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Enhancing Fiscal Outcomes through Human-Centered Design: The Economic Benefits of Salutogenic Architecture in Public Health Care Facilities

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Abstract

The study aims to investigate the economic benefits of salutogenic architecture in public healthcare facilities. The research design involves a quantitative approach that will utilize a survey to gather pertinent data. The survey comprises a meticulously designed set of questions aimed at investigating the economic benefits of salutogenic architecture in public healthcare facilities across Algeria. For comprehensive coverage, the study will encompass a sample size of 60 healthcare facilities, representing approximately 10% of the total establishments distributed across various provinces (wilayas). It aims to assess the economic advantages resulting from incorporating salutogenic design principles, such as natural light, access to nature, and a sense of environmental control, into the construction and renovation of public healthcare facilities. This research underscores the significance of salutogenic architectural principles in healthcare facility design, highlighting the importance of fostering positive atmospheres, providing access to natural elements, ensuring flexibility, and nurturing community connections to enhance patient and staff well-being by providing valuable insights into public healthcare sorting based on salutogenic architectural criteria and the demographic characteristics of the sample population. The findings highlighted the need for improvement in certain criteria such as flexibility and adaptability, a positive and healing atmosphere, and access to nature. The study also emphasized the significance of salutogenic architectural principles in healthcare facility design and suggested incorporating strategies that enhance patient and staff well-being.

Keywords: Economic benefits; Salutogenic architecture; Public health; healthcare facilities; Human-centered design.

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1. Introduction

The heightened attention directed toward salutogenic design principles and their possible positive impacts within healthcare settings has spurred recent research endeavors. Salutogenic design, an architectural approach, seeks to enhance well-being through building design (Dilani, 2009). This philosophy underscores elements like natural light, nature accessibility, and the use of materials and colors that foster positive, healing environments (Golembiewski, 2017). It has gained recognition as a means to bolster patient outcomes by reducing stress, hastening recovery, and improving overall health. Additionally, it has been shown to boost staff satisfaction and well-being, subsequently decreasing turnover rates (Mazuch, 2017).

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Moreover, salutogenic design principles can offer a cost-efficient avenue for enhancing healthcare service efficacy and efficiency (Pelikan, 2017). Nonetheless, despite the mounting interest, evidence regarding the economic benefits of implementing these principles within Algerian public healthcare facilities remains limited (Katoue et al., 2022). The paper endeavors to fill this gap by scrutinizing the economic advantages of salutogenic architecture in Algerian public healthcare facilities. By investigating staff and patient perceptions and conducting a cost-benefit analysis, this study aims to furnish proof of potential cost savings and other merits associated with integrating these principles into facility design and renovation in the country. Such insights are pivotal for policymakers, architects, and healthcare managers in making informed decisions concerning the integration of salutogenic design principles in Algerian healthcare facilities.
The central research question is: *How do salutogenic design principles influence the economic benefits of Algerian public healthcare facilities?*
The primary objective is to examine the economic benefits of salutogenic architecture within Algerian public healthcare facilities. This objective is pursued through the following secondary aims:

1. Exploring staff and patient perceptions regarding the impact of salutogenic design principles on healthcare services, staff well-being, patient experience, and overall healthcare costs.
2. Utilizing cost-benefit analysis to quantify the expenses and advantages of salutogenic design in terms of healthcare services and staff well-being, while assessing overall design cost-effectiveness.
3. Providing substantiation for potential cost reductions and other benefits associated with incorporating salutogenic design principles into the design and enhancement of Algerian public healthcare facilities.

This paper comprises four sections. The first presents the literature review, followed by the methodology in the second section. The third and fourth sections delve into the results and discussions, respectively, thereby elucidating the primary contributions of this research (Figure 1).

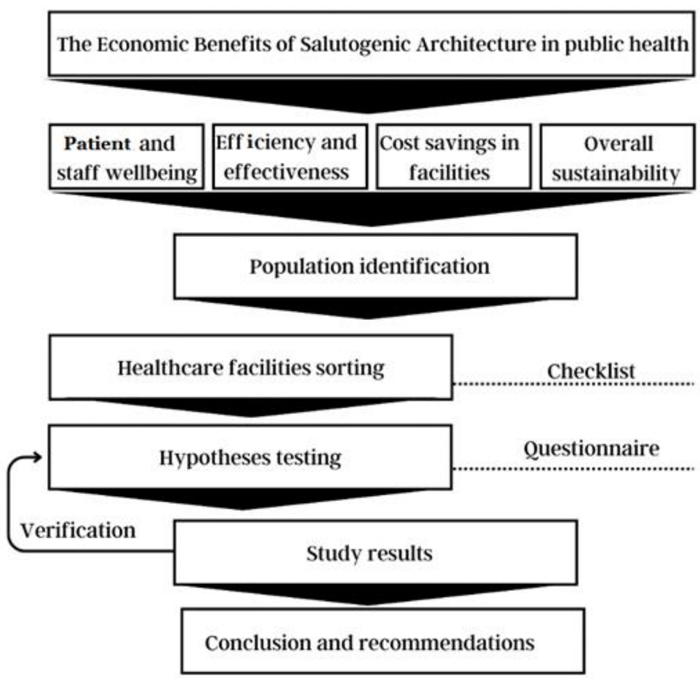

Figure 1. Study Framework.

2. Literature Review

Salutogenic architecture is an approach to design that aims to promote health through the design of infrastructures. The term "salutogenic" comes from the Latin word "salus" meaning health and well-being (Verderber et al., 2020). This approach emphasizes the importance of creating spaces that promote physical, mental, and social well-being, rather than simply preventing illness (Payton et al., 2000). The main elements of salutogenic architecture include:

1. Natural light: The incorporation of natural light is considered essential for promoting well-being as it helps to regulate circadian rhythms, which in turn can improve sleep, mood, and overall health (Brown et al., 2022).

2. Access to nature: Providing access to nature, such as through the incorporation of green spaces, plants, and natural materials, is believed to influence positively physical and mental health (Barton & Rogerson, 2017). This can include the use of green roofs, terraces, or balconies that provide views of nature and bring natural elements into the building (Zhong et al., 2023).
3. Positive and healing atmosphere: The use of colors, textures, and materials that create a positive and healing atmosphere is an important aspect of salutogenic architecture. This can include the use of warm, natural colors, and the incorporation of natural materials, such as wood and stone, to create a sense of calm and comfort (Abdelaal & Soebarto, 2019).
4. Flexibility and adaptability: Salutogenic architecture promotes flexibility and adaptability to allow spaces to be used in multiple ways, and to respond to different users' needs (Golembiewski, 2022). This can include the use of movable walls, partitions, and modular furniture that can be easily reconfigured to accommodate different activities and uses (PumaJohn, 2019).
5. Connection and community: Salutogenic architecture aims to foster a sense of connection and community by providing spaces for social interaction, such as communal spaces, gardens and shared terraces, and promoting the use of spaces for community activities (Anderson et al., 2017).

Salutogenic architecture emphasizes the integration of various design elements and features that have been identified as conducive to health and well-being (Stokols, 1992). These elements include factors such as access to natural light, appropriate ventilation systems, biophilic design principles, ergonomic considerations, and the provision of spaces that facilitate social interaction and a sense of community (Richardson & Butler, 2021). For instance, incorporating ample windows and skylights into building design allows for increased daylight penetration, which has been linked to improved mood, circadian rhythm regulation, and overall well-being (Engwall et al., 2015). Furthermore, integrating green spaces and nature within the built environment has shown positive effects on stress reduction, cognitive function, and overall psychological well-being (Zhang et al., 2020).

By considering these salutogenic design principles, architects and designers can create environments that support the health and well-being of occupants ("The Handbook of Salutogenesis," 2022). Such environments have the potential to positively impact various aspects of human experience, and overall life quality (Sui et al., 2023). For example, studies have demonstrated that well-designed healthcare facilities incorporating salutogenic principles can contribute to improved patient outcomes, increased staff satisfaction, and more efficient healthcare service delivery (Servetkienė et al., 2023).

Patients in a hospital with a salutogenic design had shorter recovery times and reported higher overall satisfaction with their hospital experience (Dilani & Armstrong, 2008). Similarly, patients in a salutogenic nursing home had a lower risk of developing depression and reported a higher overall life quality (Jongenelis et al., 2004).

Staff in a salutogenic hospital reported higher job satisfaction and a lower turnover rate compared to staff in a traditional hospital (Davidson et al., 1997). Salutogenic design in a dementia care facility was correlated with a diminution in aggressive actions among residents and an improvement in the overall quality of life for both residents and staff (Brown et al., 2022). Salutogenic design principles can lead to a reduction in healthcare costs and an improvement in patient outcomes (Golembiewski & Zeisel, 2022). This study conducted a cost-benefit analysis of a salutogenic design in a hospital setting and found that the benefits, including improved patient outcomes and reduced staff turnover, outweighed the costs.

A study by Cho (2023) found that salutogenic design in healthcare facilities can also lead to a reduction in energy consumption, which can lead to cost savings and environmental benefits.

In terms of the context of Algeria, there is a lack of studies specifically on salutogenic architecture in healthcare facilities. However, the studies conducted in different countries have provided evidence of the potential benefits of this approach. Similar benefits could likely be seen in the context of Algeria. Thus, the objective of the proposal is to investigate the economic benefits of salutogenic architecture in public healthcare facilities in Algeria, providing evidence for the potential cost savings and other benefits of incorporating these principles in the design and renovation of public healthcare facilities in the country.

The concept of Economic Benefit is an essential aspect that has not been explicitly addressed within the existing literature concerning salutogenic architecture. While the literature has extensively highlighted the various elements and advantages of salutogenic design principles, the aspect of Economic Benefit remains an understated facet that requires attention. To comprehensively understand the implications of salutogenic architecture in healthcare facilities, it is imperative to delve into the potential economic advantages that this design approach can offer the paradigm of salutogenic architecture, with its emphasis on fostering health and well-being through thoughtful design, transcends beyond its immediate impact on occupants' physical and mental states. While the current research has primarily concentrated on the positive effects of salutogenic design elements, such as natural light, access to nature, and positive atmospheres, the economic advantages intrinsic to this architectural approach have remained relatively unexplored. Economic Benefit in the context of salutogenic architecture pertains to the potential cost savings, efficiency improvements, and long-term financial gains that can be realized by incorporating these principles into the design and renovation of public healthcare facilities.

Salutogenic architecture's influence on the economic landscape of healthcare facilities extends to various facets, encompassing improved patient outcomes, optimized staff satisfaction, reduced healthcare costs, and even energy conservation. Studies conducted in different countries have highlighted the correlation between salutogenic design principles and favorable economic outcomes. Notably, research has indicated that healthcare facilities adhering to salutogenic design principles tend to witness shortened patient recovery times, heightened patient satisfaction, and enhanced staff performance. The cumulative impact of these outcomes can lead to substantial cost reductions and operational efficiencies, underscoring the economic advantages of embracing this architectural approach.

Despite the prevailing evidence of the economic benefits associated with salutogenic architecture, the literature thus far has omitted a focused exploration of this dimension. In the context of Algeria, where studies on salutogenic architecture in healthcare facilities are scarce, it becomes increasingly pertinent to investigate the potential economic gains of this approach. While the extant literature has acknowledged the relevance of salutogenic design principles in diverse global settings, its specific applicability to Algeria remains a research gap waiting to be addressed.

Additionally, while literature checked the effect of salutogenic design on patient outcomes, staff satisfaction, and energy consumption, there is a lack of research that has used cost-benefit analysis to investigate the overall cost-effectiveness of salutogenic design in healthcare facilities (Fries, 2019). This research endeavor seeks to bridge the existing void by exploring the economic benefits of salutogenic architecture in public healthcare facilities in Algeria, using cost-benefit analysis to evaluate the overall cost-effectiveness of the design.

Based on the literature review, we hypothesize that:

H.1 The implementation of salutogenic design principles in public healthcare facilities in Algeria will lead to improvements in the well-being of patients and staff.

H.2 The implementation of salutogenic design principles in public healthcare facilities in Algeria will lead to improvements in the efficiency and effectiveness of healthcare services.

H.3 The implementation of salutogenic design principles in public healthcare facilities in Algeria will lead to cost savings in terms of healthcare services and staff well-being.

H.4 The implementation of salutogenic design principles in public healthcare facilities in Algeria will lead to improvements in the overall sustainability of healthcare facilities.

3. Methodology

The proposed study will use a survey to collect data. The survey will include a set of questions that will be used to investigate the economic benefits of salutogenic architecture in public healthcare facilities in Algeria.

3.1 Population:

We have selected 10% of the total number of public healthcare facilities in Algeria (586) for our population sampling, which consists of three types: University Hospitals (CHU), Public Health Establishments (EPH), and Specialized Hospitals (EHS). By choosing these types of facilities for our sampling, we hope to obtain a representative picture of the quality of healthcare provided in public health institutions in Algeria.

Facilities sorting:

In the process of categorizing healthcare facilities, a systematic approach was adopted based on a checklist comprising 25 criteria derived from relevant literature (Table 01). The primary objective was to classify the facilities into two groups: compliant and non-compliant, based on their adherence to salutogenic architectural principles. The compliance rate was determined by considering an eligibility threshold of 80%.

Table 1: The checklist.

Domain	Criterion	Compliance
Access to Natural Light (Ruck et al., 2000)	Adequate natural lighting throughout the facility	[ ]
	Proper use of windows and skylights	[ ]
	Maximizing daylight penetration	[ ]
	Use of light-colored surfaces to enhance reflection	[ ]
	Control of glare and direct sunlight	[ ]
Access to Nature (Zhong et al., 2022)	Availability of outdoor spaces or green areas	[ ]
	Incorporation of indoor plants or living walls	[ ]
	Views of natural elements from patient areas	[ ]
	Integration of natural materials (wood, stone, etc.)	[ ]
	Use of natural colors and textures	[ ]
Positive and Healing Atmosphère (Bellini et al., 2023)	Integration of calming and soothing elements	[ ]
	Use of art and aesthetics to promote well-being	[ ]
	Consideration of acoustics for a peaceful environment	[ ]
	Integration of aromatherapy or scent control	[ ]
	Provision of comfortable and supportive furniture	[ ]
Flexibility and Adaptability (Radha, 2022)	Configurable spaces for multi-purpose use	[ ]
	Modular furniture and equipment	[ ]
	Adjustable lighting and temperature control	[ ]
	Use of movable partitions for flexible layouts	[ ]
	Integration of technology for adaptability	[ ]
Connection and Community (Marjadi et al., 2023)	Integration of communal spaces for social interaction	[ ]
	Provision of family-friendly spaces or waiting areas	[ ]
	Consideration of cultural and social diversity	[ ]
	Use of inclusive design principles	[ ]
	Promotion of patient and staff engagement	[ ]

Note: Place a checkmark [√] in the checkbox to indicate compliance with the criterion.

3.2 Study Location

We have decided to study 60 healthcare facilities, which represents 10% of the available establishments in various provinces (wilayas). We selected these facilities taking into account the diversity of their patient capacity, environment, location in provinces with high and low populations, as well as their urban profile (rural, semi-urban, and urban), (Figure 2).

Figure 2. Study location.

3.3 Sampling:

After selecting the facilities for our survey, we decided to conduct the questionnaire among a sample of the selected population, which included different types of individuals involved in these establishments: doctors, administrators, nurses, and patients. We thus chose to select 200 participants from Group 1 and 200 from Group 2 to respond to our questionnaire.

The choice of this sample of 200 participants for each group is justified by the method of calculating the sample size based on the population size. Since there are numerous public healthcare facilities in Algeria and it was not feasible to survey all of them, we used a statistical formula to determine the required sample size to obtain a representative estimate of the total population.

Taking into account the expected response rate, confidence level, margin of error, and population size, we determined the sample size. The total population size of public healthcare establishments in Algeria was estimated to be 586 (10% of the total number of establishments in Algeria).

The expected participant response rate was 50%, the desired confidences level was 95 percent, and the desired error margin was 5%.

Using these values, the size of the sample for each group can be calculated as follows in equation 1:

$$\text{Sample Size} = (\text{Z} - \text{score})^2 \times \text{p} \times {(1-\text{p})}\big/{(\text{Margin of Error})} \quad \text{----------------------(1)}$$

Where:

Z-score: the value from the standard normal distribution corresponding to the desired confidence level (in this case, 1.96 for a 95% confidence level)

p: the estimated proportion of the population that possesses the characteristic of interest (in this case, assuming p = 0.5 for a conservative estimate)

Margin of error: the desired margin of error (in this case, 0.05)

Using these values in the formula, we can calculate the sample size for each group:

Sample Size = $(1.96)^2 \times (0.5) \times {(1-0.5)}\big/{(0.05)} = 384.16 \cong 385$

Since we have two groups and identified only 21 healthcare establishments in each group, we plan to sample 200 participants from each group to ensure adequate representation.

By choosing a sample size of 200 for every group, we are able to obtain representative data for both groups while considering the constraints related to the size of the population under study. This allows us to better understand the effects of quality on various aspects of public healthcare establishments in Algeria, while providing reliable and accurate results.

3.4 The questionnaire:

The survey questions are designed to gather information about the demographic characteristics of the participants, their knowledge and awareness of salutogenic architecture, their perceptions of the importance of facility design in promoting well-being, and their satisfaction with the design of the healthcare facility where they currently work or receive treatment.

The survey questions can be categorized into the following categories (Table 02):

Table 2: The survey questions.

Category	**Survey Questions**
Demographic information	Question 1
Knowledge and awareness of salutogenic architecture	Question 2
Importance of facility design in promoting well-being	Question 3
Satisfaction with facility design	Question 4
Impact of facility design on well-being	Questions 5, 10-13
Impact of facility design on healthcare service efficiency and effectiveness	Question 6
Impact of facility design on patient experience	Question 7
Impact of facility design on staff experience	Question 8
Impact of facility design on overall cost of healthcare	Question 9
Impact of facility design on sustainability	Questions 14-19

3.5 Data collection:

The data gathering procedure included administering the questionnaire to individuals of diverse profiles within public healthcare facilities, with a division into two groups: the compliant group and the non-compliant group.

To facilitate the filling process and enhance participant engagement, two QR codes were created and provided in both types of facilities. These QR codes served as convenient access points, allowing individuals to directly access the questionnaire using their mobile devices. By simply scanning the QR code, participants were redirected to the online questionnaire, streamlining the data collection process and potentially increasing the number of participants. After cleaning the data, it will be transformed into a format that is suitable for analysis using SPSS software.

3.6 Data analysis:

a. Descriptive Statistics:

These statistics provide a concise and informative overview of various aspects, including demographic information, knowledge and awareness of salutogenic architecture, and perceptions of the importance of facility design in promoting well-being**.**

b. inferential Statistics:

Inferential statistics are employed to test the four research hypotheses regarding the relationships between variables. The use of inferential statistics allows for generalizing the findings from a sample to the larger population. Specifically, this analysis involves t-tests to evaluate the research hypotheses.

T-test is employed to compare means between two groups or conditions, and used to assess whether there are significant differences in the means of a continuous variable across different groups. In the context of investigating the relationships between variables in the study, t-test is utilized to compare the means of variables related to well-being, satisfaction, or economic benefits.

4. Results and discussion

4.1 Results

4.1.1 Facilities sorting:

The provided results describe the frequency of compliance rates for each criterion within the specified domains as follows (Figure 3):

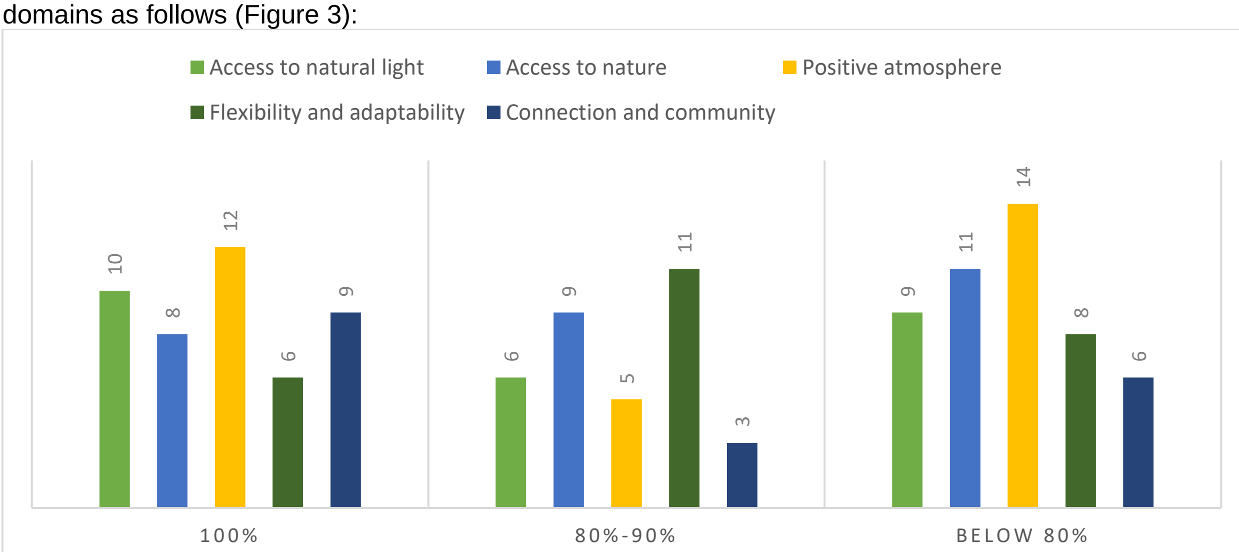

Figure 3. Facilities sorting results.

4.1.2 The survey

B1-Demographic descriptive of the sample population:

Age:

The age distribution in groups G1 and G2 is as follows: In G1, there are 6 individuals (4.8%) in the "20-29" age range, 16 individuals (12.7%) in the "30-39" age range, 1 individual (0.8%) in the "40 and above" category, 77 individuals (61.1%) in the "40 and above" age range, and 6 individuals (4.8%) under 20 years old. In G2, there are 6 individuals (4.8%) in the "20-29" age range, 22 individuals (17.5%) in the "30-39" age range, 49 individuals (38.9%) in the "40 and above" age range, and 3 individuals (2.4%) under 20 years old. The age distribution shows that both groups have a significant representation of individuals aged 40 and above, with G2 having a higher percentage in the "30-39" age range compared to G1 (Figure 4).

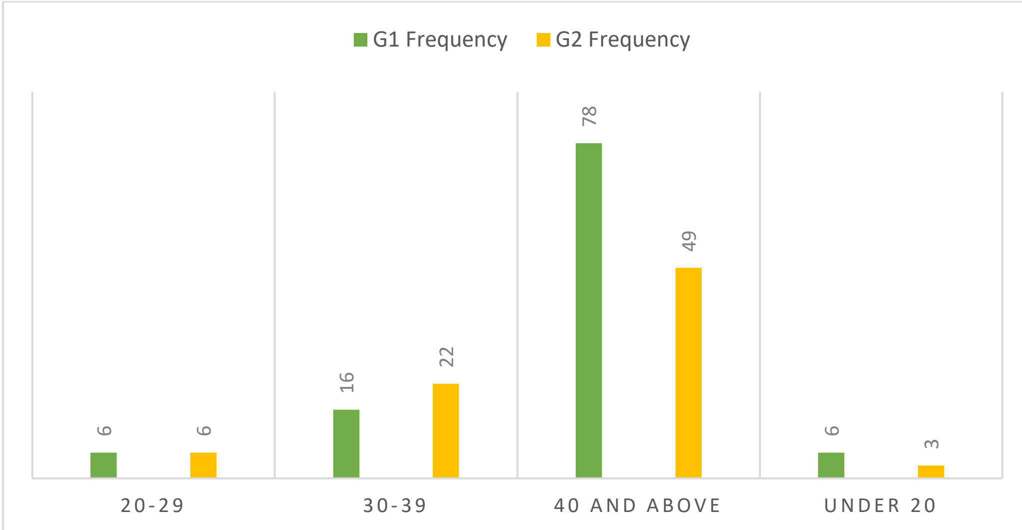

Figure 4. Age results.

Gender:

The gender distribution in groups G1 and G2 is as follows: In G1, 72 individuals (57.1%) identify as female, and 48 individuals (38.1%) identify as male. In G2, 6 individuals (4.8%) identify as female, 66 individuals (52.4%) identify as female, and 54 individuals (42.9%) identify as male. The cumulative percentages indicate the proportion of individuals accounted for up to each gender category in the respective groups. For example, in G1, the cumulative percentage for females is 61.9%, meaning that 61.9% of the individuals in G1 identify as female. The gender distribution shows that both groups have a significant representation of females, with a slightly higher percentage in G1 compared to G2 (Figure 5).

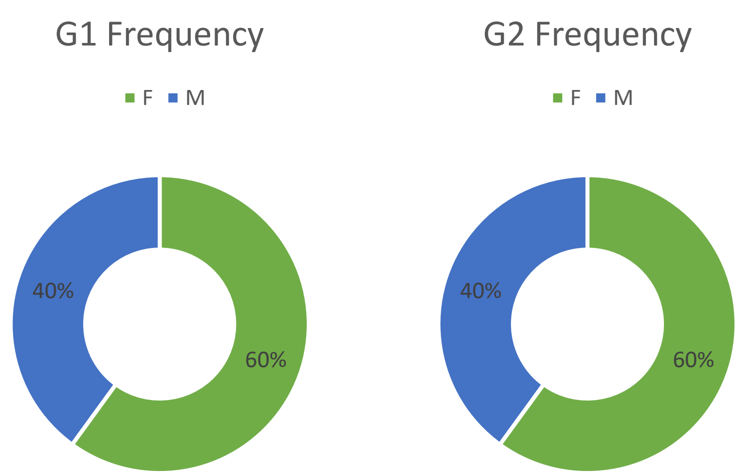

Figure 5. Gender results.

Occupation:

the results shows that there were variations in the frequency of different occupations between two groups, G1 and G2. G2 had an increase in the number of administrators and nurses compared to G1. In contrast, G2 had fewer doctors compared to G1. The frequency of patients remained the same in both groups. These findings suggest potential changes in staffing or roles within the studied context, highlighting the dynamic nature of occupations (Figure 6).

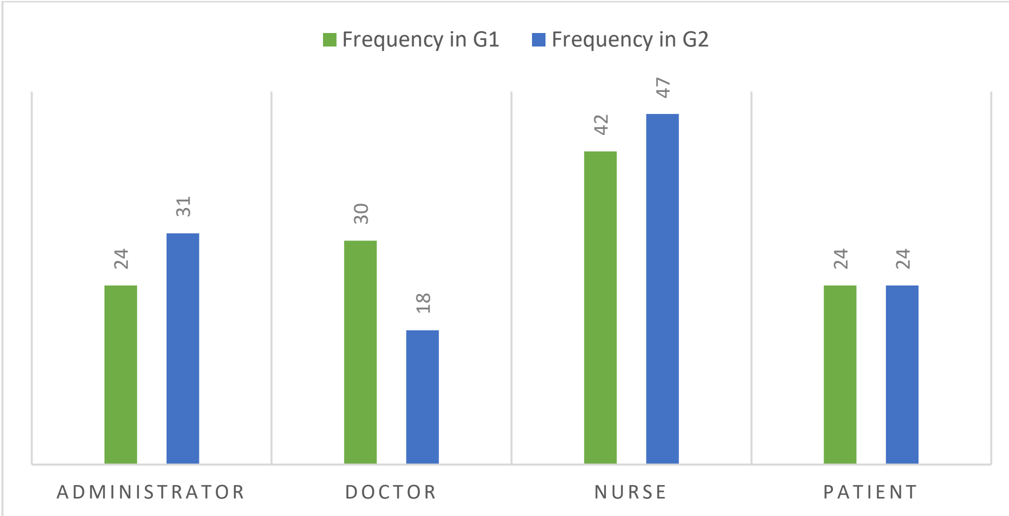

Figure 6. Occupation results.

Education Level:
the results reveal changes in the distribution of education levels between two groups, G1 and G2. G2 showed a decrease in the rate of persons with doctorate degrees and advanced education levels compared to G1. On the other hand, G2 demonstrated a rise in the rate of persons with primary and secondary education levels. These findings indicate a potential shift in the educational composition within the groups, with a decrease in higher education levels and an increase in individuals with lower education levels in G2 (Figure 7).

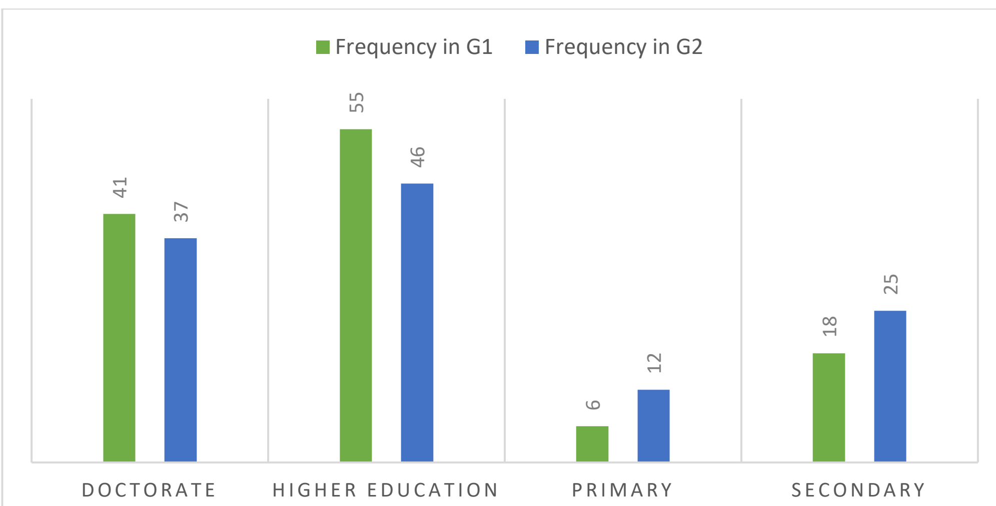

Figure 7. Education level results.

B2- Knowledge and awareness of salutogenic architecture:
Results of the surveys and interviews on participants' understanding of the concept and its application in their facility
The provided statistics in table 03 and table 04, compare the knowledge of a concept in two groups, G1 and G2. Group G2, consisting of 120 samples, has an average knowledge score of 1.8000 with a standard deviation of 0.40168. Group G1, also with 120 samples, has a slightly lower average knowledge score of 1.6000 with a larger standard deviation of 0.49195.
The one-sample test conducted on both groups, with a test value of 0, reveals highly significant differences ($p<0.001$) in groups means and the test value.

Table 3. One-Sample Statistics: Knowledge of concept.

One-Sample Statistics				
	N	Mean	Std. Deviation	Std. Error Mean
Knowlegde of concept G2	120	1,8000	,40168	,03667
Knowlegde of concept G1	120	1,6000	,49195	,04491

Table 4. One-Sample test: Knowledge of concept.

One-Sample Test						
	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Knowlegde of concept G2	49,089	119	,000	1,80000	1,7274	1,8726
Knowlegde of concept G1	35,628	119	,000	1,60000	1,5111	1,6889

B3- Importance of facility design in promoting well-being:
Results of the surveys and interviews on the perceived importance of facility design in promoting well-being

The provided statistics in table 05 and table 06 compare the promotion of well-being for patients and staff in two groups, G1 and G2. Group G1, consisting of 120 samples, has an average score of 4.2500 with a standard deviation of 1.13944. Group G2, also with 120 samples, has a slightly lower average score of 3.7000 with a larger standard deviation of 1.35100. The one-sample test conducted on both groups, with a test value of 0, reveals highly significant differences ($p<0.001$) between the means of the groups means and the test value.

The mean difference for G1 is 4.25000, with a 95% confidence interval of [4.0440, 4.4560]. For G2, the mean difference is 3.70000, with a 95% confidence interval of [3.4558, 3.9442]. These results suggest that both groups have a positive impact on promoting the well-being of patients and staff, with G1 demonstrating a slightly higher level of promotion based on the provided sample data.

Table 5. One-Sample Statistics: promoting the well-being of patients and staff.

One-Sample Statistics				
	N	Mean	Std. Deviation	Std. Error Mean
promoting the well-being of patients and staff G1	120	4,2500	1,13944	,10402
promoting the well-being of patients and staff G2	120	3,7000	1,35100	,12333

Table 6. One-Sample test: promoting the well-being of patients and staff.

One-Sample Test						
	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Différence	95% Confidence Interval of the Difference	
					Lower	Upper
promoting the well-being of patients and staff G1	40,859	119	,000	4,25000	4,0440	4,4560
promoting the well-being of patients and staff G2	30,001	119	,000	3,70000	3,4558	3,9442

B4- Satisfaction with facility design:
Results of the surveys and interviews on participants' satisfaction with the facility design

The provided statistics compare the satisfaction of facility design in two groups, G1 and G2. Group G1, consisting of 120 samples, has an average satisfaction score of 3.3167 with a standard deviation of 1.09224. Group G2, also with 120 samples, has a slightly lower average satisfaction score of 3.2500 with a larger standard deviation of 1.32367. The one-sample test conducted on both groups, with a test value of 0, reveals highly significant differences ($p<0.001$) between the means of the groups and the test value. The mean difference for G1 is 3.31667, with a 95% confidence interval of [3.1192, 3.5141].

For G2, the mean difference is 3.25000, with a 95% confidence interval of [3.0107, 3.4893]. These results suggest that both groups experience a high level of satisfaction with the facility design, with G1 demonstrating a slightly higher satisfaction level based on the provided sample data. See Tables 7 and 8.

Table 7. One-Sample Statistics: Satisfaction of the facility design.

One-Sample Statistics				
	N	Mean	Std. Deviation	Std. Error Mean
Satisfaction of the facility design G1	120	3,3167	1,09224	,09971
Satisfaction of the facility design G2	120	3,2500	1,32367	,12083

Table 8. One-Sample test: Satisfaction of the facility design.

One-Sample Test						
	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Satisfaction of the facility design G1	33,264	119	,000	3,31667	3,1192	3,5141
Satisfaction of the facility design G2	26,896	119	,000	3,25000	3,0107	3,4893

B5- Impact of facility design on well-being, healthcare service efficiency and effectiveness, patient experience, staff experience, overall cost of healthcare and sustainability:

- Efficiency and effectiveness:

The provided statistics in table 09 and table 10 compare the effects of efficiency and effectiveness between two groups, G1 and G2. Group G1, consisting of 120 samples, exhibits a slightly higher average effect (mean of 3.4417) with a standard deviation of 1.41300. Group G2, also with 120 samples, shows a slightly lower average effect (mean of 3.1000) with a similar standard deviation of 1.38054.

The t-test indicates a considerable and statistically significant disparity between the means of the two groups ($p<0.001$), with G1 having a higher mean value. The confidence intervals further support this difference, indicating that the true population mean difference lies within the respective ranges. In conclusion, G1 demonstrates a stronger impact on efficiency and effectiveness compared to G2, as indicated by the statistical analysis of the provided sample data.

Table 9. One-Sample Statistics: Effect on efficiency and effectiveness.

One-Sample Statistics				
	N	Mean	Std. Deviation	Std. Error Mean
Effect on efficiency and effectiveness G1	120	3,4417	1,41300	,12899
Effect on efficiency and effectiveness G2	120	3,1000	1,38054	,12603

Table 10. One-Sample test: Effect on efficiency and effectiveness.

One-Sample Test						
	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Effect on efficiency and effectiveness G1	26,682	119	,000	3,44167	3,1863	3,6971
Effect on efficiency and effectiveness G2	24,598	119	,000	3,10000	2,8505	3,3495

- Patient experience:

The provided statistics in table 11 and table 12 compare the effect on patient experience in two groups, G1 and G2. Group G1, consisting of 120 samples, shows an average effect of 4.0000 with a standard deviation of 1.10004. Group G2, also with 120 samples, exhibits a slightly lower average effect of 3.3500 with a similar standard deviation of 1.28108. The t-test indicates a considerable and statistically significant disparity between the means of the two groups and the test value of 0 ($p<0.001$), indicating a positive effect on patient experience.
G1 demonstrates a higher mean value compared to G2, as supported by the confidence intervals, which suggest that the true population mean difference falls within their respective ranges. In summary, both groups positively impact patient experience, with G1 showing a stronger effect based on the analysis of the provided sample data.

Table 11. One-Sample Statistics: Effect on patient experience.

One-Sample Statistics				
	N	Mean	Std. Deviation	Std. Error Mean
Effect on patient experience G1	120	4,0000	1,10004	,10042
Effect on patient experience G2	120	3,3500	1,28108	,11695

Table 12. One-Sample test: Effect on patient experience.

One-Sample Test						
	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Effect on patient experience G1	39,833	119	,000	4,00000	3,8012	4,1988
Effect on patient experience G2	28,646	119	,000	3,35000	3,1184	3,5816

- Staff experience:

The provided statistics in table 13 and table 14 compare the effect on staff experience in two groups, G1 and G2. Group G1, consisting of 120 samples, shows an average effect of 4.1500 with a standard deviation of 1.15700. Group G2, also with 120 samples, exhibits a slightly lower average effect of 3.9000 With an equivalent standard deviation of 1.22577 in both groups, the statistical test unveils a highly significant distinction in means, yielding a test value of 0 ($p < 0.001$). indicating a positive effect on staff experience.
G1 demonstrates a higher mean value compared to G2, as supported by the confidence intervals, which suggest that the true population mean difference falls within their respective ranges. In summary, both groups have a positive impact on staff experience, with G1 showing a slightly stronger effect based on the analysis of the provided sample data.

Table 13. One-Sample test: Effect on staff experience.

One-Sample Statistics				
	N	Mean	Std. Deviation	Std. Error Mean
Effect on staff experience G1	120	4,1500	1,15700	,10562
Effect on staff experience G2	120	3,9000	1,22577	,11190

Table 14. One-Sample test: Effect on staff experience.

One-Sample Test						
	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Effect on staff experience G1	39,292	119	,000	4,15000	3,9409	4,3591
Effect on staff experience G2	34,853	119	,000	3,90000	3,6784	4,1216

- Overall cost of healthcare:

The provided statistics in table 15 and table 16 compare the effect on overall cost in two groups, G1 and G2. Group G1, consisting of 120 samples, shows an average effect of 2.3000 with a standard deviation of 1.23397. Group G2, also with 120 samples, exhibits a higher average effect of 3.5000.

The statistical analysis demonstrates a substantial and statistically significant distinction between the means of both groups and the test value of 0 ($p<0.001$), indicating an effect on overall cost. G2 demonstrates a higher mean value compared to G1, as supported by the confidence intervals, which suggest that the true population mean difference falls within their respective ranges. In summary, both groups have an impact on overall cost, with G2 showing a stronger effect based on the analysis of the provided sample data.

Table 15. One-Sample test: Effect on overall cost.

One-Sample Statistics				
	N	Mean	Std. Deviation	Std. Error Mean
Effect on overall cost G1	120	2,3000	1,23397	,11265
Effect on overall cost G2	120	3,5000	1,47244	,13441

Table 16. One-Sample test: Effect on overall cost.

One-Sample Test						
	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Effect on overall cost G1	20,418	119	,000	2,30000	2,0770	2,5230
Effect on overall cost G2	26,039	119	,000	3,50000	3,2338	3,7662

- Sustainability:

The provided statistics in table 17 and table 18 compare the effect on overall cost in two groups, G1 and G2. Group G1, consisting of 120 samples, exhibits an average effect of 2.3000, along with a standard deviation of 1.23397. In contrast, Group G2, also comprising 120 samples, reveals a higher average effect of 3.5000, with a larger standard deviation of 1.47244.

When subjected to a one-sample test with a test value of 0, both groups reveal highly significant differences ($p < 0.001$) between their means and the test value. Specifically, Group G1 demonstrates a mean difference of 2.3000, with a 95% confidence interval of [2.0770, 2.5230], while Group G2 shows a mean difference of 3.5000, with a 95% confidence interval of [3.2338, 3.7662]. These results suggest that both groups have a significant impact on overall cost, with G2 demonstrating a stronger effect based on the provided sample data.

Table 17. One-Sample test: Effect on overall cost.

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Effect on overall cost G1	120	2,3000	1,23397	,11265
Effect on overall cost G2	120	3,5000	1,47244	,13441

Table 18. One-Sample test: Effect on overall cost.

One-Sample Test

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Effect on overall cost G1	20,418	119	,000	2,30000	2,0770	2,5230
Effect on overall cost G2	26,039	119	,000	3,50000	3,2338	3,7662

4.2 Discussion

4.2.1 Public healthcare sorting

The results of the compliance rates and facilities sorting for various salutogenic architectural criteria provide valuable insights for the study aimed at categorizing healthcare facilities based on their adherence to these principles. The objective was to classify the facilities into compliant and non-compliant groups, with an eligibility threshold of 80% adherence.

The criterion with the highest compliance rate was "Positive and healing atmosphere," where 12 facilities achieved 100% compliance. This indicates successful incorporation of strategies such as calming interior design and acoustics control, contributing to the well-being of patients and staff.

In contrast, the criterion with the lowest compliance rate in the 100% compliance category was "Flexibility and adaptability," with only 6 facilities meeting the criteria. This suggests a need for improvement in accommodating changing needs and healthcare practices through modular spaces and technology integration.

In the 90% to 80% compliance range, "Access to natural light" and "Access to nature" exhibited higher compliance rates. While efforts have been made to incorporate these elements, there is room for further optimization, such as maximizing daylight penetration and integrating indoor plants.

The criteria falling below the 80% compliance threshold highlight areas requiring attention and improvement. "Positive and healing atmosphere" had the highest number of facilities below the threshold, emphasizing the need to enhance emotional well-being and comfort. Similarly, "Access to nature" and "Flexibility and adaptability" also require further attention to enhance the healthcare experience.

Overall, the results underscore the significance of salutogenic architectural principles in healthcare facility design. Emphasizing criteria such as positive atmosphere, access to natural light and nature, flexibility, and community connections can improve patient and staff well-being and outcomes. Architects, designers, and healthcare administrators can utilize these findings to guide future facility design projects and create optimal healing environments.

4.2.2 The survey

A total of 120 valid respondents, representing 60% of the selected sample size of 200 participants from each group, were included in the survey. This ensured adequate representation and considered the constraints related to the population size of public healthcare establishments in Algeria.

Demographic descriptive of the sample population:

The results provide insights into the demographic characteristics, occupation, and education level distribution between two groups, G1 and G2.

In terms of age distribution, both groups had a significant representation of individuals aged 40 and above. However, G2 had a greater proportion of individuals in the "30-39" age range compared to G1. This suggests a potential difference in age demographics between the two groups, with G2 having a relatively younger population in the "30-39" age range.

Regarding gender distribution, both groups had a significant representation of females. However, G1 had a slightly higher percentage of females compared to G2. These findings indicate that both groups have a diverse representation of gender, with a relatively higher proportion of females.

Occupationally, G2 had an increased number of administrators and nurses compared to G1. In contrast, G2 had fewer doctors compared to G1. The frequency of patients remained the same in both groups. These findings suggest potential variations in staffing or roles within the studied context, highlighting the dynamic nature of occupations in healthcare settings.

In terms of education level distribution. In contrast, Group G2 saw a reduction in the number of individuals holding doctorate degrees and higher educational qualifications compared to Group G1. Conversely, Group G2 showed an increase in the frequency of individuals with primary and secondary education levels. These results suggest a potential shift in the educational composition within the groups, with a decrease in higher education levels and an increase in individuals with lower education levels in G2.

Overall, the results reflect differences and potential shifts in demographics, occupation, and education levels between G1 and G2. These findings highlight the importance of considering these factors when analyzing and interpreting study outcomes, as they may influence the perspectives, experiences, and dynamics within the research context. Understanding these variations can contribute to a more comprehensive understanding of the studied population and the implications for the research findings.

1. Knowledge and awareness of salutogenic architecture:

The findings suggest that both groups have a certain level of understanding of salutogenic architecture, but G2 shows a higher level of knowledge compared to G1. It is important to note that the results are based on the provided sample data, and further research with larger sample sizes would be beneficial to validate and generalize these findings.

The differences in knowledge and awareness between the two groups could be attributed to various factors, such as differences in educational background, professional experience, or exposure to information related to salutogenic architecture. G2 may have had more opportunities for education or training in the concept, leading to a higher level of knowledge among its participants.

Understanding the knowledge and awareness of salutogenic architecture among healthcare professionals and facility stakeholders is crucial for effective implementation of these principles in healthcare facility design. The results highlight the need for targeted education and training programs to enhance knowledge and promote awareness of salutogenic architectural concepts among healthcare professionals, ultimately leading to improved facility design and better patient outcomes.

Importance of facility design in promoting well-being:

Both groups, G1 and G2, recognize the importance of facility design in promoting the well-being of patients and staff. G1 demonstrates a slightly higher level of promotion of well-being compared to G2. These findings highlight the significance of facility design in creating positive and supportive environments in healthcare settings. Well-designed facilities can contribute to improved outcomes and experiences for patients and staff. The results emphasize the need to prioritize facility design and its potential benefits in promoting well-being and enhancing the overall quality of care provided.

2. Satisfaction with facility design:

The findings revealed that both groups, G1 and G2, express a high level of satisfaction with the facility design. G1 demonstrates slightly higher satisfaction than G2, although both groups are generally satisfied. These findings underscore the importance of considering participant satisfaction in healthcare facility design to ensure a positive experience for patients and staff. It highlights the need for ongoing attention to facility design to meet user needs and preferences, promoting overall satisfaction and well-being.

Impact of facility design on well-being, healthcare service efficiency and effectiveness, patient experience, staff experience, overall cost of healthcare and sustainability:

3. Efficiency and Effectiveness:

The analysis of the provided data suggests that group G1 has a stronger impact on efficiency and effectiveness compared to group G2. The mean effect score for G1 (mean = 3.4417) is slightly higher than that of G2 (mean = 3.1000), indicating a greater positive influence on these outcomes. The statistical test confirms the significant difference between the means of both groups, with G1 demonstrating higher effectiveness and efficiency. These findings imply that facility design elements in G1 have contributed to enhancing the efficiency and effectiveness of healthcare services.

4. Patient Experience:

Both groups, G1 and G2, show a positive effect on patient experience, but G1 exhibits a stronger impact based on the statistical analysis. The mean effect score for G1 (mean = 4.0000) is higher than that of G2 (mean = 3.3500), indicating a more favorable patient experience in G1. The confidence intervals support this difference, suggesting that the true population mean difference falls within their respective ranges.

These results emphasize the importance of facility design in creating an environment that positively influences patient experience.

5. Staff Experience:

The statistical analysis indicates a positive effect of facility design on staff experience in both groups, G1 and G2. However, G1 demonstrates a slightly stronger impact on staff experience compared to G2. The mean effect score for G1 (mean = 4.1500) is higher than that of G2 (mean = 3.9000), indicating a more favorable staff experience in G1. The confidence intervals further support this difference, implying that the true population mean difference lies within their respective ranges. These findings highlight the significance of facility design in promoting a positive work environment for healthcare staff.

6. Overall Cost of Healthcare:

Both groups, G1 and G2, exhibit an effect on the overall cost of healthcare. However, G2 demonstrates a stronger impact on overall cost compared to G1. The mean effect score for G2 (mean = 3.5000) is higher than that of G1 (mean = 2.3000), indicating a greater influence on cost reduction or containment. The confidence intervals support this difference, suggesting that the true population mean difference falls within their respective ranges. These results imply that facility design in G2 has been more effective in managing or reducing healthcare costs.

7. Sustainability:

The statistical analysis reveals that both groups, G1 and G2, have a significant impact on sustainability related to facility design. G2, however, demonstrates a stronger effect compared to G1. The mean effect score for G2 (mean = 3.5000) is higher than that of G1 (mean = 2.3000), indicating a greater emphasis on sustainable practices. The confidence intervals further support this difference, implying that the true population mean difference falls within their respective ranges. These findings emphasize the role of facility design in promoting sustainable healthcare practices and reducing environmental impact.

The T test results indicates that facility design has a significant impact on efficiency, effectiveness, patient experience, staff experience, overall cost of healthcare, and sustainability. Group G1 generally demonstrates stronger positive effects across these dimensions compared to G2. These findings underscore the importance of carefully considering facility design in healthcare settings to optimize various outcomes and create environments that support the well-being of patients, staff, and the broader healthcare system. The findings of this analysis provide empirical support for the four research hypotheses, suggesting that facility design positively influences efficiency and effectiveness, patient experience, staff experience, and the overall cost of healthcare.

5. Conclusion

The study provided valuable insights into public healthcare sorting based on salutogenic architectural criteria and the demographic characteristics of the sample population. The findings highlighted the need for improvement in certain criteria such as flexibility and adaptability, a positive and healing atmosphere, and access to nature. The study also emphasized the significance of salutogenic architectural principles in healthcare facility design and suggested incorporating strategies that enhance patient and staff well-being. The analysis also reveals differences in knowledge and awareness of salutogenic architecture between the two groups, underscoring the importance of targeted education and training programs. Facility design is recognized as crucial in promoting well-being, and the satisfaction levels of participants with facility design are generally high.

The impact of facility design on efficiency, effectiveness, patient experience, staff experience, overall cost of healthcare, and sustainability is evident, with Group G1 demonstrating stronger positive effects compared to Group G2. These findings provide empirical support for the research hypotheses and emphasize the need for thoughtful facility design to optimize outcomes and create healing environments in healthcare settings.

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Conflicts of interest

The Authors declares that there is no conflict of interest.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding authors/s.

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