

Chapter 1

Promoting Sustainability in Bahraini Primary Health Care Centers

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Introduction

Healthcare buildings are responsible for 4%-5% of the greenhouse gas emissions worldwide (Alkaabi & Aljaradin, 2023). According to the US Environmental Protection Agency (EPA), hospitals generate approximately 7,000 tons of total waste on a daily basis (Rodríguez-Jiménez et al., 2023). As per a 2021 report by the World Health Organization, the COVID-19 pandemic response resulted in a significant surge in medical waste, underscoring the pressing necessity to enhance waste management protocols in healthcare facilities (WHO, 2022). The significant impacts of the way in which building users interact with building systems, also known as occupant behavior, is often overlooked in the analysis of building energy performance and when addressing environmental sustainability issues (Tkubet et al., 2023). Additionally, healthcare buildings are amongst the building typologies which are given minimal attention in research on the topic, and require further investigation (Uddin et al., 2021). This underscores the significance of this study within the broader body of knowledge. The healthcare sector has the potential to significantly contribute to the betterment of public health, by reducing its ecological impact to preserve the environment. By adopting green infrastructure practices and prioritizing effective waste management initiatives, the healthcare sector can assume a leadership role in addressing climate change and advocating for a healthier future (WHO, 2009).

This research proposes a framework to promote sustainability in primary healthcare centers in Bahrain. By promoting sustainability, enhancing environmentally responsible behavior, and reducing the ecological footprint of buildings, primary healthcare centers can play a significant role in contributing to Bahrain's national target of achieving zero-emissions by the year 2060. The objectives of the research are to examine the current sustainability state of primary healthcare centers and assess users' perception and awareness of green buildings. The study design is constructed using an integrated approach, which incorporates diverse research methods and paradigms. According to Groat and Wang, this type of study design represents the highest level of integration, giving equal importance to all strategies. While the clear advantage of this approach is the synergistic combination of each strategy's strengths, its implementation necessitates a high level of sophistication and organization in the methodological process (Groat & Wang, 2013). To identify potential strategies for promoting sustainability in primary healthcare centers, a mixed methodology of interviews and a questionnaire is employed. Statistical analysis is utilized to uncover patterns, relationships, and correlations. The obtained findings offer valuable insights to stakeholders, serving as a roadmap for promoting sustainability in other building types that share similar socio-cultural and environmental contexts.

This research is organized in four parts, as detailed in Figure 1. The first part consists of a literature review on sustainability perspectives, sustainability in healthcare, and a brief background on primary healthcare centers in Bahrain. The second part presents the methodology, consisting of interviews to understand the current strategies implemented in primary healthcare centers, and a questionnaire to assess perception, awareness, and factors affecting comfort and behavior. The subsequent parts discuss the results and main contributions of the paper, and outline strategies for promoting sustainability in primary healthcare centers through a framework of environmental responsibility.

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Figure 1. Structure of Research

Sustainability: The Global and Local Perspectives

Sustainable Urban Development

The term “sustainability” is increasingly gaining popularity around the globe and especially within the architecture, engineering, and construction sector (AEC). International commitments such as the Paris Agreement and the Global Covenant of Mayors convened international leaders and designers to implement environmental design and sustainability (Dzebo et al., 2023). In 1992, the United Nations recognized the concept of sustainable urban development as a global agenda, forming the basis of the Sustainable Development Goals (SDGs) (Kim et al., 2023). Sustainable urban development policies balance environmental, social, and economic goals. Current research presents a global commitment to sustainability, with efforts focused on implementing the United Nations' SDGs and incorporating the pillars of sustainability into the fundamental principles of architectural design (Fini, et al., 2023; Fleming & Roberts, 2019; Jaffe et al., 2020).

Governments, organizations, and professionals worldwide have been actively striving to align their efforts with the United Nations' 2030 Agenda for Sustainable Development (Grainger-Brown & Malekpour, 2019). Previous research confirmed that numerous countries have already included the SDGs within their national standards and building codes (OECD, 2017). However, more recent research indicates that this progress in moving the agenda globally has been slow, uneven, geographically isolated, and unlikely to be achieved by 2030 (UN, 2019). The building sector in particular has been relatively slow and inconsistent in achieving the SDGs in comparison to the other sectors (Goubran et al., 2022). It has been suggested that transformative learning, effective leadership, and robust partnerships across sectors would increase the successful implementation of the 17 SDGs to bring about profound global transformations (Saxena et al., 2021). Sustainable design is also a critical component of sustainable urban development, laying down the foundation for creating environmentally responsible, economically sustainable, and socially inclusive cities.

Sustainable Design

Sustainable design is a multifaceted and multidimensional approach which has been defined by many scholars and fields. In the recent years, the definitions of sustainable design have changed, to include economic, social, and environmental considerations (Horani, 2023). While there is no fixed definition for the term, sustainable design has become a necessity, integrated by the design team from the very early stages of design. In the building sector, increasing energy efficiency has become a primary priority around the globe (Santamouris & Vasilakopoulou, 2021). The increasing deficits of oil prices created a negative influence on countries' economies, and hence the inclination towards energy efficiency within the Gulf region (Almasri & Narayan, 2021). New terminologies emerged throughout the years, branching off of sustainable design, including green buildings, sustainable architecture, energy efficient buildings, and net zero energy buildings amongst others. They incorporate passive design strategies to minimize the impact of the built environment on the natural environment. Some of the strategies include building orientation, insulation, natural ventilation, use of local materials, green walls, and roofs. Green buildings have the ability to absorb and decrease GHG emissions, create sustainable cities and mitigate climate change (Biswas et al., 2021). Green infrastructure is also considered integral in supporting health and mitigating environmental sustainability challenges within urban contexts (Dipeolu et al., 2019).

Despite their advantages, there are many challenges and barriers to the implementation of green buildings. Ibrahim emphasizes that one of the major obstacles in introducing green buildings in the MENA region is ingraining the notion of sustainability in long-established traditional communities accustomed to a particular lifestyle (Ibrahim, 2017). Ahmed et al. conducted a study that identified various risks associated with the construction of sustainable projects. These risks can be categorized as inadequate green construction codes and regulations, limited information and understanding of new techniques, challenges in acquiring skills and expertise, and insufficient funding due to a lack of interest in the local market. These factors collectively contribute to a decreased investment in sustainable projects (Ahmed et al., 2021). Nonetheless, as the popularity of green buildings increased, numerous international sustainability assessment methods emerged over the years.

Measuring Sustainability: Green Building Rating Systems

Urban policies and urban sustainability indicator frameworks have been established to measure the sustainability of cities (Kim et al., 2023). These include green building rating systems (GBRS), energy performance systems, and life cycle assessments, amongst other tools. Currently, hundreds of GBRS are used internationally, differing due to the local geography, climate, and cultural aspects (Wen, et al., 2020). There is an abundance of research on the comparison of the strengths and limitations of these assessment systems. LEED certified buildings have shown positive influences on occupants, in exhibit environmentally responsible behaviors (Hill, et al., 2019). Dominant rating systems such as LEED suffer from major structural issues, which are the main cause of the low adoption rates of the system (Ade & Rehm, 2019). Simpeh et al.'s research outlined other challenges which effect the implementation of green buildings. These include up-front costs, green technology and material, certification, behavioral barriers, inadequate skilled professionals, and regulatory and steering factors (Simpeh et al., 2021). Other issues include 'LEED brain', where designers and owners are driven by scoring points instead of implementing sustainability, a static indication of building performance, a complicated energy modelling process, and a design process that is slowed down by bureaucracy (Yudelson, 2016).

Ade et al. believe that occupant behavior is eliminated from green building rating systems, which is a severe limitation and considered a major determinant of greenhouse gas emissions and an effective mechanism for change (Ade et al., 2020). Marchi et al. argue that the main issues of green building rating systems are a lack of focus on regionality and local languages, lack in considering social and economic issues, and the affordability and risk of greenwashing (Marchi et al., 2021). Arafat et al. also emphasize the importance of regionality through the design of indicators to serve goals in a local language achieve more effective results (Arafat et al., 2023). Despite the many limitations found in literature, the lack of occupant behavior consideration within GBRS is the most reoccurring limitation which should be addressed in future developments of these systems. Although there are 39 LEED certified buildings in Bahrain (USGBC, 2024) with most projects certified under LEED Building Design and Construction: New Construction (LEED BD+C), the planning authorities still do not have a rating system in place (Abdulrahim, et al., 2024). Environmental responsibility also plays a vital role in navigating the path towards achieving greater sustainability in building practices, which is further explored in the following section.

Environmental Responsibility

The human factor is the central element of any environmental management endeavor (Jabbour et al., 2019). Hence, the environmentally responsible behavior of occupants holds immense significance in achieving an organization's environmental management objectives (Ren et al., 2017). The effectiveness of an organization's green initiatives can be undermined if users lack clarity of purpose, possess inadequate knowledge, low morale, or if there is a misalignment between their personal and organizational environmental goals (Afsar, et al., 2019). The concept of environmental responsibility emphasizes the obligation of organizations to consider their impact on the natural environment (Sheehy, 2023). It is also used to explain and forecast environmentally responsible behaviors (Ding et al., 2018). To understand and modify behavior, to ultimately minimize the impact on the environment, various influential models are used in the realm of environmental psychology. Some of these include Fishbein and Ajzen's theory of reasoned action (TRA), theory of planned behavior (TPB), norm activation theory (NAT), and Kollmuss and Agyeman's model of pro-environmental behavior (Alalawi & Omar, 2024). Occupants' environmentally responsible behaviors play a pivotal role in the realization of corporate environmental objectives (Chaudhary, 2019). Creating a culture of sustainability that enhances occupant behavior towards the environment can help in reducing the buildings' environmental impact and mitigating climate change. Leadership, and performance measurement systems, and engaging in environmentally responsible behavior are important in creating a culture of sustainability in healthcare buildings and in establishing a solid reputation for sustainability (Berniak-Woźny & Rataj, 2023). A recent study highlighted that occupant behavior can be crucial in promoting energy saving in healthcare buildings, specifically related to lighting, as manual systems promote higher savings than automated ones (Silva, et al., 2023). The following section discusses the local perspective of sustainability initiatives in Bahrain.

Sustainability Initiatives in Bahrain

From a local perspective, Bahrain has many sustainable initiatives in place. These include the Government Plan, Green Building Code, Environmental Laws, National Vision 2030, and achieving net-zero emissions by 2060 (Alsabbagh & Alnaser, 2022). In late 2008, Bahrain launched its National Vision 2030 to lay out a clear trajectory for the country's economic progress, with a strong emphasis on sustainability, competitiveness, and fairness. Through initiatives such as robust economic growth, government investment, human capital development, fairness promotion, and the cultivation of a highly competitive market, Bahrain aims to make significant strides in achieving the majority of the SDGs. These goals represent the government's current focal areas and align closely with the executive actions outlined in the existing Government Plan, which encompasses comprehensive strategies for sustainability. These strategies include strengthening the foundations of the country and society, ensuring financial stability and economic growth, and creating an environment conducive to sustainable development. Bahrain is actively addressing climate change through the implementation of legislative frameworks and mitigation policies. The Environment Law No (7) of 2022, in alignment with SDG 13 (Climate Action), aims to protect the environment from harmful activities, combat pollution, and preserve natural resources.

Through the abovementioned comprehensive analysis of relevant literature, six key categories emerge as influential factors that can bolster environmental responsibility and drive sustainability within the healthcare industry, thereby shifting it towards a greener paradigm. These categories encompass the implementation of SDGs, green design, national sustainability initiatives, GBRS, occupant behavior, and management, as illustrated in Figure 2.

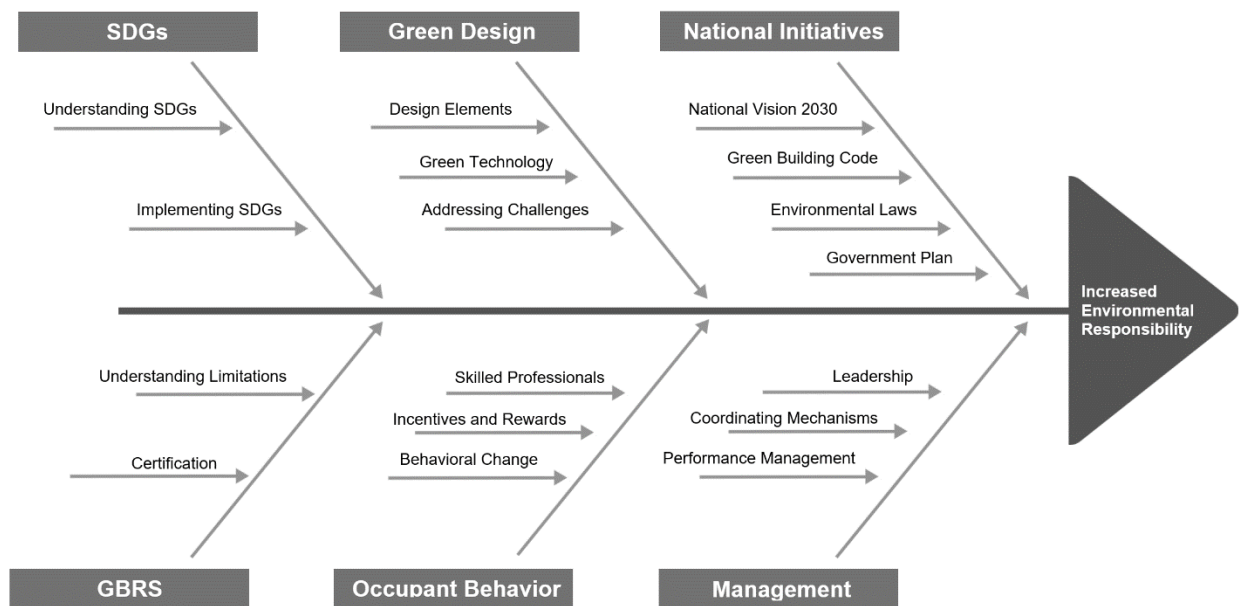


Figure 2. Factors that can enhance environmental responsibility and drive sustainability within the healthcare industry.

Following the broader discourse on sustainable urban development, sustainable design, and measuring sustainability, and the various sustainability initiatives in Bahrain, the subsequent section delves into the realm of sustainability within the context of healthcare buildings.

Defining Sustainability in Healthcare

Healthcare buildings, in particular, have a significant environmental footprint, primarily stemming from the consumption of energy and the generation of waste. For a healthcare system to be sustainable, it is crucial for it to harmonize with the local environment in which it operates. To safeguard the environment, hospitals and healthcare facilities need to adopt effective management and operational strategies for these resources. Given that hospitals are a notable contributor to pollution, the principles of green hospitals have emerged as a significant factor in hospital management. In an effort to address environmental concerns, numerous hospitals have endeavoured to adopt the concept of a "green hospital". A "green hospital" places significant importance on the environment as a fundamental aspect of delivering exceptional care. It encompasses attributes such as strategic positioning, efficient utilization of resources such as water, electricity, and air pollution, and the incorporation of high-quality materials. This approach enables increased productivity, maintains optimal indoor conditions, provides nutritious meals, and creates a natural setting. The eco-friendly hospital promotes environmentally conscious practices, non-toxic environments, green cleaning methods, waste reduction, and the inclusion of a therapeutic garden (Alkaabi et al., 2023). Kumari et al. outlines the elements of a green hospital as follows: located within close proximity to public transport, uses local materials, vegetation on site, daylighting, natural ventilation, alternative energy, water conservation, green roofs, and waste management strategies (Kumari & Kumar, 2020). Developing healthcare facilities in alignment with green standards yields several advantages, including expedited patient recovery, leading to shorter hospital stays (Danilov et al., 2020). Additionally, it helps mitigate the occurrence of sick building syndrome (SBS) among both patients and staff, while reducing stress levels among hospital personnel, thereby enhancing the quality of patient care and overall hospital performance. Furthermore, a green hospital enhances the delivery of medical services to patients by utilizing environmental resources efficiently, effectively, and sustainably (Garg & Dewan, 2022). Silva et al. present definitions of Sustainable Healthcare Buildings and Green Healthcare buildings, along with key strategies to achieve them, as illustrated in Figure 3. Occupant behavior is present in Sustainable Healthcare Buildings, emphasizing its importance in decreasing natural resources and minimizing environmental impact (Silva, et al., 2023).

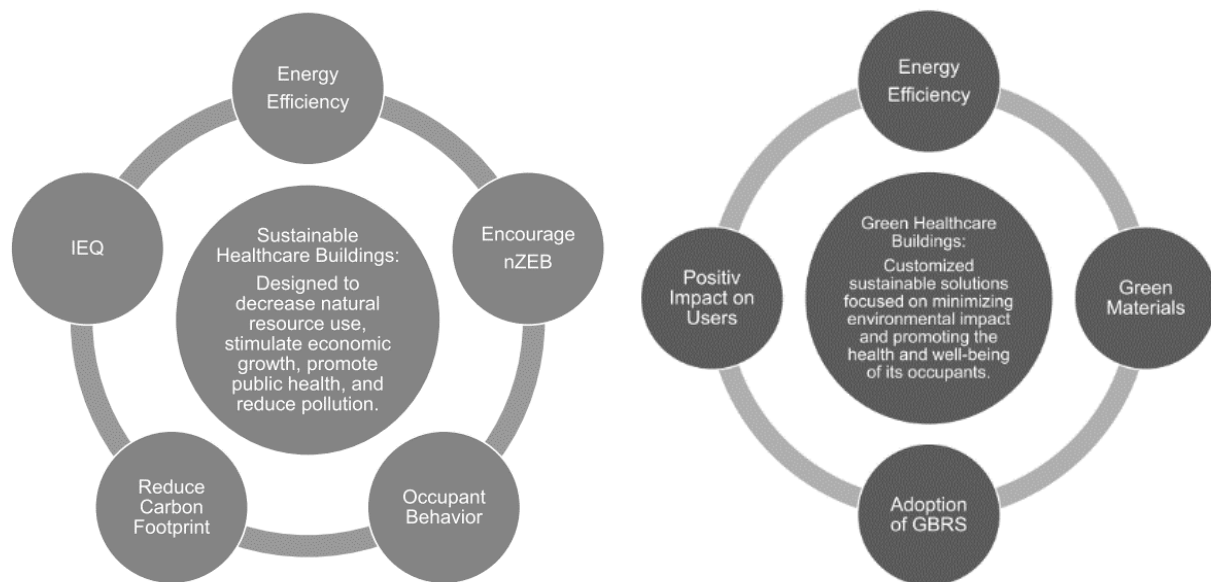


Figure 3. Left: Sustainable Healthcare Buildings definition and main strategies. Right: Green Healthcare Buildings definition and main strategies (Silva et al., 2023)

In his article "Shades of Green," Greg Roberts identifies a multitude of obstacles that impede the implementation of sustainable strategies in healthcare buildings, despite the inherent benefits they offer. He discusses how system redundancy, regulatory compliance, operational hours, infection control, and more frequent ventilation rates could be a challenge which stops the implementation of sustainable strategies. Additionally, intense energy and water usage, accreditation demands, increased waste, chemical use, and the life cycle of buildings make it hard to integrate effective green solutions (Roberts, 2011). In light of these challenges, architects remain steadfast in their commitment to implementing sustainable solutions, recognizing the pressing necessity of doing so in contemporary times. The following section discusses the significance of primary healthcare centers in the path to sustainability in Bahrain, setting the scene for this research.

Primary Healthcare Centers in Bahrain

Primary healthcare centers play a crucial role in enhancing well-being and preserving lives. However, their round-the-clock functioning has an ecological impact through substantial energy consumption and production of detrimental waste (Silva et al., 2023). Primary healthcare is the most inclusive, equitable, and affordable way towards achieving universal health coverage. As a fundamental human right, it ensures that every individual has the right to achieve the highest level of health (WHO, 2018). Primary healthcare is also a vital component of an efficient healthcare system (Saffer et al., 2021). Additionally, as an integral element of public services within the urban fabric of cities, it plays a role in constructing a 'people oriented city', reflecting and promoting sustainable development (Zhao et al., 2024). This makes primary healthcare centers a compelling building typology for this study.

In Bahrain, primary healthcare centers are the first point of contact for patients within the healthcare system, along with the emergency departments in hospitals (Abdulla et al., 2022). Currently, there are a total of 27 health centers distributed within four governorates, providing essential services including family medicine. The centers provide services for all residents, being free of charge for Bahraini citizens, and for a fee for uninsured expatriates (Alnasir, 2016). Figure 4 illustrates the location of the primary healthcare centers within the four governorates on the map of Bahrain.

The subsequent section delves into the methodology, which is split in two parts. The first explores policies and sustainable strategies through interviews, and the second assesses perception and awareness through a questionnaire, to cover all six categories with factors that can enhance environmental responsibility and promote sustainability within healthcare buildings.

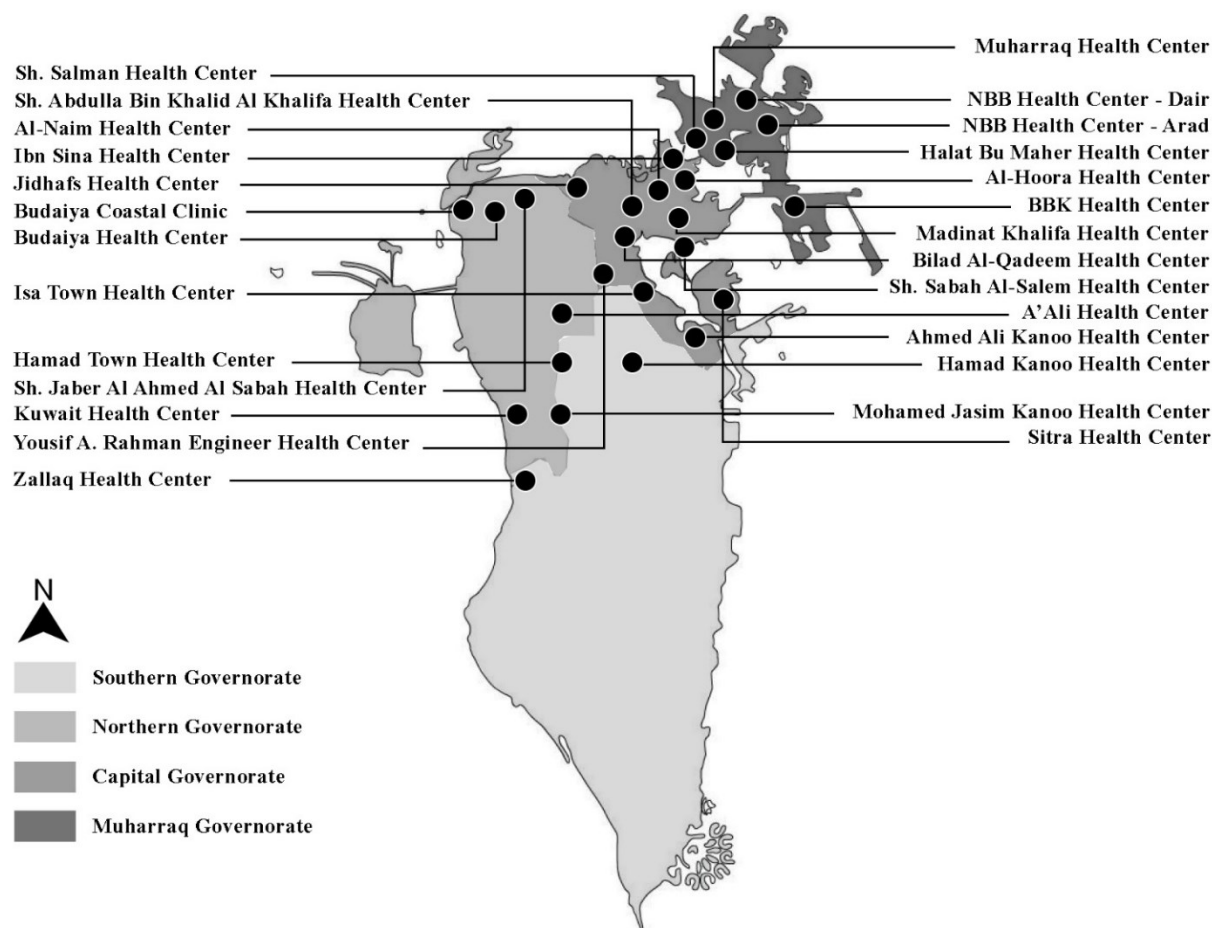


Figure 4. Location of the 27 primary healthcare centers in Bahrain.

Material and Methods

The mixed methodology of this research includes interviews and a questionnaire. The objective of the interviews is to understand the current state of primary healthcare centers and the extent to which sustainable initiatives are implemented, from a stakeholder's perspective; the Ministry of Health (MOH). The objective of the questionnaire is to assess the visitors' perception of comfort factors and awareness of sustainability initiatives at primary healthcare centers in Bahrain.

Interviews

To understand the current state of the primary healthcare centers, and the extent to which sustainable strategies have been implemented, interviews were conducted with three representatives from MOH. The participants included the Head of District Maintenance, the Executive Officer of the National Health Regulatory Authority, and the Chief of Environmental Health at the Public Health Directorate. A series of eight questions (see Table 1) were discussed.

Questionnaire

Following up from the interviews, a questionnaire was administered to assess perception and awareness, factors influencing comfort, and occupant behavior. A total of 173 participants of varying ages, with the minimum age of 18 years old participated in the study. The Google Forms platform was utilized to administer the questionnaire, ensuring participant anonymity throughout the survey process. The majority of participants (58%) identified as female, (38%) identified as male, and (3%) are unknown. Table 2 outlines the demographic characteristics in more detail.

Of the total participants, (23%) were between the ages of 18 and 35, (61%) were between the ages of 36 and 64, and (16%) aged 65 and above. The top four primary healthcare centers that the participants reported to be registered in were A'Ali Health Center (14%), Bilad Al-Qadeem Health Center (13%), Al-Naim Health Center (9%), and Isa Town Health Center (9%). There were eight primary health care centers that nobody selected, which are Halat Bu Maher Health Center, Ibn Sina Health Center, Madinat Khalifa Health Center, Muharraq Health Center, Sh. Abdulla Bin Khaled Al Khalifa Health Center, Sh. Salman Health Center, Sitra Health Center, and Zallaq Health Center.

Almost half of the participants (49%) reported rarely visiting their registered primary healthcare center, (44%) reported going once a month, (3%) were between frequently and regularly. (5%) of the data is unknown.

Table 1. Interviews Questions.

No	Questions
1	Can you tell us about any specific sustainable strategies that have been implemented at the primary healthcare centers to reduce energy usage, emissions, and waste?
2	Are there any renewable energy sources being utilized at primary healthcare centers? If so, what are they and what impact have they had on reducing energy consumption?
3	How do you ensure that staff members are educated and trained on sustainable practices and encouraged to incorporate them into their daily work routine?
4	Are there any water or energy meters installed at the primary healthcare centers to measure energy and water usage?

Table 2. Demographic characteristics of the sample.

Variable	Category	n	%
Gender	Male	72	42
	Female	101	58
Age Group	18-35	40	23
	36-55	54	31
	56-64	52	30
	65+	27	16
Registered Primary Healthcare Center	A'Ali Health Center	25	14
	Ahmed Ali Kanoo Health Center	4	2
	Al-Hoorah Health Center	4	2
	Al-Naim Health Center	16	9
	BBK Health Center	6	3
	Bilad Al-Qadeem Health Center	22	13
	Budaiya Coastal Clinic	2	1
	Budaiya Health Center	8	5
	Halat Bu Maher Health Center	0	0
	Hamad Kanoo Health Center	4	2
	Hamad Town Health Center	9	5
	Ibn Sina Health Center	0	0
	Isa Town Health Center	16	9
	Jidhafs Health Center	11	6
	Kuwait Health Center	4	2
	Madinat Khalifa Health Center	0	0
	Mohamed Jasim Kanoo Health Center	6	3
	Muharraq Health Center	0	0
	NBB Health Center – Dair	4	2
	NBB Health Center – Arad	6	4
Sh. Abdulla Bin Khalid Al Khalifa Health Center	0	0	
Sh. Sabah Al-Salem Health Center	4	2	
Sh. Salman Health Center	0	0	
Sh. Jaber Al Ahmed Al Sabah Health Center	7	4	
Sitra Health Center	0	0	

Results

Current State of Primary Healthcare Centers

Findings from the interviews confirm that the primary healthcare centers in Bahrain have already started implementing sustainable initiatives in line with the country's National Vision 2030, and UN's SDGs.

i. Terminologies

In Bahrain, three main terminologies are used to describe different types of public healthcare buildings. Firstly, hospitals are large institutions that offer round-the-clock patient treatment and have specialized medical equipment. They consume the most energy and generate the most waste compared to the other two types. Secondly, primary healthcare centers provide a range of services including treatment, prevention, and rehabilitation. All citizens and residents are registered with a health center in their residential area. These buildings are considered to have moderate energy usage, as stated by representatives from MOH. Lastly, primary healthcare centers are specialized laboratories that handle the collection of blood and other samples from patients based on requests from attending physicians. The health statistics and indicators differ in each one of these building types, and therefore the scope of this research is on primary healthcare centers.

ii. Sustainable Strategies

According to the interview data, none of the primary healthcare centers are certified under the GBRS, however the MOH has many sustainable strategies in place, some of which have already been implemented at certain hospitals and primary healthcare centers.

“Since 2012, all primary healthcare centers and hospitals in Bahrain have adopted energy-saving equipment and made a conscious choice to use environmentally friendly refrigerants like gas 402, instead of R12 and R22. Additionally, there are water and electricity meters installed in all of the healthcare buildings to monitor usage. There are two types depending on the size of the cable used, if it is less than 250ml, then it is located inside the electric room, and if it is more than 250ml, then it is located in the substation CT. Also, all primary healthcare centers use LED lighting to save energy. With regards to renewables, there is limited implementation, as only some hospitals use solar water heaters. Grey water recovery systems are also used in healthcare buildings that have therapy pools. In an initiative with the Electricity and Water Authority (EWA), water from the pools are stored in tanks and used for irrigation, which saves approximately 40 cubic meters of water per day. This initiative won a prize a while back.” Participant A.

Another participant also confirmed that all hospitals and primary healthcare centers in Bahrain use an integrated building management system (BMS) to monitor and control the HVAC systems within the buildings.

“We use the integrated building management system only for the HVAC because the air conditioning system within the buildings needs to be automatically turned on and off, depending on the time of day. We tried using it for the lights, however it proved to be not feasible, so it is not implemented everywhere.” Participant B.

Air quality is another element that is considered within the MOH plans, especially for the primary healthcare centers (laboratories).

“Currently, we have Biosafety Levels (BSL) 1, 2, and 3 implemented, however we are working towards applying BSL – 4 in the laboratories, which is the highest level of biosafety precautions.” Participant C.

iii. Environmental Education

Findings from the in-depth-interviews revealed that all engineers at MOH in Bahrain undergo extensive training in environmental education. They are also provided with scholarships to pursue higher education degrees at institutes in the United Kingdom. However, MOH representatives highlighted a gap in the awareness of the public and the staff working at healthcare centers. They emphasized that the effectiveness of the existing green initiatives relies heavily on the behavior and awareness of the occupants. In contrast to the National Health Service (NHS) in the UK, staff members in primary healthcare centers in Bahrain do not receive training in environmental education and lack the time and opportunities to actively participate in workplace green initiatives. This includes initiatives where they could be rewarded for energy-saving efforts or for consistently turning off lights.

The insightful information obtained from the in-depth interviews clearly indicates that the MOH in Bahrain is dedicated to implementing sustainable initiatives. However, there is a pressing need for heightened awareness among both the healthcare staff and visitors to healthcare buildings. Additionally, a shift in behavior towards more environmentally friendly practices and a culture of sustainability is necessary for the implemented strategies to truly achieve their intended effectiveness. Consequently, a questionnaire was developed to assess perception of sustainability and the awareness of users, which is discussed in the following section.

Assessing User Perception and Awareness

When the participants were asked to select a statement that best describes a green building, the answers varied. After excluding the blank responses, the top 3 responses demonstrate that a green building is a building that uses sustainable materials (40.0%), incorporates landscaping (33%), and uses energy-efficient lighting (17%). Interestingly, all answers highlight the characteristics of green buildings, however the question was designed to see which characteristic is prioritized the most through the public's perception. Figure 5 presents the responses by age group. The most recurring answer in the 18-35 category was a building that uses sustainable materials. However, a building with landscaping was the most recurring answer for the remaining 3 age groups (36-55, 56-64, and 65+).

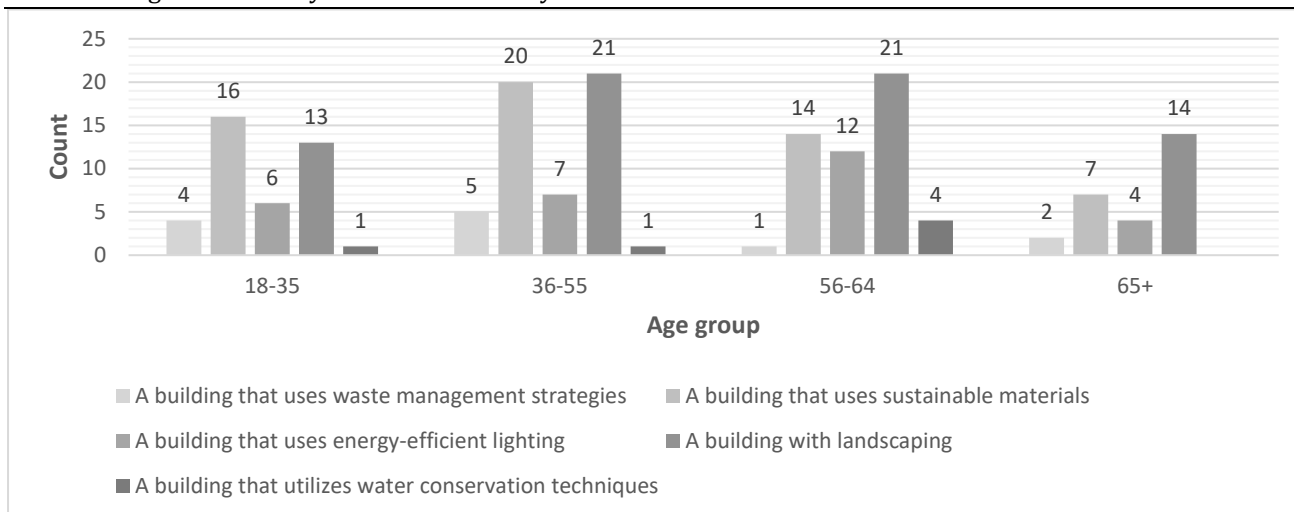


Figure 5. Participant responses on what statement best describes a green building, categorized by age group.

Additionally, the participants were asked whether they believe that green primary healthcare centers have the ability to positively impact patient well-being and recovery using a 5-point Likert scale, and the majority (61%) reported that they strongly believe that. The mean is 30, falling between points 4 and 5 on the scale, the median is 23, the mode is 4, and the standard deviation (SD) is 36.2. Figure 6 shows a histogram of the data with a negatively skewed distribution, with most participants agreeing that green public centers have a positive impact on well-being and recovery.

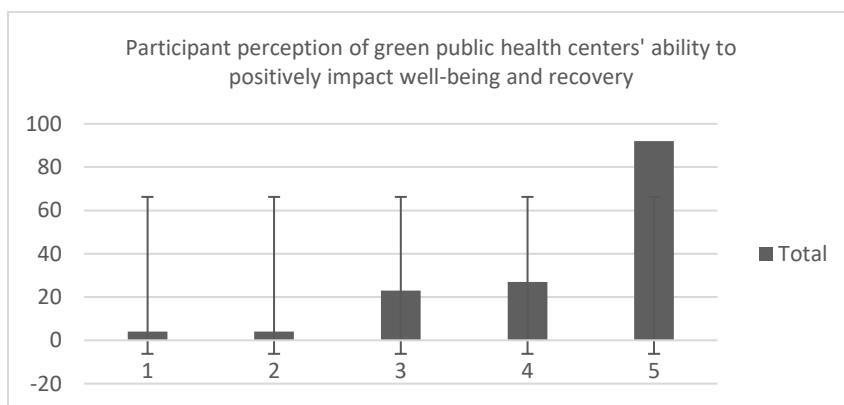


Figure 6. Histogram of participants, showing a distribution skewed to the left, with most participants agreeing that green public centers have a positive impact on well-being and recovery.

Surprisingly, approximately (6%) of the participants strongly disagreed with the notion that primary healthcare centers can enhance human well-being and recovery, while (15%) remained neutral. This indicates a significant portion of the population lack awareness regarding the benefits of green buildings, highlighting the need for additional awareness campaigns to educate and inform the public about these implications. When asked about the factors that contributed to their comfort at their designated healthcare centers, the study participants evenly distributed their responses across nine provided options. The top three choices were well-maintained cleanliness and hygiene (15%), well-designed and comfortable waiting areas (13%), and good indoor ventilation (12%). Conversely, access to a health-conscious café received the lowest number of votes, with only (6%) selecting it. Among those who chose the "other" option, several factors were mentioned as influencing their well-being. These included natural sounds, technology-based awareness programs, patient waiting time, parking availability, and the presence of helpful staff.

Regarding the suggestions to improve health services and encourage a culture of sustainability, almost one third of the participants (32%) selected the provision of educational materials on health and environmental topics, (24%) selecting accessible and informative signage, and (30%) suggested providing health lectures and workshops. Figure 7 outlines the factors and suggestions in more detail through cross tabulation, to analyze the relationship between the different variables.

	Accessible and informative signage	Implementation of recycling programs and waste reduction measures	Providing health lectures and workshops	Provision of educational materials on health and environmental topics	Other
Good indoor ventilation	19	16	18	32	9
Interior design using relaxing color schemes	19	17	21	28	8
Access to a healthy café	7	6	10	14	7
Natural views - green spaces and water features	19	14	17	30	8
Well-designed and comfortable waiting area	21	16	24	31	8
Adequate natural lighting	18	15	15	31	9
Noise reduction measures	14	17	14	13	6
Comfortable temperature	19	13	14	29	7
Well-maintained cleanliness and hygiene	21	22	24	39	10
Other	35	26	30	48	11

Figure 7. Cross tabulation table to analyze the relationship between the factors affecting comfort at primary healthcare centers, and the suggestions to improve health services and encourage sustainable development.

Providing educational materials on health and environmental topics emerges as the most significant correlation among the factors influencing comfort and well-being, in relation to suggestions for enhancing health services. (7%) of the sample voted for other and suggested various recommendations such as using innovative, tech-sustainable equipment, providing training courses for the staff to run the primary healthcare center more sustainably, and providing lectures to university and school students to raise awareness at an earlier stage in their education.

The available literature on green buildings emphasizes their environmental advantages, including increased energy efficiency, water conservation, and the use of environmentally friendly building materials (Holmgren et al., 2016) (Alkaabi et al., 2023). Despite the significant role of water conservation in defining green buildings, only a small number of participants (4%) actually selected it as a defining characteristic. Existing literature investigates various aspects of factors that influence the comfort experience in hospitals, such as communication and care, nursing and diet, and the physical environment. However, this study solely focuses on the physical environment, as it is an emerging and critical research area within the field of architecture. One aspect of the physical environment that significantly contributes to indoor thermal comfort in hospital visitors and patients is indoor air temperature and ventilation (Tian, 2023). The study findings substantiate this, with (22%) of the participants acknowledging the impact of these two factors on their well-being and comfort in primary healthcare centers. Nevertheless, a higher percentage of participants prioritize relaxing color schemes and well-maintained cleanliness and hygiene, which are in line with another study on patients' perceived quality in healthcare (Bellio & Buccoliero, 2021).

The initial findings of this study, as summarized in Table 3, shed light on visitors' perception of green buildings, and the factors affecting their wellbeing in primary healthcare centers and outlining potential strategies to help in enhancing well-being.

Table 3. Assessing user perception and awareness, factors enhancing comfort, and strategies to promote sustainability through occupant behavior.

No	Question	Possible Response	n	%
User Perception and Awareness				
1	Which of the following best describes a green building?	A building with landscaping	69	40
		A building that uses sustainable materials	57	33
		A building that uses energy-efficient lighting	29	17
		A building that utilizes water conservation techniques	6	3
		A building that uses waste management strategies	12	7
2	To what extent do you believe that green primary healthcare centers can positively impact patient well-being and recovery?	5-Strongly agree	99	57
		4-Agree	31	18
		3-Neutral	27	15
		2-Disagree	8	5
		1-Strongly disagree	8	5
Factors Enhancing Comfort				
3	Which of the following features enhance your comfort and well-being within the health center?	Indoor design using relaxing color schemes	99	57
		Natural views – green spaces and water features	94	54
		Well-maintained cleanliness and hygiene	123	71
		Access to a healthy cafe	46	27
		Good indoor ventilation	100	58
		Adequate natural lighting	95	55
		Comfortable temperature	86	50
		Noise reduction measures	68	39
		Well-designed and comfortable waiting areas	107	62
Other	14	8		
Strategies to promote sustainability through occupant behavior				
4	How do you think health centers should encourage sustainable development to improve health services?	Health lectures and workshops	35	20
		Educational materials on health and environment	52	30
		Accessible and informative signage	40	23
		Implementation of recycling and waste measures	30	17
		Other	16	10

The outcomes of this study are crucial for establishing a theoretical framework for implementing greener practices in primary healthcare centers in Bahrain. Considering the preferences and feelings of the population, the survey provides valuable insights into their wishes and perceptions about green buildings. This study enriches the existing literature by uncovering the factors that affect the comfort of individuals within the specific context of primary healthcare centers in Bahrain. The findings underline the widespread awareness of green buildings and the willingness to participate in environmental programs and initiatives aimed at promoting sustainability. In addition, results emphasize the importance of early integration of sustainable education into national education programs.

To determine the associations between gender, age, and frequency of the visits to the primary healthcare centers and their effects on the perception of green buildings, their ability to impact wellbeing, and the factors that promote sustainability, data analysis was conducted using the Statistical Package from Excel 2016 (Microsoft

Corporation). A linear regression analysis was conducted with a 95% confidence interval, and the results of the value inflation factors show no evidence of multicollinearity in the data. The results show that neither gender nor age are statistically significant or have an impact on the perception of green buildings and their ability to impact well-being. However, the frequency of the visit is statistically significant and positively influences the perception of green buildings and their ability to impact well-being. Table 4 presents the data.

Table 4. Linear Regression Analysis of dataset.

		Coefficient	Std. Error	p Value
Perception of Green Buildings	Gender	2.124	1.158	0.757
	Age	2.264	1.155	0.295
	Frequency of Visit	2.424	1.144	0.041
Green Building's ability to impact well-being	Gender	4.287	1.178	0.550
	Age	4.116	1.180	0.937
	Frequency of Visit	4.693	1.149	0.003
Perception of factors that promote sustainability	Gender	2.973	1.098	0.141
	Age	3.134	1.083	0.009
	Frequency of Visit	2.560	1.104	0.743

A Framework for Environmental Responsibility

Based on the findings from the literature review, in-depth-interviews, and questionnaire, a framework for environmental responsibility is developed to promote sustainability within primary healthcare centers in Bahrain (see Figure 8). The framework is built upon the fundamental principles of sustainability, with economic, environmental, and community considerations serving as its cornerstones.

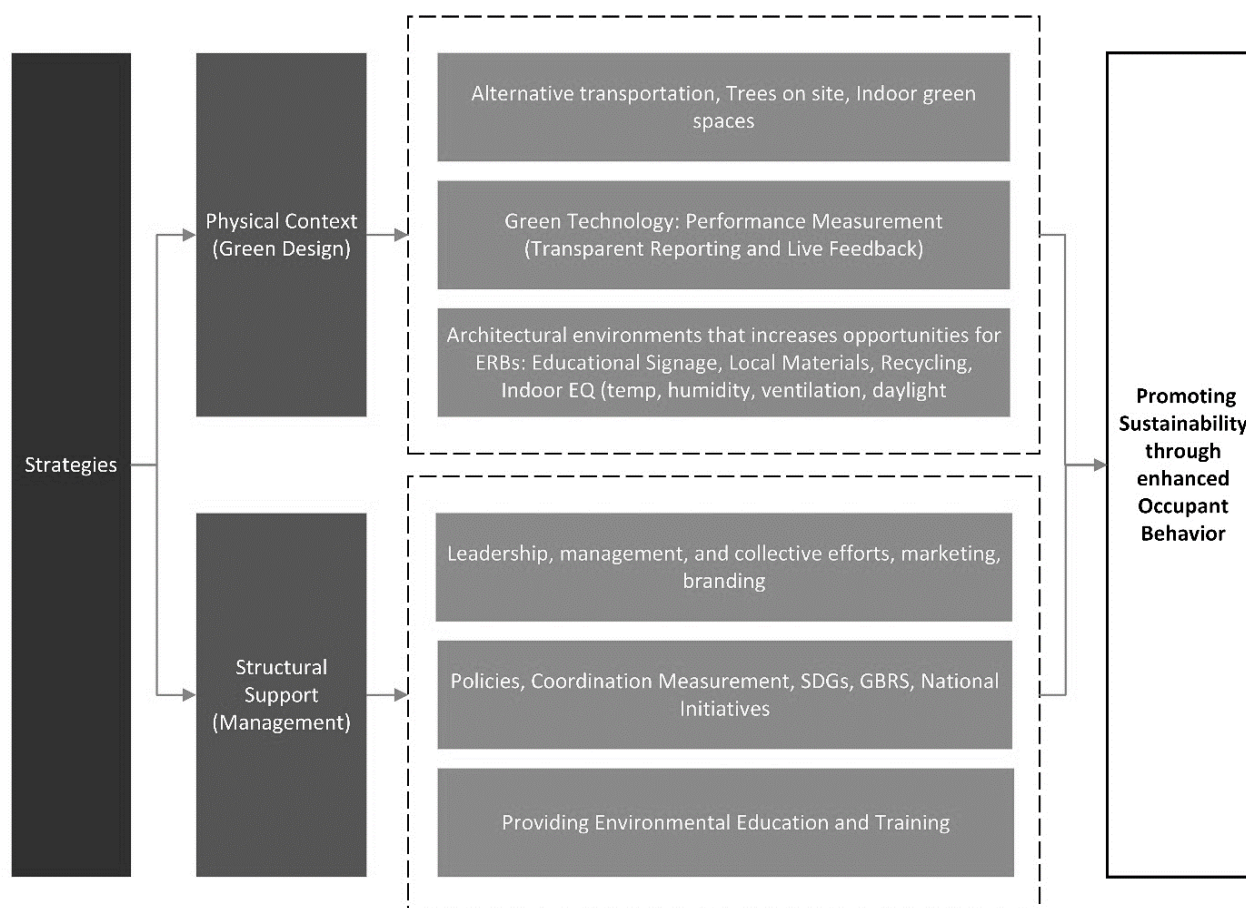


Figure 8. Proposed Framework for Environmental Responsibility to promote sustainability in Bahrain's Primary Healthcare Centers, through economic, environmental, and community considerations.

The strategies are categorized into physical context strategies, and structural support. Regarding the physical context which considers green architectural design, primary healthcare centers should be located within close proximity to alternative transportation systems and include trees or vegetation on site and biophilic elements indoors. Additionally, the buildings should utilize green technologies such as performance management systems like transparent reporting, live feedback, sensors, and smart technologies, so that users and staff can monitor energy usage. Fostering an architectural physical environment that increases opportunities for environmentally responsible behavior, such as providing multiple light switch options to reduce electric consumption and multi-sort recycling bins. Moreover, educational signage, the use of local materials, and a focus on indoor environmental quality such as temperature, humidity, and natural ventilation. As for the structural support strategies, greening existing buildings requires collective efforts and leadership. Coordination measurement such as mutual adjustment, direct supervision, and having a clear sustainability vision with defined goals, and providing environmental education and training is of utmost importance. Stakeholders need to put in the efforts to get the centers certified, marketed, and branded, and in line with the national and international green policies and initiatives. The aforementioned strategies will contribute to improving occupant behavior through environmental responsibility, leading to the promotion of sustainability and ultimately resulting in greener primary healthcare centers.

Conclusion

This study provides initial insights on the sustainability of primary healthcare centers in Bahrain, proposing a framework aimed at greening primary healthcare centers in Bahrain. The results underscore the importance of different strategies related to the physical context, and structural support, to improve occupant behavior, promote sustainability through environmental responsibility. The findings highlight the general acceptance of green buildings and awareness of their ability to positively impact well-being and recovery within the community. Facilitating educational materials on health and environmental topics, in addition to accessible and informative signage, providing workshops and lectures on health and well-being, and the implementation of recycling programs

is essential in enhancing environmental awareness and occupant behavior, which fosters a culture of sustainability, leading to greener primary healthcare centers.

The administered questionnaire and interviews effectively provided preliminary insights into the perception of green buildings and sustainability, factors influencing comfort in primary healthcare centers, and suggested strategies for promoting sustainability. The findings highlight the presence of well-defined sustainability strategies by stakeholders, and emphasize the significance of environmental education and responsibility, occupant behavior, and technology in greening primary healthcare centers. A primary limitation of this study pertains to the sample. Convenience sampling, particularly with a small sample size, may not fully represent the entire population. The current sample was obtained online, with participants registered in different primary healthcare centers. To establish more specific patterns and trends, it is advisable to physically collect data from specific primary health care centers or significantly increase the sample size to ensure a comprehensive representation of Bahrain's entire population. Future research should employ more rigorous sample selection criteria with a larger and more diverse sample size. It is recommended to study a number of primary healthcare centers in detail to enhance the generalizability of the findings. Furthermore, in future research, it would be valuable to gather empirical data on energy usage across various primary healthcare centers in Bahrain to see current data on what strategies are being implemented. This data would help identify specific centers that require more attention and intervention.

Nevertheless, considering the limitations inherent in the present study, further investigation is required. Future research could consider expanding the sample population size in order to investigate a broader range of factors and strategies that could promote environmentally responsible behavior. It would be particularly valuable to include healthcare staff from primary healthcare centers, they occupy the building the most, and occupant behavior plays a crucial role in the sustainability and greening efforts of the building (Leung, 2018). Occupants' characteristics can affect the energy use of a building around 4% (Santin et al., 2009). It is also important for stakeholders to acknowledge that sustainable buildings require substantial investments, as they are long-term projects (Yilmaz, 2021). In conclusion, the findings offer valuable insights to stakeholders, especially the MOH, providing them with a roadmap for promoting sustainability in other building types that share similar socio-cultural and environmental contexts.

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Conflict of Interests

The author declares no conflict of interest.

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