ANALYSIS OF EVALUATION INDICATORS FOR THE FRIENDLINESS OF SPORTS VENUES TO INDIVIDUALS WITH LOWER LIMB DISABILITIES

Han-Chen Huang

College of Tourism, Chung Hua University, Hsinchu city, Taiwan

ABSTRACT

This study investigates the accessibility and inclusivity of sports venues for individuals with lower limb disabilities, aiming to identify key factors that enhance participation and usability. Utilizing the Delphi method and Analytic Hierarchy Process (AHP), the study constructs a framework comprising six evaluation dimensions and 24 indicators, including safety and availability of assistive devices, operability and accessibility, comfort and participation, psychological and social inclusion, activity diversity and cost-effectiveness, and long-term sustainability and scalability. Results indicate that "safety and availability of assistive devices" and "operability and accessibility" are the most critical dimensions, emphasizing the importance of accessible infrastructure and equipment. "Comfort and participation" and "psychological and social inclusion" also significantly influence participation, while "activity diversity and cost-effectiveness" and "long-term sustainability and scalability" are comparatively less crucial. The findings provide strategic insights for venue design and policy, highlighting the need to prioritize accessible environments and inclusive practices to promote greater sports participation among individuals with lower limb disabilities.

KEYWORDS

Accessible Facilities, Lower Limb Disabilities, Sports Venue Friendliness

1. INTRODUCTION

1.1. Research Motivation and Purpose

In 2020, Taiwan's population of individuals with disabilities reached 1.19 million. To protect their right to engage in sports, the Sports Administration of the Ministry of Education has implemented policies in line with the *Convention on the Rights of Persons with Disabilities* (CRPD) and Article 5 of the *National Sports Act*. Key initiatives include publishing the *Guidelines for Sports Venue Staff to Assist Persons with Disabilities* and the *Friendly Facility Installation and Service Guidelines for Sports Venues*. These initiatives focus on both improving physical facilities and enhancing the service knowledge of staff to create a "friendly sports environment" (Sports Administration, 2021).

As sports popularity rises and society ages, the exercise needs of people with disabilities and the elderly are receiving increasing attention. Meeting these needs should be a priority for sports facility management, as it presents significant potential for growth. However, despite Taiwan’s sports venues being designed to government standards, many still fall short in fully meeting the needs of individuals with disabilities. Challenges such as difficulty entering venues independently, locating facilities, or using equipment hinder their participation (Sports Administration, 2019; 2020).

This study aims to develop an evaluation framework to assess the friendliness of sports venues for individuals with lower limb disabilities. As social participation grows for people with disabilities, the accessibility and user-friendliness of sports venues—key public spaces for promoting inclusion and health—have become critical benchmarks. For individuals with lower limb disabilities, the quality of accessible facilities and services directly affects their willingness and ability to participate in sports.

To achieve this, the study uses the Delphi method to select evaluation indicators and the Analytic Hierarchy Process (AHP) to determine their relative importance. The resulting framework will provide actionable recommendations to help venue managers improve accessibility and services, enhancing sports participation opportunities and promoting social inclusion and public health.
The objectives of this study are as follows:

- **Develop evaluation indicators for the friendliness of sports venues to individuals with lower limb disabilities:** Design a comprehensive evaluation framework to systematically assess the accessibility and user-friendliness of sports venues for this group.
- **Determine the relative importance of the indicators:** Utilize the Analytic Hierarchy Process (AHP) and expert opinions to identify the relative weight of each evaluation indicator, offering clear directions for venue improvement.
- **Enhance accessibility and user experience:** Provide recommendations based on the study results to improve accessible facilities and services at sports venues, thereby increasing the willingness and experience of individuals with lower limb disabilities to participate in sports, and advancing social inclusion and equitable sports rights.

1.2. Literature Review

Individuals with disabilities often face barriers to participating in sports, including issues with space design, societal attitudes, psychological challenges, and environmental factors. An inclusive sports environment is crucial for improving the quality of life for people with disabilities, enhancing social acceptance, and reducing stigma. Creating such an environment requires a comprehensive approach, addressing the needs of individuals with disabilities, designing suitable facilities, providing support systems, and fostering an inclusive atmosphere. Understanding the different types of disabilities and their specific challenges is essential for developing effective solutions. The following section outlines the main categories of disabilities, providing a foundation for understanding the needs of individuals with disabilities in sports.

1.2.1. Categories of Disabilities

Disabilities encompass a wide range of conditions characterized by functional impairments, varying abilities to adapt to the environment, and specific life needs. According to Taiwan's *Special Education Act* (Ministry of Education, 2024) and the *People with Disabilities Rights Protection Act* (Ministry of Health and Welfare, 2024), individuals with disabilities are primarily classified into categories including physical, visual, auditory, speech, intellectual, autism spectrum disorders, chronic diseases, and multiple disabilities (Table 1).

Table 1.Categories of Disabilities

Category	Impairment Description
1. Neurological and mental/cognitive functions	Intellectual disabilities, vegetative state, dementia, autism, chronic mental illness, refractory epilepsy
2. Sensory functions (eyes, ears, and related structures)	Visual impairment, hearing dysfunction, balance dysfunction
3. Speech and vocalization functions	Impairments in voice or speech functions
4. Circulatory, hematological, immune, and respiratory systems	Loss of essential organ function (heart, hematopoiesis, respiratory organs)
5. Digestive, metabolic, and endocrine systems	Loss of essential organ function (swallowing, stomach, intestines, liver)
6. Urinary and reproductive systems	Loss of essential organ function (kidneys, bladder)
7. Neuromuscular and skeletal systems related to mobility	Physical disabilities
8. Skin and related structures	Facial disfigurement
Multiple or rare conditions	Disabilities arising from rare diseases, complex conditions, or other recognized impairments

Among the disability categories, Category 7: Physical Disabilities refers to impairments in motor functions caused by injuries or disorders affecting bones, joints, nerves, or muscles. For example, upper or lower limb mobility may be restricted due to trauma, illness, or congenital conditions, leading to difficulties in daily movement and activities.

Individuals with physical disabilities can be further categorized into those who use assistive devices (e.g., walking aids) and those who rely on wheelchairs**.** These groups face significant challenges when participating in sports, including poorly designed facilities, transportation difficulties, and limited accessibility. These barriers directly impact their willingness and ability to engage in physical activities (Sports Administration, 2019; 2020; 2021).

Given these challenges, this study focuses on understanding the specific needs of individuals with lower limb disabilities. By addressing their requirements, the research aims to propose actionable strategies for improving the accessibility and inclusivity of sports facilities. Ultimately, the goal is to enhance their participation experiences and increase opportunities for physical activity, contributing to better integration and equity in sports participation.

1.2.2. Barriers to Sports Participation for Individuals with Physical Disabilities

Individuals with physical disabilities face multiple challenges when participating in sports, ranging from facility design to societal attitudes, psychological barriers, and environmental conditions (Kuo& Yang, 2018; Liang et al., 2015; Chou &Chou, 2022). Understanding these obstacles is crucial for promoting accessible sports environments and safeguarding the rights of people with disabilities to engage in physical activities.

(1) Facility and Equipment Barriers: The design of sports facilities and equipment often fails to adequately consider the needs of individuals with physical disabilities, posing a significant barrier to participation

- **Insufficient space:** Many sports venues are designed with limited space that cannot accommodate the needs of users with walking aids or wheelchairs, particularly in dynamic sports like team or ball games. This restricts the ability of people with physical disabilities to fully participate in these activities (Liang et al., 2015).

- **Inaccessible equipment:** Most fitness equipment is not adapted for individuals with physical disabilities. For example, the height of equipment or its instability may make it difficult and unsafe for them to use (Ku et al., 2022).
- **Lack of stability in facilities:** Equipment and support structures that lack stability pose safety risks, further deterring people with disabilities from engaging in sports (He & Li, 2023).

(2) Societal and Cultural Barriers: Social attitudes and the absence of adequate support systems create additional barriers

- **Lack of inclusive sports environments:** Many sports activities do not account for the specific needs of people with physical disabilities. The limited variety of activities often makes it difficult for them to find something they can comfortably participate in (Chou &Chou, 2022).
- **Inadequate social awareness:** Some individuals hold misconceptions about the abilities of people with physical disabilities, which can harm their self-esteem and create negative stereotypes (Wu & Kuo, 2015).
- **Lack of support systems:** A shortage of professional guidance and family support can lead to isolation, preventing consistent participation in sports (Liang et al., 2015).

(3) Personal and Psychological Barriers: Psychological factors play a significant role in the sports participation of people with physical disabilities

- **Psychological stress and low self-esteem:** People with physical disabilities often feel self-conscious about their limitations, fearing judgment or ridicule in sports settings, which affects their confidence and willingness to participate (Ku et al., 2022; Wu & Kuo, 2015).
- **Lack of motor skills:** Limited opportunities for physical activity often restrict the development of motor skills, which in turn lowers their confidence in participating in sports (Kuo & Yang, 2018).
- **Low motivation:** A lack of interest in sports or concerns about safety can lead to reduced motivation to participate in physical activities (Chen & Liang, 2003).

(4) Environmental and Physical Barriers: External environmental conditions also pose significant challenges to people with physical disabilities

- **Inconvenient transportation:** The lack of accessible transportation options and remote locations of sports venues create barriers for individuals with disabilities, making it difficult for them to attend sports events (Sports Administration, 2020).
- **Insufficient accessible facilities:** The absence of essential features like ramps, handrails, or elevators reduces the accessibility and convenience of sports venues (Sports Administration, 2021).
- **Inappropriate sports environments:** Environmental factors like noise levels and temperature in sports facilities can cause discomfort for individuals with physical disabilities, diminishing their desire to participate (United Nations, 2020).

Barriers to sports participation for people with physical disabilities are multifaceted and interconnected. For instance, psychological stress may be exacerbated by inadequate facilities, and social misconceptions may deepen feelings of inferiority. Therefore, addressing these issues requires a comprehensive approach that combines facility improvements, the creation of inclusive cultural environments, and psychological support strategies. By focusing on these areas, we can

foster a more accessible and inclusive sports environment that promotes the health and well-being of people with disabilities (Sports Administration, 2019, 2020, 2021; United Nations, 2020).

1.2.3. Friendly Treatment of Persons with Disabilities at Sports Venues

The friendliness of sports venues toward people with disabilities is one of the key factors affecting their participation in sports. The design of barrier-free facilities, the provision of services, and the adaptability of the overall environment directly influence the sports experience and willingness of persons with disabilities to participate. The friendliness of sports venues is not limited to the improvement of hardware facilities; it also encompasses service attitudes and policy support. The core goal is to create a fair and inclusive sports environment (Sports Administration, 2019, 2020, 2021).

(1) Design and Improvement of Barrier-Free Facilities: Barrier-free facilities are the basic guarantee for providing convenience for persons with disabilities at sports venues. For example, the installation of wheelchair ramps, elevators, barrier-free toilets, and changing rooms must fully consider the actual needs of users. For people with mobility impairments, the slope of ramps should meet design standards, and surfaces should be non-slip to ensure safety. At the same time, sports equipment should offer a variety of options, such as adjustable height equipment or devices specifically designed for wheelchair users, to meet different needs (Sports Administration, 2021).

(2) Friendly Space Planning at Sports Venues: The planning of sports venues should take into account the spatial needs of persons with disabilities. The design of movement lines within the venue should be spacious and smooth, allowing wheelchair or walker users to pass freely, and obstacles such as height differences should be avoided. Additionally, the signage and guidance system should consider the needs of persons with visual and auditory impairments, using clear and understandable icons, voice navigation, and braille signs to assist in enhancing the venue's accessibility and friendliness (Wu &Kuo, 2015; Sports Administration, 2020).

(3) Professionalization of Staff Services: Professional service is an essential component of a friendly sports venue. Staff at the venue should be sensitive to the needs of persons with disabilities and possess the necessary skills, such as assisting wheelchair users with facility usage or providing necessary guidance and explanations for persons with visual and auditory impairments. Research has shown that friendly and professional services can significantly enhance the satisfaction and willingness of persons with disabilities to participate. In addition, venues should regularly provide staff with training related to barrier-free services to increase their understanding and ability to serve the needs of persons with disabilities (Liang et al., 2015; Chou &Chou, 2022; Sports Administration, 2019).

(4) Social Support and Inclusive Culture: The friendliness of sports venues is also reflected in the creation of an inclusive social and cultural atmosphere. Venues can organize exclusive sports activities for persons with disabilities and encourage non-disabled individuals to participate, promoting mutual exchange and understanding. Furthermore, inviting athletes with disabilities to demonstrate their skills can effectively enhance public awareness of the abilities of persons with disabilities, reducing prejudice and discrimination (He& Li, 2023; Kuet al., 2022).

(5) Technological Assistance and Digital Applications: Advances in technology provide innovative solutions for sports venues to treat persons with disabilities more friendly.

For example, smart systems can provide venue reservations, navigation, and facility usage information through mobile apps. Additionally, virtual reality (VR) technology can simulate the venue environment, helping persons with disabilities familiarize themselves with the venue layout in advance, reducing anxiety when entering unfamiliar environments (Chen et al., 2023).

(6) Policy Support and Standards: Policy support is key to the implementation of friendliness in sports venues. The government should establish relevant standards, such as the "Barrier-Free Facility Specifications," and strengthen supervision of the implementation of these standards. At the same time, financial subsidies should be provided to support venue upgrades and staff training, ensuring the sustainability and effectiveness of friendly measures (Sports Administration, 2021; Chen & Liang, 2003).

The friendly treatment of persons with disabilities at sports venues should be enhanced comprehensively, including hardware facilities, service attitudes, social support, and policy guarantees. Through the improvement of barrier-free designs, professional services, an inclusive cultural atmosphere, as well as technological and policy support, the participation rate of persons with disabilities in sports can be effectively increased, promoting fairness and diversity in sports participation.

1.2.4. Friendly Treatment Indicators for Persons with Disabilities at Sports Venues

To encourage the active participation of persons with disabilities in sports activities, sports venues should establish comprehensive friendly indicators that cover hardware facilities, service measures, cultural atmosphere, and other aspects, ensuring full support and convenience. Based on relevant literature (Liang et al., 2015; Sports Administration, 2019; 2020; 2021; Wu &Kuo, 2015; Ku et al., 2022; He & Li, 2023; Chou & Chou, 2022; Chen & Liang, 2003; Kuo& Yang, 2018; United Nations, 2020), the following friendly indicators cover ten major dimensions (Table 2).

Table 2.Indicators for Assessing the Friendliness of Sports Venues for Persons with Disabilities

Indicator Category	Description
Hardware Facilities	Ensure accessible pathways, parking spaces, sports equipment, and changing rooms meet the needs of persons with disabilities.
Service Quality	Design ramps to comply with accessibility standards with non-slip surfaces.
Inclusive Design	Ensure parking spaces are located near entrances and clearly marked.
Policy and Oversight	Sports equipment should accommodate wheelchair users, with adjustable heights.
Safety and Availability of Assistive Equipment	Accessible changing rooms should have ample space and auxiliary facilities.
Operability and Accessibility	Staff should be trained on accessible services and emergency support systems should be in place, with first-aid equipment and professionals available.
Comfort and Participation	Offer multilingual guides, braille materials, and sign language interpretation to enhance participation and satisfaction for persons with disabilities.
Psychological and Social Integration	Venue design should include spacious, barrier-free areas, avoiding excessive height differences or narrow spaces.
Activity Diversity and Cost-effectiveness	Ensure signage is clear and mobile apps or tools assist persons with disabilities.
Long-term Sustainability and	Offer a variety of sports activities to encourage diverse participation and

Indicator Category	Description
Expandability	foster interaction.

2. METHODS

This study uses two research methods: The Delphi Method and Analytic Hierarchy Process (AHP) for data collection and analysis. The Delphi Method gathers expert opinions through anonymous rounds of questionnaires to achieve consensus on complex issues. AHP quantifies and compares evaluation criteria by assigning weights to analyze their relative importance. In this study, the Delphi Method is used to select evaluation criteria for accessible sports venues for individuals with lower limb disabilities, while AHP analyzes and prioritizes these factors. Together, these methods ensure scientific, practical criteria and provide data to support venue improvements.

2.1. Delphi Method

The Delphi Method is a systematic forecasting technique that collects expert opinions through multiple rounds of questionnaires and analyzes the responses to reach a consensus (Murry& Hammons, 1995). In this study, the Delphi Method was employed to invite field experts to conduct a preliminary screening of the friendly treatment evaluation indicators for lower-limb disabled individuals in sports venues, followed by multiple rounds of feedback to reach a consensus.

The Delphi Method originated at the RAND Corporation in the United States and was developed in the 1950s. Initially, it was applied to address uncertainty issues and is particularly suitable for decision-making, forecasting, and problem analysis that require expert input (Murry & Hammons, 1995; Okoli & Pawlowski, 2004). The core concept is to gather the opinions of multiple experts anonymously, eliminating disruptive factors in the discussion process (such as authority effects or group pressure), thereby more accurately reflecting the expert's professional judgment.

The general process of the Delphi Method includes the following steps (Yeh, 2007; Li, 2015):

- **Define the research problem and objectives**: Establish the issues to be discussed or the goals to be forecasted.
- **Select the expert panel**: Invite experts with relevant knowledge and experience to participate.
- **Design and distribute the questionnaire**: Prepare the first-round questionnaire and ask experts to independently assess the issues.
- **Anonymous feedback and revision**:
    - After collecting the expert opinions, summarize and analyze them, providing averages or statistical results as feedback.
    - Return the summarized information to the expert panel, allowing them to revise or confirm their views based on the feedback from other experts.
- **Repeat the survey rounds**: This step is typically repeated multiple times until the experts' opinions stabilize or consensus is reached.
- **Final analysis and conclusions**: Organize all the results where experts have reached consensus and use them as the research conclusion or decision-making basis.

According to Satty (2005), the optimal number of experts in a group should range from 5 to 15. Therefore, this study invited 7 experts, including 2 directors from associations for individuals

with physical disabilities (the Spinal Cord Injury Association and the Association of Self-Reliance for the Physically Disabled), 2 venue specialists (a hydrotherapy rehabilitation instructor and a life instructor for individuals with physical disabilities from a disability development center), and 3 sports experts (a university professor of physical education, an associate professor, and a referee for disability athletics).

2.2. Analytic Hierarchy Process (AHP)

The Analytic Hierarchy Process (AHP) is a structured decision-making methodology designed to decompose complex problems into a hierarchical structure and perform quantitative comparisons. In this study, AHP will be used to assign weights to various evaluation indicators to further determine the relative importance of different aspects and indicators. AHP was introduced in the 1970s by American mathematician Thomas L. Saaty as a multi-criteria decision-making method intended to solve complex decision problems that involve multiple criteria and options. Basic Principles of AHP (Saaty, 2004; Pei& Huang, 2009)

- **Hierarchical Structuring:** The fundamental process of AHP involves breaking down a problem into a hierarchical structure, typically consisting of the following three levels:
- **Goal Level**: The ultimate problem to be solved or the objective to be achieved.
- **Criterion Level (Aspects)**: The evaluation criteria or key factors that influence the achievement of the goal.
- **Alternative Level (Options)**: The available solutions or strategies to be compared.
- **Pairwise Comparison:** At each level, experts perform pairwise comparisons between each pair of factors, answering questions like "Which is more important?" and "What is the relative importance of these two factors?" This process helps determine the importance of each criterion and alternative, providing a foundation for the subsequent weighted analysis.
- **Consistency Checking:** An important step in AHP is checking the consistency of the experts' judgments. This is typically done by calculating the Consistency Index (CI) and the Consistency Ratio (CR). If the consistency ratio exceeds 0.1, it suggests that the experts' judgments may be inconsistent, and a reevaluation is necessary.
- **Weight Calculation:** Using matrix algebra or eigenvector methods, AHP calculates the weights for each criterion and alternative, ultimately deriving the composite weights of each option relative to the goal. These weights reflect the relative importance of each aspect and indicator in the decision-making process and help compare different choices to make the optimal decision.

The advantage of AHP is that it combines subjective judgment with mathematical analysis, quantifying expert opinions to assist researchers in making more scientific and reasonable choices when faced with multi-criteria decision-making. In this study, AHP will be used to assign weights to different aspects and indicators, determining which factors are most important in enhancing the friendliness of sports venues for individuals with disabilities.

2.3. Friendly Service Indicators and Dimensions

Based on the literature review, the evaluation of the friendly services offered by sports venues for individuals with disabilities should be considered from multiple perspectives, particularly focusing on safety and the availability of assistive devices. Numerous studies have highlighted the critical role that accessible facilities and assistive devices play in increasing the engagement of individuals with disabilities in sports activities. For individuals with lower-limb disabilities, accessible ramps, elevators, and wheelchair-accessible sports equipment are essential for ensuring their smooth entry into and participation in venue activities (Sports Administration, 2019; 2020; 2021). Additionally, sports venues should have adequate safety measures, including

emergency medical equipment, dedicated help buttons, and emergency response systems. These measures not only ensure the safety of individuals with disabilities but also increase their trust and participation (Chou &Chou, 2022).

Therefore, sports venues should regularly inspect and update these facilities to ensure that they continue to meet international accessibility standards, offering comprehensive support for people with disabilities. In this study, after implementing the Delphi method, expert consensus was reached through two rounds, leading to the revision of the friendly evaluation items outlined in Table 2. The final version resulted in a framework of six dimensions and 24 indicators for evaluating friendliness (Table 3).

Table 3.Friendly Service Indicators and Evaluation Criteria

Dimension	Evaluation Indicator	Description
Safety and Availability of Assistive Devices	Barrier-Free Facilities	Ensure the venue has barrier-free entrances, restrooms, elevators, ramps, etc., making it easier for lower limb disabled individuals to enter and use the facility.
	Availability of Assistive Devices	The venue provides necessary assistive devices such as wheelchairs and walkers to help lower limb disabled individuals use the facilities.
	Safety Precautions	Whether emergency exits, first aid equipment, and guidance personnel are available to ensure the safety of lower limb disabled individuals.
	Safety Monitoring and Emergency System	Whether the venue has a comprehensive monitoring system to handle emergency situations and ensure the safety of disabled individuals.
Usability and Accessibility	Venue Accessibility	Evaluate the convenience of the venue's location and ensure there are barrier-free transportation routes (e.g., bus and subway stations).
	Barrier-Free Facility Design	Ensure that doors, corridors, and rest areas comply with barrier-free standards for wheelchair and walker users.
	Venue Internal Mobility	Whether there is enough space within the venue for disabled individuals to move freely without obstruction.
	Signage and Guidance Facilities	Whether the venue has clear signage to help disabled individuals easily find barrier-free facilities.
Comfort and Participation	Venue Environmental Comfort	Evaluate the comfort of the venue in terms of temperature, ventilation, lighting, etc., ensuring it is suitable for disabled individuals using assistive devices.
	Participation in Activity Design	Whether the venue designs activities that encourage participation from disabled individuals and provide a sense of achievement.
	Adaptability of Activity Facilities	Whether the facilities can be adjusted according to the needs of disabled individuals, providing professional guidance.
	Social and Emotional Support	Whether the venue provides emotional support to facilitate interaction between disabled and non-disabled individuals, enhancing confidence.
Psychological and Social Integration	Social Integration Opportunities	Promote opportunities for disabled and non-disabled individuals to participate together, fostering mutual understanding and support.
	Psychological Support	Whether the venue offers psychological counseling services (e.g., books, audiovisual materials, consultations) to help disabled individuals build confidence and self-esteem.
	Supportive Environment	Provide a friendly and inclusive environment, avoid exclusion, and encourage active participation from disabled individuals.

Dimension	Evaluation Indicator	Description
	Cultural Adaptation and Integration	Promote multicultural integration, address the cultural needs of different disabled groups, and provide targeted services.
Activity Diversity and Cost-effectiveness	Diversity of Activity Design	Provide a variety of sports to meet the needs of lower limb disabled groups (e.g., wheelchair basketball, sitting volleyball, etc.).
	Cost Reasonableness and Discounts	Offer discounted tickets or subsidy programs to reduce the economic burden on disabled individuals.
	Resource Utilization and Management	Effectively utilize resources to support disabled individuals and ensure long-term operations.
	Facility Sustainability and Expansion	Regularly update facilities and expand activity offerings based on demand.
Long-Term Sustainability and Expansion	Facility Maintenance and Updates	Regularly maintain facilities to ensure the normal operation of barrier-free facilities and update them according to changing demands.
	Activity Expandability	Expand service potential by adjusting facilities or providing more activity space based on demand.
	Long-Term Participation Opportunities	Collaborate with the community to provide long-term opportunities for disabled individuals to engage in sports activities.
	Development Potential and Collaboration Opportunities	Collaborate with social organizations or professional institutions to expand the service range and encourage greater participation from disabled individuals.

3. RESULTS

In this study, the Delphi method was used to identify the criteria and indicators that influence the friendliness of sports venues for lower limb disabled individuals. The Analytic Hierarchy Process (AHP) was applied to evaluate the friendliness of the venues, allowing us to quantify the importance of each dimension and indicator and prioritize them. This provides a scientific basis for further venue design and policy development. The steps of the AHP calculation are as follows (Saaty, 2004):

- **Establish the Hierarchical Structure Model:** Identify the evaluation goal, criteria, and alternatives, and form a clear hierarchical structure. This structure helps organize and analyze the relationships between different levels, providing clear guidance for subsequent analysis.
- **Construct the Pairwise Comparison Matrix:** Using the 9-point scale method (Saaty's scale), experts conduct pairwise comparisons of the elements within the same level. Each pair of elements is scored according to their relative importance, which forms the comparison matrix.
- **Calculate the Weight Vector:** Normalize each column of the pairwise comparison matrix by dividing each element in the column by the sum of the column. Then calculate the average of each row to obtain the relative weight of each criterion or alternative. These weights reflect the importance of each dimension or indicator in the overall evaluation.
- **Consistency Test:** Calculate the Consistency Index (CI) and Consistency Ratio (CR) to check the consistency of the matrix. According to Saaty's recommendation, if $CI < 0.1$ and $CR < 0.1$, the matrix is considered consistent, indicating that the expert evaluations are statistically consistent.

- **Comprehensive Weight Calculation and Ranking:** Finally, the weights of each criterion or indicator are integrated and ranked from bottom to top to obtain the importance ranking of each option toward the goal. This ranking helps identify the factors that are most important for the evaluation goal and provides a basis for subsequent decision-making.

In this study, we established evaluation indicators for the friendliness of sports venues to individuals with lower-limb disabilities based on the opinions of seven experts, identifying six dimensions and 24 specific indicators. Subsequently, a survey was conducted with 12 participants, including two academics (university professors and associate professors specializing in physical education), four practitioners (managers from comprehensive sports centers and rehabilitation centers), and six individuals with physical disabilities (members of the Spinal Cord Injury Association and the Self-Strengthening Association for Individuals with Physical Disabilities).

Using their feedback, an AHP pairwise comparison matrix was constructed. The weight vectors for each indicator were calculated, and consistency tests were performed (Table 4). The results indicated that both the Consistency Index (CI) and the Consistency Ratio (CR) were below 0.1, meeting the consistency standards recommended by Satty (2004). Thus, the consistency of the matrix is acceptable. Finally, based on the calculated results, the weights for each dimension and indicator were determined. These results are presented in Tables 5 and 6.

Table 4.Consistency Test Results

Dimension	CI	CR	Evaluation Indicators	CI	CR
Safety and Availability of Assistive Devices	0.0578	0.0466	Barrier-Free Facilities	0.0684	0.076
			Availability of Assistive Devices		
			Safety Precautions		
			Safety Monitoring and Emergency System		
Usability and Accessibility			Venue Accessibility	0.0586	0.04156
			Barrier-Free Facility Design		
			Venue Internal Mobility		
			Signage and Guidance Facilities		
Comfort and Participation			Venue Environmental Comfort	0.0321	0.02169
			Participation in Activity Design		
			Adaptability of Activity Facilities		
			Social and Emotional Support		
Psychological and Social Integration			Social Integration Opportunities	0.0670	0.0426
			Psychological Support		
			Supportive Environment		
			Cultural Adaptation and Integration		
Activity Diversity and Cost-effectiveness			Diversity of Activity Design	0.0524	0.0582
			Cost Reasonableness and Discounts		
			Resource Utilization and Management		
			Facility Sustainability and Expansion		
Long-Term Sustainability and Expansion			Facility Maintenance and Updates	0.0715	0.0794
			Activity Expandability		
			Long-Term Participation Opportunities		
			Development Potential and Collaboration Opportunities		

Table 5.Importance Analysis of Dimensions

Dimension	Dimension Importance (%)	Rank	Explanation
Safety and Availability of Assistive Devices	30.12	1	Focuses on whether the venue has barrier-free facilities and safety measures, such as accessible entrances, elevators, and ramps, ensuring the safety of lower-limb disabled individuals. It also includes the availability of auxiliary equipment (e.g., wheelchairs, walkers).
Operability and Accessibility	24.98	2	Addresses the accessibility of the venue's location and internal mobility, including barrier-free pathways, doors, aisles, and rest areas for easy movement by wheelchair users or those using walkers.
Comfort and Participation	20.25	3	Emphasizes the venue's environmental comfort (e.g., temperature, lighting) and whether the activity design encourages participation, providing a comfortable environment for disabled individuals to engage in activities.
Psychological and Social Integration	9.95	4	Focuses on the social integration opportunities and psychological support services, such as supportive activities, counseling services, and an inclusive, friendly atmosphere promoting interaction between disabled and non-disabled individuals.
Long-Term Sustainability and Expansion	9.59	5	Concerns facility maintenance, updates, and future expansion, ensuring regular upkeep and adjustments to meet future demands and ensure long-term stability.
Activity Diversity and Cost-effectiveness	5.11	6	Focuses on offering diverse sports activities and reasonable costs, reducing financial burdens for lower-limb disabled participants.

Table 6. Importance of Evaluation Indicators

Evaluation Indicator	Overall Indicator Importance (%)	Overall Indicator Rank	Explanation
Barrier-Free Facilities	12.80	1	Barrier-free facilities are crucial for ensuring safe and easy access for lower-limb disabled individuals. Key elements include accessible entrances, restrooms, and elevators.
Barrier-Free Facility Design	8.54	2	The design of barrier-free facilities impacts usability, including standards for doors, aisles, and rest areas, affecting disabled individuals' experiences.
Availability of Assistive Devices	7.35	3	Availability of auxiliary equipment (e.g., wheelchairs, walkers) enhances mobility and encourages participation in activities for lower-limb disabled individuals.
Venue Internal Mobility	7.24	4	Internal mobility within the venue is key, with barrier-free spaces allowing disabled individuals to move freely and easily.
Participation in Activity Design	7.02	5	Activity design should meet the needs of disabled individuals, with engaging activities that encourage participation and sports involvement.
Safety Precautions	6.19	6	Safety facilities like emergency exits and first aid equipment are essential to protect disabled individuals, especially in emergencies.
Venue	6.14	7	Environmental comfort, including temperature,

Evaluation Indicator	Overall Indicator Importance (%)	Overall Indicator Rank	Explanation
Environmental Comfort			lighting, and air circulation, significantly affects participation and overall experience.
Venue Accessibility	5.88	8	Accessibility of the venue, including transportation and barrier-free pathways, ensures ease of access for disabled individuals.
Adaptability of Activity Facilities	4.13	9	Adaptability of activity facilities to suit different needs (e.g., adjustable equipment, professional guidance) enhances inclusivity and participation.
Safety Monitoring and Emergency System	3.78	10	A safety monitoring system and emergency response are essential to ensure protection for all users, particularly disabled individuals.
Long-Term Participation Opportunities	3.50	11	Long-term participation opportunities, such as community partnerships, help promote consistent exercise habits, supporting physical and mental health.
Social Integration Opportunities	3.33	12	Promoting participation between disabled and non-disabled individuals fosters social understanding and boosts disabled individuals' self-confidence.
Signage and Guidance Facilities	3.33	13	Clear signage systems help disabled individuals easily locate barrier-free facilities, improving the usability of the venue.
Social and Emotional Support	2.96	14	Social activities and interaction areas provide emotional support, enhancing self-confidence and promoting social interaction among disabled individuals.
Development Potential and Collaboration Opportunities	2.91	15	Collaboration with other organizations expands the venue's service scope, supporting more disabled individuals and ensuring sustainable development.
Supportive Environment	2.89	16	A supportive environment that encourages participation and eliminates social exclusion positively impacts participation and experience.
Psychological Support	2.46	17	Psychological counseling services help disabled individuals build confidence, cope with challenges, and encourage long-term sports involvement.
Diversity of Activity Design	2.11	18	Offering a variety of sports activities tailored to different disabilities enhances the attractiveness and inclusivity of the venue.
Facility Maintenance and Updates	1.86	19	Regular maintenance ensures facilities are usable long-term and adaptable to changing needs.
Cost Reasonableness and Discounts	1.73	20	Setting reasonable costs and discounts reduces financial barriers, encouraging greater participation from disabled individuals.
Activity Expandability	1.33	21	Expanding the scope of activities increases service diversity, providing opportunities for more disabled individuals to participate.
Cultural Adaptation and Integration	1.26	22	Cultural adaptation meets the needs of different disabled groups, contributing to social diversity and integration, though its importance is lower.
Facility Sustainability and	0.73	23	Facility sustainability and expansion are important for long-term venue operation, although this factor

Evaluation Indicator	Overall Indicator Importance (%)	Overall Indicator Rank	Explanation
Expansion			holds relatively low importance.
Resource Utilization and Management	0.53	24	Efficient resource management ensures optimal use of services and facilities to meet user needs.

4. DISCUSSION

The accessibility and usability of sports venues for individuals with lower-limb disabilities are critical factors in fostering participation in sports activities. This section delves into the analysis of the key dimensions that affect venue accessibility and participation, shedding light on the relative importance of each dimension. By understanding these factors, we can better tailor venue designs and policies to meet the needs of disabled individuals, ultimately enhancing their involvement in sports and physical activities. This analysis not only contributes to improving venue environments but also supports the broader goal of social inclusion for people with disabilities.

4.1. Analysis of Dimension Importance

The analysis of dimension importance is detailed in Table 5. From the table, it can be observed that **"Safety and Availability of Assistive Devices"** holds the highest importance among all dimensions, with an importance value of 30.12%. This indicates that the safety and availability of auxiliary equipment have the greatest impact on the accessibility of the venue for lower-limb disabled individuals. For these individuals, the extent to which barrier-free facilities are provided and whether the venue offers necessary auxiliary equipment directly affect their ability to enter and use the venue, thus influencing their willingness to participate in activities.

The second most important dimension is **"Operability and Accessibility,"** with an importance value of 24.98%. This shows that the accessibility of the venue and the design of barrier-free facilities are crucial to the friendliness of the sports venue. Regardless of the venue's location, a lack of accessible facilities or poorly designed mobility features can create barriers for lower-limb disabled individuals in using the venue.

The third most important dimension is **"Comfort and Participation,"** which accounts for 20.25%. This reflects the significant impact of environmental conditions and activity design on participants. If a sports venue can provide a comfortable environment and attractively designed activities, it will contribute to enhancing the sports experience and participation of lower-limb disabled individuals.

"Psychological and Social Integration" represents 9.95% of the overall importance. While its importance is relatively smaller, it cannot be overlooked. Social interaction and psychological support are crucial for enhancing the overall well-being and participation of disabled individuals, as these factors facilitate their integration into the community and activities.

"Long-Term Sustainability and Expansion" has an importance value of 9.59%, indicating that facility maintenance and the long-term development of activities play a vital role in ensuring the continued participation of lower-limb disabled individuals in sports.

Finally, **"Activity Diversity and Cost-Effectiveness"** holds the smallest importance, at 5.11%. Although this is the least important dimension in the assessment, providing diverse sports

activities and reasonable cost structures remains a key factor in ensuring that lower-limb disabled individuals can continuously participate in activities.

4.2. Overall Indicator Importance Analysis

Based on the overall indicator importance (Table 6), a detailed exploration of the impact of each indicator is conducted. These indicators reflect various aspects of a venue's design and operation in terms of accessibility for lower limb disabled individuals. Indicators with higher importance are crucial for improving venue usability and participation.

4.2.1. Key Indicators

These indicators play a central role in improving the venue's accessibility for lower limb disabled individuals, directly affecting the venue's accessibility, safety, operability, and comfort. The design and implementation of these indicators often determine whether the venue can truly meet the needs of disabled individuals.

- **Barrier-Free Facilities (12.80%):** The importance of accessibility facilities lies in their role as the basic condition for ensuring that disabled individuals can enter the venue smoothly. The availability of accessible entrances, ramps, restrooms, and elevators directly affects whether disabled individuals can use the venue. These facilities are crucial for the overall usability and convenience of the venue, thus ranking first.For example, designing accessible entrances, compliant restrooms, elevators, etc., allows wheelchair users to enter the venue without obstruction, thereby increasing their willingness to participate.
- **Barrier-Free Facility Design (8.54%):** This indicator focuses on whether the internal space of the venue complies with accessibility standards and can ensure smooth movement for disabled individuals. The design of accessibility facilities should consider the needs of various disabled individuals, such as wheelchair and walker users, and provide comfortable activity spaces.
- **Availability of Assistive Devices (7.35%):** Assistive devices such as wheelchairs and walkers are crucial for the activities of lower limb disabled individuals. Whether the venue provides sufficient assistive devices and makes them easily accessible directly influences the participation experience and activity levels of disabled individuals.

4.2.2. Moderately Important Indicators

These indicators, while not ranked at the top, still have a significant impact on the venue's operation, activity design, and participation, directly affecting the overall experience of disabled individuals.

- **Venue Internal Mobility (7.24%):** Internal mobility within the venue is key to ensuring that disabled individuals can move smoothly. The venue design should avoid obstacles and provide spacious corridors and spaces, ensuring that lower limb disabled individuals can move freely. If the venue's internal space is designed to be accessible, with wide passageways, it will significantly enhance the experience for disabled individuals.
- **Participation in Activity Design (7.02%):** This indicator assesses whether the design of activities within the venue can attract the participation of lower limb disabled individuals and provide a strong sense of participation. Designing diverse activities can attract disabled individuals with different needs and enhance their sense of accomplishment. For example, if

the venue offers activities designed for disabled individuals, such as wheelchair basketball or sitting volleyball, it will greatly increase their participation.

- **Safety Measures (6.19%):** The venue should have comprehensive safety measures, including emergency exits and first aid facilities, to ensure the safety of disabled individuals. The completeness of these facilities directly relates to user safety, especially for disabled individuals. Providing emergency instructions and setting up specialized evacuation routes can ensure the safety of lower limb disabled individuals in emergency situations.

4.2.3. Lower Importance Indicators

These indicators have a smaller impact but still play a supporting role in the long-term operation of the venue and social integration.

- **Venue Environmental Comfort (6.14%):** The comfort of the venue environment involves factors such as air circulation, lighting, and temperature, which affect the experience of lower limb disabled individuals. A comfortable environment helps maintain good emotions, thereby increasing participation. For example, the temperature inside the venue should be pleasant, and the lighting should be soft to improve the experience for disabled individuals spending extended periods at the venue.
- **Venue Accessibility (5.88%):** Venue accessibility includes the convenience of the venue's location and the accessibility of transportation facilities. For lower limb disabled individuals, venue accessibility directly affects whether they choose to use the facilities. The venue should be located in a convenient area with accessible parking spaces and transportation routes to accommodate disabled individuals.
- **Adaptability of Activity Facilities (4.13%):** The adaptability of facilities refers to whether the venue can adjust its facilities to meet the needs of different disabled individuals, such as providing seating at varying heights or facilities suitable for wheelchair users.
  This adjustability helps enhance the inclusivity of the facilities, allowing disabled individuals with diverse needs to participate in activities at the venue.

4.2.4. Lower Priority Indicators

These indicators have a smaller direct impact on the venue’s overall performance but play a role in long-term operation and social integration.

- **Cultural Adaptation and Integration (1.26%):** Although cultural adaptation and integration can promote the integration of disabled groups, its impact is relatively indirect, making it a lower priority compared to other indicators.
- **Facility Sustainability and Expansion (0.73%):** This indicator evaluates the sustainability and future expandability of the venue's facilities. While it has some influence on venue operations, its importance is relatively low.
- **Resource Utilization and Management (0.53%):** The utilization and management of resources are crucial for the venue’s long-term operations, but its impact on the accessibility for lower limb disabled individuals is more indirect, placing it lower in ranking.

Based on the overall indicator importance analysis, we can conclude the following:

- Key indicators such as accessibility facilities, accessibility facility design, and availability of assistive devices play a crucial role in improving the venue’s accessibility for lower limb disabled individuals. The design of these indicators directly determines whether disabled individuals can use the venue and participate in activities.

- Moderately important indicators, including internal mobility, safety measures, and participation in activity design, have a significant impact on improving the overall experience and sense of participation for disabled individuals.
- Lower priority indicators, such as cultural adaptation and integration, sustainability, and resource management, play a supporting role in the venue's long-term development and social integration, but have smaller direct impacts.

Overall, the design of accessibility facilities, provision of assistive devices, and ensuring internal mobility are the most important factors in improving the accessibility of venues for lower limb disabled individuals.

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