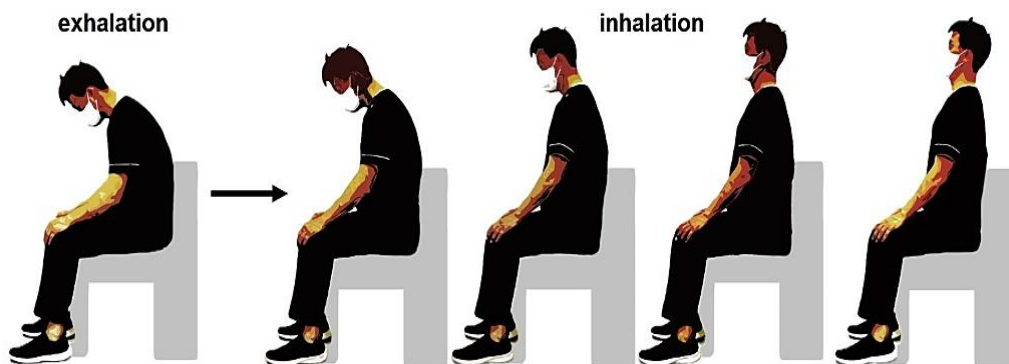
Figure 4. Main exercise (3) holding the breath at maximal inhalation.



3.2.4. Breathing steadily while changing spinal posture accordingly

The goal of this exercise is to improve PD patients' axial postural instability and heart rate variability. Have the patients sit upright on a chair with a backrest. First, instruct the patients to exhale as much as possible while relaxing the torso and spine and releasing any remaining tension in the body. Then teach the patients to inhale while straightening the body in the following order: coccyx, sacrum, lumbar, thoracic, and cervical spine. Finally, when the patients are sitting up straight, instruct them to try harder to pull the crown of their head toward the ceiling, imagining that the space between their vertebrae is stretching further. After that, instruct the patients to exhale again and relax their torso and spine as much as possible <Figure 5>.

Figure 5. Main exercise (4) inhaling and exhaling at a steady rhythm (5 to 6 breaths per minute) and changing the spinal posture accordingly.



Once the patients are comfortable with changing the spinal posture, instruct them to gradually straighten their body from the coccyx to the crown of their head for 5 to 6 seconds while inhaling, then progressively relax their body for 5 to 6 seconds while exhaling. The instructor can use a stopwatch to measure time and one hand to visually guide the patients' breathing rate and posture changes by slowly raising the hand from the bottom to the top when inhaling and slowly lowering the hand from the top to the bottom when exhaling. Perform for three minutes, then rest for one minute. Perform three sets (i.e., a total of 11 minutes: 3-minute exercise – 1-minute rest – 3-minute exercise – 1-minute rest – 3-minute exercise). The patients must be informed to be careful not to hyperventilate while exercising. In between sessions, ask the patients about symptoms of hyperventilation such as lightheadedness, dizziness, heart palpitations, and anxiety. Instruct patients to breathe less deeply if necessary.

4. Discussion

PD patients suffer from complicated motor and non-motor symptoms. Motor symptoms of PD include bradykinesia, tremor, rigidity, and postural instability, and non-motor symptoms of PD include anxiety, depression, constipation, bladder dysfunction, fatigue, orthostatic hypotension, cognitive impairment, sleep disturbances, and REM sleep behavior disorder. Recently, there has been a developing understanding that the various symptoms of PD do not appear individually, but rather are interconnected and may appear concurrently[19][20][21]. Additionally, there is growing evidence that PD impairs a chain of neurons in autonomic pathways, causing non-motor symptoms across multiple organ systems[31].

Although non-motor symptoms of PD have a high unmet treatment need, they are currently receiving less attention in clinical practice[3]. Despite its high prevalence, autonomic dysfunction in PD is commonly underdiagnosed, and its relationship to non-motor symptoms is poorly understood[32]. Furthermore, a wide range of neurological and non-neurological symptoms expose many PD patients to a high level of polypharmacy[33], and a lack of understanding of PD pathology in connection to autonomic dysfunction can exacerbate polypharmacy in PD.

Since non-motor symptoms and autonomic dysfunction can manifest as a variety of symptoms throughout the body, it is thought that handling the symptoms requires comprehensive symptom evaluation and a multidisciplinary approach[34]. When addressing autonomic problems associated with PD, cessation of possibly causative or aggravating medications, patient education, and nonpharmacological therapy should come first[32]. In this context, we developed TERA-PD to address some of the common features of PD, such as deterioration of respiratory muscle strength, postural instability, and autonomic nervous system balance.

The main goal of TERA-PD is to promote autonomic nervous system balance. Cardiovascular dysautonomia affects almost all PD patients as the pathophysiology is related to synucleinopathies, although not all experience symptoms such as orthostatic hypotension. When alpha-synuclein deposits impair postganglionic peripheral sympathetic neurons, the neurons that innervate the myocardium and the blood vessels are damaged, and the denervated organs are functionally impacted[32]. Furthermore, alpha-synuclein and Lewy body pathology can damage the brainstem in PD. All of these can lead to reduced baroreflex function in PD patients[35].

Impaired baroreflex sensitivity is observed both in PD patients[36][37], and animal models of PD[38][39]. In PD, an altered baroreflex sensitivity can start a vicious loop that can gradually impair patients' quality of life. As a result, measures for improving baroreflex sensitivity, such as exercise training and noninvasive transcutaneous vagus nerve stimulation, will be appreciated[35]. Although little study has been conducted on people with PD, HRV biofeedback is also a well-known method for improving baroreflex sensitivity[40]. Baroreflex dysfunction has been linked to poor health outcomes and mortality in a variety of disorders[35]. With expanding evidence, HRV biofeedback may provide psychological and physiological benefits, making it useful for treating patients with chronic conditions[41].

In this article, we only described the general methodology of TERA-PD. In future studies, TERA-PD could be tailored to individual patients. Patients can be instructed to inhale, exhale, and alter their spinal position based on their particular resonance frequency. Patients' HRV can be evaluated before TERA-PD. Patients with a high low frequency to high frequency (LF/HF) ratio can be taught to exhale longer, whereas those with a low ratio can be taught to inhale longer or breathe in a 5:5 ratio of inhalation/exhalation.

When performing the breathing exercise, we also aimed to improve the dropped head/bent spine posture, which is common in PD, by having patients breathe at a rate close to the resonance frequency of 5 to 6 breaths per minute while rhythmically straightening and relaxing their

spine. In addition, exercises to strengthen and activate the diaphragm and respiratory muscles were also incorporated.

So far, no structured treatment has been identified that can simultaneously manage autonomic dysfunction, respiratory muscle weakness, and postural instability in PD patients. To implement TERA-PD in clinical practice in the future, we intend to undertake a study to confirm the effects of exercise by comparing patients' respiratory muscle strength, heart rate variability, and motor and non-motor symptoms before and after TERA-PD. By comprehensively examining the effectiveness of TERA-PD, we will be able to establish it as a viable treatment option for motor and non-motor symptoms, as well as dysautonomia in PD patients.

5. Conclusion

PD patients experience respiratory muscle weakness, postural instability, and autonomic nervous system dysfunction. Each of these symptoms has significant unmet therapeutic needs. Because PD patients are subjected to a high level of polypharmacy, nonpharmacological treatment for these symptoms is required. In this sense, we designed TERA-PD to assist PD patients in improving their axial postural stability, respiratory muscle strength, and heart rate variability. In the future, we intend to implement TERA-PD in clinical settings to assess its effectiveness. With additional research, we anticipate that TERA-PD can develop into an effective strategy for relieving symptoms and increasing the quality of life of PD patients.

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7. Appendix

7.1. Author's contribution

	Initial name	Contribution
Lead Author	MSP	-Set of concepts <input checked="" type="checkbox"/>
		-Design <input checked="" type="checkbox"/>
		-Getting results <input checked="" type="checkbox"/>
		-Analysis <input checked="" type="checkbox"/>
		-Make a significant contribution to collection <input checked="" type="checkbox"/>
Co-author	HY	-Final approval of the paper <input checked="" type="checkbox"/>
		-Corresponding <input checked="" type="checkbox"/>
		-Play a decisive role in modification <input checked="" type="checkbox"/>
Corresponding Author*	SP	-Significant contributions to concepts, designs, practices, analysis and interpretation of data <input checked="" type="checkbox"/>
		-Participants in Drafting and Revising Papers <input checked="" type="checkbox"/>
		-Someone who can explain all aspects of the paper <input checked="" type="checkbox"/>

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