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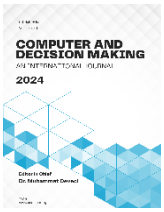

Ranking of AI-Based Criteria in Health Tourism Using Fuzzy SWARA Method

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ABSTRACT

Health tourism, as a dynamic and rapidly growing sector of the tourism industry, plays a fundamental role in strengthening national economies, increasing international interactions and improving the quality of healthcare services. By integrating healthcare, wellness and recreational services, this field has become one of the key drivers for attracting foreign tourists. The emergence of artificial intelligence (AI) as a transformative technology offers unparalleled potential to optimize health tourism services. Using AI in trip planning, improving user experience and predicting the needs of health tourists has gained significant importance. This study aims to identify and rank AI-based criteria in health tourism. By reviewing and analysing previous studies, key criteria in health tourism influenced by AI were identified. Subsequently, these criteria were evaluated and ranked using Fuzzy SWARA method. The ranking results indicate that "Healthcare service quality (C11)", "Competence and reputation of physicians (C12)", "Hospital equipment and facilities (C13)", "Political stability and security (C41)" and "Access to medical information (C14)" were ranked first to fifth, respectively. These findings highlight the crucial role of AI in enhancing service quality and improving the experience of health tourists. The results of this study can be beneficial for policymakers and stakeholders in the health tourism sector for better planning and attracting more tourists.

1. Introduction

Health tourism, as one of the important and rapidly growing branches of the tourism industry, refers to trips undertaken with the aim of improving individuals' physical, mental, or spiritual health.

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This type of tourism is not limited to treating diseases and also includes preventive services, health care, and relaxing experiences such as using natural therapeutic resources (such as hot springs, mineral mud, and medicinal plants) [1]. By combining medical science and tourism, health tourism provides countless opportunities for individuals to benefit from the natural and cultural attractions of various destinations in addition to treating or improving their health. This industry has become one of the important axes of sustainable development in many countries due to its positive economic and social impacts.

Health tourism has been a focus for societies for centuries, with people historically relying on natural resources like hot springs and healing waters for health and recovery [2]. Today, this concept includes medical tourism (travel for advanced healthcare), wellness tourism (emphasizing relaxation and disease prevention) and therapeutic tourism (using natural resources for health benefits). Beyond improving individual well-being, health tourism is vital for economic growth, generating jobs and income. Its positive effects on personal and societal health make it a key driver of sustainable development in many countries. As a dynamic industry, health tourism presents numerous opportunities for nations and individuals, integrating medical expertise with tourism to enhance quality of life and contribute to sustainable development.

Health tourism is a diverse industry encompassing various sub-categories, including diagnostic, therapeutic, surgical, hospital, traditional and unconventional methods such as acupuncture, energy therapy, yoga, meditation and preventive tourism [3]. Its primary aim is to address individuals' medical issues, prompting tourists to seek advanced medical treatments or alternative therapies abroad. Conversely, preventive tourism emphasizes the use of natural resources like hot springs, mineral mud, and calming environments to help individuals rejuvenate physically and mentally. This form of tourism benefits those with specific ailments [1] and is also ideal for disease prevention and health maintenance [4]. Overall, health tourism significantly enhances individuals' quality of life and contributes to the sustainable development of societies by offering a broad spectrum of services, from specialized treatments to relaxing experiences.

The rise of new technologies, particularly artificial intelligence, has significantly transformed the health tourism industry. As an advanced communication tool, AI enhances operational efficiency and functionality. By simulating human intelligence, AI achieves targeted outcomes across various aspects of health tourism. It aids in data analysis and accurate predictions, which help alleviate anxiety and boost tourists' confidence [5]. For instance, traveling to unfamiliar areas can be stressful, but AI offers a safe experience by delivering precise information about destinations. This technology leverages historical data to inform its predictions and establishes a decision-making framework that accounts for cognitive and emotional processes [6], [7], [8].

Integrating AI with telemedicine allows tourists to access medical and health service information before traveling. This not only enhances tourist satisfaction but also enables businesses to better anticipate needs, thereby strengthening their competitive edge. AI also improves the quality of health tourism services [9] by providing accurate healthcare standards and informing patients about affordable, quality treatment options. Benefits such as reduced waiting times and access to advanced medical services further enhance health tourism. By leveraging AI, developing countries can attract health tourists and achieve sustainable growth in this sector by building trust and confidence.

AI offers the advantage of utilizing historical data and advanced analytics to predict patient needs and develop optimal treatment plans [10]. AI-based monitoring systems enhance patient safety and privacy throughout the treatment process. This technology improves access to health information and facilitates remote medical consultations [11]. Thus, AI not only enhances the quality of healthcare services but also enriches the patient experience in health tourism. Ultimately, AI drives

health tourism towards a more advanced and efficient future. This technology, already prevalent across various scientific fields, continues to evolve and is poised to challenge human intelligence. AI keeps the focus on tourists while fostering sustainable growth and improving quality of life by providing efficiency and profitability to health tourism companies.

This study highlights the significance of artificial intelligence in health tourism by ranking AI-based criteria using Fuzzy SWARA method. Such rankings can guide companies in the sector to prioritize areas that significantly enhance service quality and customer satisfaction. The findings will serve as a roadmap for health tourism businesses to effectively leverage AI technologies, enabling them to offer better quality, personalized and cost-effective services. This improvement is vital for enhancing patient satisfaction and overall quality of life while also contributing to the sustainable growth of the health tourism industry.

2. Literature Review

2.1 The Role of Health Tourism in Sustainable Development

The need for sustainable development solutions has become a fundamental pillar of human activities. Human interventions in natural ecosystems have caused a growing imbalance between limited resources and humanity's increasing needs, notably driven by the tourism and hospitality sector. While numerous studies have explored the impacts of tourism-related transportation and real estate [12], [13] other issues like waste generation, noise pollution, overtourism, and excessive water and energy consumption must also be addressed [14], [15]. Recently, the tourism industry has significantly diversified, leading to the rise of ecotourism, defined as "a form of nature-based tourism where the main motivation of the tourist is to observe and appreciate nature or traditional cultures in natural areas" [16].

Health tourism, a prominent sub-sector of the tourism industry, significantly supports ecotourism investments through the development of fitness centers, herbal therapies and natural treatment facilities. Understanding the benefits of ecotourism within health tourism and hospitality is crucial for achieving long-term environmental sustainability and mitigating the negative impacts of tourism on natural resources [17]. Although companies active in the tourism and hospitality sector are not directly responsible for the behaviors of tourists, they can encourage them to adopt environmentally friendly behaviors through educational programs and incentive policies, such as appropriate pricing. Furthermore, these companies can implement sustainable development practices, including corporate social responsibility, environmental strategies and management systems, to make a positive impact.

Stakeholder theory posits that sustainable development in organizations necessitates addressing the needs of all stakeholder groups, including owners, employees, customers, suppliers, creditors, local communities, government and the environment. For tourism companies, achieving sustainable development hinges on the active participation of all stakeholders. This theory is particularly relevant in health tourism, as it elucidates the interests and impacts of all participants in the value creation process [18]. By adopting a holistic approach, stakeholder theory integrates economic, social, environmental and ethical considerations, emphasizing long-term relationships over short-term transactions [19], [20]. Implementing sustainable business models [21] enables tourism firms to align their operations with sustainable development principles, which is crucial in light of challenges like climate change, rising energy costs, regulatory frameworks to internalize external costs [22] and growing public awareness of environmental issues [12].

2.2 Transformations in Health Tourism in the Age of Technology

The Fourth Industrial Revolution (IR 4.0) has transformed health tourism significantly. Technologies like the Internet of Things (IoT), Artificial Intelligence (AI) [23], robotics, virtual reality and big data analytics have enhanced the accuracy and quality of healthcare services, improved access and reduced the need for travel. For instance, telemedicine allows patients in remote areas to consult top specialists worldwide [9]. These transformations, particularly in pre- and post-surgical care, have greatly improved the experience for health tourists.

Wearable technologies and digital sensors are transforming health tourism [1]. Devices that monitor blood sugar, blood pressure and oxygen levels collect real-time health data and transmit it to mobile applications. This enables medical professionals to remotely track patients' health and offer tailored recommendations, which is particularly beneficial for health tourists requiring ongoing treatment. Additionally, the Internet of Medical Things (IoMT) enhances the delivery of accurate and personalized medical services by linking various devices.

While modern technologies offer numerous advantages in health tourism, they also come with certain challenges. Issues like data breaches, privacy concerns and cybersecurity threats demand careful consideration. Moreover, some critics suggest that an overdependence on technologies such as artificial intelligence and robotics could limit human interactions and weaken the sense of empathy in medical care [9]. Despite these challenges, the industry continues to grow rapidly, as many countries adopt advanced technologies to position themselves among the top health tourism destinations.

The future of health tourism will be profoundly shaped by advancements in technology. As telemedicine, robotics and artificial intelligence continue to evolve, the necessity for physical travel to receive medical care will greatly diminish [11], [24]. These innovations will be particularly advantageous for elderly individuals and those with mobility challenges. Furthermore, leveraging cutting-edge technologies can lower healthcare expenses and expand access to medical services for a wider population. In the long run, health tourism will not only enhance individuals' quality of life but also contribute significantly to sustainable economic growth by generating new opportunities.

Health tourism, as a rapidly expanding sector within the tourism industry, has drawn significant interest from researchers and policymakers. This concept merges medical tourism with health-related activities, encompassing travel for medical treatment, physical and mental well-being enhancement and spiritual experiences. Broadly speaking, health tourism refers to a type of travel that not only serves medical purposes but also includes leisure and relaxation [25]. Advances in medical science and the availability of modern healthcare facilities in various countries have opened new avenues for the growth of this industry. This underscores the vital role of health tourism in strengthening local economies and delivering high-quality healthcare services to travelers. Academic literature categorizes health tourism into three primary areas: regional analysis, theoretical perspectives and case studies. Regional analysis evaluates the strengths and challenges of different locations in attracting health tourists [26], whereas theoretical perspectives contribute to the development of conceptual models for a deeper understanding of the phenomenon. Case studies, meanwhile, explore specific instances to identify key factors that contribute to the success or failure of health tourism initiatives [5]. These studies emphasize that beyond its economic benefits, health tourism holds substantial social and cultural significance. Several elements influence the success of health tourism. Patient satisfaction, for example, is widely regarded as a crucial indicator in evaluating the quality of healthcare services. Factors such as prior patient experiences, age, gender and educational background play an essential role in shaping overall satisfaction levels.

Artificial Intelligence is considered one of the most transformative technologies of the modern era, significantly influencing various industries and services. With its capability to process vast amounts of data, recognize patterns, and generate intelligent solutions, AI has enhanced efficiency, precision, and innovation across multiple domains. Artificial Intelligence is widely applied in sectors such as healthcare, finance, automotive, agriculture, retail and tourism. For instance, in the medical field, AI plays a vital role in disease diagnosis, drug discovery, and the delivery of personalized treatments [27], [28]. In finance, AI-based algorithms are employed for market predictions, risk assessment and intelligent advisory services. Likewise, in agriculture, AI contributes to optimizing farming techniques and boosting productivity.

AI is increasingly making its way into the tourism industry, driving significant transformations [11]. By enhancing customer experiences, tailoring services and streamlining business operations, AI has reshaped various aspects of this sector [27], [29]. For instance, smart chatbots and virtual assistants assist travelers with trip planning, hotel reservations and real-time information access. Additionally, AI-based recommendation systems analyze user behavior and preferences to deliver customized suggestions [9]. At the same time, health tourism—an essential branch of the tourism industry—has also reaped the benefits of AI integration. In this domain, AI enhances patient experiences, optimizes resource management and improves the quality of healthcare services [30]. For example, intelligent systems can process patient data to recommend the most suitable treatment options or even accelerate diagnostic and therapeutic procedures [11].

In research on health tourism, various multi-criteria decision-making (MCDM) methods have been applied to assess and analyze the factors influencing this industry. For instance, approaches such as FUZZY DEMATEL [31], F-DEMATEL, F-TOPSIS [32], and F-SWARA-PROMETHEE [33] have been utilized to identify and rank the key factors impacting the performance of health tourism. These techniques enable organizations and researchers to enhance their performance across different areas and make more informed strategic decisions through precise data analysis [34], [35].

Given the increasing importance of artificial intelligence in the tourism industry and especially health tourism, this study aims to use the Fuzzy SWARA method to rank AI-based criteria in health tourism. The criteria examined in this study were extracted through a review of previous studies and are presented in Table 1. The Fuzzy SWARA method has been selected as a suitable tool for analyzing these criteria due to its ability to weight and prioritize criteria under uncertain conditions.

Table 1
AI-based health tourism criteria

Code	Criteria	Code	Sub-criteria	Reference
C1	Medical and health services	C11	Quality of medical services	[26]
		C12	Competence and reputation of doctors	[31]
		C13	Hospital equipment and facilities	[3]
		C14	Access to medical information	[5], [9]
		C15	Variety of medical services	[25], [31]
C2	Infrastructure and services facilitating travel	C21	IT infrastructure, transportation, internet and accommodation facilities	[1], [9], [36]
		C22	Interaction between health tourism companies	[11]
		C23	Managing patients' medical affairs by the tourism company	[3]
		C24	Investment in related fields	[1], [2], [37]
C3	Costs and regulations	C31	Medical service costs	[5], [26], [33]
		C32	Medical service tariffs	[3], [5]
		C33	Facilitating rules and regulations	[25]

		C34	Monetary value difference	[33]
		C35	Travel expenses	[32], [33]
C4	Side and environmental attractions	C41	Political stability and security	[32], [38]
		C42	Tourist attractions	[2], [3], [33]
		C43	Suitable weather	[2], [32]
		C44	Media, branding and advertising capabilities	[3], [39]

3. Methodology

3.1 Fuzzy Logic

Fuzzy Logic emerged as a revision of scientific reasoning methods, grounded in the patterns of real human thought. This concept was first introduced by Max Black under the theory of vagueness and later systematically developed by Lotfi Zadeh in 1965 [40]. Fuzzy Logic stands in contrast to Aristotelian binary logic, focusing not on absolute values of zero and one but on a spectrum of values between zero and one, representing varying degrees of membership and relative truth [41], [42]. This approach, defined in conditions of uncertainty and ambiguity, has been proposed as a method for adaptive information processing, reflecting humanity's ability to control and make decisions based on imprecise data. By introducing fuzzy sets, where members belong to a set with varying degrees, Zadeh utilized this logic as a tool for modeling vague and multi-valued concepts such as satisfaction or human preferences [43]. These characteristics make fuzzy logic more aligned with human ways of thinking and acting.

3.2 Fuzzy SWARA Method

In this study, the Fuzzy SWARA method has been employed as an effective framework for managing and analyzing ambiguous and uncertain data. This method was chosen due to its unique capabilities in addressing complex and multi-criteria conditions. In many decision-making problems, particularly in complex and dynamic environments, challenges such as data inaccuracies, evaluation ambiguities, and conflicting criteria make decision-making difficult [44]. The Fuzzy SWARA method, by leveraging fuzzy logic and expert opinions, enables the systematic and precise processing and analysis of qualitative and uncertain data, which is typically provided by specialists and decision-makers.

The fuzzy SWARA method is particularly effective in situations where criteria and alternatives are associated with uncertainty and ambiguity [45]. This method assists researchers and decision-makers in achieving a more accurate ranking of alternatives by incorporating fuzzy preferences and evaluations, ultimately leading to more optimal decision-making [46]. Among the advantages of this method are its simplicity in implementation, flexibility in handling ambiguous data and its compatibility with other multi-criteria decision-making techniques. The steps of the Fuzzy SWARA method are as follows, as shown in Figure 1.

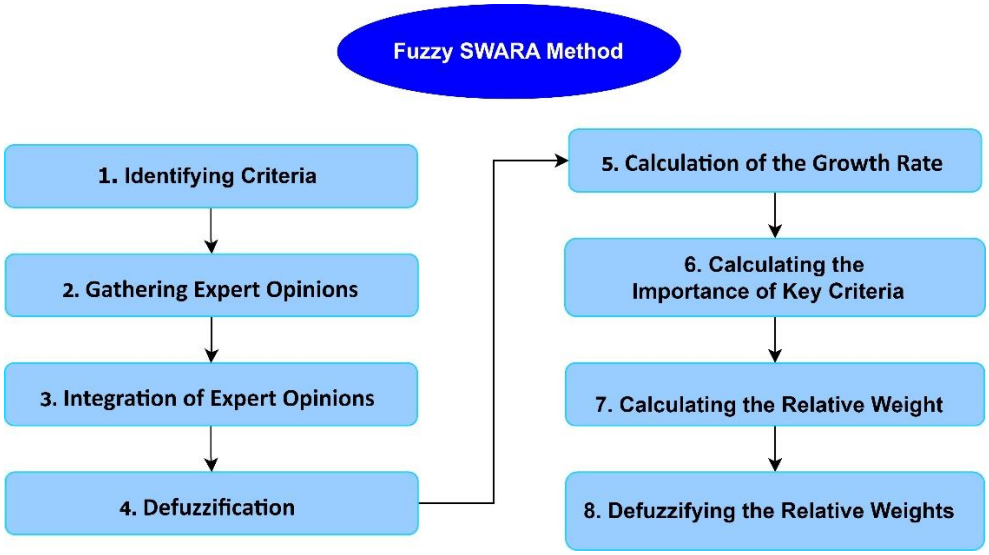

Fig. 1. Steps of Fuzzy SWARA Method

Step 1: Identifying Criteria

In the first step of the fuzzy SWARA method, the relevant criteria for the decision-making problem are identified and determined. This stage is of great importance because the accuracy and comprehensiveness of the selected criteria directly impact the quality of the final results. In this study, the criteria were extracted through a comprehensive review of previous studies and consultations with experts and specialists in the subject area. The final criteria are presented in Table1.

Step Two: Gathering Expert Opinions

In the second step of this research, the opinions of experts in the fields of health tourism and artificial intelligence were collected [47]. These experts were selected as individuals with recognized expertise and experience in areas related to information technology, information systems, and health tourism. The chosen experts included university professors, information systems specialists, and managers of projects related to digital health, each with at least four years of practical experience in projects involving information technology and digital health. They had a distinguished track record of publishing reputable papers in the fields of artificial intelligence, health tourism, and information systems, and had actively participated in applied projects collaborating with healthcare and health tourism centers to implement smart technologies. A systematic and precise process was designed to select these individuals, resulting in the identification of 10 individuals with specific qualifications and relevant academic and practical expertise in these fields. The purpose of gathering their opinions was to enhance the accuracy and validity of the analysis results, ensure the alignment of the research findings with practical and scientific realities, and achieve precise scientific and applied analyses that would support optimal decision-making in AI-based health tourism. The experts' opinions were collected based on the linguistic variables presented in Table 2.

Table 2
Triangular fuzzy linguistic variables

Verbal variable	Sub-criteria
Very unimportant	(0, 0, 0.25)
Unimportant	(0, 0.25, 0.5)
Moderate	(0.25, 0.5, 0.75)
Important	(0.5, 0.75, 1)
Very important	(0.75, 1, 1)

Step 3: Integration of Expert Opinions

The opinions of the experts were combined using Equation 1. In this equation, M represents a triangular fuzzy number and k denotes the number of experts.

$$\tilde{G}_{i,j-1} = \frac{\sum_{i=1}^{k} \tilde{M}_{i,j-1,k}}{k} \tag{1}$$

The sum of two triangular fuzzy numbers is calculated using Equation 2.

$$\tilde{M}_1 + \tilde{M}_2 = (l1 + l1, m1 + m2, u1 + u2) \tag{2}$$

Step 4: Defuzzification

The integrated expert opinions are defuzzified using Equation 3, which allows for better comparison.

$$D_{ij} = \frac{u_{ij} - I_{ij} + m_{ij} - I_{ij}}{3} + I_{ij} \tag{3}$$

Step 5: Calculation of the Growth Rate

The criteria are sorted in descending order based on their defuzzified values. Then, the difference between each criterion and the previous one is calculated, represented by the symbol S_j. After that, the growth rate of the j th criterion is calculated using Equation 4. For the first criterion, this rate is defaulted to 1.

$$k_j = \begin{cases} 1 & j = 1 \\ s_j \oplus 1 & j > 1 \end{cases} \tag{4}$$

Step 6: Calculating the Importance of Key Criteria

The degree of importance for the criteria is calculated using Equation 5. By default, the coefficient for the first criterion is set to 1.

$$q_j = \begin{cases} 1 & j = 1 \\ \dfrac{q_{j-1}}{k_j} & j > 1 \end{cases} \tag{5}$$

Step 7: Calculating the Relative Weight

The relative weight of each key criterion is calculated independently using Equation 6.

$$w_j = \frac{q_j}{\sum_{j-1}^{n} q_j} \tag{6}$$

Step 8: Defuzzifying the Relative Weights

The final weight of each criterion is calculated using Equation 7. These weights represent the final ranking.

$$D_{ij} = \frac{(w_{uj} - w_{lj}) + (w_{mj} - w_{lj})}{3} + w_{lj} \tag{7}$$

4. Results

In this study, 18 key AI-based criteria in the field of health tourism were examined and ranked using the fuzzy SWARA method. The fuzzy SWARA method, which is implemented in 8 main stages, was used to analyze and rank the criteria related to health tourism. The relative triangular fuzzy weights of the criteria, obtained using Equation 6, are presented in Table 3.

Table 3
Triangular Fuzzy Relative Weights of the Criteria

Code	Sub-criteria	w_{uj}	w_{mj}	w_{lj}
C11	Quality of medical services	0.455	0.425	0.345
C12	Competence and reputation of doctors	0.41	0.395	0.325
C13	Hospital equipment and facilities	0.34	0.325	0.31
C41	Political stability and security	0.314	0.295	0.28
C14	Access to medical information	0.286	0.269	0.246
C21	IT infrastructure, transportation, internet and accommodation facilities	0.23	0.21	0.205
C31	Medical service costs	0.222	0.205	0.195
C32	Medical service tariffs	0.175	0.16	0.14
C33	Facilitating rules and regulations	0.16	0.145	0.13
C42	Tourist attractions	0.143	0.125	0.111
C15	Variety of medical services	0.1	0.091	0.074
C22	Interaction between health tourism companies	0.095	0.085	0.072
C23	Managing patients' medical affairs by the tourism company	0.113	0.04	0.09
C43	Suitable weather	0.064	0.062	0.053
C44	Media, branding and advertising capabilities	0.051	0.045	0.04
C34	Monetary value difference	0.034	0.032	0.025
C24	Investment in related fields	0.025	0.023	0.022
C35	Travel expenses	0.02	0.015	0.01

After defuzzifying the criteria using Equation 7, the final rankings were obtained and are presented in Table 4. Figure 2 illustrates the chart related to the weight of the criteria.

Table 4
Ranking Criteria Using Fuzzy SWARA Method

Code	Sub-criteria	w_j	ranking
C11	Quality of medical services	0.408	1
C12	Competence and reputation of doctors	0.377	2
C13	Hospital equipment and facilities	0.325	3
C41	Political stability and security	0.296	4
C14	Access to medical information	0.267	5
C21	IT infrastructure, transportation, internet and accommodation facilities	0.215	6
C31	Medical service costs	0.207	7

C32	Medical service tariffs	0.158	8
C33	Facilitating rules and regulations	0.145	9
C42	Tourist attractions	0.126	10
C15	Variety of medical services	0.088	11
C22	Interaction between health tourism companies	0.084	12
C23	Managing patients' medical affairs by the tourism company	0.081	13
C43	Suitable weather	0.060	14
C44	Media, branding and advertising capabilities	0.045	15
C34	Monetary value difference	0.030	16
C24	Investment in related fields	0.023	17
C35	Travel expenses	0.015	18

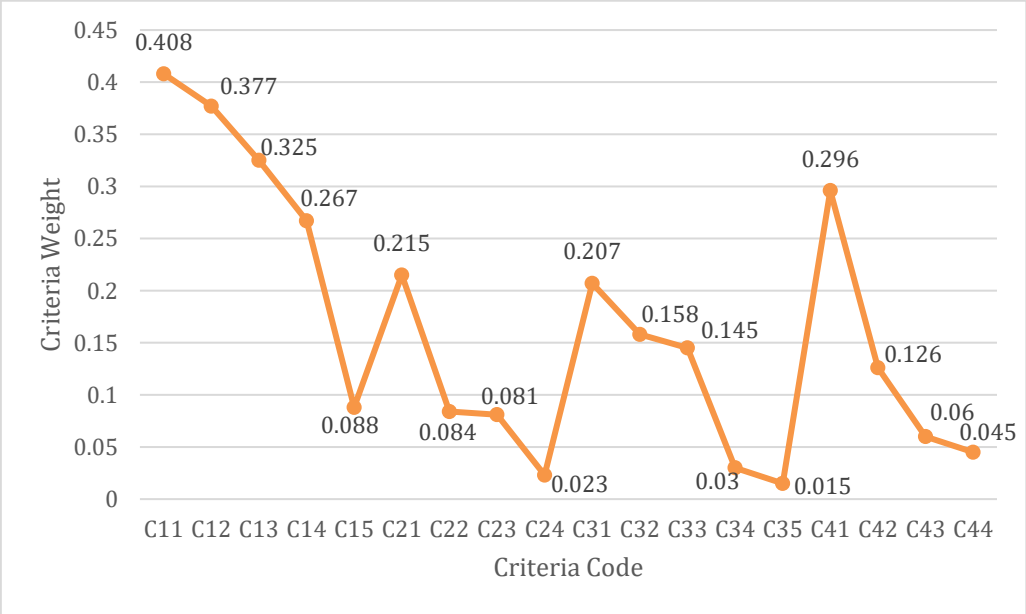

Fig. 2. Weight Distribution of the Criteria

4. Conclusion

Health tourism is recognized as one of the significant and growing sectors within the global tourism industry, contributing to the improvement of individual health and well-being while playing a notable role in the economic growth of nations and the creation of employment opportunities. By attracting patients and health travelers from around the world, this field has led to the development of medical infrastructure and increased foreign exchange earnings for countries. In this context, artificial intelligence (AI), as a transformative technology, has had profound impacts on health tourism. Through the provision of innovative solutions such as intelligent diagnostic systems, medical data analysis, and enhanced patient management processes, AI has enabled the delivery of higher-quality and faster healthcare services. The primary objective of this research is to examine the importance of AI-based criteria in the field of health tourism and to rank these criteria in order to identify key factors influencing the development of this industry. This ranking assists policymakers and stakeholders in health tourism by enabling them to prioritize effective criteria, allocate resources optimally and design more effective strategies for attracting international patients and improving healthcare services. To achieve this goal, the Fuzzy SWARA method was employed, which, due to its ability to manage uncertainty and ambiguity in data, was selected as an appropriate method for ranking the criteria. This method was implemented in seven main steps and the results indicate that

"Quality of medical services (C11)", "Competence and reputation of doctors (C12)", "Hospital equipment and facilities (C13)", "Political stability and security (C41)" and "Access to medical information (C14)" have been ranked first to fifth, respectively.

Quality of medical services (C11) has been identified as the most critical criterion in the ranking, reflecting the standard of medical services provided to patients. Quality of medical services (C11) encompasses diagnostic accuracy, treatment delivery speed, adherence to health protocols, and patient satisfaction with the services received. International patients seek healthcare centers where they can confidently receive high-quality medical services. Consequently, continuous improvement in healthcare service quality enhances patient satisfaction and the reputation of medical institutions. Competence and reputation of doctors (C12), ranked as the second most important criterion, emphasize the role of experienced and renowned specialists in attracting international patients. Patients prefer to be treated by reputable and experienced physicians with a distinguished track record in their field of expertise. This criterion includes the clinical skills of physicians, their ability to utilize advanced technologies, and their national and international reputation. Renowned physicians can serve as health ambassadors, playing a significant role in attracting patients from other countries.

Hospital equipment and facilities (C13), as the third criterion, highlight the importance of advanced infrastructure and modern technologies in healthcare centers. Hospitals and clinics equipped with the latest medical technologies are capable of delivering diagnostic and treatment services with greater accuracy and speed. This criterion encompasses the presence of advanced imaging devices, well-equipped laboratories, modern operating rooms, and patient amenities. International patients prefer to receive treatment in facilities that meet global standards in terms of equipment. Political stability and security (C41), as the fourth criterion, play a critical role in fostering trust and confidence among international patients. Patients traveling abroad for treatment seek destinations that are politically stable and secure. This criterion includes government stability, the absence of political and social tensions, and overall public safety in the country. A secure and stable environment encourages patients to travel for treatment without concerns. Access to medical information (C14), as the fifth criterion, emphasizes the importance of transparency and ease of access to medical data for both patients and healthcare providers. This criterion includes patients' ability to access their medical records, information about treatment methods and test results. Additionally, physicians' access to comprehensive and up-to-date patient information enables the delivery of more personalized and precise services. In the digital age, integrated and user-friendly information systems play a significant role in attracting international patients.

To enhance the quality of medical services (C11), medical centers must focus on elevating their service standards. This includes continuous training for medical and nursing staff, implementing rigorous quality control systems and utilizing advanced technologies such as artificial intelligence to improve diagnostic and treatment accuracy. Additionally, establishing mechanisms for patient feedback and continuously improving services based on their input can increase patient satisfaction. To strengthen Competence and reputation of doctors (C12), attracting and retaining experienced specialists through competitive benefits and professional development opportunities is essential. Participation of physicians in international conferences and events can also contribute to their global recognition.

In the context of hospital equipment and facilities (C13), investment in the procurement and updating of advanced medical equipment and the development of hospital infrastructure should be prioritized. Collaboration with medical technology companies to access the latest innovations can also bring healthcare centers closer to global standards. To enhance political stability and security (C41), strengthening international relations and implementing transparent and stable policies can

build trust among international patients. Launching promotional campaigns to present the country as a safe and stable destination also plays a significant role in attracting health tourists. Finally, to improve access to medical information (C14), the development of user-friendly digital platforms and the establishment of integrated information systems to facilitate the exchange of medical data between healthcare centers and patients are essential. Educating both patients and service providers on the effective use of these technologies can further enhance the patient experience.

Author Contributions

Conceptualization, S.B., S.R., D.B., S.K., and M.E.; methodology, S.B., and D.B.; software, S.B., and S.R.; validation, S.K., and M.E.; formal analysis, S.B.; investigation, S.R.; resources, S.K., and M.E.; writing—original draft preparation, S.R., and D.B.; writing—review and editing, S.K., and M.E.; supervision and project administration, M.E. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References

[1] Reshadi, M. S., & Chehragh, A. M. (2025). A review of medical tourism entrepreneurship and marketing at regional and global levels and a quick glance into the applications of artificial intelligence in medical tourism. AI & SOCIETY. https://doi.org/10.1007/s00146-024-02178-6.

[2] Pessot, E., Spoladore, D., Zangiacomi, A., & Sacco, M. (2021). Natural Resources in Health Tourism: A Systematic Literature Review. Sustainability, 13(5), Article 5. https://doi.org/10.3390/su13052661.

[3] Martins, P., Neves de Jesus, S., Pocinho, M., & Pinto, P. (n.d.). Wellness tourism: A systematic literature review. International Journal of Spa and Wellness, 0(0), 1–31. https://doi.org/10.1080/24721735.2025.2467608.

[4] Saeidian, P. (2024). Trip Production Models for Persons With Disabilities [Master of Science (MS) Thesis, Utah State University]. USU Library. https://digitalcommons.usu.edu/etd2023/252

[5] Sheikhhassan, M., Sadeghzadeh, M., & Faghihi, M. (2021). Application of data mining techniques to present model of tourist's health behavior analysis. Razavi International Journal of Medicine, 9(1), 27–31. https://doi.org/10.30483/rijm.2021.254183.1036.

[6] Sadeghi, S., & Niu, C. (2024). Augmenting Human Decision-Making in K-12 Education: The Role of Artificial Intelligence in Assisting the Recruitment and Retention of Teachers of Color for Enhanced Diversity and Inclusivity. Leadership and Policy in Schools, 1–21. https://doi.org/10.1080/15700763.2024.2358303

[7] Mohammadi, L., Asadi, M., & Taheri, R. (2024). Transforming EFL Lesson Planning with 'To Teach AI': Insights from Teachers' Perspectives. Technology Assisted Language Education, 2(3), 46-73. https://doi.org/10.22126/tale.2025.11490.1080

[8] Haseli, G., Ranjbarzadeh, R., Hajiaghaei-Keshteli, M., Ghoushchi, S. J., Hasani, A., Deveci, M., & Ding, W. (2023). HECON: Weight assessment of the product loyalty criteria considering the customer decision's halo effect using the convolutional neural networks. Information Sciences, 623, 184–205. https://doi.org/10.1016/j.ins.2022.12.027.

[9] Wong, B. K. M., & Hazley, S. A. S. (2020). The future of health tourism in the industrial revolution 4.0 era. Journal of Tourism Futures, 7(2), 267–272. https://doi.org/10.1108/JTF-01-2020-0006.

[10] Nawaser, K., Jafarkhani, F., Khamoushi, S., Yazdi, A., Mohsenifard, H., & Gharleghi, B. (2024). The Dark Side of Digitalization: A Visual Journey of Research through Digital Game Addiction Mental Health. IEEEineering Management Review, 1-27. https://doi.org/10.1109/EMR.2024.3462740

[11] Goodarzi, M., Ariya Nejad, N., & Soltani, Z. (2025). Explaining and Measuring Factors Affecting Artificial Intelligence Use in Medical Tourism Development (Case Study: Ahvaz City). Urban Tourism. https://doi.org/10.22059/jut.2024.377844.1216.

[12] Dinc, A., & Elbadawy, I. (2020). Global warming potential optimization of a turbofan powered unmanned aerial vehicle during surveillance mission. Transportation Research Part D: Transport and Environment, 85, 102472. https://doi.org/10.1016/j.trd.2020.102472.

[13] Jungbluth, N., & Meili, C. (2019). Recommendations for calculation of the global warming potential of aviation including the radiative forcing index. The International Journal of Life Cycle Assessment, 24(3), 404–411. https://doi.org/10.1007/s11367-018-1556-3.

[14] Haseli, G., & Jafarzadeh Ghoushchi, S. (2022). Extended base-criterion method based on the spherical fuzzy sets to evaluate waste management. Soft Computing, 26(19), 9979–9992. https://doi.org/10.1007/s00500-022-07366-4.

[15] Haseli, G., Torkayesh, A. E., Hajiaghaei-Keshteli, M., & Venghaus, S. (2023). Sustainable resilient recycling partner selection for urban waste management: Consolidating perspectives of decision-makers and experts. Applied Soft Computing, 137, 110120. https://doi.org/10.1016/j.asoc.2023.110120.

[16] Szromek, A. R., Puciato, D., Markiewicz-Patkowska, J. I., & Colmekcioglu, N. (2022). Health tourism enterprises and adaptation for sustainable development. International Journal of Contemporary Hospitality Management, 35(1), 1–25. https://doi.org/10.1108/IJCHM-01-2022-0060.

[17] Nazarian Jashnabadi, J., Pooya, A., & Bagheri, R. (2023). Provide a Model for Budget Policy in University-Community Communication Programs with a System Dynamics Approach (Case Study: Ferdowsi University of Mashhad). Journal of Industrial Management Perspective, 13(1), 9–40. https://doi.org/10.48308/jimp.13.1.9.

[18] Amiri Sardari, Z., Abdoli Mohamadabadi, T., Nazarian-Jashnabadi, J., Tesoriere, G., & Campisi, T. (2024). Smart Experience and Green Health Tourism: The Moderating Role of Content Marketing. Sustainability, 16(11), 4546. https://doi.org/10.3390/su16114546.

[19] Barakat, S. R., & Wada, E. K. (2021). Stakeholder theory in the hospitality field: Insights drawn from a systematic literature review. Hospitality & Society, 11(2), 183–207. https://doi.org/10.1386/hosp_00031_1.

[20] Mahdavimanshadi, M., Anaraki, M. G., Mowlai, M., & Ahmadirad, Z. (2024). A Multistage Stochastic Optimization Model for Resilient Pharmaceutical Supply Chain in COVID-19 Pandemic Based on Patient Group Priority. 2024 Systems and Information Engineering Design Symposium (SIEDS) (pp. 382-387). IEEE. https://doi.org/10.1109/SIEDS61124.2024.10534683

[21] Nazarian-Jashnabadi, J., Haseli, G., & Tomaskova, H. (2024). Digital transformation for the sustainable development of business intelligence goals. In Decision Support Systems for Sustainable Computing (pp. 169–186). Elsevier. https://doi.org/10.1016/B978-0-443-23597-9.00008-1.

[22] Rezazadeh, J., Bagheri, R., Karimi, S., Nazarian-Jashnabadi, J., & Nezhad, M. Z. (2023). Examining the impact of product innovation and pricing capability on the international performance of exporting companies with the mediating role of competitive advantage for analysis and decision making. Journal of Operations Intelligence, 1(1), 30–43. https://doi.org/10.31181/jopi1120232.

[23] Nazarian-Jashnabadi, J. , Ronaghi, M. , alimohammadlu, M. and Ebrahimi, A. (2023). The framework of factors affecting the maturity of business intelligence. Business Intelligence Management Studies, 12(46), 1-39. https://doi.org/10.22054/ims.2023.74305.2346.

[24] Sepahi, T., Shahbazi, M., & Roudposhti, M. S. (2021). Drug Distribution System in Iran: A Multi Method Study of Defects and Solutions. Depiction of Health, 11(4), Article 4. https://doi.org/10.34172/doh.2020.41.

[25] Mozolev, O., Shorobura, I., Zdanevych, L., Hutsal, L., Marusynets, M., & Kravchuk, L. (2020). Influence of Physical Fitness of Students on the Quality of Leisure Organization in a Sports and Health Tourism. http://dx.doi.org/10.18662/rrem/12.2/269.

[26] Mojaradi, Z., Bozorgi-Amiri, A., & Hashemzadeh, S. (2021). Strategic Planning for Supply Chain of Health Tourism in Iran: Razavi Hospital. Razavi International Journal of Medicine, 9(2), 21–33. https://doi.org/10.30483/rijm.2021.254150.1005.

[27] Bathla, G., Raina, A., & Rana, V. S. (2024). Artificial Intelligence-Driven Enhancements in Medical Tourism: Opportunities, Challenges, and Future Prospects. In Impact of AI and Robotics on the Medical Tourism Industry (pp. 139–162). IGI Global Scientific Publishing. https://doi.org/10.4018/979-8-3693-2248-2.ch006.

[28] EskandariNasab, M., Raeisi, Z., Lashaki, R. A., & Najafi, H. (2024). A GRU–CNN model for auditory attention detection using microstate and recurrence quantification analysis. Scientific Reports, 14(1), 8861. https://doi.org/10.1038/s41598-024-58886-y

[29] Espahbod, S. (2020). Intelligent Freight Transportation and Supply Chain Drivers: A Literature Survey. In Proceedings of the Seventh International Forum on Decision Sciences (pp. 49-56). Springer Singapore. https://doi.org/10.1007/978-981-15-5720-0_6

[30] Mohamadabadi, T. A., Nazarian-Jashnabadi, J., Daryani, M. A., Al-Rashid, M. A., & Campisi, T. (2025). Factors affecting online customer experience of food delivery services during crisis: TISM and Delphi techniques. Sustainable Futures, 9, 100408. https://doi.org/10.1016/j.sftr.2024.100408.

[31] Merdivenci, F., & Karakaş, H. (2020). Analysis of Factors Affecting Health Tourism Performance Using Fuzzy DEMATEL Method. Advances in Hospitality and Tourism Research (AHTR), 8(2), Article 2. https://doi.org/10.30519/ahtr.734339.

[32] Nilashi, M., Samad, S., Manaf, A. A., Ahmadi, H., Rashid, T. A., Munshi, A., Almukadi, W., Ibrahim, O., & Hassan Ahmed, O. (2019). Factors influencing medical tourism adoption in Malaysia: A DEMATEL-Fuzzy TOPSIS approach. Computers & Industrial Engineering, 137, 106005. https://doi.org/10.1016/j.cie.2019.106005.

[33] Ghasemi, P., Mehdiabadi, A., Spulbar, C., & Birau, R. (2021). Ranking of Sustainable Medical Tourism Destinations in Iran: An Integrated Approach Using Fuzzy SWARA-PROMETHEE. Sustainability, 13(2), Article 2. https://doi.org/10.3390/su13020683.

[34] Haseli, G., Sheikh, R., & Sana, S. S. (2020). Base-criterion on multi-criteria decision-making method and its applications. International Journal of Management Science and Engineering Management, 15(2), 79–88. https://doi.org/10.1080/17509653.2019.1633964.

[35] Haseli, G., & Sheikh, R. (2022). Base criterion method (BCM). In Multiple criteria decision making: Techniques, Analysis and Applications (pp. 17–38). Springer. https://doi.org/10.1007/978-981-16-7414-3_2.

[36] Madanchi, F., Maghroor, H., & O'Neal, T. (2024). A Systematic Review of the Internet of Things Contribution to Obtain Supply Chain Integration. In 9th North American Conference on Industrial Engineering and Operations Management, https://doi.org/10.46254/NA09.20240221

[37] Roshdieh, N., & Farzad, G. (2024). The effect of fiscal decentralization on foreign direct investment in developing countries: Panel smooth transition regression. International Research Journal of Economics and Management Studies IRJEMS, 3(7). https://doi.org/10.56472/25835238/IRJEMS-V3I7P114

[38] Mirbakhsh, S., & Azizi, M. (2024). Adaptive Traffic Signal Safety Efficiency Improvement by Multi Objective Deep Reinforcement Learning Approach. International Journal of Innovative Research in Multidisciplinary Education, 03, 1245-1257. https://doi.org/10.58806/ijirme.2024.v3i7n10

[39] Arjmandi, H., & Zhao, X. (2024). Social Media Impact on FEMA Funding Programs. AMCIS 2024 Proceedings. 11. https://aisel.aisnet.org/amcis2024/elevlife/elevlife/11

[40] Zadeh, L. A. (1965). Fuzzy sets. *Information and control*, *8*(3), 338-353. https://doi.org/10.1016/S0019-9958(65)90241-X.

[41] Haseli, G., Yaran Ögel, İ., Ecer, F., & Hajiaghaei-Keshteli, M. (2023). Luxury in female technology (FemTech): Selection of smart jewelry for women through BCM-MARCOS group decision-making framework with fuzzy ZE-numbers. Technological Forecasting and Social Change, 196, 122870. https://doi.org/10.1016/j.techfore.2023.122870.

[42] Kazemi, A., Kazemi, Z., Heshmat, H., Nazarian-Jashnabadi, J., & Tomášková, H. (2024). Ranking factors affecting sustainable competitive advantage from the business intelligence perspective: Using content analysis and F-TOPSIS. Journal of Soft Computing and Decision Analytics, 2(1), 39–53. https://doi.org/10.31181/jscda21202430.

[43] Ghoushchi, S. J., Jalalat, S. M., Bonab, S. R., Ghiaci, A. M., Haseli, G., & Tomaskova, H. (2022). Evaluation of Wind Turbine Failure Modes Using the Developed SWARA-CoCoSo Methods Based on the Spherical Fuzzy Environment. IEEE Access, 10, 86750–86764. IEEE Access. https://doi.org/10.1109/ACCESS.2022.3199359.

[44] Haseli, G., Sheikh, R., Wang, J., Tomaskova, H., & Tirkolaee, E. B. (2021). A novel approach for group decision making based on the best–worst method (G-bwm): Application

to supply chain management. Mathematics, 9(16), 1881. https://doi.org/10.3390/math9161881.

[45] Nezhad, M. Z., Nazarian-Jashnabadi, J., Mehraeen, M., & Rezazadeh, J. (2024). PERAM: An Efficient Readiness Assessment Model for the Banking Industry to Implement IoT – A Systematic Review and Fuzzy SWARA Methods. Journal of Intelligent Decision Making and Information Science, 1, 120–155. https://doi.org/10.59543/jidmis.v1i.12617.

[46] Ghoushchi, S. J., Bonab, S. R., Ghiaci, A. M., Haseli, G., Tomaskova, H., & Hajiaghaei-Keshteli, M. (2021). Landfill Site Selection for Medical Waste Using an Integrated SWARA-WASPAS Framework Based on Spherical Fuzzy Set. Sustainability, 13(24), Article 24. https://doi.org/10.3390/su132413950.

[47] Keršuliene, V., Zavadskas, E. K., & Turskis, Z. (2010). Selection of rational dispute resolution method by applying new step-wise weight assessment ratio analysis (Swara). Journal of Business Economics and Management, 11(2), 243–258. https://doi.org/10.3846/jbem.2010.12.