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Full length article

## Towards a therapeutic landscape design approach for orthopedic hospitals: The case study of KAT Attica general hospital<sup>☆</sup>

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## ABSTRACT

The need to expand green spaces in urban areas and hospitals is increasingly evident, as they promote both physical and psychosomatic well-being. Historically, gardens and landscapes have been recognized for their healing effects across cultures. Therapeutic gardens, located near medical facilities, are designed to address the physical, psychological, social, and spiritual needs of patients, caregivers, and visitors.

However, research on the experiences of individuals with mobility impairments in therapeutic gardens remains limited. Despite the recognition of nature's benefits, further research is essential to address the specific needs of orthopedic patients, ensuring hospital outdoor spaces are accessible and beneficial for all users.

The paper aims to highlight the role of landscape architects to the design of orthopedics hospital outdoor environments, with a focus on the case of the Attica General Hospital KAT, addressing simultaneously the specific needs of users by an exemplary landscape design master plan and a framework of guidelines, advocating the value of nature. This research is based on an extensive literature review, case study analysis, and a social survey through questionnaires. Specifically, a literature review was conducted using various databases and search engines to gather essential information regarding design approaches for orthopedic hospital outdoor spaces. Subsequently, examples from Greece and abroad were examined to understand the effectiveness of different approaches. Simultaneously, social survey was conducted with the help of questionnaires distributed to staff, patients, and visitors of the hospital. The collected data revealed the primary needs and preferences of the users, which formed the basis for developing the design principles of the new hospital outdoor environment.

The research embraces people and nature in a hospital environment, leading to landscape design guidelines, that can be used to a master plan specialized for orthopedic hospitals gardens. The final design proposal includes the creation of spaces for physiotherapy and rehabilitation, a sensory garden, therapeutic horticulture areas, an event space, a playground, and other supportive spaces, all of which enhance the mental and physical recovery of patients, staff, and visitors.

In conclusion, the study finds that the contribution of landscape architects is crucial in creating an outdoor environment that promotes holistic recovery and well-being in a medical setting through the application of scientifically grounded and aesthetically effective solutions.

### 1. Introduction

The World Health Organization (WHO) defines human health as a state of complete physical, psychological and social well-being, and not only a state without any disease or physical disorder [1]. Green spaces are closely linked to health and life satisfaction, with exposure playing a key role in physical and mental well-being by encouraging exercise, social interaction, and offering recreational and aesthetic benefits [2].

Historically, gardens and landscapes have been recognized for their healing effects across cultures. Environmental spaces have been reported to reduce depression and stress in certain cases [3]. However, urbanization often undermines these benefits, contributing to environmental and health issues, such as those linked to the climate crisis. The COVID-19 pandemic further highlighted the importance of open spaces in reducing pathogen transmission [4–6], reinforcing the need to expand green areas in urban environments.

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Therapeutic gardens, located near medical facilities, are outdoor spaces designed to address the physical, psychological, social, and spiritual needs of patients, caregivers, and visitors [7]. The recovery garden constitutes a therapeutic environment aimed at improving people's well-being by offering a space for connection with nature, activities that promote mental tranquility, and contributing to overall welfare [8–10]. Incorporating natural elements such as plants, flowers, and water features, these gardens aim to reduce stress and provide benefits for users through activities like walking, resting, and observation. Ulrich identified four key factors that reduce stress: movement, socialization, a sense of control, and distraction through nature [11].

The need to expand green spaces in urban areas and hospitals is increasingly evident, as they promote both physical and psychosomatic well-being. Research has shown that hospital waiting areas featuring real plants or images of plants significantly reduce patient anxiety [12]. Similarly, views of natural landscapes have been linked to shorter hospital stays compared to urban views, such as walls [13]. Outdoor exercise has also been found to benefit individuals with depression more than indoor activity, boosting enthusiasm and energy levels [14].

Research confirms that natural environments reduce depression by offering tranquility, relief, and motivation, making interaction with nature a cost-effective way to improve health and quality of life [15,16]. According to Attention Restoration Theory, exposure to nature restores focus by engaging involuntary attention and promoting rest, which facilitates recovery [17]. The Aesthetic-Affective Theory suggests that nature's therapeutic effect on humans occurs unconsciously, influencing parts of the brain associated with emotions, evoking relaxation and reducing stress. For instance, open natural landscapes quickly create feelings of safety and calm and are particularly beneficial for individuals with high anxiety, promoting mental well-being [18]. Research also suggests that flowering plants reduce stress more effectively than non-flowering plants [20]. Likewise, the functionality and aesthetics of urban equipment in hospital environments influence mood and the usability of space [21]. More specifically, concerning vegetation, research in various hospital spaces and patients has correlated the presence of natural elements in both interior and exterior hospital areas with satisfaction not only of patients but also of their visitors [22–24].

Outdoor rehabilitation supports orthopedic patients by aiding recovery, fostering social interaction, and promoting psychological renewal. However, research on the experiences of individuals with mobility impairments in therapeutic gardens remains limited. Despite recognition of nature's benefits, factors such as accessibility challenges, lack of adapted facilities, and underrepresentation of this group in studies hinder progress in this area. Further research is essential to address the specific needs of orthopedic patients, ensuring hospital outdoor spaces are accessible and beneficial for all users.

The impact of the external environment on healthcare facility staff has been studied at various levels and depends on several factors. A 2007 study found that a significant portion of European workers experience work-related anxiety, with the healthcare, social services, and education sectors being the most affected. [25]. Similarly, a 2015 study specifically about the KAT General Hospital of Attica revealed that most healthcare professionals faced high workloads daily and rated their work environment satisfaction as moderate [26].

Research highlights the positive impact of nature on staff mental health. A study showed that integrating natural elements improves mental health and cognitive capacity [27]. Another study found that the presence of natural landscapes and water features helps reduce stress among hospital staff [21]. Additionally, exposure to natural elements was linked to reduced depression, higher workplace satisfaction, and greater organizational engagement. It also mitigated the effects of role stressors on job satisfaction and anxiety, showing that nature positively influences mood and workplace outcomes [28].

Proper management of these factors can improve visitors' psychological state, enhance their overall experience, and support the healing process, particularly in psychiatry and stress management. Additionally, hospital

outdoor spaces can function as urban parks, providing benefits not only to patients and visitors but also to local residents [29].

The research aims to highlight the role of landscape architects to the design of orthopedics hospital outdoor environments, with a focus on the case of the Attica General Hospital KAT, addressing simultaneously the specific needs of orthopedic patients, visitors and staffs by an exemplary landscape design master plan and a framework of guidelines, advocating the value of nature.

## 2. Material and methods

### 2.1. Case study

KAT Attica General Hospital also known as KAT Hospital, is a tertiary-level hospital in the Attica region of Greece (Fig. 1). It is located in Kifisia, a northern suburb of Athens.

It is one of the largest hospitals in Attica with a clear orientation in orthopedics and traumatology so it has been established in the consciousness of the citizens as the hospital for accidents and fractures. The hospital owes its name to the 449 Wound Rehabilitation Center (449 KAT) hospital that operated after the war for the rehabilitation of war wounded. At that time, the 449 Trauma Rehabilitation Center was renowned for its pioneering patient care approach and holistic treatment methods. Its patients followed a daily program that included therapies such as kinesitherapy, paraffin baths, phototherapy, diathermy, and massages, alongside with activities such as basketball games, garment-making workshops and agricultural activities. According to historical data, 62 % of patients admitted to the hospital achieved full recovery, while the remaining cases were categorized as partial recovery or non-recovery. In 1955, the construction of a new hospital building commenced, designed by Austrian engineer Wolfgang Bauer. The building's distinctive curved design was intended to maximize sunlight exposure throughout the facility. Additionally, 27 ha of adjacent land were purchased in the same year, expanding the hospital's total area to its current size [30].

In 1983, it was integrated into the National Greek Health System (NHS), with a focus on traumatology, orthopedics, and the promotion of medical research. Its structure included orthopedic clinics, physiotherapy services, a radiology laboratory, and schools for nursing and physiotherapy.

Today the hospital occupies an area of approximately 70.000 square meters and is located opposite the Syggrou Estate Park, separated by Kifisias Avenue and several residential blocks.

The general area of the hospital premises is characterized by rising temperatures during the summer months, presenting challenges to both vegetation and human health. Based on climatic data provided by the Hellenic National Meteorological Service, minimum monthly temperature in the winter months can reach 5.4 degrees Celsius, while the maximum monthly temperature in the summer months can reach 33.8 degrees Celsius. Regarding relative humidity, the projected range from 62.8 % to 67.6 % suggests a tendency towards increased humidity in the area. Forecasts for the study area predict a rise in mean annual minimum temperature by 7 to 10.5 °C, signaling increased temperatures potentially linked to the global climate crisis. The mean annual maximum temperature is projected to increase more significantly, ranging from 16.7 to 19.1 °C. Accordingly, the estimated mean annual temperature for the broader Athens region, indicates a positive temperature trend, signifying warming in Athens due to climate change. These climatic conditions may affect the working environment for hospital staff and patient recovery, necessitating adjustments in healthcare practices.

Figure 2 (top) shows the mean annual temperature for Athens, with the dashed blue line representing the climate change trend: an upward slope indicates warming, a horizontal line suggests no change, and a downward slope signals cooling. Below, the “warming stripes” depict annual temperature averages, with blue for colder years and red for warmer ones.

The General Hospital of Attica “KAT” is located at one of the greenest suburbs of Athens and the Hospital grounds are dominated by *Pinus*



Fig. 1. Location of the study area (source: <https://maps.google.com>).

*halepensis*, in smaller percentages by *Cupressus sempervirens*, *Cercis siliquastrum* and *Citrus sp.*

Within the hospital grounds, visitors can observe a variety of planted species, such as *Cupressus sempervirens*, *Cercis siliquastrum*, *Citrus sp.*, *Olea europaea*, *Morus nigra*, *Prunus armeniaca*, *Robinia pseudoacacia*, *Viburnum tinus*, *Hedera helix*, *Laurus nobilis*, *Nerium oleander*, *Euonymus japonicus*, *Pittosporum tobira*, *Ligustrum japonicum*. However, the landscape is characterized by distinct planting patterns and zones. Very characteristics are the hedgerows of *Cupressus sempervirens* and *Citrus sp.* On the southern side of the site, two primary planting zones are evident: one characterized by *Ligustrum japonicum*, which lines and defines pedestrian pathways in the garden, and another dominated by *Pinus halepensis*.

However, it is apparent in several parts of the garden that certain trees require safe removal due to significant trunk tilting or structural issues. This plant diversity, combined with the challenges of maintenance and tree health, highlights the need for careful management to ensure the safety and sustainability of the hospital's environment.

According to the “New Building Regulation” in Greece and the public participation procedure on the draft law titled “Modernization of Spatial and Urban Planning Legislation”, specific obligations and guidelines have been outlined for the redesign of outdoor spaces in public hospital facilities to ensure accessibility for people with disabilities [31]. As such, hospitals have the potential to create safe, accessible, and pleasant environments for all employees, including those with special needs. Such improvements

not only enhance the quality of the workplace and environmental care but also improve and enhance equal access and safety for all in the hospital's working places.

In recent years, the primary uses (Fig. 3) of the outdoor spaces at the General Hospital of Attica “KAT” were the Outdoor waiting areas, Waste collection areas, Parking lots, a hospital cafeteria and a Playground for the childcare center. Meanwhile, spaces that were used in the past but are now abandoned include an Open-air cinema, a greenhouse and an outdoor Library.

## 2.2. Method

The method that was used consisted of the following phases:

**Phase 1: Landscape analysis:** A detailed site analysis was undertaken for the General Hospital of Attica “KAT”, which included a systematic review and collection of data regarding visual, physical, and cultural attributes, socioeconomic data, policies, and legislation for the area. These data include historical information (e.g. postcard images, drawings, photographs, modern garden history reference works, contemporary publications), statistical quantitative information, and maps (ordnance survey maps, historic maps). Additionally, mapping and evaluation of the existing vegetation were conducted, along with an analysis of the area's climatic data to ensure a comprehensive understanding of the environmental conditions.

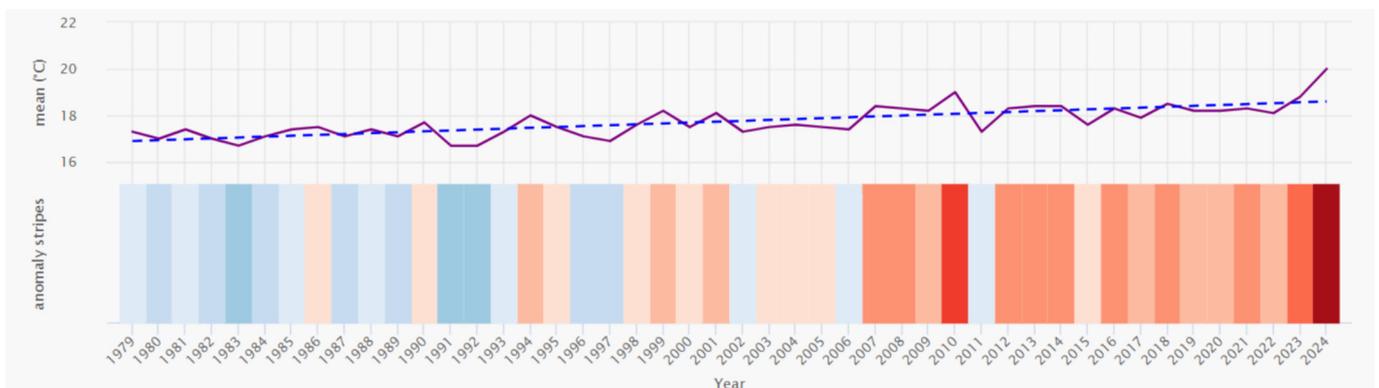


Fig. 2. Yearly temperature change Athens, 1979–2024 (Source: meteoblue).



Fig. 3. (1) Different buildings and spaces within the General Hospital of Attica “KAT” area. (2) Different uses of the hospital's outdoor spaces, (3) Existing planting.

*Phase 2: Social survey:* A social survey addressed at KAT Attica General Hospital employees (doctors, nurses, technical and administration staff), patients (long term and short term) and visitors were implemented, to evaluate the personal perceptions, impressions, and needs of the users of the

hospital. In each case, a questionnaire was created aiming to explore the personal opinions of users (Fig. 4) regarding the necessity of an appropriate hospital outdoor environment, to evaluate the current condition of the landscape and the appropriate ideal design changes.



Fig. 4. Diagrams of stakeholders needs.

Our survey was based on Marcus's guidelines (2003), stating that the design of a hospital's outdoor spaces should involve active discussions with the patients and potential primary users to ensure that the design meets their specific needs [32].

The questionnaires were distributed in both printed and electronic formats via the Jotform platform. Distribution was facilitated by the hospital's human resources and nursing staff, with participants fully informed about the research purpose and General Data Protection Regulation (GDPR) compliance regarding personal data as well as the Data Protection Policy of the Agricultural University of Athens.

The survey took place from May 2023–November 2023. Each questionnaire included single-choice, multiple-choice, and Likert-scale questions (Tables 1,2,3). The questionnaires aimed to collect data for guiding the future landscape design processes, with slightly different questions addressed to each group, taking into consideration their time spent and manner of using each space. Responses were collected from 28 patients, 110 employees, and 61 visitors. A statistical analysis was conducted to evaluate the responses, using Microsoft Excel 365.

**Phase 3: SWOT(Strength-Weakness-Opportunities-Threats) analysis:** The SWOT analysis was performed by the researchers and considered the data collected by the social survey in relation to the results obtained by the site analysis. The swot analysis was used as an ancillary tool for the landscape design plan derived. In order to mitigate evaluation bias in the SWOT analysis, a variety of stakeholders were used (hospital patients, employees, visitors), and the evaluation criteria were clear and objective, based on the social survey. The data were gathered from multiple sources based also on-site analysis and related bibliography. Interviews and ongoing assistance from the Manager and the Directors of Technical and

**Table 1**  
Content of social survey addressed to hospital patients.

Questions	Response Options
<b>Participant details</b>	
Gender	Male, Female, Other
Age	<18, 18–34, 35–44, 45–55, ≥56
<b>Satisfaction with the hospital's outdoor environment</b>	
How satisfied are you with the hospital's surroundings?	Not at all, A little, Moderately, Quite a bit, Very much, Extremely
<b>Impact of nature on psychological well-being</b>	
To what extent do you believe contact with nature positively impacts your mental health during hospitalization/rehabilitation?	Not at all, A little, Moderately, Quite a bit, Very much, Extremely
<b>Interest in designated garden spaces</b>	
Would you be interested in having a garden space to meet with visitors during rehabilitation?	Yes, No
<b>Safety and accessibility issues</b>	
Are there any issues with the safety and accessibility of the hospital's outdoor areas?	Yes, accessing the hospital's outdoor space was difficult; Yes, the garden is not safe (e.g., lack of lighting); No issues
<b>Preferences for hospital outdoor environment</b>	
What features would you like the hospital's outdoor area to offer?	Safe, well-lit spaces during nighttime; More pathways to various hospital areas; Aesthetic designs visible from inside the building; More greenery visible from inside the building; Weather-protected spaces; Rehabilitation spaces for patients; Isolation and relaxation areas; Socializing areas for visitors; Garden visitation spaces for patients; Movement pathways; Recovery and physiotherapy areas in the hospital garden; Dining tables and seating
<b>Therapeutic outdoor sessions</b>	
Would you like to conduct recovery or physiotherapy sessions in specially designed outdoor spaces?	Yes, No

**Table 2**  
Content of social survey addressed to hospital visitors.

Questions	Response Options
<b>Participant details</b>	
Gender	Male, Female, Other
Age	<18, 18–34, 35–44, 45–55, ≥56
<b>Satisfaction with the hospital's outdoor environment</b>	
How satisfied are you with the hospital's surroundings?	Not at all, A little, Moderately, Quite a bit, Very much, Extremely
<b>Impact of nature on psychological well-being</b>	
To what extent do you believe contact with nature positively impacts your mental health during the hospitalization/rehabilitation of the person you are visiting?	Not at all, A little, Moderately, Quite a bit, Very much, Extremely
<b>Interest in designated garden spaces</b>	
Would you be interested in having a garden space to meet with the hospitalized person you are visiting during their rehabilitation?	Yes, No
<b>Issues with the outdoor waiting area</b>	
Do you encounter any problems in the hospital's outdoor waiting area?	Lack of protection from weather conditions (e.g., lack of shading or shelters); Lack of urban equipment (e.g., seating, bins, lighting); Lack of dining areas/external cafeteria (e.g., tables and chairs); Lack of privacy or isolation; Poor space arrangement (e.g., benches too close together); Accessibility challenges (e.g., lack of pathways or ramps)
<b>Preferences for hospital outdoor environment</b>	
What features would you like the hospital's outdoor area to offer?	Safe, well-lit spaces during nighttime; More pathways to various hospital areas; Aesthetic designs visible from inside the building; More greenery visible from inside the building; Weather-protected spaces; Rehabilitation spaces for patients; Isolation and relaxation areas; Socializing areas for visitors; Garden visitation spaces for patients; Movement pathways; Recovery and physiotherapy areas in the hospital garden; Dining tables and seating

Administrative Services provided valuable insights into the SWOT analysis, helping to prevent individual biases from dominating and allowing for review and cross-checking after completion. At the same time, the researchers regularly questioned themselves whether certain findings are being overstated or overlooked due to personal bias.

### 3. Results

#### 3.1. Social survey results

The profile of stakeholders who have answered the questionnaire, are a) A total of 28 hospital patients participated in the study, including 15 men and 13 women. B) A total of 66 staff members participated in the survey, including 26 men and 40 women, c) 61 visitors participated in the survey, 19 of whom were men and 42 women. The age of stakeholders varies, with the bigger percentage between 41 and 55 years and the smaller between 25 and 30 years.

According to the survey, approximately 93 % of patients believed that contact with nature would have a moderately to highly positive impact on their mental health during hospitalization, highlighting the importance of patient perspectives regarding the hospital's outdoor environment (Fig. 5). Additionally, the need for contact with nature was deemed particularly important for the visitors, with an overwhelming majority believing that such contact would positively impact on their psychology during the hospitalization or rehabilitation of the person they are visiting (Fig. 5).

**Table 3**  
Content of social survey addressed to hospital staff.

Questions	Response Options
<b>Participant details</b>	
Gender	Male, Female, Other
Age	<18, 18–34, 35–44, 45–55, ≥ 56
<b>Staff category</b>	
Which staff category do you belong to?	Medical staff, Nursing staff, Administrative/Financial Services, Legal Department, Organization & IT Department, Other
<b>Satisfaction with the hospital's outdoor environment</b>	
How satisfied are you with the hospital's surroundings?	Not at all, A little, Moderately, Quite a bit, Very much, Extremely
<b>Importance of outdoor space during work hours</b>	
How important is it for you to spend time in the hospital's outdoor space during your workday?	Not at all, A little, Moderately, Quite a bit, Very much, Extremely
<b>Use of hospital garden</b>	
How do you use the hospital garden? (Multiple choice)	To make phone calls, To socialize with visitors/colleagues, To isolate/relax, To smoke, To eat, To walk
<b>Preferred time for garden visits</b>	
When do you prefer to visit the hospital garden?	Morning hours, Midday hours, Afternoon hours, Evening hours
<b>Frequency of garden visits</b>	
How often do you visit the hospital garden?	Never, About once a week, About 2 times a week, About 3 times a week, About 4 times a week, More than 4 times a week
<b>Issues in the hospital garden</b>	
What problems do you encounter in the hospital garden? (Multiple choice)	Lack of protection from weather conditions (e.g., lack of shading or shelters); Lack of urban equipment (e.g., seating, bins, lights); Lack of privacy or isolation; Poor space arrangement (e.g., benches too close together); Accessibility challenges (e.g., lack of pathways or ramps)
<b>Garden features for work facilitation</b>	
What features would you like the garden to offer to facilitate your work? (Multiple choice)	Better parking; Safe, well-lit spaces during nighttime; Weather-protected spaces; More pathways to different hospital areas; Rehabilitation spaces for patients (work in outdoor spaces); Spaces for breaks; More aesthetic design visible from inside the building; More greenery
<b>Garden features for staff breaks</b>	
What features would you like the garden to offer during your breaks? (Multiple choice)	Isolation/relaxation areas; Socialization areas; Walking/movement areas; Dining tables and seating; Weather-protected spaces
<b>Garden improvements for patient recovery</b>	
How would you like the garden to improve to contribute to better patient recovery/rehabilitation? (Multiple choice)	Recovery/physiotherapy spaces in the hospital garden; Visitation spaces for patients in the garden; More greenery visible from inside the hospital; Better accessibility for patients (e.g., ramps)
<b>Childcare facility outdoor area</b>	
If you have a child attending the hospital's daycare, are you satisfied with its outdoor space?	Yes, No, I don't have a child attending the hospital's daycare

Regarding the satisfaction with the hospital's outdoor space, patients' responses indicated a range from low to moderate, with many patients desiring further improvements. Specifically, 61 % of respondents were not sufficiently satisfied with the hospital's outdoor environment (Fig. 6). Similarly, the majority of staff (67 %) reported low satisfaction with the outdoor spaces, rating their satisfaction as “not at all” to “moderately satisfied, highlighting as such a significant need for improvements (Fig. 6). A significant percentage of visitors (65 %) have also expressed a desire for further improvements (Fig. 6).

In response to the question, what would you like the hospital's surrounding area to offer, patients' preferences included outdoor physiotherapy areas (10 %), spaces sheltered from weather conditions (9 %), well-lit areas (11 %), additional movement spaces (12 %), and specially designed garden visitation areas (11 %) (Fig. 7a).

Additionally, 96 % of respondents said that interaction with visitors during their recovery in specially designed garden spaces would be desirable.

Accordingly, the staff indicated the most important land uses for the facilitation of their work during the day: 19 % expressed the desire for break areas, recognizing the importance of renewal and relaxation during breaks, 17 % expressed the desire for safe and well-lit spaces during nighttime, offering the necessary safety and comfort during work shifts. The same percentage of 17 % highlighted the importance of protection from weather conditions. Moreover, 15 % expressed the need for a more beautiful design, visible from inside the building, emphasizing the importance of the broader

work environment's aesthetics for staff well-being. Eleven percent (11 %) expressed the need for rehabilitation and physiotherapy spaces for patients in the outdoor area, supporting the idea that working in a natural environment can contribute to health and well-being. Eight percent (8 %) requested better parking, while another 8 % desired more pathways to different points of the hospital. Finally, 6 % expressed the need for more greenery in the area (Fig. 7b).

On a second similar question, what do they expect the garden to offer during their break, 27 % (27 %) of the hospital staff express the desire for spaces protected from weather conditions, emphasizing the importance of comfort and protection from the weather. The same percentage of 27 % express the desire for tables and chairs for eating, emphasizing the creation of a space where they can enjoy their meals in a natural environment. Next, 18 % wish for spaces for seclusion and relaxation, enhancing the importance of psychological well-being and escaping workplace stress, while 17 % express the desire for spaces for movement and walking, emphasizing the importance of physical activity during breaks. Finally, 12 % mention the need for space for socializing, corresponding to the desire for social interaction and gathering with colleagues (Fig. 8a).

As a result, visitors' proposals for improving the hospital's outdoor space were as follows (Fig. 8b): Giving more emphasis on a friendly and functional outdoor space that will contribute to the comfort and well-being of both visitors and patients.

Among the main problems identified by all three groups, the patients have been asked to give their opinion about safety and accessibility. 39 %

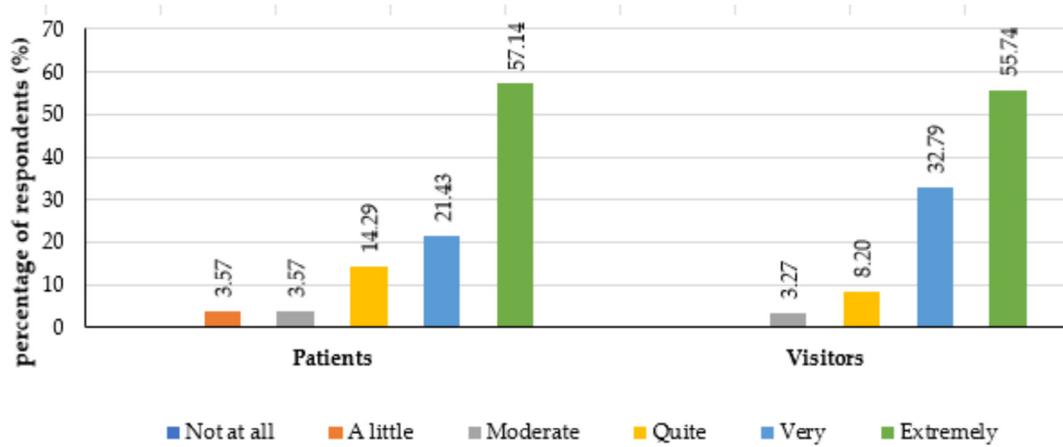


Fig. 5. Diagrams about the effect of nature on patients and visitors psychology.

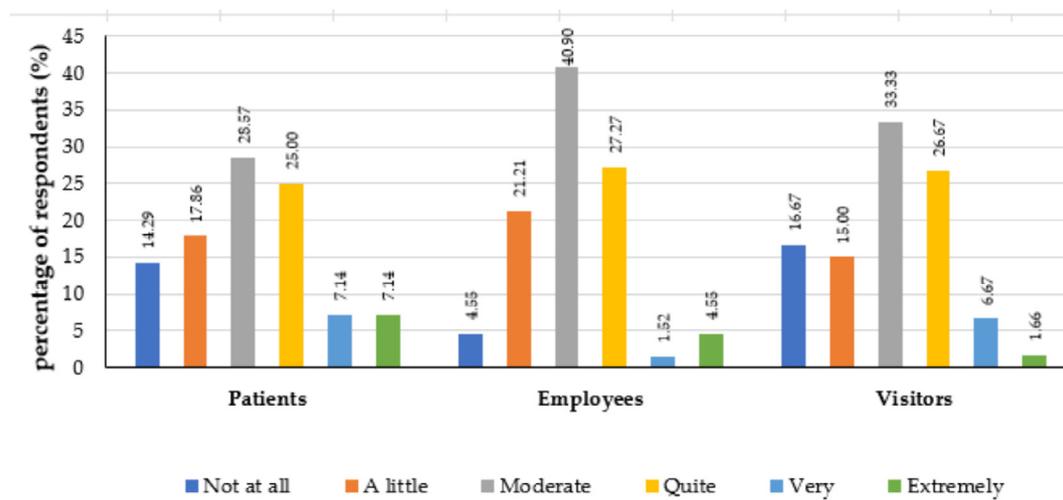


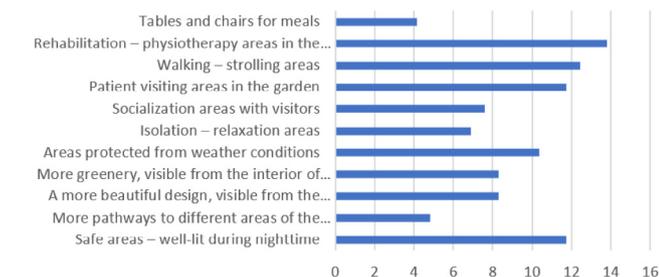
Fig. 6. Satisfaction of patients, employees, and visitors with the hospital's outdoor environment.

identified inadequate lighting as a safety issue (Fig. 9a), 42 % had serious concerns about the accessibility to the outdoor spaces and 19 % did not have any problem with accessing the main building.

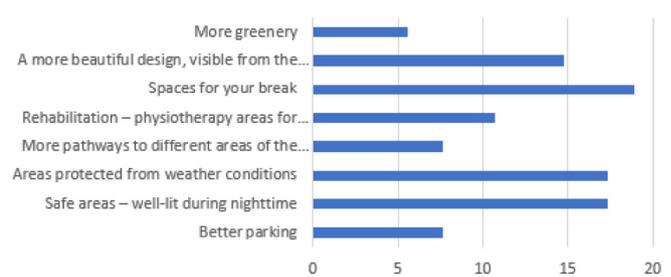
Regarding the answers from the hospital staff about the problems that they identify in the garden of the KAT hospital, the lack of protection from weather conditions stands out as the main issue, with a percentage reaching 43 %. The lack of urban equipment (seating, bins, lights) at 26 % and accessibility difficulties (lack of pathways, ramps) at 16 % are

also considered quite significant issues regarding the hospital's outdoor space. Fewer respondents seem to be concerned about the quality of spatial layout (8 %) and the possibility of seclusion and privacy (8 %) (Fig. 9b).

Similarly, when the visitors were asked to state the problems of the outdoor areas during their stay in the waiting room, the most prominent ones were the lack of protection from weather conditions (27 %) and the lack of space for dining (21 %). These were followed by the lack of urban equipment (18 %), limited accessibility (16 %), and poor spatial layout (12 %).



a.



b.

Fig. 7. a. The opinion of KAT Hospital patients (participants) regarding what they would include in the hospital's surrounding area. b. The staff's needs from the garden to facilitate their work.

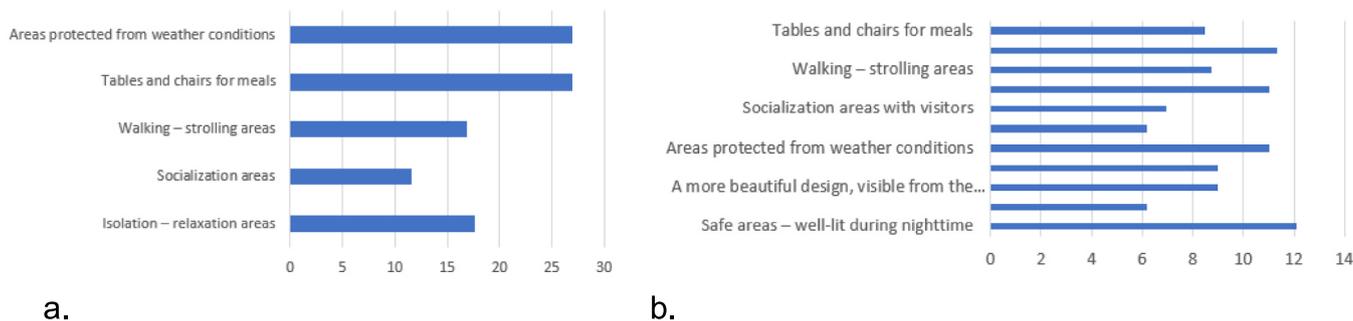


Fig. 8. a. The staff's needs from the garden to facilitate their breaks. b The needs of visitors from the garden.

A smaller percentage (7 %) pointed to the lack of opportunities for seclusion and privacy (Fig. 9c).

The last common question among patients and staff was related to physiotherapy and rehabilitation. Staff indicated the provision of designated spaces for physiotherapy and rehabilitation as a key request, underscoring the role of physical activity and nature contact in patient recovery. Specifically, 96 % of respondents indicated their preference for rehabilitation and physiotherapy sessions to be conducted in specially designed outdoor spaces, in addition to the existing indoor physiotherapy facilities. Only 4 % did not support the inclusion of such an option.

Similarly, when the staff were asked to propose solutions regarding the recovery and rehabilitation of patients, they propose improving accessibility to better serve patients (31 %), creating patient visiting areas (39,50 %), highlighting the importance of social interaction and psychological support, and outdoor therapy spaces, with 18,50 % supporting the idea of outdoor treatment for patients. A smaller percentage (11 %) of employees suggested increasing greenery visible from inside the hospital, emphasizing the positive effect of nature on psychological well-being (Fig. 10).

Regarding the question about the preferred time for visiting the hospital garden by the staff, the highest was in the morning. Afternoon usage followed at 23 %, while mid-day usage was less frequent. Significantly, usage dropped sharply during the evening hours, with only 7 % of respondents using space at night (Fig. 11a).

Regarding the frequency of garden visits, most staff reported visiting the garden up to twice per week, while a notable 32 % stated they never visited the hospital's outdoor spaces. Approximately 34 % reported visiting once a week, and 11 % indicated they used the garden about twice per week (Fig. 11b).

Furthermore, staff rated the importance of their garden visits as moderately to highly significant, with 68 % of respondents acknowledging their value (Fig. 11c).

In terms of garden usage, staff primarily used the space for solitude (26 %) and making phone calls (25 %). Additional reported uses included walking (21 %) and socializing (15 %). Smaller percentages of respondents used the garden for eating (9 %) or smoking (3 %) (Fig. 12).

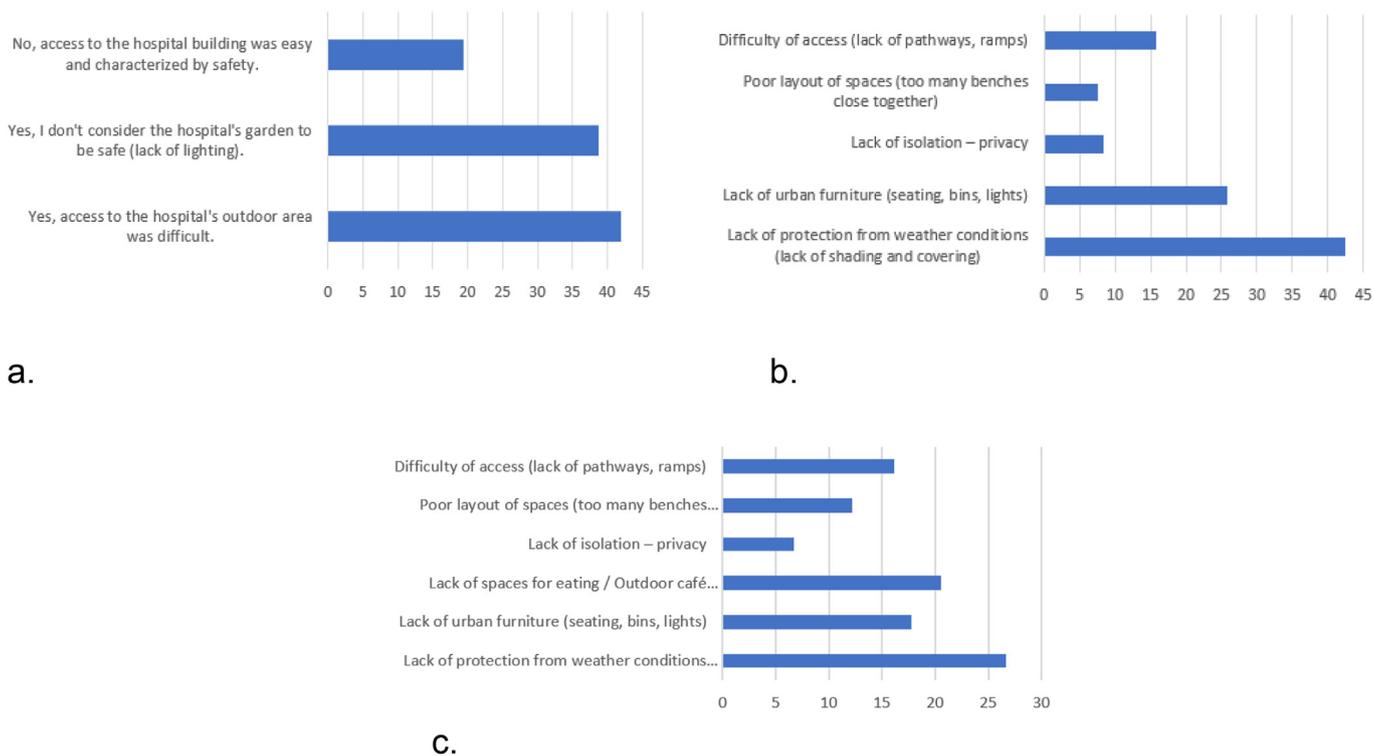


Fig. 9. a. The identification of problems (safety and accessibility) issues in the hospital's outdoor environment, by the patients. b. The identification of problems in the hospital's outdoor environment by the staff. c. The identification of problems with the hospital's outdoor area by the visitors.

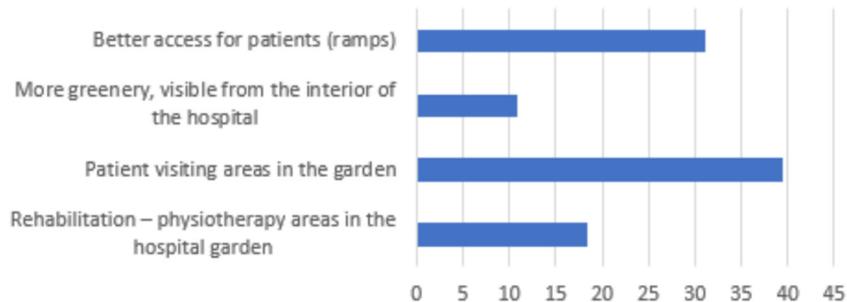
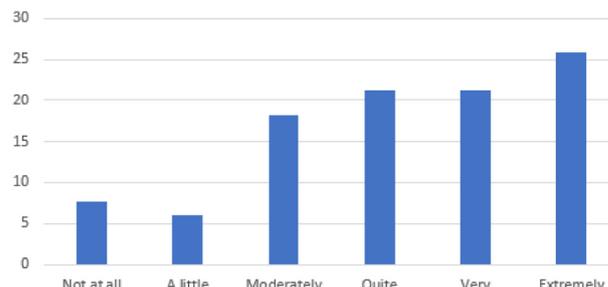
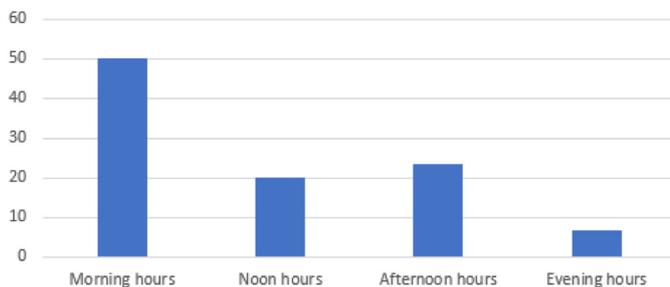
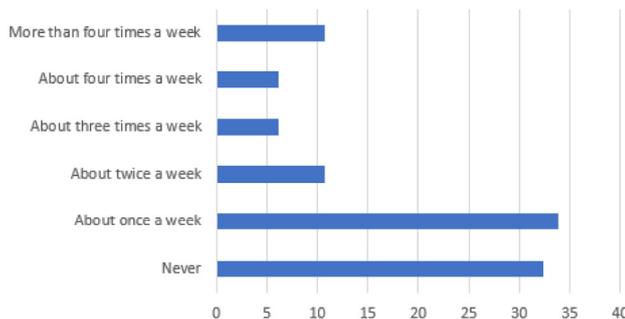


Fig. 10. The staff's proposals regarding the design of the outdoor space for better patient recovery.



a.

b.



c.

Fig. 11. a. The preferred time for visiting the hospital garden by the staff. b. The importance of visiting the outdoor spaces of the hospital during the working day by the staff. c. Staff frequently visit the hospital's garden.

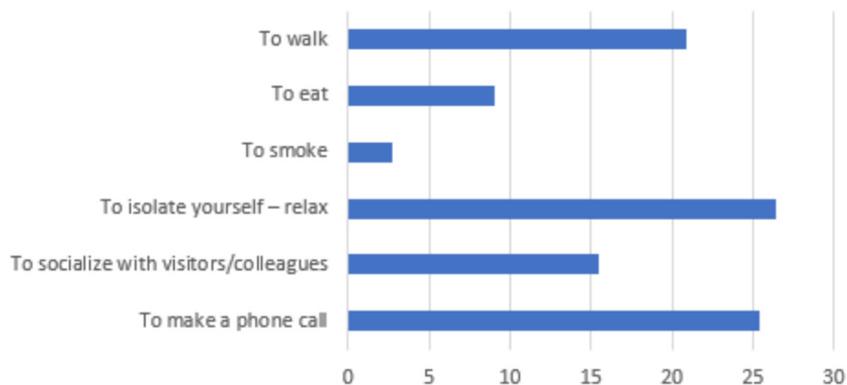


Fig. 12. Ways of using the garden according to KAT hospital staff.

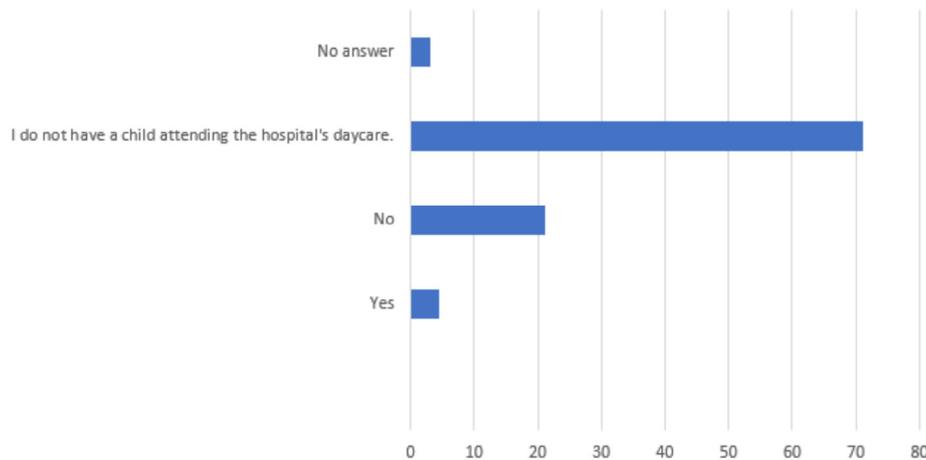


Fig. 13. Views of parents with children attending the hospital's daycare, about the daycare garden.

In addition, as far as the nursery garden is concerned, most parents who use this service are not satisfied with it (Fig. 13).

### 3.2. SWOT analysis results

The results of the social survey emphasize the significance of nature for the well-being and mental health of patients, visitors, and staff. About 93 % of patients and most visitors believed that contact with nature positively affects mental health during hospitalization, emphasizing the value of outdoor hospital environments (Fig. 5). Additionally, the site analysis indicates that the area is surrounded by numerous green spaces, underscoring the need to expand these spaces due to the climate crisis and increasing social demand. This highlights a key strength in the SWOT analysis: The hospital's garden is located within a natural setting and is in proximity to various public green spaces, contributing to patient recovery. Additionally, there is significant demand from both staff and hospital administration to enhance the outdoor environment of the facility. Staff responses indicated needs for improved outdoor environments: 19 % requested break areas for rest, 15 % highlighted the importance of visible aesthetic design, 11 % supported outdoor rehabilitation spaces for patients, and 6 % asked for more greenery (Fig. 7b). The hospital's landscape features and historical context, as outlined in the landscape analysis, along with input from staff and patients on the need for a functional and aesthetically designed outdoor space, highlight a key strength: the expansive outdoor area, which offers opportunities for custom designs, including spaces for events, socialization, and more. More specifically, regarding expectations for the garden during breaks, 27 % of staff expressed a desire for tables and chairs to eat in a natural setting, 18 % preferred secluded areas for

relaxation and stress relief, and 12 % highlighted the need for social spaces to interact with colleagues. Additionally, the growing interest in physiotherapy and alternative therapeutic methods is reflected in staff and patients' responses regarding the need for dedicated rehabilitation and physiotherapy spaces in the outdoor areas (Table 4). In response to what the hospital's surroundings should offer, 10 % of patients preferred outdoor physiotherapy areas. Similarly, 11 % of staff identified rehabilitation and physiotherapy spaces as important for supporting patient care, reinforcing the role of natural environments in promoting health and well-being.

On the other hand, the site survey and key issues identified during the social survey—such as accessibility difficulties, spatial layout quality, and concerns regarding seclusion and privacy—highlight the main weaknesses in the SWOT analysis (Table 4). More specifically, 39 % of patients identified inadequate lighting as a safety issue (Fig. 9a), and 42 % had serious concerns about the accessibility to the outdoor spaces. Patients believed that key issues in the hospital's outdoor space include lack of urban equipment (26 %) and poor accessibility (16 %), while fewer respondents are concerned about spatial layout and privacy (8 % each) (Fig. 9b).

KAT Hospital, one of the largest in Attica, specializes in orthopedics and traumatology, with facilities such as orthopedic clinics, physiotherapy services, a radiology lab, and schools for nursing and physiotherapy. It also offers event spaces like an open-air cinema, greenhouse, and outdoor library. These features create opportunities to host events and educational programs in the hospital's outdoor areas, while also meeting the needs of patient rehabilitation and children attending the daycare. Lastly, the social survey and site analysis, supported by information from the Technical Service staff, highlight the main threats identified in the SWOT analysis. The social survey results show that 43 % of hospital staff identified lack of

Table 4

Main outcomes of the SWOT analysis.

Strengths	Weaknesses
<ul style="list-style-type: none"> <li>Hospital's garden is already surrounded by a natural environment and it is close to many public green areas, helping patient recovery. The Hospital is among the most well-known hospitals in Greece for musculoskeletal issues and easily accessible by transport. The large outdoor space allows for specialized designs aimed at creating areas for events, socialization, etc. Hospital's specialization in injuries and musculoskeletal issues, presents also the growing interest in physiotherapy and alternative therapeutic methods. There is a big demand from staff and all hospital administration units to improve the hospital's outdoor environment.</li> </ul>	<ul style="list-style-type: none"> <li>Lack of protection from weather conditions (absence of shading structures and shelters).</li> <li>Accessibility challenges (lack of pathways and ramps).</li> <li>Insufficient urban equipment (seating, waste bins, lighting).</li> <li>Lack of privacy and isolation.</li> <li>Poor spatial arrangement (e.g. benches clustered too closely together).</li> <li>The need for continuous maintenance and care of the garden, which may require resources such as time, funding, and workforce.</li> </ul>
Opportunities	Threats
<ul style="list-style-type: none"> <li>Community or donor support for the creation and maintenance of a therapeutic garden, leveraging the hospital's long history and the network of individuals and organizations that recognize its significance.</li> <li>Opportunities to host events and educational programs in the hospital's outdoor spaces.</li> <li>Opportunities to develop educational programs for staff, and later for patients, focused on therapeutic gardening.</li> </ul>	<ul style="list-style-type: none"> <li>Economic crisis and non-funding support by the state.</li> <li>Natural disasters (without adequate prevention measures).</li> <li>Legislative issues.</li> <li>Lack of staff to support the management of the hospital's outdoor spaces.</li> </ul>

weather protection as the main issue in the KAT garden. Visitors similarly reported this as a key problem during their time in the waiting area, indicating a shared concern across user groups.

### 3.3. Proposal guidelines

The analysis of the data collected from the KAT hospital; the results of the social survey and the examples of similar cases led to the formation of design guidelines to be used for the design of the masterplan.

The main lessons learned from the examples from both Greece and abroad highlighted the fundamental design principles that serve as valuable guidelines for the spatial planning of hospital environments. More specifically:

- A. **Vegetation:** The presence of a diverse range of plants with varying colors within space is of great importance. Attracting birds and insects can create a multisensory experience [33]. However, plants with strong fragrances should be avoided, as they may cause discomfort to patients undergoing cancer treatment.
  - B. **Outdoor Equipment:** Creating weather-protected spaces for year-round use is essential, with attention to sunlight-reflecting paving materials. The design should include areas for varying levels of social interaction, from private to public. Additionally, a mix of movable and fixed seating, both covered and uncovered, enhances usability in medical environments [33].
  - C. **Views:** Views from interior spaces towards the healing garden offer patients a psychological outlet while maintaining their privacy for health-related reasons. Therefore, it is desirable for the spatial design to allow for visual access to the garden from within the interior spaces, ensuring patients maintain a connection with it [33].
  - D. **Accessibility/ Privacy:** For outdoor hospital spaces designed for individuals with neurological or musculoskeletal disabilities [34], there is a need for calm, accessible environments. Pathways should be easy to navigate for those with mobility issues, with clear hierarchies and proper signage [33]. The design of small spaces connected by pathways provides a sense of intimacy and variety, fostering feelings of discovery and exploration within the garden. Additionally, it is recommended to create private spaces for staff, protected from weather conditions, incorporating plants around rest areas and using movable seating facing natural views.
  - E. **Space layout:** Providing shaded and sunlit areas, along with rest spaces, encourages mobility and comfort for patients.
  - F. **Use of appropriate equipment:** Provision for the external placement of beds and the inclusion of integrated sockets for oxygen and other medical needs enhances the functionality of the space for patients. The design considers the height of plants and water features to ensure they are accessible and comfortable for individuals confined to beds or wheelchairs.
  - G. **Aesthetics:** The use of flowing water that generates sound adds a calming dimension to the space, enriching the sensory experience. The incorporation of plants that provide visual stimuli (such as grasses moving with the wind), olfactory stimuli (herbs), and gustatory stimuli, along with shrubs and trees with distinctive textures and shapes during the winter months.
  - H. **Social participation:** Waiting areas with playgrounds and bench-type seating to promote comfort and relaxation. Providing spaces for staff rest and relaxation that improve satisfaction and reduce stress.
  - I. **Sustainable and Bioclimatic design:** Collection and management of rain-water, preservation of natural areas, and planting of trees and shrubs to enhance biodiversity.
1. Of course, the proposed guidelines took into consideration the aforementioned design guidelines as well as the hospital specialization, the therapeutic approaches, the participant types, and the historical significance of KAT hospital (Table 5).

### 3.4. Master plan

The design proposal adopts a holistic approach to health and recovery, addressing both physical and mental well-being while emphasizing the influence of the environment and culture on human health. As such, the meaning of “Rehabilitation” is analyzed (Fig. 14) to capture all the potential uses for the landscape design of the hospital.

The design proposal for KAT Hospital's garden specifically addresses the recovery of patients, well-being of staff, and comfort for visitors in several ways. Therefore, the master plan prioritizes accessibility and rehabilitation spaces, alongside areas for socialization and tranquility, integrating the hospital's cultural, historical, and environmental identity into the design (Fig. 15). The site is divided into subspaces with designated uses, including Historical landmarks, Rehabilitation Areas, Therapeutic Gardening Area, Paths system, Sensory Garden, Cafeteria, Emergency Visitor Waiting Area, Event Space, Playground, Nursing School Garden.

#### 3.4.1. Patient recovery

- **-Rehabilitation areas:** The newly designed physiotherapy spaces in the hospital garden will serve both orthopedic patients who visit for treatment and those who are hospitalized at KAT hospital. As part of the garden renovation, the addition of two rehabilitation and physiotherapy areas is proposed: one for upper limbs and one for lower limbs. Each will be equipped to address the needs of patients with mild to severe injuries or mobility challenges. The upper limb area will focus on exercises for restoring and strengthening the muscles of the shoulders, arms, and hands while the lower limb area will target mobility and strength in the legs and hips (Fig. 16). As such, the landscape design fulfills the needs of patients for additional movement spaces, contact with nature, their preferences for rehabilitation and recovery opportunities outdoor, as addressed by the SWOT analysis and social survey.
- **-The therapeutic gardening area** is designed for individuals undergoing addiction rehabilitation, with wheelchair-accessible planting beds and a secluded, sunny location at the edge of the garden amidst dense pine tree coverage, supports outdoor treatment for patients, while staff also emphasized the importance of visible greenery for psychological well-being.
- **Paths system:** To ensure access to above spaces, appropriately designed paths will be included, ensuring comfortable and safe access for both patients and medical staff, with ramps for accessibility, and short easily accessible routes facilitating movement. The proposed spatial layout and pathway design complies with the preferences for additional paths leading to different hospital points, is solving the problem of limited accessibility, and fulfills the human needs for outdoor space improvements, for walking opportunities in a pleasant natural environment.

At the center of the southeastern garden, a pathway with an increased incline and difficulty level is proposed, serving as an alternative to conventional physical therapy and rehabilitation methods. Additionally, the path will create a raised line that separates areas and forms zones of isolation within the garden, providing a sense of natural topography, allowing patients to choose a route with a gentle slope and views of nature. Therefore, the master plan proposals address the serious concerns regarding outdoor accessibility, responding to patients' key issues such as inadequate urban equipment and limited access.

A sensory garden (Fig. 17) in front of the southeastern secondary entrance of the main building is proposed to enhance the user experience by stimulating all the senses, to offer relaxation and therapeutic benefits. To achieve this, a perimeter with medium and low-level planting has been designed, divided into areas with plant mixes of aromatic plants to stimulate smell, along with materials like gravel to engage touch, ensuring that all senses are awakened.

The sensory garden increases the aesthetics of the place, strengthens the connection of physical activity with nature, corresponds to the needs for

**Table 5**

Design guidelines for KAT Hospital's outdoor spaces in relation to the main results from the social survey and SWOT analysis.

Design principles	Guidelines	Main results from the social survey and SWOT analysis
Accessibility	<ul style="list-style-type: none"> <li>– Ensure ease of movement for all users, including ramps, non-slip surfaces, and spacious pathways.</li> <li>– Create short routes connecting the hospital's interior to outdoor rehabilitation and social areas.</li> </ul>	<ul style="list-style-type: none"> <li>- Need for a better parking</li> <li>- More pathways to different hospital points</li> <li>- Need for additional movement spaces</li> </ul> Limited accessibility.
Safety	<ul style="list-style-type: none"> <li>– Stable flooring, adequate lighting, structures for weather protection and clear signage.</li> </ul>	<ul style="list-style-type: none"> <li>– Most important factors for outdoor safety:</li> <li>• Sheltered spaces</li> <li>• Well-lit areas</li> </ul>
Flexibility	<ul style="list-style-type: none"> <li>– Enable diverse activities (physiotherapy, relaxation, events, social gatherings).</li> <li>– Adapt spaces to users needs, e.g., summer cinema or event venue.</li> </ul>	<ul style="list-style-type: none"> <li>– Desire for break areas for relaxation</li> </ul>
Privacy	<ul style="list-style-type: none"> <li>– Provide secluded areas using natural or artificial barriers (e.g., shrubs or fences).</li> </ul>	<ul style="list-style-type: none"> <li>- Use the space for socializing</li> <li>– Need for spaces for seclusion and relaxation to reduce stress.</li> </ul>
Interactive Spaces	<ul style="list-style-type: none"> <li>– Create social areas with benches, picnic tables, pergolas, and communal spaces to foster communication.</li> </ul>	<ul style="list-style-type: none"> <li>– Desire for tables and chairs to enjoy meals in nature</li> <li>– Need for social spaces to interact with colleagues</li> <li>– Lack of space for dining</li> <li>– Lack of urban equipment</li> <li>– Need to use space for walking</li> <li>– Need to use the space for socializing</li> </ul>
Connection with Nature	<ul style="list-style-type: none"> <li>– Incorporate plants, flowers, water features, and trees to promote tranquility and relaxation</li> </ul>	<ul style="list-style-type: none"> <li>- Contact with nature would positively affect people's mental health during hospitalization or rehabilitation</li> <li>Increase greenery visible from inside the hospital</li> </ul>
Aesthetics	<ul style="list-style-type: none"> <li>– Use harmonious designs with appealing colors, materials, and decorations for a pleasant environment.</li> </ul>	<ul style="list-style-type: none"> <li>– Need for a more beautiful design</li> </ul>
Maintenance	<ul style="list-style-type: none"> <li>– Select durable, low-maintenance materials and practical design solutions.</li> <li>– Facilitate staff in maintaining the spaces and serving users effectively.</li> </ul>	<ul style="list-style-type: none"> <li>– Need for continuous maintenance and care of the garden</li> <li>– Lack of staff to support the management of the hospital's outdoor space</li> <li>– Need for outdoor space improvements</li> </ul>
Use of Appropriate Equipment	<ul style="list-style-type: none"> <li>– Incorporate physiotherapy equipment and visitor safety technologies (e.g., monitoring systems).</li> </ul>	<ul style="list-style-type: none"> <li>- Importance of physical activity and nature contact in patient recovery.</li> <li>– Preference for rehabilitation and physiotherapy in outdoor spaces, alongside indoor facilities</li> <li>– Outdoor treatment options for patients</li> <li>– Landscape analysis presented the environmental – climatic data and physiographic conditions</li> </ul>
Existing Vegetation	<ul style="list-style-type: none"> <li>– Integrate existing healthy vegetation into the design or transplant it as needed.</li> <li>– Choose plants suited to the local climate and user needs.</li> </ul>	<ul style="list-style-type: none"> <li>– Landscape analysis presented the environmental – climatic data and physiographic conditions</li> </ul>
Space Layout	<ul style="list-style-type: none"> <li>– Design pathways and circulation routes for easy navigation and access for all users.</li> <li>– Prioritize accessibility for individuals with mobility issues, especially for an orthopedic hospital.</li> </ul>	<ul style="list-style-type: none"> <li>– Desire for areas for movement and walking during staff breaks</li> <li>– Poor spatial layout.</li> <li>– Accessibility difficulties (lack of pathways, ramps)</li> </ul>
Historical Elements and Structures	<ul style="list-style-type: none"> <li>– Preserve or renovate historical buildings to highlight the site's cultural and historical value.</li> <li>– Integrate historical structures or exhibitions into the design.</li> </ul>	<ul style="list-style-type: none"> <li>– The Hospital is among the most well-known hospitals in Greece for musculoskeletal issues</li> <li>– Its history is revealed through landscape analysis.</li> </ul>
Social Participation	<ul style="list-style-type: none"> <li>– Engage employees, patients, and visitors in the design process to reflect user needs and priorities.</li> </ul>	<ul style="list-style-type: none"> <li>– The need was the outcome of the social survey</li> </ul>
Sustainable and Bioclimatic Design	<ul style="list-style-type: none"> <li>– Use endemic plants, natural air filters, and low-carbon footprint materials.</li> <li>– Install solar panels and rainwater harvesting systems for sustainability.</li> <li>– Add shaded areas and water features to improve user comfort and reduce heat during summer months</li> </ul>	<ul style="list-style-type: none"> <li>– Landscape analysis presented the environmental – climatic data</li> </ul>

socialization and takes into account the large size of outdoor hospital space for multifunctional uses.

### 3.4.2. Staff well-being

- Cafeteria: The landscape design will introduce new functions and aesthetics, creating a welcoming environment for relaxation and recreation for both visitors and staff, in line with the initial requests from the social survey and the weaknesses identified in the SWOT analysis.
- Nursing School Garden: The garden design creates tranquil and social spaces in an area where the surrounding tall plantings offer both protection and seclusion. To provide a calming environment for staff, flower beds were designed in front of the nursing school building, preserving the original layout, with a fountain placed at the center. Tall trees and shrubs ensure privacy, shielding users from the sun and enhancing seclusion. Seating arrangements offer relaxation opportunities, allowing staff to enjoy the natural surroundings. Additionally, pergolas are strategically placed to provide shaded resting spots. This design meets the needs and preferences of staff, as identified in the social survey and SWOT analysis, while addressing the issue of insufficiently organized seating areas. Therefore, the proposal successfully addresses the issues identified by the staff, including the lack of weather protection and

dining space, insufficient urban equipment, and limited opportunities for seclusion and privacy, while also responding to the expressed need for break areas, outdoor dining with appropriate furnishings, relaxation spaces, and areas that promote social interaction and outdoor therapy.

### 3.4.3. Visitor comfort

- Emergency Visitor Waiting Area: The proposal aims to create a more welcoming space by maintaining the existing high vegetation, adding more plants, and installing urban furniture along the proposed path. This path will visually extend the proposed semicircular route, with curves that evoke a sense of flow and tranquility. Focusing on accessibility, benches and plantings will be placed along the path to enhance this flow. As such, the master plan takes seriously into consideration the need for weather protection, and the creation of a beautiful environment, particularly during visitors' time in the waiting area.
- Event Space: The conversion of an abandoned summer cinema into a multifunctional event space and outdoor cinema for KAT hospital patients and staff offer opportunities for scientific and social events. The space will be accessible to individuals with mobility impairments, featuring ramps, widened corridors, and handrails and adequate

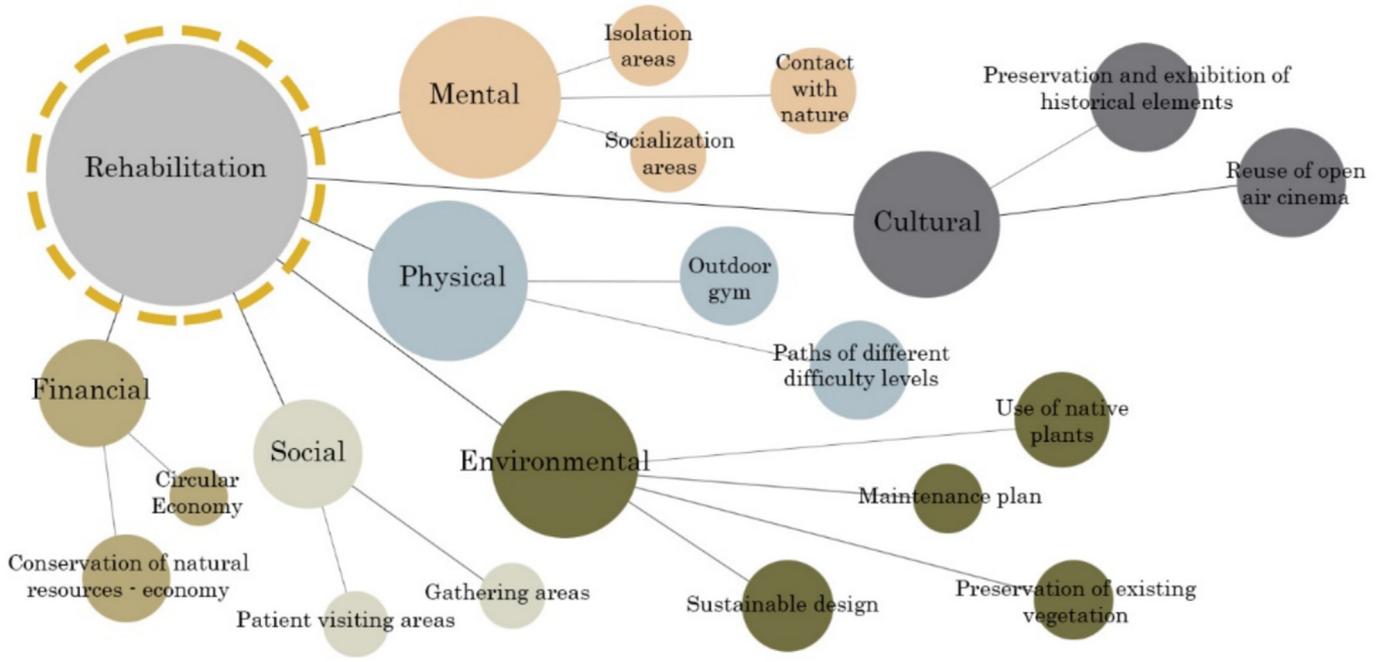


Fig. 14. Rehabilitation analysis framework as proposed by the authors.

equipment will be installed for screenings, ensuring the space is suitable for wheelchair users and patients in medical beds.

3.4.4. Overall enhancements

- Historical landmarks: KAT Hospital has a long history in treating injuries and musculoskeletal issues and is also deeply connected to the history of the municipality. Therefore, the landscape design aims to align with the original path layout while showcasing unique sculptures found in the garden. Small seating areas are created for education and

to highlight the history of KAT Hospital.

- Playground: The playground will feature a natural, sustainable design, offering young children a safe, comfortable space for recreation, development, and socialization, fulfilling parents' needs for better daycare and services. It will be expanded to provide more play areas and upgraded with new equipment suitable for younger children, along with a maintenance guide for the hospital's technical services. Tree shade will provide better sun protection and comfort than artificial structures. Additionally, well-designed flower beds and seating areas



Fig. 15. Proposed master plan for KAT hospital.



Fig. 16. Section of the rehabilitation area.

for parents, teachers, and children will enhance the space's aesthetics, sustainability, and opportunities for social interaction, while the master plan aims to resolve the current image and condition issues of the nursery garden, addressing parents' dissatisfaction.

#### 4. Discussion

This research presents landscape design proposals tailored to the outdoor environment of a hospital in Greece, focusing on therapeutic gardens for individuals with mobility impairments. While research on this topic remains scarce, particularly within the Greek context, the study addresses the specific needs of orthopedic patients in an exemplary way. It ensures that hospital outdoor spaces are both accessible and beneficial for all users through a systematic and interlinked methodological approach. This includes a survey analysis to identify user needs, a SWOT analysis to explore challenges and opportunities, and the development of a set of guidelines emphasizing the therapeutic value of nature. Ultimately, the research concludes with the creation of a master plan for the designated outdoor space.

The study emphasizes the holistic approach to health and recovery that integrates care for both the body and the mind while recognizing the role of the environment and culture in human health. The majority of patients stressed the importance of contact with nature for their medical treatment, mental health, psychology and rehabilitation. Regarding the need for improvement of the hospital's outdoor spaces they have focused on outdoor physiotherapy areas and well-designed garden areas. The interaction with visitors during their recovery in specially designed garden spaces was very important.

The staff expressed the desire for break areas, and the creation of a space where they can enjoy their meals in a natural environment. All three groups stressed the importance of safety and accessibility and the need of

protection from weather conditions. Whereas staff indicated the provision of designated spaces for physiotherapy and rehabilitation close to nature and with social interaction and psychological support.

Through the landscape design of KAT Hospital, the guidelines derived give priority to accessibility and rehabilitation spaces but equally values areas for socialization and tranquility. Efforts are also made to integrate the cultural, historical, and environmental identity of the hospital into the design aiming to create a space that respects local culture, history and the natural environment. This study provides solutions for a sustainable and bioclimatic design taking seriously into consideration the individual exposures to combined environmental factors of air pollution, noise and greenspace [35,36]. This is achieved through a well-organized master plan that emphasizes the integration of nature with user needs within the broader context of the area.

This research supports the work done by the Council of Europe [37], emphasizing that landscape quality contributes to the well-being and health, both physical and mental and its degradation, impoverishment and standardization are detrimental to the well-being and health of people. It presents the valuable input of Landscape Architects [38] through healing and therapeutic landscape design for medical facilities. It also emphasizes the approach that a healing garden can serve as an additional part of a treatment [39,40]. Providing access to nature within healthcare facilities supports these evidence-based design concepts and offers opportunities for positive distractions.

This particular research presents a snapshot of the need for people (patients, staff and visitors) to be closer to nature through their medical treatment and work in such environments. It is tested in a hospital in Greece, facing several limitations that influenced the process, such as the lack of primary data (topographical maps, record of the extensive



Fig. 17. Section of the sensory garden.

vegetation, electrical and plumbing plans), and low participation from patients and visitors in completing questionnaires. The variation in green spaces, considering seasonal changes, day-night differences, and weekdays versus weekends, was primarily assessed in terms of safety, preferred weather conditions, and optimal visiting times. Many studies have emphasized the importance of temporal dynamics in urban planning for high-density areas, highlighting the need to increase green coverage and ensure visibility and accessibility to green spaces [41]. However, the study could not explore the effects of temporal changes further, nor investigate the significant size differences in people's activity spaces between day and night, weekdays and weekends, or across different geographic contexts [42].

Another limitation of our study is the lack of highlighting the potential confounding associations between people's exposure to green space and outdoor artificial light at night [43]. However, during the landscape design process, outdoor lighting design proposal was included.

The social survey shows the importance of public participation in the design process and the ultimate need for a landscape design approach especially adapted to orthopedic hospital outdoor areas. However, the study is aligned with the goal of Greek Government to expanding access to health care, enhancing the quality of health services for all, and empowering frontline health professionals.

The future goal from now on, it will be to integrate this proposed methodological approach and guidelines into more orthopedic hospitals in Greece. However, more standards related to outdoor landscape physiotherapy could be derived adjusted to the particularities of the area and people's needs [44].

## 5. Conclusions

In conclusion, this research embraces people and nature in a hospital environment, leading to landscape design guidelines, that can be used to a master plan specialized for orthopedic hospitals gardens. The landscape design addresses critical aspects of patient recovery, staff well-being, and visitor comfort by integrating therapeutic spaces, enhancing accessibility, and

fostering connections with nature. These elements directly respond to feedback from the social survey and SWOT analysis, ensuring that the hospital environment supports physical, mental, and emotional health for patients, staff, and visitors alike.

The redesign of the KAT hospital's outdoor environment incorporated principles from similar projects and the specific needs of users identified in the social survey. Studies in landscape architecture for orthopedic hospitals provided valuable design standards based on scientific data. The social survey revealed user perspectives on their experiences of the outdoor space, design elements affecting their interactions, and the application of therapeutic programs. Based on the above results, recommendations were developed to address functional and aesthetic requirements based on these insights.

The benefits from the research will be precisely towards a) the improvement of hospitals outdoor environments, b) work towards a more resilient landscape, c) contribute to people's physiotherapy through nature, d) increase public awareness about the value of nature and beautiful garden design e) encourage and empower people to participate in decision making process about their place and f) serve as guide for sustainable hospital landscape design.

On the other hand, the proposed design guidelines and master plan emphasize the role of nature by protecting and restoring ecosystems and integrating development with natural processes, thereby strengthening public health, while creating attractive, high-quality spaces. The broader ecological benefits of the design proposal include the enrichment of the hospital's wider green infrastructure through restoration of existing natural systems and enhancement of ecosystem size, connectivity, and resilience. The diverse use of native plants—from ground cover to canopy—supports local wildlife, increases biodiversity, and incorporates green corridors to facilitate wildlife movement between habitats.

- The role of Landscape Architects in the design of an orthopedic hospital's outdoor environment proved to be vital due to their expertise in integrating natural and man-made elements. The Landscape

Architect applies scientific knowledge from architecture, ergonomics, and spatial psychology to develop functionally and aesthetically effective solutions. Managing challenges such as mapping, preserving existing vegetation, and incorporating new plant material requires specialized expertise and sensitivity to the needs of the hospital environment. Through these design decisions he contributes significantly to the holistic recovery of patients, enhancing the therapeutic experience and fostering health and well-being in the medical space.

### CRedit authorship contribution statement

**Aikaterini Gkoltsiou:** Writing – review & editing, Writing – original draft, Validation, Supervision, Project administration, Methodology, Formal analysis, Conceptualization. **Chrysoula-Angeliki Krita:** Writing – original draft, Visualization, Software, Investigation, Formal analysis, Data curation.

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### Declaration of competing interest

The authors declare that they have no any conflict of interests. 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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