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# Financial Performance-Based Clustering of Spa Enterprises in Slovakia

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**Abstract**

This paper presents a cluster analysis of 20 spa enterprises operating in Slovakia, based on key financial indicators for the years 2018 and 2023. A comparative time-based approach was adopted to capture changes in financial performance over time. The primary objective is to group the spas into homogeneous clusters to better understand their financial performance and strategic positioning. Ten financial indicators were selected across five dimensions: profitability (return on assets, return on sales), efficiency (assets turnover), cost efficiency (personnel cost ratio, cost-to-sales ratio, return on costs), liquidity (net working capital, current ratio), and indebtedness (equity to total liabilities ratio, debt ratio). Hierarchical cluster analysis—a widely used statistical method in unsupervised machine learning and a foundational technique in artificial intelligence—was employed, serving as a robust tool for data-driven decision making. The analysis identified distinct clusters of spas with similar financial characteristics. The results reveal meaningful segmentation that can inform resource allocation, performance benchmarking, and strategic planning. The findings provide spa managers, investors, and policy makers with a clearer understanding of financial patterns in the Slovak spa sector and offer practical implications for enhancing competitiveness and operational effectiveness.

**Keywords:** financial performance; spa enterprises; tourism; cluster analysis

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## 1. Introduction

Amid the growing global emphasis on health, prevention, and overall quality of life, spa tourism has emerged as a vital and increasingly prominent segment of the international tourism industry (Roman et al., 2023; But et al., 2024). In Slovakia, the spa industry plays a vital role in both tourism and the regional economy. According to data from the Statistical Office of the Slovak Republic (via the Tourism Satellite Account), the sector generated approximately EUR 95.8 million in gross added value in 2018. However, this figure dropped to EUR 61.8 million in 2020 as a result of the COVID-19 pandemic. Between 2014 and 2019, the number of overnight stays in spa facilities grew by more than 307,000. However, in 2020, the sector recorded a sharp decline, with overnight stays falling by about 1,036,000 compared to the previous year. Despite these challenges, the spa industry remains an important employer, providing nearly 4222 jobs in 2020—around 2.5% of total employment in the health and social care sector (Halenárová, 2024). In the context of Slovakia, spa enterprises play a dual role: they are an integral part of the national healthcare system and a stable contributor to the regional economy. Beyond providing employment

opportunities and stimulating secondary service activities, they also support the sustainable development and responsible use of natural healing resources (Košíková et al., 2025; Štefko et al., 2020). Slovak spas benefit from a long-standing tradition and exceptional access to mineral springs; however, their economic performance varies considerably. These differences are influenced by internal operational processes, managerial decisions, and broader market conditions, as evidenced by analyses of the spa sector and related industries in both Slovakia and other Central European countries (Dryglas & Salamaga, 2018; Ramos & Ashqar, 2023; Jencova et al., 2021). In light of increasing competition and heightened expectations for efficient resource management, financial performance has become a critical element of strategic decision making within the spa industry.

Previous research in the field of health and spa tourism has primarily focused on areas such as visitor segmentation (Dryglas & Salamaga, 2018; Anaya-Aguilar et al., 2021), marketing strategies and service typologies (Hürten & Kimmich, 2020; Torkzadeh et al., 2024), as well as the influence of health outcomes and client satisfaction on spa destinations (Roman et al., 2023). While some studies have applied cluster analysis, its use has largely been limited to classifying tourist regions or developing strategies within medical tourism (Pan et al., 2024; But et al., 2024). In the existing literature, cluster analysis has yet to be applied specifically to a set of financial indicators of individual spa enterprises in a manner that would facilitate the identification of distinct performance typologies. This gap is especially notable in the Slovak context, where spa enterprises operate under diverse conditions regarding size, ownership structure, and geographic location, and where relatively detailed accounting data is accessible. Despite these favorable conditions for financial analysis, such an approach remains underutilized. Therefore, the systematic use of financial indicators to cluster spa service providers represents an innovative contribution to understanding economic heterogeneity within the sector.

This study addresses a recognized research gap: despite the public availability of financial data on Slovak spa enterprises and the significant role of spa tourism in the regional economy, cluster analysis has not yet been systematically applied to classify these enterprises based on comprehensive financial indicators. To address this gap, this study classifies Slovak spa enterprises using multidimensional economic indicators to capture financial diversity, identify performance types, and support data-driven strategic decision making. The analysis focuses on financial characteristics that influence the strategic positioning of spa facilities and may also serve as indicators of their resilience to external shocks. By considering a multidimensional set of financial indicators, this study enables the identification not only of the strengths and weaknesses of individual enterprises but also of typical management models within a sector of significant social importance.

This analysis is also grounded in the broader context of health tourism. Although the sector faces significant challenges related to service standardization, demographic shifts, and technological transformation (Pan et al., 2024), it also offers opportunities to diversify regional economies and enhance their resilience to external shocks. Segmenting service providers based on performance indicators can support more effective allocation of public support instruments and assist private investors in identifying areas with growth potential (Borkowska-Niszczota, 2020; But et al., 2024). Emphasizing internal performance parameters—such as profitability, efficiency, liquidity, and indebtedness—contributes to a more objective evaluation of spa enterprises and facilitates transparent benchmarking within the sector (Ramos & Ashqar, 2023; Gáll et al., 2024).

Based on the literature review and the specific context of the sector, the following research hypotheses were formulated:

**Hypothesis 1.** *There are significant differences in the financial performance of Slovak spa enterprises, allowing for meaningful grouping through cluster analysis.*

**Hypothesis 2.** *Slovak spa enterprises with high profitability and liquidity form distinct clusters characterized by more resilient and efficient financial structures.*

**Hypothesis 3.** *The financial performance of Slovak spa enterprises has evolved between 2018 and 2023 in a manner that can be measured and classified into distinct performance typologies.*

The results of this study can, therefore, be practically applied in various areas, including strategic management, benchmarking analyses, and investment decision making. This study contributes to both theory and practice in several ways. First, it represents the first attempt to apply hierarchical cluster analysis to a comprehensive set of financial indicators of Slovak spa enterprises, thereby enabling the identification of performance typologies in a previously underexplored context. Second, by contrasting pre-pandemic (2018) and post-pandemic (2023) data, it sheds light on dynamic changes in financial structures and resilience patterns within the sector. Third, it develops a methodological framework for segmenting spa enterprises that integrates indicators of profitability, efficiency, cost-effectiveness, liquidity, and indebtedness, offering potential applicability to other service industries. Finally, the findings generate practical implications for managers, investors, and policy makers, particularly in enhancing performance benchmarking, optimizing resource allocation, and strengthening the strategic positioning of the spa sector.

While the authors Štefko et al. (2020), Jenčová and Vašaničová (2019), Jenčová et al. (2019), and Jenčová et al. (2018) have previously researched Slovak spa enterprises, their earlier studies focused on different thematic areas and employed alternative methodologies, such as the Cobb–Douglas production function and regression analysis (Jenčová et al., 2018), multi-criteria evaluation and correlation analysis (Jenčová et al., 2019), financial analysis (Jenčová & Vašaničová, 2019), and multidimensional scaling (Štefko et al., 2020). Moreover, these studies relied on earlier datasets. The present study builds on this foundation by introducing hierarchical cluster analysis with Ward's method, combined with the Duda–Hart index for determining the optimal number of clusters. This approach is preferable because it enables the simultaneous evaluation of multiple financial indicators and identifies natural groupings of spa enterprises based on overall financial profiles rather than isolated measures. Unlike regression or correlation analysis, which examine relationships between individual variables, cluster analysis uncovers structural similarities and differences across the entire sample. This makes it possible to detect stable financial models, identify enterprises with exceptional performance or vulnerability, and track their movement between groups over time. By using more recent data and a holistic methodology, the study provides updated and more nuanced insights into the financial performance and resilience of Slovak spa enterprises.

## 2. Literature Review

In recent decades, health and spa tourism has increasingly emerged as a strategic sector with a strong multiplier effect on regional development, public health, employment, and the economic stability of destinations. Numerous analyses indicate that spa tourism is no longer merely a complementary component of the healthcare industry but is evolving into an independent segment of growing economic significance. It is well positioned to address demographic aging, rising demand for preventive and relaxation services, and broader environmental and social challenges related to quality of life and sustainability (Ivona et al., 2019; Torres-Pruñonosa et al., 2022). The sector's importance was further underscored during the COVID-19 pandemic, which revealed both its potential and its

vulnerabilities. Spa facilities experienced severe revenue losses, mobility restrictions, shifts in visitor behavior, and significant staffing challenges (Mirek, 2025). At the same time, they demonstrated their essential role in preventive healthcare and the psychosocial recovery of the population (Oprea et al., 2023; Pinos Navarrete & Shaw, 2020). These developments highlight the need for consistent monitoring of the sector's financial performance, adaptability, and resilience to external shocks.

Given the research focus on the economic aspects of spa and health tourism, the theoretical framework of this paper was developed through a bibliometric analysis aimed at identifying key research directions, thematic clusters, and methodological approaches within the field. The bibliometric search was conducted using the Web of Science—Core Collection database, employing a purposefully formulated search query: ("spa tourism" OR "health tourism" OR "wellness tourism" OR "medical tourism") AND ("financial performance" OR "financial indicators" OR "economic efficiency" OR "economic impact" OR "regional development" OR "public health" OR "sustainability"). The selection of keywords was guided by three main criteria, detailed as follows.

- Sector focus: Terms such as spa tourism, health tourism, wellness tourism, and medical tourism were included to encompass a broad spectrum of studies addressing the therapeutic, recreational, and preventive dimensions of spa and health tourism.
- Economic perspective: Keywords like financial performance, financial indicators, economic efficiency, and economic impact were selected to capture research that evaluates business performance, effectiveness, costs, and profitability within the sector.
- Social and regional context: Terms such as regional development, public health, and sustainability reflect the wider societal relevance of spa tourism, particularly its linkages to public policy objectives, regional economic development, and environmental sustainability.

The selected combination of search terms enabled the identification of relevant research studies that examine the economic performance of spa and health tourism from multiple perspectives, ranging from the corporate level to broader strategic and regional contexts. The resulting dataset formed the basis for the thematic and methodological synthesis presented in this section. The search initially yielded 292 publications. Following thematic relevance and formal criteria, 212 peer-reviewed scientific articles of the "article" type were retained for further bibliometric analysis, including five categorized as "early access."

In terms of temporal distribution, the highest number of publications appeared in recent years, with peak output recorded in 2024 (36 articles), followed by 2021 (31 articles) and 2023 (30 articles). This trend indicates a growing and current research interest in the economic aspects of spa and health tourism. The earliest relevant publication identified dates back to 2003, allowing for a long-term perspective on the development and evolution of the topic.

In terms of disciplinary distribution, the most frequently represented categories within the Web of Science database were as follows:

- Hospitality, Leisure, Sport and Tourism—54 publications;
- Environmental Sciences—33 publications;
- Public, Environmental and Occupational Health—32 publications;
- Environmental Studies—30 publications;
- Green and Sustainable Science and Technology—27 publications.

These categories reflect not only the interdisciplinary nature of the topic but also the increasing interconnectedness of economic, environmental, and health dimensions within the field of health and spa tourism.

The authors of the analyzed articles represented a broad geographical spectrum. The highest number of publications originated from the USA (34), China (26), and Canada (23), followed by England (16), Poland (12), Malaysia (11), Romania, and Spain (10 each), as well as Australia, India, Portugal, Germany, Slovakia, and Thailand (with 7 or more publications each). This diversity underscores the global significance of research on health and spa tourism, as well as the varied approaches to evaluating its impact and performance shaped by different national contexts.

The bibliometric analysis was further processed using VOSviewer 1.6.20, a tool that enables the visualization and clustering of publications based on keyword co-occurrence. The objectives of this analysis were to

- identify thematic research directions within the field of spa and health tourism;
- reveal dominant research clusters related to economic performance, public health, regional development, and sustainability;
- determine methodological approaches employed in these topics, such as the use of terms like "cluster analysis," "efficiency evaluation," "resilience," and "profitability assessment."

The results of this analysis form the foundation for the theoretical framework of this paper, structured around the identified research clusters. The co-occurrence analysis in VOSviewer identified a total of 1132 unique keywords. For interpretative clarity, only those terms appearing at least five times were included in the visualization, yielding a set of 43 most frequent keywords. The most prominent terms included medical tourism (72 occurrences, total link strength 153), impact (17, 71), care (16, 61), sustainability (22, 59), health tourism (25, 55), health (25, 52), tourism (22, 47), and wellness tourism (20, 41). These keywords represent the core discourse within the analyzed field. The resulting visualization (Figure 1) revealed six thematic clusters, which correspond to the dominant research directions in the area:

- Red cluster (13 terms): This cluster includes terms such as competitiveness, health, health tourism, hospitality, industry, innovation, performance, spa, spa tourism, sustainability, sustainable development, tourism, and wellness. It highlights the interconnected dimensions of performance, competitiveness, and sustainability of spa facilities within the broader economic and social context.
- Green cluster (9 terms): Primarily focused on satisfaction, destination image, and subjective experiences, this cluster contains keywords like China, destination image, experiences, model, satisfaction, scale, travel, well-being, and wellness tourism.
- Blue cluster (7 terms): Concentrating on health policy, trade, and service provision, especially in countries such as Malaysia and China, this cluster includes terms such as countries, health policy, healthcare, Malaysia, medical tourism, services, and trade.
- Yellow cluster (5 terms): Reflecting destination management and public health concerns, this cluster comprises keywords like destination, experience, management, public health, and risk.
- Purple cluster (5 terms): This cluster links sustainable tourism with quality and equity issues, including keywords such as equity, impact, public health, quality, and sustainable tourism.
- Light blue (turquoise) cluster (4 terms): Connecting topics of care, COVID-19, globalization, and health and wellness tourism, this cluster emphasizes the broader pandemic context.

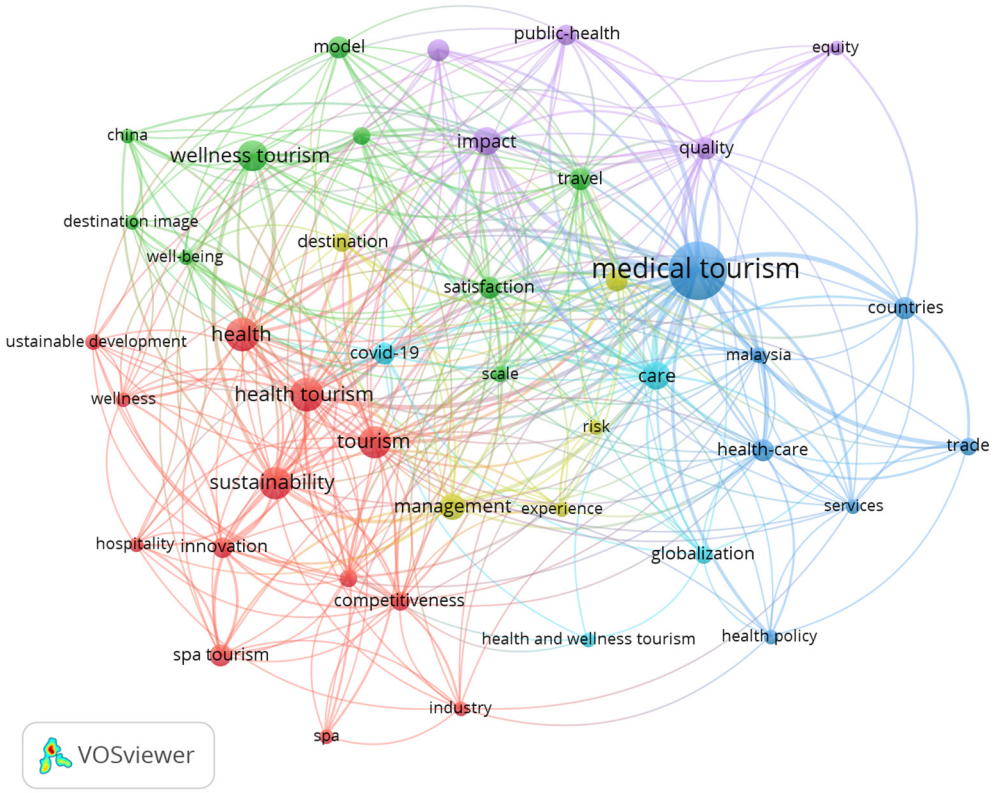



**Figure 1.** Bibliometric map of keywords' occurrence. Source: own processing in VOSviewer.

Based on the bibliometric analysis outlined above, it is evident that research in the field of spa and health tourism has developed a multidimensional character, with distinct thematic clusters reflecting various approaches to evaluating the performance and impact of these services. In the following subsections, we provide a synthesis of key findings and research directions aligned with the dominant thematic clusters, placing particular emphasis on studies related to economic performance, cluster analysis, and the financial management of spa facilities.

### *2.1. Performance, Competitiveness, and Sustainability of Spa Tourism Enterprises (Red Cluster)*

Spa tourism is a distinct form of tourism that plays a significant role in the economic, social, and environmental development of regions. Given the increasing emphasis on sustainability and innovation, research focused on the performance and competitiveness of spa facilities is essential for developing effective regional development strategies and enhancing public health outcomes (Romão, 2018; Zhang et al., 2023).

According to Grecu et al. (2020), spa destinations constitute a vital component of local economies, characterized by dynamic economic profiles. Their analysis of key economic indicators—such as turnover, profit, and number of employees—at selected spa resorts in Romania confirmed the increasing importance of spas within tourism systems. Beyond job creation, spas also contribute to the diversification of economic activity, particularly in less developed regions.

Service quality is a key determinant of the competitiveness of spa facilities. As Kovac (2014) highlights, the implementation of quality management systems—such as the ISO 9001 standard—significantly enhances the safety, efficiency, and international reputation of health and wellness services. The case of Croatia's St. Catherine Specialty Hospital demonstrates that quality certification not only facilitates market entry into health tourism but also boosts the trust of foreign clients.

The performance of spa facilities can also be evaluated using efficiency measurement methods. Yu et al. (2018), for example, applied Data Envelopment Analysis (DEA) to assess the performance of the medical tourism ecosystem across Chinese regions. Their study emphasizes the importance of optimizing inputs and outputs to promote more efficient development of spa destinations, particularly in terms of health infrastructure and service provision.

The concept of sustainability in spa tourism encompasses not only environmental considerations but also social integration and the innovative capacity of enterprises. As Torres-Pruñonosa et al. (2022) highlight, sustainability in rural tourism necessitates balancing economic diversification, cultural heritage preservation, and ecological responsibility. The identified clusters indicate that spa facilities successfully linking economic performance with regional development tend to foster stronger connections with local communities while more effectively responding to evolving tourist demands.

Similarly, Zhang et al. (2023) conceptualize the development of spa and health tourism in China through a framework centered on both demand- and supply-side factors. Their model identifies economic, social, political, and environmental determinants that shape the success of health tourism, with particular emphasis on the aging population and the increasing demand for long-term stays in naturally attractive locations.

Innovation and adaptability to current trends are critical components of competitiveness in the spa sector. Torres-Pruñonosa et al. (2022) demonstrate that companies developing innovative and eco-friendly products exhibit greater economic resilience and adaptability. Dang et al. (2020) highlight the strategic shift from traditional spa services toward integrated health tourism models, driven by technological advancements and a multidisciplinary approach, which substantially enhances sector performance and sustainability. Similarly, Lubowiecki-Vikuk and Kurkowiak (2017), through a bibliometric analysis of wellness tourism, emphasize that company performance and competitiveness increasingly depend on meeting the complex needs of visitors, ranging from health and relaxation to cultural and environmental authenticity.

In Slovakia, research on spa facility performance primarily centers on analyzing economic indicators and their trends over time. Derco et al. (2020) highlighted the necessity of modernization and service quality enhancement, emphasizing the strong connection between the innovative capacity of spa enterprises and their competitiveness within the European market.

In summary, current research indicates that the sustainable performance of spa facilities depends on a multidimensional approach encompassing quality and innovation integration, environmental responsibility, economic efficiency, and adaptability to evolving market demands. Together, these factors form the foundation for the long-term competitiveness and resilience of the spa sector within the broader framework of sustainable tourism development. Dargahov et al. (2023) further emphasize that the ability to create perceived value for customers—through a combination of innovation, service personalization, and effective marketing management—is also critical to sustaining high performance in wellness and spa tourism.

### *2.2. Satisfaction, Destination Image, and Wellness Experience (Green Cluster)*

Current research in wellness and spa tourism highlights the importance of visitor satisfaction, a positive destination image, and personally experienced moments for enhancing competitiveness and differentiating offerings. These factors are crucial in shaping customer loyalty, length of stay, and spending; however, their direct relationship with specific financial indicators of spa facilities remains only partially explored. For example, Dryglas and Smith (2023) identify five key components of the "health tourism experiencescape" based

on expert insights from the Visegrad Four countries: quality infrastructure, individualized services, client segmentation, and hygiene standards. While these elements can significantly impact customer satisfaction and loyalty, the study does not assess their economic effects, such as changes in sales, costs, or return on investment related to service quality.

Dujnić Hundrić et al. (2020) studied wellness tourism in Croatia, highlighting its potential for year-round operation and sustainable profitability. They identified key service quality attributes—professionalism of staff, cleanliness, a peaceful atmosphere, and quality accommodation—as fundamental drivers of client satisfaction and overall experience. The authors recommend systematic monitoring of these factors as part of management's performance evaluation.

Mijatov Ladičorbić et al. (2024) analyzed wellness visitors' experiences in Slovenia, revealing that satisfaction is influenced by factors such as the quality of the natural environment, service availability, and the facility's trustworthiness. While these elements are crucial in shaping client decisions, their direct economic impacts—such as effects on revenues or costs—were not explicitly quantified in the study.

From the perspective of destination image, how spa locations communicate their value is crucial. Antunes et al. (2022), in their study from Portugal, emphasize the importance of targeted marketing and consistent brand management in thermal regions. Particularly during crises like the COVID-19 pandemic, building trust through a strong image and positive customer experiences is essential for encouraging repeat visits. However, the study did not examine the direct financial impact of these marketing and branding efforts.

Overall, research on satisfaction and destination image in spa and wellness tourism offers valuable insights into customer preferences and decision making factors. However, most studies lack a systematic connection to financial metrics such as revenue, costs, or operational efficiency. This gap presents a challenge for future research aiming to integrate subjective customer indicators with the economic performance of spa businesses.

### *2.3. Health Policy, Services, and Trade in Medical Tourism (Blue Cluster)*

The literature grouped in the blue cluster, as identified through bibliometric analysis, highlights a concentration of research on medical tourism—one of the fastest-growing tourism segments. Unlike wellness tourism, medical tourism is often associated with specific medical procedures, thus taking on the nature of necessary travel (Y.-C. Wen et al., 2025). However, many cases also involve elective treatments driven by factors such as lower costs, shorter waiting times, or higher quality care. These characteristics significantly influence demand patterns and place new expectations on service providers within the spa and health tourism sector.

Countries such as Malaysia, India, and China adopt a centralized state approach to developing health tourism, where the government plays a pivotal role in regulating, supporting, and promoting the industry (Hunter, 2025; Chowdhary & Majumdar, 2025). This model fosters synergistic effects among the health sector, economic policy, and service exports. In contrast, the European context features a decentralized health policy framework, a stronger focus on public health, and heightened attention to ethical and legislative standards (Bojorquez et al., 2024; Keháidou et al., 2025). These structural differences limit the direct application of some models to Europe but simultaneously open opportunities for tailored solutions based on public–private partnerships.

According to Islam et al. (2025), effective health policy management is vital for the development of health tourism, with service accessibility, system transparency, and quality of care being key factors. Their research demonstrates that a state-supported framework—including service standardization, certification, and marketing support—not only enhances the trust of foreign patients but also strengthens the competitive position of the destination.

An important dimension of health tourism is its link to international trade in services, encompassing technology transfer, skilled personnel, and health infrastructure. Jalali et al. (2025) emphasize that this multifaceted perspective demands comprehensive policy instruments and coordinated efforts across the health, tourism, and economic sectors. International examples demonstrate that a strategic framework grounded in multidisciplinary collaboration is essential for the long-term sustainability of spa and health tourism.

For developing countries, medical tourism holds significant potential as a catalyst for economic growth. Chowdhary and Majumdar (2025) argue that even in settings with limited infrastructure, a strategic focus on specialized health services can attract foreign investment and generate new employment opportunities. However, the successful implementation of this model requires strict regulatory frameworks and robust quality monitoring to safeguard the integrity of the public health system.

For Slovakia and the Central European region, the findings of Reshadi and Chehragh (2025) are particularly relevant. They identified key factors influencing demand for cross-border health services, such as language accessibility, cultural proximity, logistics, and system transparency. These factors can enhance the appeal of Slovak spa facilities, especially among clients from neighboring countries like the Czech Republic, Austria, and Hungary.

Research within the blue cluster highlights that the development of spa and health tourism is closely tied to health policy frameworks, service quality, and integration into the international trade system. While European countries face distinct systemic challenges compared to developing destinations, their competitiveness and financial performance will depend heavily on how effectively they adapt global strategies to local contexts.

### *2.4. Destination Management and Public Health Risk (Yellow Cluster)*

The literature clustered in the yellow group from the bibliometric analysis highlights a growing interest in connecting strategic destination management with public health protection. Key terms such as destination, experience, management, public health, and risk indicate a shift towards an integrated approach that considers health risks, regional resilience, and the quality of the tourist experience amid evolving socio-health conditions. A pertinent example is Slovakia, where public health insurance significantly influences the clientele structure and service availability in spa tourism. As Derco (2014) notes, restrictions imposed by health insurance companies compel spa facilities to diversify into wellness offerings and collaborate with destination management organizations to develop new products. However, the study lacks a comprehensive evaluation of economic performance and public financing efficiency—an issue that also poses challenges for other countries in the region.

In the Greek context, Keháidou et al. (2025) document significant legislative reforms in health tourism, including the creation of a provider registry and the establishment of criteria for spa treatments. However, they highlight the lack of long-term strategic planning and emphasize the need to align development efforts with public health responsibilities and economic sustainability.

Globally, Zheng et al. (2025) identify a rising interdisciplinary interest in "healing tourism," which connects tourism with public health and healthy aging. Their analysis of 101 studies revealed four key research areas: disease prevention, mental health, wellness experiences, and physical activity. However, they also highlight a notable lack of economic indicators and evaluations of the effectiveness of therapeutic interventions, which limits the ability to assess return on investment in health tourism infrastructure.

The perceived risks to safety and public health during the COVID-19 pandemic have heightened the importance of a destination's electronic reputation. A study by Goyal and Taneja (2023) confirmed that electronic word-of-mouth (eWOM) significantly influences

tourists' decision making in the wellness tourism sector. Destinations with a positive image and credible communication were better able to respond to the crisis. However, the connection between these reputation factors and economic outcomes, such as return on marketing investment, remains underexplored.

Huang et al. (2022) and L. Liu et al. (2023) highlight that despite the significant potential for medical tourism in Southeast Asian regions such as Thailand, government institutions seldom conduct systematic analyses of financial performance indicators for service providers. These findings underscore the need to connect strategic destination management with comprehensive economic evaluations of impacts on public spending, sector productivity, and regional development.

The above findings suggest that, although destination management in health and wellness tourism increasingly incorporates public health considerations, there remains a lack of systematic integration with performance and financial indicators. This disconnect presents a key challenge for both policy makers and researchers, highlighting the need for studies that quantify the impact of management and regulatory measures on the sustainability and effectiveness of health tourism.

### *2.5. Sustainable Tourism, Qualitym and Equity (Purple Cluster)*

Health, wellness, and spa tourism is increasingly positioned as a driver of sustainable regional development, with direct impacts on public health, quality of life for both residents and visitors, and the regional economy. However, many existing studies focus predominantly on qualitative aspects—such as access equity, user satisfaction, psychosocial benefits, and perceived environmental quality—while integrating only a limited range of economic indicators.

For example, Azimi et al. (2025) found that wellness tourism significantly enhances the psychosocial well-being of the elderly population. Intervention programs studied in Iran demonstrated improvements in life satisfaction and overall well-being, largely attributed to the perception of a restorative environment. Notably, the authors highlight gender differences in these outcomes, underscoring the importance of inclusive service design and the need for public health policies that are responsive to diverse needs. They also recommend that wellness programs be not only financially accessible—e.g., through subsidies—but also targeted and physically accessible to various demographic groups. In the context of an aging population, ensuring equity in access is a critical consideration.

Cuba offers a noteworthy example of systemic solutions and public policy in health tourism, where the sector has long been integrated with community medicine and universally accessible healthcare. In his analysis, Wylie (2021) highlights how Cuba's robust, low-cost health system—combined with its tradition of medical diplomacy—enabled an effective response to the COVID-19 crisis. The Cuban model demonstrates that health tourism need not be reserved for elite or commercially exclusive markets; instead, it can align with principles of solidarity, equity, and social justice. This stands in contrast to the predominantly market-driven models that characterize much of global health tourism.

Equity and quality in health and wellness tourism are also closely tied to the technological infrastructure of destinations, as demonstrated by Panyadee et al. (2023). Their study showed that the introduction of smart wellness technologies in Chiang Mai, Thailand, following the COVID-19 crisis, helped to restore tourist confidence while enabling more precise service monitoring and customization for various target groups. This led to improved service quality and greater adaptability to users' specific needs. However, the authors also caution against the risk of digital exclusion, particularly among vulnerable populations, highlighting once again the critical issue of ensuring equal access in the digital age.

Similar conclusions are drawn by Hartwell et al. (2016), who argue that sustainable destinations should be evaluated not only in terms of attractiveness or economic benefits but also through their impact on the emotional, psychological, and social well-being of both visitors and residents. The authors propose a three-dimensional evaluation framework considering the perspectives of the tourist, the host community, and the destination as a whole. They emphasize the need for research assessments to include measurable indicators of quality of life, satisfaction, and equitable access to services, factors that are often missing or only superficially addressed in the current literature.

Recent developments highlight the growing need for integrated models to assess the impacts of wellness and health tourism—models that combine both qualitative dimensions (such as user satisfaction, perceived value, and service accessibility) and quantitative measures (including economic indicators, cost-benefit analyses, and affordability). While the concepts of well-being and sustainability are now well embedded within tourism discourse, critical aspects like health equity and affordability remain underexplored and demand a more systematic and evidence-based approach.

### *2.6. Global Shocks and Resilience in Spa and Wellness Tourism (Light Blue Cluster)*

The COVID-19 pandemic has had a profound impact on health and wellness tourism, affecting not only demand patterns but also the economic and operational structures of spa and wellness facilities. These disruptions exposed the sector's vulnerabilities while simultaneously highlighting its adaptive capacity. This duality directly aligns with the objectives of this paper, particularly in terms of evaluating the economic performance of spa enterprises and their resilience to external shocks.

Oprea et al. (2023) examined the impact of the pandemic on spa destinations in Romania and emphasized the need for strategic risk management and diversification of revenue streams. Their findings indicate that destinations with a strong domestic clientele and a broad range of services—such as rehabilitation, recreational, and therapeutic programs—exhibited greater resilience. Similar conclusions were drawn by Dryglas and Smith (2025) in a study focused on the Visegrad Group (V4) countries. They found that health tourism significantly contributes to regional development and social well-being, with the highest resilience observed in facilities that (1) collaborate with local governments and healthcare institutions; (2) leverage digital technologies for communication and booking; and (3) adapt their services to post-pandemic client behavior, particularly through a focus on prevention, wellness, and personalized care.

These findings are further supported by Mota et al. (2023), who investigated the response of spa facilities in Portugal's Estrela Geopark. Their research demonstrated that these facilities successfully adapted to the decline in international tourism by targeting domestic visitors and diversifying their service offerings. This strategic shift had a positive effect on employment and occupancy rates during the crisis. The study also underscored the importance of employing alternative economic performance metrics—such as Total Revenue per Available Room (TRevPAR)—which offer more nuanced insights into the financial recovery and operational efficiency of spa enterprises.

From the perspective of corporate financial health, X. Liu et al. (2024) offer valuable insights through their analysis of financial data from publicly traded health and wellness companies in China. Their study reveals considerable volatility in revenue and profitability during the COVID-19 pandemic, with firms characterized by high leverage and low liquidity experiencing the greatest adverse impacts. To enhance early risk detection, the authors advocate for the systematic application of financial warning indicators, such as the Altman Z-score, to identify companies vulnerable to significant revenue declines.

The pandemic has also prompted a notable transformation in consumer behavior. J. Wen et al. (2020) report that Chinese tourists are increasingly favoring individual and wellness-oriented travel, reflecting a growing awareness of disease prevention and immune system strengthening. This shift has sparked a rapid resurgence of interest in health tourism, presenting spa facilities with opportunities to adapt and tailor their offerings to evolving visitor expectations.

Last but not least, access to wellness services during the pandemic changed significantly for vulnerable groups. Mintz et al. (2025) highlight that online wellness programs proved particularly effective for individuals with physical disabilities, with adherence rates notably higher when content was customized and instructors adopted an empathetic approach. These findings underscore the need for hybrid wellness service models that combine both physical and virtual availability, enhancing system resilience while promoting equity in access.

The thematic areas discussed above confirm that spa and health tourism research is increasingly linked to performance, public health, regional development, and environmental sustainability. However, a notable research gap remains in the application of comprehensive financial analyses at the level of individual spa enterprises. Few studies have utilized methods such as cluster analysis to classify spas based on financial indicators. Our study aims to address this gap by applying hierarchical cluster analysis to current data on Slovak spas, offering a fresh perspective on their economic diversity and performance typologies.

The delineation of cluster characteristics draws on the most recent body of literature, independent of the temporal context in which the underlying data were collected. The primary objective of this section is the conceptual identification and thematic delineation of research trajectories, rather than an assessment of political or economic contingencies tied to a specific period.

## 3. Materials and Methods

This paper presents a cluster analysis of 20 spa enterprises operating in Slovakia, based on key financial indicators for the years 2018 and 2023. The primary objective is to group spas into homogeneous clusters to better understand their financial performance and strategic positioning. Comparing the financial performance of Slovak spa enterprises in 2018 and 2023 offers valuable insights into how these businesses have evolved during a period marked by both stability and disruption. The year 2018 serves as a baseline, representing pre-pandemic operating conditions and reflecting the typical financial environment before major external shocks. In contrast, 2023 reflects a post-pandemic context in which spas have had to adapt to changing market dynamics, consumer behavior, and economic challenges. This comparison allows for the identification of shifts in financial performance and strategic positioning, revealing how different clusters of spas have responded to these challenges. Furthermore, the five-year interval is sufficiently long to capture meaningful changes in profitability, efficiency, cost management, liquidity, and indebtedness, while still maintaining relevance to current industry conditions. This temporal comparison strengthens the cluster analysis by highlighting not only static differences but also dynamic trends in the financial health and resilience of the sector.

### *3.1. Data*

Slovakia has 21 spa towns hosting a total of 30 operating spa enterprises. This study focused on those functioning as joint-stock companies, limited liability companies, or state-owned enterprises. In the context of this study, the term spa enterprise is used consistently. This designation was chosen because it more accurately reflects the legal and economic diversity of the Slovak spa sector, which includes joint-stock companies, limited

liability companies, and state-owned enterprises. The word enterprise thus captures the full spectrum of organizational and ownership forms, whereas the term company would suggest only private, company-based structures. Of the 30 active spa entities, only 20 had complete data for the observed period and were therefore included in the analysis. These include Bardejov Spa, Natural Iodine Spa Číž, Spa Dudince, Spa Kováčová, Spa Bojnice, Spa Horný Smokovec, Spa Lúčivná, Spa Lúčky, Spa Nový Smokovec, Spa Vyšné Ružbachy, Specialized Medical Institute Marína, Spa Nimnica, PIENINY RESORT, Slovak Health Spa Piešťany, Slovak Health Spa Rajecké Teplice, Spa Sliač, Slovthermae Spa Diamant Dudince, Spa Štós, Spa Trenčianske Teplice, and Slovak Health Spa Turčianske Teplice. The locations of these spa enterprises are shown on the map in Figure 2.

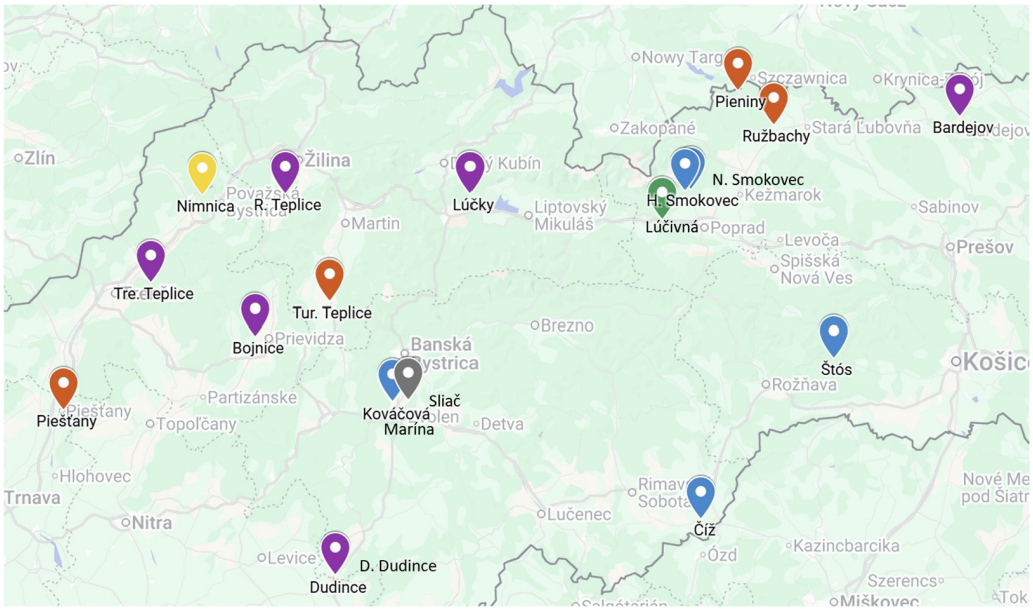



**Figure 2.** Research sample: 20 spa enterprises in Slovakia.

The financial indicators were selected to provide a comprehensive overview of key dimensions of corporate performance, including profitability, efficiency, cost efficiency, liquidity, and indebtedness. within the dimension of profitability, return on assets (ROA) and return on sales (ROS) were employed, while efficiency was captured through asset turnover (AT). Cost efficiency was measured by three indicators: personnel cost ratio (PCR, defined as personnel costs to total costs), cost-to-sales ratio (CSR), and return on costs (ROC). Liquidity was assessed using net working capital (NWC) and the current ratio (CR). Finally, indebtedness was represented by the equity to total liabilities ratio (E/TL) and the debt ratio (DR, total debt to total assets). The selection of these indicators was based on their frequent use in prior research on spa enterprises and health tourism, ensuring comparability with earlier studies and methodological continuity (e.g., Derco, 2017; Jenčová et al., 2019; Štefko et al., 2020; Kraftová et al., 2020; Čabinová et al., 2021; Santoso & Supatmi, 2021). This classification thus not only captures all essential aspects of financial health but also aligns with established approaches in the literature, strengthening the validity and interpretability of the results. The input data were sourced from publicly available financial statements registered in the Register of Financial Statements maintained by the Ministry of Finance of the Slovak Republic.

### *3.2. Methods*

One effective approach to leveraging multidimensional financial data is to group spa enterprises into relatively homogeneous clusters, where enterprises within the same

cluster exhibit more similar financial performance than those in different clusters. Cluster analysis is used for this purpose, reducing the complexity of the data by summarizing multiple financial indicators into a single classification that reflects each enterprise's group membership. As a statistical technique, cluster analysis plays a key role in unsupervised machine learning and is an important tool within artificial intelligence (AI), especially in data-driven or automated decision making systems.

In this study, hierarchical cluster analysis is applied to group spa enterprises based on financial performance indicators. This method organizes enterprises into a nested structure of groups and subgroups, where each cluster can contain smaller subclusters and also belong to a broader group. Ward's method, one of the most widely used hierarchical clustering techniques, is employed. It aims to form clusters of similar size and shape by maximizing within-cluster similarity. An important advantage of Ward's method is that it minimizes the increase in within-cluster variance at each step of clustering, which results in internally homogeneous and compact groups. Compared with other linkage methods, it also tends to produce clusters of relatively balanced size, avoiding overly fragmented or chain-like groupings (Ward, 1963). These properties make it particularly suitable for analyzing financial indicators, as it ensures that spa enterprises with similar financial profiles are grouped together in a stable and interpretable way. The clustering results are visually presented using a dendrogram, illustrating the hierarchical relationships among the enterprises.

Prior to conducting the hierarchical cluster analysis, all variables were standardized to z-scores (mean = 0, standard deviation = 1) using the egen . . . = std() command in StataNow 19 in order to eliminate the effect of differences in numerical scale between indicators.

To identify the optimal number of clusters, the Duda–Hart index ($Je(2)/Je(1)$) and the corresponding pseudo-$T^2$ statistic were used. These measures help pinpoint the stage at which merging additional clusters offers minimal benefit. In this context, $Je(1)$ represents the within-cluster sum of squares for a single cluster before splitting, while $Je(2)$ is the combined within-cluster sum of squares after dividing it into two clusters. The ratio $Je(2)/Je(1)$ reflects the relative change in internal cluster variability across clustering steps, and the pseudo-$T^2$ statistic assesses how distinct the merged clusters are. Optimal cluster splits are typically indicated by local peaks in the Duda–Hart index along with low pseudo-$T^2$ values. These metrics were chosen to produce stable and interpretable clustering outcomes.

## 4. Results

We applied cluster analysis using Ward's method to all 10 financial performance indicators. Since Ward's method produced several smaller clusters, we used the Duda–Hart $Je(2)/Je(1)$ index to determine the optimal number of clusters. Calculations were conducted for cluster solutions ranging from one to fifteen groups. The ideal number of clusters corresponds to the highest value of the index combined with the lowest pseudo-$T^2$ value. Based on these criteria, summarized in Table 1, five clusters were selected for 2018 and six clusters for 2023. The resulting dendrograms are presented in Figure 3 (2018) and Figure 4 (2023). The cluster division for 2023 is not only illustrated in the dendrogram labeled C1 to C6 (Figure 4) but is also visually represented on the map in Figure 2 using distinct color coding for each cluster. This stepwise procedure ensured that the final cluster solution was not chosen arbitrarily or solely by the software but instead reflected a combination of statistical criteria and interpretability of the resulting groups.

**Table 1.** Duda–Hart index.

| Number of Clusters | *Je*(2)/*Je*(1) in 2018 | Pseudo-$T^2$ in 2018 | *Je*(2)/*Je*(1) in 2023 | Pseudo-$T^2$ in 2023 |
|---|---|---|---|---|
| 1 | 0.6793 | 8.50 | 0.7138 | 7.22 |
| 2 | 0.7793 | 4.82 | 0.7650 | 4.91 |
| 3 | 0.7128 | 3.63 | 0.5914 | 6.91 |
| 4 | 0.5301 | 3.55 | 0.5964 | 6.09 |
| 5 | 0.6349 | 3.45 | 0.0000 | – |
| 6 | 0.2550 | 5.84 | 0.5647 | 3.85 |
| 7 | 0.4722 | 2.24 | 0.5436 | 3.36 |
| 8 | 0.4403 | 3.81 | 0.3694 | 3.41 |
| 9 | 0.1954 | 4.12 | 0.5259 | 3.61 |
| 10 | 0.5705 | 1.51 | 0.4457 | 2.49 |
| 11 | 0.3628 | 1.76 | 0.3826 | 3.23 |
| 12 | 0.4364 | 1.29 | 0.0000 | – |
| 13 | 0.6075 | 1.29 | 0.4266 | 1.34 |
| 14 | 0.0000 | – | 0.0000 | – |
| 15 | 0.0000 | – | 0.0000 | – |

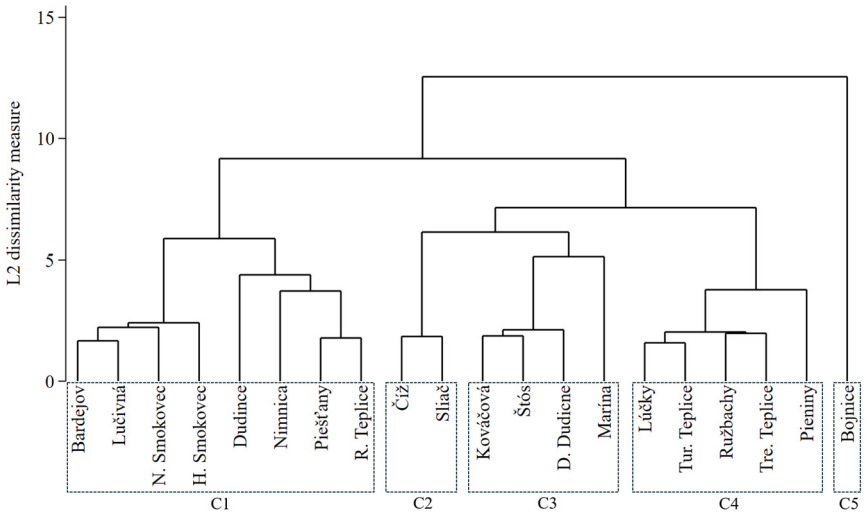



**Figure 3.** Dendrogram in 2018. Note: C1–C5 denotes designations from Cluster 1 to Cluster 5.

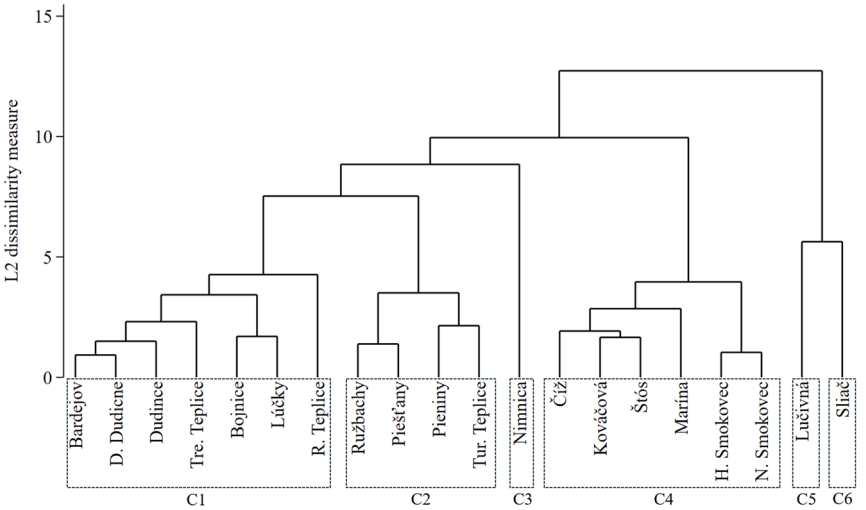



**Figure 4.** Dendrogram in 2023. Note: C1–C6 denotes designations from Cluster 1 to Cluster 6.

To better understand the financial profiles of the spa enterprises grouped into the five (six in 2023) clusters, we examined the descriptive statistics (mean, standard deviation, minimum, and maximum) of ten selected financial indicators (Tables 2 and 3). These indicators provide insight into profitability (ROA, ROS), efficiency (AT), cost efficiency (PCR, CSR, ROC), liquidity (NWC, CR), and indebtedness (E/TL, DR).

**Table 2.** Descriptive statistics of the financial indicators for each cluster in 2018.

| | **Cluster 1** | | | | **Cluster 2** | | | | **Cluster 3** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | S.D. | Min | Max | Mean | S.D. | Min | Max | Mean | S.D. | Min | Max |
| ROA | 0.055 | 0.030 | 0.017 | 0.108 | −0.106 | 0.038 | −0.133 | −0.079 | −0.008 | 0.038 | −0.053 | 0.035 |
| ROS | 0.084 | 0.048 | 0.019 | 0.167 | −0.131 | 0.043 | −0.162 | −0.101 | −0.014 | 0.055 | −0.073 | 0.048 |
| AT | 0.702 | 0.227 | 0.390 | 1.106 | 0.805 | 0.025 | 0.788 | 0.823 | 0.673 | 0.100 | 0.524 | 0.735 |
| E/TL | 4.488 | 2.896 | 1.304 | 10.045 | 1.422 | 1.990 | 0.015 | 2.829 | 5.010 | 4.545 | −0.275 | 9.124 |
| NWC | 1,318,547 | 1,562,143 | −264,104 | 3,692,185 | −129,443 | 160,300 | −242,792 | −16,094 | 1,081,793 | 1,429,136 | 19,840 | 3,126,239 |
| DR | 0.073 | 0.026 | 0.039 | 0.103 | 0.114 | 0.028 | 0.094 | 0.134 | 0.055 | 0.016 | 0.044 | 0.079 |
| CR | 2.688 | 2.345 | 0.551 | 7.965 | 0.629 | 0.468 | 0.298 | 0.960 | 4.384 | 3.010 | 1.213 | 8.470 |
| PCR | 0.367 | 0.073 | 0.280 | 0.495 | 0.484 | 0.022 | 0.469 | 0.500 | 0.553 | 0.131 | 0.449 | 0.744 |
| CSR | 1.020 | 0.178 | 0.898 | 1.428 | 1.169 | 0.015 | 1.158 | 1.180 | 1.073 | 0.092 | 0.954 | 1.174 |
| ROC | 0.079 | 0.055 | 0.012 | 0.195 | −0.123 | 0.028 | −0.143 | −0.103 | −0.037 | 0.060 | −0.082 | 0.050 |
| | **Cluster 4** | | | | **Cluster 5** | | | | | | | |
| | Mean | S.D. | Min | Max | Mean | S.D. | Min | Max | | | | |
| ROA | −0.001 | 0.015 | −0.023 | 0.015 | 0.088 | – | 0.088 | 0.088 | | | | |
| ROS | −0.010 | 0.042 | −0.067 | 0.028 | 0.267 | – | 0.267 | 0.267 | | | | |
| AT | 0.395 | 0.188 | 0.136 | 0.596 | 0.327 | – | 0.327 | 0.327 | | | | |
| E/TL | 1.882 | 1.576 | 0.585 | 4.525 | 23.350 | – | 23.350 | 23.350 | | | | |
| NWC | 272,019 | 1,016,606 | −877,509 | 1,709,172 | 9,895,261 | – | 9,895,261 | 9,895,261 | | | | |
| DR | 0.096 | 0.028 | 0.066 | 0.140 | 0.025 | – | 0.025 | 0.025 | | | | |
| CR | 0.951 | 0.584 | 0.316 | 1.599 | 12.001 | – | 12.001 | 12.001 | | | | |
| PCR | 0.350 | 0.059 | 0.262 | 0.420 | 0.439 | – | 0.439 | 0.439 | | | | |
| CSR | 1.151 | 0.118 | 0.998 | 1.301 | 0.745 | – | 0.745 | 0.745 | | | | |
| ROC | −0.025 | 0.045 | −0.086 | 0.020 | 0.356 | – | 0.356 | 0.356 | | | | |

Note: S.D. denotes standard deviation, Min is the minimum value within the cluster, and Max represents the maximum value within the cluster.

**Table 3.** Descriptive statistics of the financial indicators for each cluster in 2023.

| | **Cluster 1** | | | | **Cluster 2** | | | | **Cluster 3** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | S.D. | Min | Max | Mean | S.D. | Min | Max | Mean | S.D. | Min | Max |
| ROA | 0.094 | 0.043 | 0.050 | 0.165 | 0.046 | 0.053 | −0.008 | 0.113 | 0.126 | – | 0.126 | 0.126 |
| ROS | 0.157 | 0.071 | 0.094 | 0.260 | 0.099 | 0.095 | −0.012 | 0.185 | 0.200 | – | 0.200 | 0.200 |
| AT | 0.629 | 0.185 | 0.309 | 0.828 | 0.517 | 0.162 | 0.352 | 0.693 | 0.631 | – | 0.631 | 0.631 |
| E/TL | 4.656 | 2.419 | 2.317 | 8.059 | 1.385 | 1.287 | 0.282 | 3.202 | 8.596 | – | 8.596 | 8.596 |
| NWC | 2,724,734 | 1,841,781 | 1,017,781 | 6,645,297 | −99,317 | 971,534 | −1,163,243 | 1,036,540 | 10,100,000 | – | 10,100,000 | 10,100,000 |
| DR | 0.078 | 0.023 | 0.049 | 0.116 | 0.116 | 0.043 | 0.083 | 0.178 | 0.050 | – | 0.050 | 0.050 |
| CR | 2.504 | 0.654 | 1.595 | 3.358 | 0.999 | 0.613 | 0.193 | 1.612 | 14.206 | – | 14.206 | 14.206 |
| PCR | 0.424 | 0.082 | 0.272 | 0.518 | 0.336 | 0.077 | 0.257 | 0.403 | 0.476 | – | 0.476 | 0.476 |
| CSR | 0.878 | 0.064 | 0.771 | 0.946 | 1.180 | 0.167 | 1.040 | 1.421 | 0.782 | – | 0.782 | 0.782 |
| ROC | 0.179 | 0.093 | 0.094 | 0.297 | 0.056 | 0.071 | −0.020 | 0.131 | 0.290 | – | 0.290 | 0.290 |
| | **Cluster 4** | | | | **Cluster 5** | | | | **Cluster 6** | | | |
| | Mean | S.D. | Min | Max | Mean | S.D. | Min | Max | Mean | S.D. | Min | Max |
| ROA | 0.087 | 0.086 | −0.059 | 0.199 | −0.081 | – | −0.081 | −0.081 | −0.295 | – | −0.295 | −0.295 |
| ROS | 0.068 | 0.064 | −0.044 | 0.150 | −0.188 | – | −0.188 | −0.188 | −0.395 | – | −0.395 | −0.395 |
| AT | 1.282 | 0.136 | 1.077 | 1.464 | 0.431 | – | 0.431 | 0.431 | 0.748 | – | 0.748 | 0.748 |
| E/TL | 1.921 | 1.725 | −0.513 | 3.738 | 0.409 | – | 0.409 | 0.409 | 0.505 | – | 0.505 | 0.505 |
| NWC | 503,091 | 504,963 | −155,714 | 1,153,852 | −2,124,406 | – | −2,124,406 | −2,124,406 | 1,676,217 | – | 1,676,217 | 1,676,217 |
| DR | 0.131 | 0.042 | 0.065 | 0.189 | 0.429 | – | 0.429 | 0.429 | 0.097 | – | 0.097 | 0.097 |
| CR | 2.802 | 1.123 | 0.737 | 3.629 | 0.118 | – | 0.118 | 0.118 | 3.597 | – | 3.597 | 3.597 |
| PCR | 0.536 | 0.090 | 0.445 | 0.688 | 0.216 | – | 0.216 | 0.216 | 0.459 | – | 0.459 | 0.459 |
| CSR | 0.974 | 0.079 | 0.866 | 1.082 | 1.294 | – | 1.294 | 1.294 | 1.449 | – | 1.449 | 1.449 |
| ROC | 0.056 | 0.074 | −0.042 | 0.166 | −0.168 | – | −0.168 | −0.168 | −0.284 | – | −0.284 | −0.284 |

Note: S.D. denotes standard deviation, Min is the minimum value within the cluster, and Max represents the maximum value within the cluster.

Results for 2018 show that the cluster analysis of Slovak spa enterprises based on key standardized financial indicators resulted in five distinct groups, each exhibiting unique financial characteristics and performance profiles.

Cluster 1, the largest group, includes Bardejov Spa, Spa Lučivná, Spa Nový Smokovec, Spa Horný Smokovec, Spa Dudince, Spa Nimnica, Slovak Health Spa Piešťany, and Slovak

Health Spa Rajecké Teplice. These spas show moderate profitability (ROA: mean 0.055, S.D. 0.030, min 0.017, max 0.108; ROS: mean 0.084, S.D. 0.048, min 0.019, max 0.167) and relatively efficient asset utilization (AT: mean 0.702, S.D. 0.227, min 0.390, max 1.106). Liquidity is above average (CR: mean 2.688, S.D. 2.345, min 0.551, max 7.965), while indebtedness remains low (DR: mean 0.073, S.D. 0.026, min 0.039, max 0.103). The equity-to-liabilities ratio is also relatively high (E/TL: mean 4.488, S.D. 2.896, min 1.304, max 10.045), suggesting a conservative financial structure. Net working capital (NWC (in EUR): mean 1,318,547, S.D. 1,562,143, min −264,104, max 3,692,185) shows considerable dispersion, pointing to heterogeneity within the cluster.

Cluster 2, consisting of Natural Iodine Spa Číž and Spa Sliač, is characterized by negative profitability (ROA: mean −0.106, S.D. 0.038, min −0.133, max −0.079; ROS: mean −0.131, S.D. 0.043, min −0.162, max −0.101) despite maintaining reasonable asset turnover (AT: mean 0.805, S.D. 0.025, min 0.788, max 0.823). Liquidity is weak (CR: mean 0.629, S.D. 0.468, min 0.298, max 0.960), and indebtedness is somewhat higher (DR: mean 0.114, S.D. 0.028, min 0.094, max 0.134). The equity-to-liabilities ratio is low (E/TL: mean 1.422, S.D. 1.990, min 0.015, max 2.829), reflecting a more leveraged position.

Cluster 3, represented by Spa Kováčová, Spa Štós, Slovthermae Spa Diamant Dudince, and Specialized Medical Institute Marína, shows slightly negative profitability (ROA: mean −0.008, S.D. 0.038, min −0.053, max 0.035; ROS: mean −0.014, S.D. 0.055, min −0.073, max 0.048). Liquidity is strong (CR: mean 4.384, S.D. 3.010, min 1.213, max 8.470), while indebtedness remains modest (DR: mean 0.055, S.D. 0.016, min 0.044, max 0.079). The equity-to-liabilities ratio is high (E/TL: mean 5.010, S.D. 4.545, min −0.275, max 9.124), suggesting solvency and long-term resilience despite weaker short-term profitability.

Cluster 4, which includes Spa Lúčky, Slovak Health Spa Turčianske Teplice, Spa Vyšné Ružbachy, Spa Trenčianske Teplice, and Pieniny Resort, is defined by low or slightly negative profitability (ROA: mean −0.001, S.D. 0.015, min −0.023, max 0.015; ROS: mean −0.010, S.D. 0.042, min −0.067, max 0.028). Asset turnover is relatively weak (AT: mean 0.395, S.D. 0.188, min 0.136, max 0.596), while liquidity is also low (CR: mean 0.951, S.D. 0.584, min 0.316, max 1.599). Their equity-to-liabilities ratio is moderate (E/TL: mean 1.882, S.D. 1.576, min 0.585, max 4.525), but cost ratios are relatively high (CSR: mean 1.151, S.D. 0.118, min 0.998, max 1.301). These indicators suggest ongoing operational challenges and limited short-term flexibility.

Cluster 5, represented solely by Spa Bojnice, demonstrates the strongest financial position. It shows the highest profitability (ROA 0.088; ROS 0.267), exceptional solvency (E/TL 23.350), and the highest liquidity (CR 12.001). Debt levels are minimal (DR 0.025), and cost ratios are highly favorable (CSR 0.745). This cluster highlights an enterprise with outstanding financial health, efficiency, and resilience.

Results for 2023 show that Cluster 3 (Spa Nimnica) and Cluster 1 represent the best-performing spa enterprises, combining strong profitability, robust equity positions, and healthy liquidity. Cluster 4 also demonstrates efficient and balanced operations, with the highest asset turnover among all clusters. By contrast, Clusters 5 (Spa Lučivná) and 6 (Spa Sliač) show clear signs of financial distress, with negative profitability and unstable financial structures. Cluster 2 occupies an intermediate position, with weaker profitability and efficiency compared to the top-performing groups, but still maintains operational viability.

Cluster 1 consists of Bardejov Spa, Slovthermae Spa Diamant Dudince, Spa Dudince, Spa Trenčianske Teplice, Spa Bojnice, Spa Lúčky, and Spa Slovak Health Rajecké Teplice, representing the largest group. These enterprises demonstrate above-average financial performance. Profitability is positive (ROA: mean 0.094, S.D. 0.043, min 0.050, max 0.165; ROS: mean 0.157, S.D. 0.071, min 0.094, max 0.260), supported by moderate asset turnover (AT: mean 0.629, S.D. 0.185). Their capital structure is conservative (E/TL: mean 4.656,

S.D. 2.419), while liquidity remains healthy (CR: mean 2.504, S.D. 0.654). Personnel and cost ratios are moderate (PCR: mean 0.424; CSR: mean 0.878), reflecting efficient but not exceptional operations. Overall, these spas can be considered financially stable enterprises with moderate profitability and secure financing structures.

Cluster 2 includes Spa Vyšné Ružbachy, Slovak Health Spa Piešťany, PIENINY RESORT, and Slovak Health Spa Turčianske Teplice. This group shows lower profitability compared to Cluster 1 (ROA: mean 0.046, S.D. 0.053, min −0.008, max 0.113; ROS: mean 0.099, S.D. 0.095, min −0.012, max 0.185). Equity positions are weaker (E/TL: mean 1.385, S.D. 1.287), liquidity is reduced (CR: mean 0.999, S.D. 0.613, min 0.193, max 1.612), and debt ratios are higher (DR: mean 0.116). Cost ratios indicate less efficient management (CSR: mean 1.180; S.D. 0.167). Despite moderate asset turnover (AT: mean 0.517), these spas operate under tighter financial conditions and are more vulnerable to debt-related risks.

Cluster 3 consists only of Spa Nimnica, which continues to stand out as one of the best-performing spas in Slovakia. Profitability is strong (ROA = 0.126; ROS = 0.200; ROC = 0.290), supported by a very robust equity position (E/TL = 8.596) and excellent liquidity (CR = 14.206). Personnel costs are relatively high (PCR = 0.476) but are more than offset by efficient cost management (CSR = 0.782). With net working capital of EUR 10.1 million, Spa Nimnica demonstrates outstanding financial health and operational efficiency.

Cluster 4 brings together Natural Iodine Spa Číž, Spa Kováčová, Spa Štós, Specialized Medical Institute Marína, Spa Horný Smokovec, and Spa Nový Smokovec. This cluster is characterized by moderately positive performance. Profitability is fair (ROA: mean 0.087, S.D. 0.086, min −0.059, max 0.199; ROS: 0.068, S.D. 0.064), but with the highest asset turnover among all clusters (AT: mean 1.282, S.D. 0.136, max 1.464), suggesting very efficient use of assets. Equity positions are moderate (E/TL: mean 1.921, S.D. 1.725, min −0.513, max 3.738), liquidity is healthy (CR: mean 2.802, S.D. 1.123), and cost ratios remain reasonable (PCR: mean 0.536; CSR: mean 0.974). Overall, these spas represent well-performing enterprises with efficient operations and balanced financial structures, though with some variability in profitability.

Cluster 5 includes only Spa Lučivná, which records weak and negative performance. Profitability is clearly negative (ROA = −0.081; ROS = −0.188; ROC = −0.168), asset turnover is relatively low (AT = 0.431), and both equity position (E/TL = 0.409) and liquidity (CR = 0.118) indicate serious financial difficulties. Net working capital is deeply negative (EUR −2.12 million), further confirming financial distress. This spa represents a high-risk enterprise under significant financial pressure.

Cluster 6 consists of Spa Sliač, which also demonstrates negative performance across nearly all indicators. Profitability is highly unfavorable (ROA = −0.295; ROS = −0.395; ROC = −0.284), while equity position is weak (E/TL = 0.505). Liquidity appears strong (CR = 3.597), but this is likely driven by one-off balance sheet effects rather than sustainable operations. Costs are excessive (CSR = 1.449; PCR = 0.459), confirming a financially unstable enterprise with unsustainable profitability and cost structures.

In summary, the comparison between 2018 and 2023 reveals a more polarized spa sector. While several enterprises—most notably Spa Nimnica, Slovthermae Spa Diamant Dudince, Spa Lúčky, and Spa Trenčianske Teplice—significantly improved their financial standing, others such as Slovak Health Spa Piešťany, Spa Lučivná, and Spa Sliač recorded deterioration. The stability of core performers like Bardejov Spa, Spa Dudince, and Slovak Health Spa Rajecké Teplice highlights the resilience of established business models, whereas the persistence of distressed clusters confirms structural vulnerabilities that remain unresolved in parts of the industry. These dynamics illustrate the diverging paths of Slovak spa enterprises, with a clear separation between well-capitalized, profitable operators and those facing chronic financial difficulties.

## 5. Discussion

To understand the strategic and financial trajectories of Slovak spa enterprises, average values of key financial indicators were examined for each cluster in both 2018 and 2023. This analysis allows us to classify clusters not merely by numeric labels but by their underlying financial characteristics, such as profitability, efficiency, leverage, and liquidity. Consequently, the evolution of each spa was interpreted based on the nature of the cluster it belonged to in each year, irrespective of cluster numbering.

In 2018, Cluster 5 clearly represented the strongest financial performers, with the highest return on assets (ROA = 0.088), return on sales (ROS = 0.267), and return on capital (ROC = 0.356). This cluster also stood out for its extremely strong equity-to-total liabilities ratio (23.35) and exceptional liquidity (CR = 12.00), supported by high net working capital, indicating very solid financial stability. Cluster 1 also achieved positive profitability and relatively balanced liquidity and solvency, while Cluster 3 displayed moderate but mixed results. In contrast, Clusters 2 and 4 were the weakest groups, both showing negative profitability, relatively low liquidity, and less favorable capital structures (e.g., CR close to or below 1).

By 2023, the cluster structure showed notable differentiation. Cluster 3 emerged as the best-performing group, with outstanding profitability (ROA = 0.126, ROS = 0.200, ROC = 0.290), strong solvency (E/TL = 8.596), and very high liquidity (CR = 14.21), making it the most financially robust cluster in the dataset. Cluster 1 also performed well, with above-average profitability (ROA = 0.094, ROC = 0.179), solid liquidity (CR = 2.50), and favorable capital structure. Cluster 4 achieved high asset turnover (AT = 1.282) but only moderate profitability, while Clusters 5 and 6 recorded severe financial distress with strongly negative profitability (ROA of $-0.081$ and $-0.295$, respectively, and corresponding negative ROS and ROC values). Cluster 2 represented a middle group with modest but positive profitability, though limited solvency (E/TL = 1.385) and weaker liquidity compared to the top performers.

When comparing the cluster results of 2018 (five groups) and 2023 (six groups), several important transitions can be identified. Despite the methodological change in the number of clusters, it is possible to trace the continuity of financial profiles rather than numerical cluster identities.

Several spa enterprises remained within the broad category of stronger performers. Bardejov Spa, Spa Dudince, and Slovak Health Spa Rajecké Teplice stayed consistently within the financially stable and above-average group (2018 Cluster 1 $\rightarrow$ 2023 Cluster 1). Spa Bojnice, which in 2018 formed a standalone cluster of above-average performance, integrated into the main group of well-performing spas in 2023 (Cluster 1), thereby maintaining a strong financial position. These spas maintained stable financial positions over time, without significant improvement or decline, suggesting mature business models and consistent financial management. Similar to the findings of Derco et al. (2020), the stability of spa businesses often stems from a long-term focus on traditional customers, a strong reputation, and consistent service quality—factors that do not necessarily translate into innovation or growth potential.

At the same time, a number of enterprises showed clear upward movement. Slovthermae Spa Diamant Dudince improved from the mixed-profile cluster of 2018 (Cluster 3) to the above-average group in 2023 (Cluster 1). A similar positive transition is observed for Spa Lúčky and Spa Trenčianske Teplice, which advanced from the weaker-performing group (2018 Cluster 4) to the strong performers (2023 Cluster 1). Research by Ivona et al. (2019) highlights that improvements in economic indicators of spa businesses in Slovakia are often driven by the utilization of EU structural funds and facility modernization, which could also explain the positive development observed at Spa Lúčky. Spa Vyšné Ružbachy,

PIENINY RESORT, and Slovak Health Spa Turčianske Teplice also recorded progress, moving from the weaker 2018 profile (Cluster 4) to the mid-tier but financially viable group of 2023 (Cluster 2). The most remarkable improvement can be seen in Spa Nimnica, which advanced from the average-to-above-average group in 2018 (Cluster 1) to a single-member cluster in 2023 (Cluster 3), distinguished by exceptional profitability, solvency, and liquidity. Similarly, Natural Iodine Spa Číž shifted from the distressed 2018 cluster (Cluster 2) into a more balanced and efficient group in 2023 (Cluster 4). Spa Kováčová, Specialized Medical Institute Marína, and Spa Štós also improved, moving from a low-return but stable group in 2018 (Cluster 3) to the efficient, balanced category of 2023 (Cluster 4).

Some transitions represent re-segmentation rather than clear improvement or decline. Spa Horný Smokovec and Spa Nový Smokovec shifted from the average-performing group in 2018 (Cluster 1) to the efficiency-oriented cluster in 2023 (Cluster 4), reflecting moderate profitability and higher asset turnover rather than a significant change in financial health.

By contrast, certain spas experienced downward movement or persistent financial weaknesses. Slovak Health Spa Piešťany declined from the above-average group of 2018 (Cluster 1) to the mid-tier profile of 2023 (Cluster 2), indicating weakened profitability and liquidity. According to Mijatov Ladičorbić et al. (2024), health tourism businesses may experience declines in performance due to shifting patient preferences, increased foreign competition, and rising operating costs—factors that could explain the regression observed in some facilities. This financial vulnerability and the pressing need to adapt to external shocks were critically underscored during the COVID-19 pandemic, which exposed both the weaknesses and adaptive potential of the sector (Ivona et al., 2019; Torres-Pruñonosa et al., 2022). For instance, Oprea et al. (2023) found that Romanian spa destinations with a strong domestic clientele and diversified service offerings demonstrated greater resilience during the pandemic. Similar findings were reported by Dryglas and Smith (2025) in the V4 countries, where resilience was linked to cooperation with local institutions, the adoption of digital technologies, and service adaptations. Likewise, Mota et al. (2023) showed that Portuguese spas effectively responded to the decline in foreign tourism by pivoting toward domestic visitors and diversifying their services, positively impacting employment and occupancy rates during the crisis.

Spa Lučivná worsened considerably, moving from the average-performing group in 2018 (Cluster 1) to the distressed profile of 2023 (Cluster 5). This shift towards greater financial volatility—characterized by high profitability combined with low liquidity and increased risk—indicates that profitability alone does not guarantee financial stability. Spa facilities exhibiting these traits are particularly vulnerable to external shocks. This vulnerability is supported by X. Liu et al. (2024), who analyzed financial data from publicly traded companies in China's public health and wellness sector. Their study revealed significant fluctuations in revenue and profitability during the pandemic, with firms burdened by high debt and low liquidity suffering the most. For spa destinations, this means that despite the potential for high returns, insufficient liquidity and an unfavorable capital structure can lead to operational difficulties and threaten long-term sustainability (Derco, 2017). The case of Spa Rajecké Teplice aligns with the findings of Novotná et al. (2024) regarding the Czech spa industry, where resorts with greater tourist appeal faced sharper sales declines during the pandemic. Moreover, despite government subsidies, the effect on economic performance was limited, highlighting the critical need to diversify service portfolios to enhance resilience.

Spa Sliač continued to show signs of severe financial distress, shifting from the weak 2018 cluster (Cluster 2) to the newly identified distressed group in 2023 (Cluster 6), characterized by strongly negative profitability despite temporarily favorable liquidity.

Finally, several spas underwent lateral transitions between clusters that were not clearly stronger or weaker but represented different financial orientations. These lateral transitions—reflecting internal restructuring, diversification, or shifts in market strategies—are key indicators of adaptability. Current research underscores that the capacity to respond to evolving market conditions is vital for the long-term sustainability of the spa sector (Szromek et al., 2022). In the same vein, Dang et al. (2020) emphasize the importance of a strategic shift from traditional spa services toward integrated health tourism models, leveraging technological innovations and a multidisciplinary approach—an evolution that many businesses in the sector could have embraced. A similar diversification of strategies is documented by Ngo et al. (2025), who highlight the importance of adapting spa services to the preferences of various demographic groups. Their study shows that successful facilities tend to combine healthcare offerings with recreational and cultural experiences, thereby broadening their appeal and strengthening their market position. Building on the importance of service diversification, Oghbatalab et al. (2025) identified that high-performing spas share key characteristics such as strategic marketing, effective use of digital technologies for customer communication, and strong integration with healthcare services. These factors not only enhance customer engagement but also serve as valuable examples for other market players aiming to improve their competitiveness and resilience.

From a policy perspective, Ramanauskas et al. (2023) recommend that public interventions in the spa industry prioritize sustainability by offering tax incentives, supporting human resource development, and simplifying access to investment funding. Such measures could be particularly beneficial for Slovak spa businesses exhibiting lower financial performance, helping to enhance their competitiveness and long-term viability. More broadly, the results may assist regional policy makers and tourism development authorities. The study by Panyadee et al. (2023) highlights the importance of benchmarking models and performance evaluation in guiding regional policy making within the health and wellness tourism sector. Identifying high-performing destinations enables more effective targeting of public investments, infrastructure development, and the implementation of technological innovations aligned with sustainability objectives, promoting more balanced and sustainable development of the spa sector in Slovakia.

## 6. Conclusions

This study applied cluster analysis to assess the financial performance of 20 Slovak spa enterprises using data from 2018 and 2023, enabling a time-series comparison across key financial indicators. By capturing both pre- and post-pandemic conditions, the analysis highlights shifts in profitability, efficiency, cost management, liquidity, and indebtedness, providing valuable insights into the evolving financial dynamics and strategic positioning within the sector.

In conclusion, interpreting cluster membership through average financial indicators reveals deeper insights into the financial evolution of Slovak spa enterprises. While some spas maintained financial stability, others demonstrated clear improvement or decline, and a third group repositioned themselves in terms of financial structure. These patterns offer valuable guidance for stakeholders seeking to identify best practices, emerging risks, and strategic opportunities within the sector.

This study is limited by its focus on 20 spa enterprises with complete financial data and the use of only two time points, which may overlook short-term trends and external factors influencing performance. The findings of this study have practical relevance for multiple stakeholder groups. For spa managers, the classification highlights enterprises with comparable financial structures, facilitating targeted benchmarking and the transfer of best practices. For investors, the identified clusters reveal relative risk–return profiles,

thereby supporting strategic decision making and portfolio diversification. For policy makers, the results provide a basis for allocating public support more effectively and for directing development programs toward enterprises with either the greatest growth potential or the most pressing financial challenges. In addition, the selected financial indicators identified in this study can be employed as objective variables in causal analyses, enabling the evaluation of how management decisions, public subsidies, or regulatory changes influence profitability, liquidity, and cost-effectiveness within the spa sector.

Future research may proceed in several directions. First, the sample could be expanded to include all operating Slovak spa enterprises and extended into a multi-year panel (e.g., 2015–2025) to capture pre-crisis, crisis, and post-crisis dynamics. Second, financial indicators could be complemented with non-financial data—such as capacity utilization, average length of stay, clientele composition, certifications, service quality metrics, or client ratings—to provide a more integrated view of operational and financial performance. Third, alternative clustering techniques (e.g., k-median, model-based, or spectral methods) could be applied, with results validated through internal consistency and stability tests. Fourth, future studies could explore the causal linkages between managerial decisions and economic outcomes, for example through panel modeling or difference-in-differences designs examining regulatory or service innovations. Finally, comparative analyses across Central European spa enterprises would enable assessment of the transferability of best practices and the identification of regional competitiveness factors.

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## Abbreviations

The following abbreviations are used in this manuscript:

| | |
|---|---|
| AT | Asset Turnover |
| C | Cluster |
| CR | Current Ratio |
| CSR | Cost-to-Sales Ratio |
| DR | Debt Ratio |
| E/TL | Equity-to-Total-Liabilities Ratio |

| | |
|---|---|
| PCR | Personnel Cost Ratio |
| ROA | Return on Assets |
| ROC | Return on Costs |
| ROS | Return on Sales |
| NWC | Net Working Capital |
| S.D. | Standard Deviation |

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