

Environmental Sustainability Practices in Hospitals of Punjab

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Abstract:

This study aimed to identify environmental sustainability indicators in hospitals across Punjab, India, and evaluate hospital performance based on these indicators. The sustainability index was adapted from Smercenik and Anderson (2011), assessing hospitals across six dimensions: Sustainable Management, Hospital Pollution Management, Environmental Communication, Resource Conservation, Energy Conservation, and Patient Room Sustainability. The sample included 230 medical practitioners and administrative staff from 76 private and government hospitals in Punjab. Data analysis was conducted using SPSS 24, employing descriptive statistics and bar graphs to evaluate the implementation of sustainability practices. The findings revealed that the overall implementation of these practices was below average. The highest levels of implementation were observed in 'Resource Conservation,' followed by 'Managing Hospital Pollution,' 'Patient Room Sustainability,' and 'Energy Conservation.' Conversely, 'Sustainable Management,' 'Environmental Communication,' and 'Water Recycling' were the least implemented practices. By exploring the extent and nature of eco-friendly practices in a resource-constrained region, this study contributes to the limited understanding of environmental sustainability in developing cities, offering valuable insights into current trends within the healthcare sector and the state of hospital sustainability.

Keywords: Environmental Sustainability Sustainable Management Resource Conservation Healthcare India.

Introduction

The concept of 'sustainability' gained popularity and attention in the 1980s when United Nations Commission on Environment and Development (UNCED) in its report 'Our Common Future' linked sustainability with 'Sustainable Development' (Wolf and Mujtaba, 2011). The Brundtland Commission, which framed the report, defined sustainable development as "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (p. 43). Since then, sustainability and sustainable development have been used interchangeably. Again, in 1992 Rio de Janeiro conference titled 'The Earth Summit' propagated subsequent recommendations through Agenda 21. It provided a roadmap for the proliferation of sustainable activities across the range of human activities on the planet (Wolf and Mujtaba, 2011). The foundation of sustainable development is based on the three pillars of sustainability: social sustainability, economic sustainability and environmental sustainability. Thus, sustainability could be seen as the interrelationship of nature and society as to how social paradigm shapes the environment and how

environmental change shapes the society (Clark and Dickson, 2003). Since the businesses directly involve economy, society, and environment and the environment is a place where the triple bottom line interplays, it is very crucial to get a feasible solution for the equation (Jabbour and Santos, 2008). As a result, the business community started exhibiting heightened interest in the area (Jackson and Seo, 2010) and followingly, the issue of environmental sustainability garnered the attention of academic researchers (Jackson and Seo, 2010). Further, many agencies had been set up in India and throughout the world to assess the impact of environmental degradation and search the solutions for sustainable ecology. The issue of present settings is that of what, which and how policies will govern and promote the sustainability transitions (OECD, 2011; UNEP, 2011). With the increase in demand for environmentally friendly products and services, the manufacturing organizations started adopting cleaner production and environmental management practices to boost environmental sustainability (Daily et al., 2012). Further, organizations gained confidence and invested their competencies in green product innovation (Dangelico and Pujari, 2010). Greenbiz (2009) noted that 1570 products claimed to be 'sustainable', 'green products' or 'environment friendly'. Services industries also could not remain aloof from the sustainable movement (Wolf and Mujtaba, 2011). These industries had to modify their operations to ensure that their business functions are environmentally sustainable and customer needs for more environmentally friendly services are met (Wolf and Mujtaba, 2011). The Healthcare industry is not an exception. Throughout the world health care services are encountering identical problems (Mitleton-Kelly, 2011). The demand for eco-friendly services has increased from all the stakeholders of the hospitals. When it comes to environmental sustainability, every aspect of hospital operations needs close and thorough scrutiny (Topf, 2005). Hospitals are diseased with the phenomenon of overconsumption of resources (Topf, 2005). The routine increase in the use of chemicals, disinfectants, bleach and detergents at the laundry, kitchen and housekeeping departments of hospitals has been found to contribute greatly toward environmental degradation (Sattler, 2002). Patient linens are changed every single day for every new patient due to the threat of infection and kitchen waste is increasing continuously with the growth in the number of patient admissions (Topf, 2005). Hospitals deploy sophisticated utilities whose environment-friendly management is critically needed. To be more precise, it has been observed that hospitals are highly energy exhaustive, and consume a substantial amount of resources (Pencheon, 2009). They also produce a large amount of waste. For example, in a developed country like Australia, the carbon emissions from the hospital were recorded to be 44% when compared to other ancillaries of the healthcare industries (Australian Medical Association, 2019). In addition to carbon emissions, water usage, waste production, radioactive and ultrasonic waves are the other contributors to degradation of the quality of natural environment (Karliner and Guenther, 2011). Sustainability has emerged as a serious challenge to be addressed in such situations. In response to the ecological calls, administrative departments of the hospitals are looking for more environment-friendly solutions to ensure long term economic growth. Despite the importance of sustainability in this sector, healthcare industry lacks clarity on the sustainable organization and faces a research crunch on sustainability aspects, (Rodriguez et al., 2020). Sherman et al. (2020) asserted that awareness about the deleterious effects of healthcare activities is low among the clinical community and the realization of the responsibility to address the problem is only beginning to gain momentum. They emphasized upon the need for a comprehensive approach to research on healthcare environmental emissions and development of performance metrics to guide and

gauge progress. Further, Naylor and Appleby (2012) underscored that achieving environmental sustainability in healthcare would require framing standard metrics, models to estimate the impacts of different options, integrating environmental sustainability with wider health research, assessment of barriers to change and benefits of a sustainable approach, and coordinating research efforts across the nations. A review of literature suggests that majority of the studies on environmental sustainability have come from manufacturing sectors in developed western nations. Little knowledge is available on environmental sustainability practices in healthcare facilities in a developing country like India.

In India, hospitals are performing well enough to sustain their businesses but are still lagging on the environmental front.¹ Their modus operandi has caused a serious environmental breakdown. However, the scenario is changing and specifically in developing countries the consciousness for environmental sustainability has escalated with time. Organizations are focusing more and more on eco innovations which could be disseminated at workplaces to meet the demands of customers for eco-products and services. In India, healthcare industry is facing some serious challenges in dealing with the situation.

The Indian healthcare industry is currently valued at US\$70 billion and is projected to reach US\$ 280 billion by 2020.² It plays a leading role in Indian economy and hence, its involvement is critical to achieving sustainability goals. However, how sustainability framework is applied in healthcare sector is not clearly understood. Achieving sustainability in healthcare becomes even more important given the complexity of operational and infrastructural systems. According to a report by UK National Health Service, the activities involved in healthcare facilities accounted for the highest share in the use of electricity (energy), revenues and resources.² Hospitals have been reported to consume a wide range of natural resources such as oil, water, food and minerals, and cause environmental depletion (McGain and Naylor, 2014). Treatment and care services of healthcare sector consume a vast amount of resources, from construction and land acquisitions for huge complexes, day to day operations, running heavy technological and radiological equipments that generate microwaves and radiological wastes are causing health degradation not just to community but also employees working there. It has been reported that India generates about 550.9 tonnes of medical wastes per day and by 2022 it is expected to reach 775.5 tonnes daily (ASSOCHAM & Velocity joint report).³ Ecoefficiency, which is the core ideology behind sustainability (Smerecnik and Andersen, 2011), can best be practiced by decreasing environmental impact, eliminating waste and reducing inputs (McDonough and Braungart, 2002). This clearly suggests the need for change in current processes, practices and operations in all the sectors of the economy including the healthcare. Implementation and conceptualization of sustainable solutions in resource-scarce states such as Punjab is even more complicated. In a scenario where patient care is compromised due to the scarcity of resources it would be hard to imagine the environment sustainability procedures. The absence of any specialized agency for ensuring ecological safety and quality-driven healthcare system makes the condition even more deteriorating. In such a case it is very crucial for the hospitals in Punjab to maintain a balance between patient care and environmental sustainability. A resource stagnant and deficient state of Punjab is still in its nascent stage in reducing the negative impacts of hospital pollution. However, no study so far has come up with the sustainability dimensions on which the overall environmental performance of the organization could be assessed (Salmones et al., 2005). There are studies that have attempted to unearth such practices in different sectors such as tourism (Tiwari and Thakur, 2020), telecom, teaching and banking (Kapoor et al., 2013;

Wani and Ali, 2015), but, empirical evidence on status of environmental sustainability performance of hospitals is scarce. A limited number of studies have discussed about sustainability practices in hospitals internationally (Dhillon and Kaur, 2015, McGain and Naylor, 2014, Langstaff and Brzozowski, 2017) whereas in Indian settings no systematic empirical investigation is traceable. The inadequate status of healthcare services in Punjab is a matter of concern as climate change and its impact poses a potential threat that can disrupt the development plans in the health sector of the state (Punjab State Action Plan on Climate Change, 2015). Moreover, healthcare professionals in the state of Punjab lack information and training on international negotiations on climate treaties especially Paris Agreement (Health Energy Initiative, 2020). Further, these professionals are not aware of the national and state action plans on combating environmental change. They do not have access to simple guidelines and easy to use tools to minimize the ecological impact (Health Energy Initiative, 2020).

Against this backdrop, the objective of the present study is to investigate the status of implementation of environmental sustainability practices in the public and private hospitals in the state of Punjab. Reducing the ecological repercussions of clinical-care activities demands innovation beyond the ascertainment of environmentally preferable alternatives (Sherman et al., 2020). Organizations introduce sustainability innovations to implement new environmental policies, practices and products regardless of various motivations (Bansal and Roth, 2000; Smerecnik and Andersen, 2011). Therefore, an effort will be made to understand the extent of adoption of eco-innovations in hospitals and if these innovations are important to hospital administration and staff. More specifically, it attempts to assess the performance of hospitals on various environmental sustainability dimensions identified through the literature. The authors try to investigate the condition of ecological sustainability through the lens of healthcare infrastructures and facilities. Climate change is not only limited to speculations but has become a bitter reality with a detrimental effect on community health. Clinical activities of the hospitals have become the major drivers of resource consumption and waste generation in medical services. Healthcare services delivery requires an overall rethinking and overhauling (Zimmerman et al., 2020). The outcomes of this research will identify the problem areas that are increasing health sector's carbon footprint such as unsustainable operations, inefficient handling of resources etc. Enhanced sustainability performance requires extensive remodelling of organizations, supply chains, and communities which can only be accomplished through learning and innovation (Silvestre and T, 2019). The study draws constructs from novel and innovative sustainability practices executed in developed nations to mitigate climate change and preserve natural resources, and endeavours to examine the degree of implementation of these practices in hospitals of an under developed state of a developing country. It will provide important insights on current trends in the healthcare industry and paint a picture of environmental sustainability innovations in hospitals. Knowing the status of adoption of sustainability innovations will help us identify the ways in which healthcare sector is responding to climate change.

1. Review of literature

1.1. Environment sustainability in hospitals in an evidence-based review, McGain and Naylor (2014) noted that healthcare activities involve the greatest apportion of revenues, energy, and resource exhaustion. They studied hospital sustainability under several themes such as hospital infrastructure, power usage patterns, transportation, procurement, waste management systems and behavior of

employees. Marimuthu and Paulose (2016) outlined environmentally efficient practices in hospitals such as sustainable designs and environment-friendly facilities for low energy and resource consumptions to maintain ecological balances. Further, an environmental communication program has been asserted to reduce environmental impacts and help in sustainable positioning of the hospitals (Langstaff and Brzozowski, 2017). In addition, it has been reported that energy conservation and waste reduction can be an added advantage for the environment and triple bottom line (Langstaff and Brzozowski, 2017). Ramirez et al. (2013) noted that proper attention must be devoted to all the dimensions of environmental sustainability to make a sustainable organization. Blass et al. (2017) opined that the available frameworks to assess the environmental sustainability are insufficient and underlined the need for a more reliable and robust framework. They suggested that environmental dimensions such as materials, energy, water, biodiversity, emissions, effluents and waste, transport, supplier environmental assessment, and environmental grievance mechanisms etc. are crucial for evaluating environmental status of hospitals. Sherman et al. (2020) argued that minimizing environmental impact would require innovation beyond optimizing resource and waste management. In this direction, Smerecnik and Andersen (2011) highlighted that new tools and techniques of ecological sustainability evolved through innovation have helped organizations achieve improved social, economic and environmental performance. A review of papers as shown in Table 1 offers an understanding of existing environmental sustainability practices in the healthcare sector across the developed and developing nations. A review of past research highlights the crucial need for exploration of the innovative sustainability practices to advance the environmental sustainability agenda. The sustainability index proposed by Smerecnik and Andersen (2011) is an exhaustive measure that has been extensively used to assess environmental sustainability performance in the hospitality sector (Tiwari and Thakur, 2020, Horng et al., 2017). The index covers all the major aspects of environmental sustainability which can be effectively adapted in the healthcare sector. Drawing from Smerecnik and Andersen (2011), the present study conceptualizes environmental sustainability in hospitals in terms of “sustainable management”, “environmental communication”, “managing hospital pollution”, “resource conservation”, “water recycling”, “energy conservation”, and “patient room sustainability” (Fig. 1).

1.2. Sustainable management Environmental management in this era has become a proliferating buzzword for the industries and its policy architects (Deng-Westphal et al., 2015). The most significant ecological practice in an organizational setting is the adoption of a sustainable management plan underpinned by the environmental conservation strategy (Smerecnik and Andersen, 2011). To become more sustainable, industries need to perform their activities in a more environmentally friendly way from backward to forward integration at all levels of the value chain (Jørgensen, 2008). The implementation of sustainability parameters in hospital settings ameliorates the quality and revenues of the institute (Tudor, 2007). Looking at the bigger picture, sustainable management practices aim to conserve the resources of the environment and reduce the expenditure to ascertain financial sustainability (Kinney, 2010). The systems related to sustainable management form the foundation of transitions towards sustainability. Sustainable management practices try to ensure that there is a proper balance between the constituents of the triple bottom line (Jørgensen, 2008).

1.3. Environmental communication: The top-down model of communication presumes that there is

a knowledge deficiency among the general public about the environmental issues and it needs to be communicated to them through expert knowledge (Irwin, 1995). It is expected that public apathy and isolation from the democratic institution can be vanquished if proper messages are communicated (Burgess et al., 1998). Environmental sustainability could be best administered when it involves requisite environmental communication (e.g. educating attendants or patients about environmental issues) (Salmones et al., 2005). It helps in catalyzing the effects of environmental training to secure the desired environmental outcomes (Smerecnik and Andersen, 2011). It also involves advertising environmentally friendly practices through public messages (Smerecnik and Andersen, 2011). A cross-cultural comparison of environmental solutions would provide decision-makers an opportunity to investigate the messages communicated about sustainability (Burgess et al., 1998). It provides the most suitable way to propagate the right message to the stakeholders (Burgess et al., 1998).

1.4. Managing hospital pollution: Hospitals tend to generate catastrophic pollution from their daily modus operandi (Saad, 2003). The drivers of this segment of pollutions are used surgical instruments, medical procedures, human anatomical wastes, etc. (Saad, 2003). In India, most of the healthcare facilities lack an effective system for safe management of hospital wastes (Dhillon and Kaur, 2015). There is a serious need for commitment of management towards sustainability. The hospital staff should also be ready to extend the support for managing the pollution (Saad, 2003). To manage pollution and reduce environmental impact, hospitals must design interventions which could be evaluated routinely (Pencheon, 2009). Managing hospital pollution due to the medical wastes requires inputs from the administration and active engagement of trained staff in segregating and disposing the wastes (Patil and Shekdar, 2001). A dedicated person must be appointed and provided with the authority to monitor the conservation of resources, segmentation, and disposal of hazardous wastes, and make environmental impact assessment report accordingly (Saad, 2003). Further, it has been outlined that an environmental checklist must be framed to provide training to the ecological group members and induce them to accomplish and maintain the standards of sanitation and hygiene in hospital premises (Saad, 2003). Healthcare facilities must minimize the pollution and emissions by cleaning the effluents from chemicals and properly disposing the wastes so that local biodiversity could not get contaminated from pathogenic elements and if so, then their maintenance could be ensured (Dhillon and Kaur, 2015).

1.5. Resource conservation Organizations must emphasize on collecting and segregating the hazardous and recyclable wastes (Smerecnik and Andersen, 2011). This would help to collect all the items which could be recycled and reused. Purchasing of less hazardous materials would be an added advantage for sustainability (Smerecnik and Andersen, 2011). A huge amount of waste gets generated in the kitchens of hospitals (Daschner and Dettenkofer, 1997). These food wastes could be recovered and composed to get organic fertilizers for the plants and trees (Smerecnik and Andersen, 2011). Organizations must also possess the idea about the firms that are involved in recycling procedures (Smerecnik and Andersen, 2011). Another point to be noted in the context of hospitals is that several returned medicines could be reused and as per research one-third of it is suitable and safe (Mackridge and Marriott, 2007). Healthcare manufacturers and service providers are also engaged in practices such as Healthcare Without Harm (HCWH) to reduce the impact of packaging and waste (Messelbeck and Sutherland, 2000). These methods help in reducing the environmental impact (Smerecnik and

Andersen, 2011). Procurement of life-saving drugs machinery and other equipments must be done from local markets as it would help to reduce cost and carbon footprint via reduced usage of transportation during the purchase process (Smerecnik and Andersen, 2011). Producers and retailers must be encouraged by hospitals to use environmentally friendly and recycled materials in manufacturing (Daschner and Dettenkofer, 1997) as it will reduce the consumption of energy and other resources in manufacturing and distribution of products.

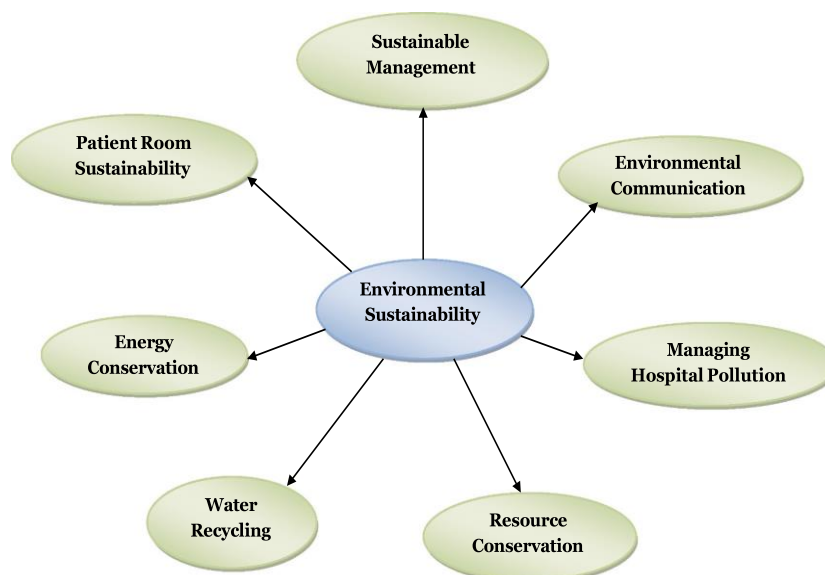


Fig 1 Source: Sustainability framework

2.6 Water recycling

Healthcare facilities use a considerable amount of water (Dhillon and Kaur, 2015; Department of Health, Victoria, Australia, 2011). In hospitals, water is used for sanitation and sterilization which contributes to 20-40% of total water usage (Department of Health, Victoria, Australia, 2011). Kalaiselvi et al. (2016) noted that proper monitoring and regulation of water conservation systems must be ensured in water scarce areas. There must be presence of water recycling and saving techniques (McGain and Naylor, 2014). About 10–25% of water can be saved by auditing the usage of water and installing water meters and check valves (McGain and Naylor, 2014). Hospitals should boost the installation of rainwater catch-pits to increase their water storage capacity. Dhillon and Kaur (2015) argued that conserving rainwater could help hospitals use it for non-drinking purposes. Treated hospital waste water can be used for gardening and sanitary purposes Kalaiselvi et al. (2016), which can indirectly increase the surface water levels (Verlicchi et al., 2010). Through an experiment in Indian hospital, (Kalaiselvi et al., 2016) noted that critical evaluation of water recycling procedures at every stage is essential for ensuring the quality of water to mitigate the risk of contamination.

2.7 Patient room sustainability

Energy saver control systems are now installed at many hospitals to reduce energy usage and carbon footprints (Daschner and Dettenkofer, 1997). The rooms are now being designed, keeping in mind the environmental sustainability aspects (AMA, 2019). Efforts are being made to develop healthcare

infrastructure (specifically rooms) in an environmentally sustainable way (AMA, 2019). Building designs are promoting connection between nature and mankind thereby reducing environmental impact (AMA, 2019). Single patient rooms have low infection rates but the initial cost of construction is high (Verderber, 2010). Replacing the old windows with efficient ones and heatproof glasses would reduce the carbon footprints, electricity consumption, and operating costs of hospitals (Daschner and Dettenkofer, 1997). In patient rooms, automatic taps/ geysers/ and lights must be used to reduce the consumption of resources when not in use and hence foster environmental sustainability (Daschner and Dettenkofer, 1997; McGain and Naylor, 2014).

METHODOLOGY

Achieving the desired sustainable outcomes in healthcare settings is challenging due to the complexity of both operational and infrastructural systems. This study focuses on the environmental aspect of sustainability by evaluating the preparedness of hospitals in Punjab, India, to address environmental degradation. The "Environmental Sustainability Index" was applied to both government and private hospitals in Punjab. The study included hospitals with at least 50 beds, with some facilities having more than 1500 beds. The research was conducted in the following phases:

1. Extensive literature reviews were conducted to understand environmental sustainability in healthcare settings.
2. Secondary sources were used to identify and select hospitals based on the state's hospital hierarchy (as shown in Fig. 2). Preliminary data on the environmental sustainability goals of these hospitals were also gathered.
3. A comparison was made between the current practices in the state and academic research on environmental sustainability, using the preliminary data collected.
4. The status of hospitals' involvement in sustainability practices was analyzed using a self-administered "Sustainability Index." This phase involved frequent hospital visits and the distribution of a questionnaire to assess the extent of eco-sustainability practices implemented.
5. Informal discussions were held with hospital staff to gain insights into the challenges faced in implementing sustainability practices and the steps taken to address them (if any), providing a deeper understanding of the on-the-ground situation.
6. The collected responses were analyzed using descriptive statistics.

PARTICIPANTS AND PROCEDURES

The sample included medical practitioners and administrative staff from both private and government hospitals in Punjab, India. Punjab is divided into 9 administrative divisions and 38 districts. Responses were collected from all divisions, specifically focusing on the divisional headquarters. In total, 22 districts were selected from these 9 divisions. A total of 162 hospitals were visited, of which 76 responded positively and were included in the study. Primary and community health centers were excluded due to their limited capacity and poor infrastructure. A total of 456 questionnaires were distributed to hospital employees through personal visits, and 250 responses were returned. After discarding 16 incomplete questionnaires, 234 usable responses remained. The respondents included

administrative staff, nursing superintendents, and housekeeping staff, who are responsible for developing and implementing environmental policies. On average, 3.08 responses were received from each hospital. The detailed demographic characteristics of the respondents are presented in Table 1.

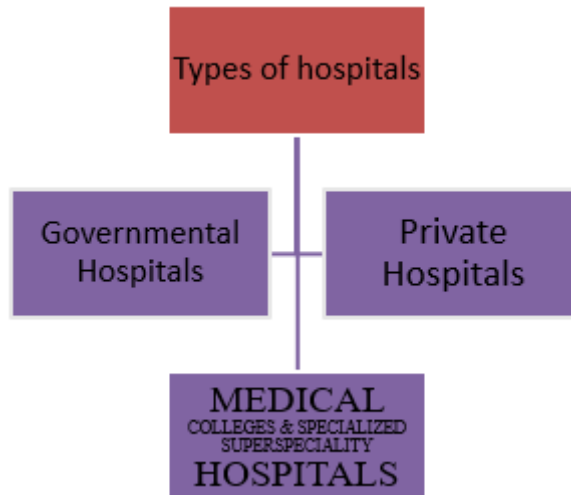


Fig 2: Segmentation of hospitals

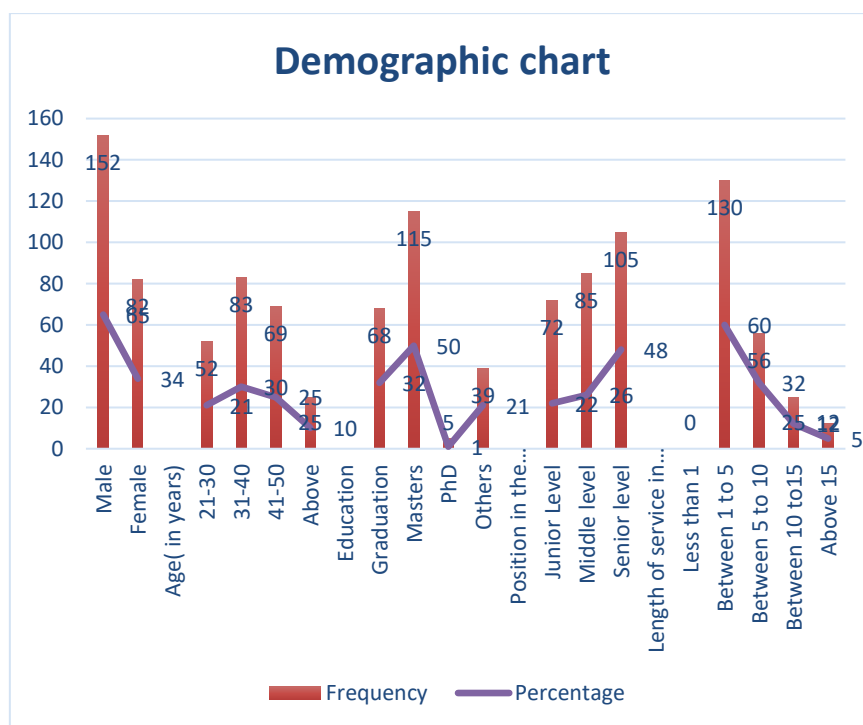
Data analysis

The data were analyzed using SPSS 24. Descriptive statistics and bar graphs were employed to evaluate the performance of hospitals across various eco-sustainability dimensions.

Table 1 Demographic profile of the respondents.

Demographic variable	Frequency	Percentage
Gender		
Male	152	65
Female	82	34
Age (in years)		
21-30	52	21
31-40	83	30
41-50	69	25
Above	25	10
Education		
Graduation	68	32
Masters	115	50
PhD	5	1

Others	39	21
Position in the organization		
Junior Level	72	22
Middle level	85	26
Senior level	105	48
Length of service in current organization		
Less than 1	0	
Between 1 to 5	130	60
Between 5 to 10	56	32
Between 10 to 15	25	12
Above 15	12	5



Measures

A set of 44 items, adapted from Smerecnik and Andersen (2011), was used to assess the environmental sustainability performance of hospitals across seven indicators: "sustainable management," "environmental communication," "managing hospital pollution," "resource conservation," "water recycling," "energy conservation," and "patient room sustainability." Responses were collected using

a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The scale items and Cronbach's alpha values for each dimension are provided in Table 2.

S No	Environmental Sustainability Index	Mean	SD
	Sustainable Management (Cronbach's alpha 0.87)		
	Our hospital		
1	It has an environmental committee responsible for monitoring and evaluating the environmental impact of daily operations.	3.02	1.16
2	It maintains a formalized environmental policy document or charter.	3.46	0.99
3	Regularly prepares reports assessing environmental impacts.	3.93	0.25
4	Implements a thorough program aimed at minimizing environmental effects.	2.11	0.52
5	Engages external experts to provide guidance on environmental policies and initiatives.	3.56	1.43
6	Delegates representatives to attend sustainability-focused conferences.	2.78	1.78
7	Includes mechanisms for evaluating greenhouse gas emissions and carbon footprint.	2.99	0.55
8	Adheres to nationally or internationally accredited sustainability certification standards.	3.02	0.67
	Environmental Communication(Cronbach's alpha 0.80)		
9	Provides environmental training programs for staff members.	2.18	1.47
10	Educates patients and their attendants about environmental awareness.	3.64	1.66
11	Shares environmental commitments through public messages or hospital profiles.	3.21	1.98
12	Hosts regular discussions to address environmental concerns.	2.37	0.25
13	Promotes environmental initiatives within the community.	3.68	0.36
14	Engages in discussions with other healthcare institutions to foster environmental sustainability.	3.55	0.47
	Managing Hospital Pollution (Cronbach's alpha 0.74)		
15	Possesses awareness of environmental pollution in the hospital's vicinity.	2.47	0.52
16	Plans and implements measures to mitigate pollution.	2.98	1.43
17	Takes steps to preserve the local habitat and protect biodiversity.	2.11	1.72

			8
	Resource Conservation (Cronbach's alpha 0.77)		0.5 5
18	Separates hazardous, biomedical, and human anatomical waste for proper disposal.	3.77	0.6 7
19	Focuses on reducing, recovering, and recycling food waste.	3.59	
20	Maintains knowledge of local recycling firms and collaborates with them on recycling initiatives.	2.57	1.4 7
21	Prioritizes purchasing recycled goods and reusable products to minimize environmental impact.	2.46	1.6 6
22	Encourages patients to adopt recycling practices.	2.99	1.9 8
23	Prefers sourcing from local firms and companies.	1.04	0.9 9
24	Advocates for the use of energy-efficient and less hazardous materials.	2.54	
	Water Recycling (Cronbach's alpha 0.78):		
25	Operates an on-site wastewater treatment facility.	2.18	0.5 2
26	Ensures the safe discharge of treated wastewater into the environment.	3.64	1.4 3
27	Implements systems for capturing and reusing rainwater runoff.	3.21	1.7 8
28	Uses treated wastewater for landscaping, irrigation, and horticulture.	2.37	0.5 5
29	Employs recycled water for sanitation purposes.	3.68	0.6 7
	Energy Conservation (Cronbach's alpha 0.77):		
30	Generates all required energy through solar, wind, or other renewable sources.	3.46	1.4 7
31	Prefers procuring renewable energy from local utility providers.	3.93	1.6 6
32	Plans to invest in renewable energy credits or green tags.	2.11	1.9 8
33	Manages a transportation fleet powered by alternative fuels or hybrid technology.	3.56	0.2 5
34	Provides public transportation options for patients and their attendants.	2.78	0.3 6
35	Encourages employee carpooling and offers incentives for alternative transportation.	2.99	0.4 7

36	Constructs buildings designed for energy efficiency using sustainable materials and methods, meeting standards such as LEED or Energy Star certifications.	2.47	0.3 3
Patient Room Sustainability (Cronbach's alpha 0.73)			
37	Utilizes energy-saving control systems in patient private wards, general wards, and OPD rooms.	3.02	0.9 8
38	Implements a keycard system in OPD rooms and private wards to automatically turn off power when the card is removed.	3.55	0.4 7
39	Employs energy-efficient light bulbs in private rooms and OPD spaces.	3.87	0.2 6
40	Uses recycled paper and containers to reduce waste.	2.18	1.3 9
41	Operates a voluntary program encouraging the reuse of linens and towels.	3.64	1.4 7
42	Has a housekeeping department that sorts linens based on the level of dirtiness.	3.21	1.8 9
43	Actively reduces the usage of cleaning chemicals.	2.37	0.5 5
44	Installs sensor-activated lighting in lobbies, restrooms, and other areas where lighting is needed intermittently.	3.68	1.3 6

RESULTS AND DISCUSSION

The scores for each individual item across various sustainability dimensions were averaged to calculate an overall sustainability index, with higher values indicating greater environmental sustainability. The overall sustainability index achieved a mean score of 2.52, reflecting a moderate implementation of environmental sustainability practices in the sampled hospitals. Figure 3 illustrates the implementation status of different sustainability practices. Among the seven practices listed in the index, the highest level of implementation was found in 'resource conservation' (2.99), followed by 'managing hospital pollution' (2.76), 'patient room sustainability' (2.56), and 'energy conservation' (2.47). The lowest levels of implementation were observed in 'sustainable management' (2.16), followed by 'environmental communication' (2.37) and 'water recycling' (2.39). A detailed item-by-item analysis of the sustainability index was performed, with the mean values of all subscale items shown in Table 3. The highest mean scores were observed in certain items related to resource conservation (RC), patient room sustainability (PRS), and managing hospital pollution (MHP), such as "Our hospital segregates hazardous/biomedical wastes/human anatomical wastes (RC) (3.80)," "Our hospital believes in purchasing energy-saving and less hazardous materials (RC) (3.13)," "Our hospital focuses on purchasing from local firms and companies (RC) (3.09)," "Our hospital has energy-saving light bulbs in private/OPD rooms (PRS) (3.68)," and "Our hospital has knowledge of environmental pollution around the hospital (MHP) (3.02)." On the other hand, the lowest levels of implementation were seen in some items under patient room sustainability (PRS), energy conservation (EC), and sustainable management (SM), such as "Our hospital has a keycard control system in OPD rooms and

private wards that automatically shuts off power when the card is removed (PRS) (2.16)," "Our hospital encourages carpooling and provides alternative transportation incentives (EC) (2.23)," "Our hospital sends officials to conferences related to sustainability (SM) (2.08)," and "Our hospital hires external consultants to advise on environmental policies and programs (SM) (2.12)." The following section will provide a detailed discussion of the study's findings.

Discussion

This section provides a discussion of the findings, their implications, and their contribution to the field of environmental sustainability research. The aim of the study was to assess the extent to which sustainable practices are implemented in hospitals across Punjab. The results are presented in order, starting with the sustainability dimensions that showed the highest levels of implementation, progressing to those with the lowest.

Limitations and scope for future work

This study has several limitations that offer important directions for future research. The first limitation is the use of closed-ended self-administered questionnaires to gather data on sustainability practices. While off-the-record discussions were conducted with respondents, a more structured interview approach could have yielded additional insights. Due to the hospital administration and staff being heavily involved in COVID-19-related duties, it was difficult to secure time for in-depth interviews. However, we suggest that future researchers explore more detailed information through qualitative methods once the pandemic subsides. Secondly, this study was focused on identifying the nature and extent of implementation of various sustainability practices, so future research could expand by investigating the factors and outcomes associated with these practices. Third, further research should explore the psychological processes and factors that influence the relationship between environmental sustainability practices and both individual and organizational outcomes. Lastly, this study could be extended by comparing the results with data from hospitals in both developing and developed countries to gain broader insights.

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