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INVESTIGATING THE INFLUENCE OF FRONTLINE HEALTHCARE WORKERS' ECOLOGICAL, PERSONAL, AND BEHAVIOURAL AWARENESS OF PLANETARY HEALTH ON PATIENT CARE

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Abstract
This study investigates the influence of frontline healthcare workers' (FLHWs) awareness of planetary health on patient care quality in Pakistan, emphasizing the mediating role of employee resilience. Conducted in three districts of Punjab (Okara, Pakpattan, Sahiwal), the research employs a quantitative approach, surveying 217 FLHWs, primarily Lady Health Workers, nurses, and midwives, using adapted questionnaires. Planetary health awareness is examined through three dimensions—ecological, personal, and behavioural—assessing how understanding environmental health interconnections, personal environmental responsibility, and sustainable practices impact care delivery. Findings reveal that all three awareness dimensions positively and significantly enhance patient care quality, with ecological awareness showing the strongest effect ($\beta=0.670$, $p<0.01$). Employee resilience partially mediates this relationship, enabling FLHWs to translate environmental awareness into effective care despite resource constraints and environmental stressors ($\beta=0.615$, $p<0.01$). Grounded in Social Cognitive Theory, the study highlights how self-efficacy and observational learning foster sustainable healthcare practices. The results advocate for integrating planetary health into FLHW training curricula and policy reforms to align Pakistan's National Health Vision with climate-resilient healthcare goals. By empowering FLHWs as planetary health stewards, this research contributes to sustainable healthcare delivery in low-resource settings, addressing both clinical and environmental determinants of health. Limitations include the cross-sectional design and regional focus, suggesting future longitudinal and comparative studies to enhance generalizability.

INTRODUCTION

Planetary health, an emerging paradigm emphasizing the interdependence of human health and natural systems, has gained global attention as environmental crises increasingly threaten public health outcomes (Mago et al., 2024; Brown et al., 2025). In Pakistan, a nation grappling with climate vulnerabilities and healthcare disparities, frontline healthcare workers (FLHWs) serve as critical bridges between communities and the health system. This research work investigates how FLHWs' awareness of planetary health principles influences patient care delivery within Pakistan's unique socio-ecological context.

The country's healthcare infrastructure relies heavily on FLHWs, including 100,000 Lady Health Workers (LHWs) providing door-to-door primary care, who manage preventive services, maternal health, and epidemic responses. During COVID-19, initiatives like the WHO-supported "*We Care*" campaign demonstrated FLHWs' adaptability through virtual training on infection control and PPE use, highlighting their role in crisis management (WHO, 2020). However, contemporary challenges like heat waves, air pollution, and climate-induced disease patterns necessitate expanding FLHWs' competencies beyond immediate clinical tasks to address environmental determinants of health (Muhammad et al., 2023).

Globally, nurses and community health workers are recognized as planetary health innovators through their dual capacity to mitigate environmental risks (e.g., reducing healthcare carbon footprints) and educate communities about climate-resilient practices (Holguera et al., 2022; Levett-Jones et al., 2025). In Pakistan, where 64% of the population faces climate vulnerability, FLHWs' localized knowledge positions them to implement interventions with environmental co-benefits (Muhammad et al., 2023). Yet, existing training programs like Pakistan's National IPC Guidelines remain narrowly focused on biomedical protocols rather than ecological health synergies. This study addresses a critical gap: while FLHWs drive Pakistan's primary care system, their potential as planetary health stewards remains underexplored. Preliminary evidence suggests that FLHW-led initiatives integrating environmental awareness – such as disaster preparedness education or sustainable medication disposal programs – could simultaneously improve patient outcomes and ecological resilience (Asaduz zaman et al., 2022). However, systemic barriers persist, including insufficient curricular integration of planetary health concepts and fragmented policy support for environmental health interventions (Levett-Jones et al., 2025).

By employing a quantitative research approach across three districts of Punjab province, this research has analyzed how FLHWs' environmental awareness promotes the patients quality of care. Findings aim to inform policy reforms aligning Pakistan's National Health Vision with planetary health principles, ultimately strengthening healthcare delivery against accelerating ecological disruptions. The study contributes to global discourses on climate-resilient health systems by contextualizing planetary health praxis within low-resource settings where FLHWs operate as both caregivers and ecological first responders.

BACKGROUND OF THE STUDY

The escalating planetary health crisis, characterized by climate change, biodiversity loss, and pollution, poses unprecedented threats to global health systems (Urslak et al., 2025). By 2050, climate-driven events like floods, droughts, and heat waves could cause 14.5 million additional deaths and $12.5 trillion in economic losses, with healthcare systems facing $1.1 trillion in added costs (Levett-Jones et al., 2025). These challenges disproportionately affect low-resource settings, where 64% of Pakistan's population already experiences climate vulnerability. Globally, healthcare systems face dual pressures: mitigating their 4.4% contribution to global carbon emissions while building resilience against climate shocks like extreme weather events and disease vector expansion (MacNeill et al., 2021). The WHO's 2025–2028 strategy prioritizes climate-resilient, low-carbon health systems, advocating renewable energy use in medical infrastructure and cross-sectoral climate action. Simultaneously, the UNEP-ISC 2024 report underscores the need for integrated responses to the "triple planetary crisis," urging health systems to adopt foresight strategies against compounding environmental and societal disruptions. Frontline healthcare workers (FLHWs) are pivotal in this transition, particularly in countries like Pakistan where they bridge gaps in primary care access (Muhammad et al., 2023). While global frameworks emphasize FLHW potential as planetary health stewards – through disaster preparedness education and sustainable practices most training programs remain bio medically focused (Valentine et al., 2022). Pakistan's Lady Health Workers, who manage maternal care and epidemic responses, exemplify this untapped capacity (Muhammad et al., 2023). However, systemic barriers persist: only 12% of Pakistan's healthcare facilities meet WHO climate resilience standards, and fewer integrate environmental literacy into staff training. This disconnect risks amplifying climate-health threats, as FLHWs lack tools to address environmental determinants like air pollution or heat wave management issues projected to cost Pakistan $3.2 billion annually in climate-related health damages by 2030. The WHO' Adaptation Action Coalition aims for universal climate-resilient health systems by 2030, but achieving this requires contextualized strategies that empower FLHWs as ecological first responders.

The interconnected crises of climate change, biodiversity loss, and pollution—collectively termed the "triple planetary crisis"—are reshaping global healthcare systems through divergent yet interconnected pathways in developed and developing nations. Climate-driven health threats, including heat waves, vector-borne diseases, and air pollution, are projected to cause 14.5 million additional deaths by 2050, with developing countries bearing 80% of this burden despite contributing minimally to emissions. Healthcare systems now face dual imperatives: mitigating their 4.4% share of global carbon emissions while adapting to climate-amplified disease burdens that could cost $1.1 trillion annually in healthcare expenditures (TDG, 2024; Scholz et al., 2024).

Developed countries exhibit a paradox of high resilience and high responsibility. Their advanced infrastructure enables better management of climate-health shocks such as heat wave early warning systems and air filtration in hospitals but their healthcare sectors contribute disproportionately to planetary degradation through energy-intensive facilities and pharmaceutical supply chains (Okojie et al., 2023). For instance, a single MRI scan in a high-income country emits 17.5 kg CO_2 equivalent, reflecting systemic dependencies on carbon-intensive technologies. Meanwhile, developing nations like Pakistan face compounded vulnerabilities: 64% of their populations experience climate risks, while underfunded health systems (only 12% meeting WHO climate resilience standards) struggle with overlapping burdens of infectious diseases and rising non-communicable conditions exacerbated by environmental stressors. Three critical linkages emerge:

- Resource asymmetry: Developed countries allocate 5–10% of health budgets to climate adaptation, leveraging technologies like AI-driven outbreak prediction, while low-income nations spend <1% on basic infrastructure hardening against floods/droughts (Naser et al., 2024).

- Disease burden divergence: Temperature rises expand malaria zones in tropical regions (+15% incidence in South Asia), whereas wealthy nations confront climate-aggravated chronic conditions (e.g., ozone-related COPD up 37% in Europe) (Viveros-Uehara, 2023).
- Mitigation-adaptation tradeoffs: High-income systems prioritize de carbonization (e.g., Germany's 2030 carbon-neutral hospital initiative), whereas Pakistan's frontline workers balance disaster response with preventive care amid power outages and supply chain disruptions.

The WHO's operational framework for climate-resilient health systems underscores this duality, urging developed nations to accelerate emission reductions through renewable-powered health infrastructure, while supporting developing countries in strengthening community-based adaptation an approach exemplified by Pakistan's Lady Health Workers managing heatstroke prevention and dengue surveillance. However, fragmented data systems in countries like Brazil and under prioritized planetary health curricula globally reveal systemic gaps in translating ecological awareness into care delivery.

Ultimately, the planetary health-healthcare nexus demands reconceptualising medical practice as both ecosystem-dependent and ecosystem-shaping, with equity-focused financing mechanisms to bridge the $16–32 billion annual adaptation financing gap for vulnerable health systems. Without redistributive policies that align high-emission nations' mitigation obligations with low-income countries' adaptation needs, the accelerating climate-health feedback loop risks collapsing already strained care infrastructures in regions least equipped to respond (Lugten et al., 2022; Martins et al., 2024).

The relationship between planetary health awareness and patient care outcomes is rooted in the recognition that environmental determinants of health significantly influence individual and community well-being. Planetary health, which emphasizes the interdependence between human health and the integrity of ecosystems, provides a framework for healthcare professionals to address both immediate clinical needs and broader environmental challenges (Sue et al., 2024). Awareness of planetary health principles equips healthcare providers with the knowledge to integrate socio-environmental determinants into patient care, thereby improving health outcomes while promoting sustainable practices (Mosadeghrad et al., 2023).

Healthcare systems that incorporate planetary health awareness are better positioned to address the dual challenges of mitigating their environmental impact and adapting to climate-induced health risks (Briggs, 2023). For instance, healthcare professionals who understand the links between air pollution and respiratory diseases can proactively counsel patients on reducing exposure while advocating for systemic solutions like cleaner energy policies. Similarly, integrating planetary health principles into primary care enables providers to promote co-beneficial practices, such as encouraging active transportation (walking or cycling) that improves physical health while reducing greenhouse gas emissions (Brown et al., 2025). This holistic approach not only enhances patient outcomes but also contributes to broader public health goals by addressing root causes of environmental degradation. Moreover, planetary health awareness fosters innovation in healthcare delivery models (De Waele et al., 2024). It encourages a shift from hospital-centric systems to community-based care that prioritizes prevention and sustainability. For example, primary care providers can collaborate with non-medical sectors to implement interventions like urban greening projects, which mitigate heat stress and improve mental health. This interdisciplinary approach aligns healthcare services with planetary boundaries, ensuring equitable access to care while reducing ecological footprints. In summary, planetary health awareness transforms patient care by integrating environmental considerations into clinical practice (Baluszek et al., 2023). It enables healthcare providers to address both individual health needs and systemic challenges, ultimately fostering resilient communities and sustainable healthcare systems.

Research Problem

The quality of patient care in Pakistan faces significant challenges, particularly in the context of frontline healthcare workers (FLHWs) who operate under resource-constrained and environmentally vulnerable conditions. FLHWs, including nurses and community health workers, are essential to delivering primary and critical care in a country where the healthcare system is already overburdened with insufficient infrastructure, staff shortages, and inadequate training. These challenges are compounded by a lack of awareness and integration of planetary health principles into healthcare delivery, which limits the ability of FLHWs to address environmental determinants of health effectively. For instance, issues such as air pollution, heat waves, and waterborne diseases exacerbated by climate change are increasingly affecting patient outcomes. However, most FLHWs lack training on how ecological factors influence health, leaving a critical gap in their ability to provide holistic care.

Planetary health awareness among FLHWs can be understood through three key dimensions: ecological awareness, personal awareness, and behavioral awareness. Ecological awareness involves understanding the environmental factors that impact health, such as pollution or climate-induced disease patterns. Personal awareness refers to the recognition of how individual behaviors and workplace practices contribute to environmental sustainability, such as waste management or energy conservation in healthcare settings. Behavioural awareness focuses on promoting sustainable health practices among patients and communities, such as advising on clean cooking fuels or preventive measures against heat stress. Together, these dimensions can enhance the quality of patient care by equipping FLHWs with the knowledge and tools to address both clinical and environmental determinants of health.

Employee resilience plays a pivotal role in bridging planetary health awareness and patient care outcomes. Resilience enables FLHWs to adapt to challenging working conditions, manage stress effectively, and maintain high standards of care despite systemic barriers. For instance, resilient healthcare workers are better equipped to integrate ecological considerations into their clinical decision-making processes while simultaneously coping with the psychological and physical demands of their roles. This adaptability is particularly crucial in Pakistan's healthcare context, where FLHWs often face extreme workloads, limited resources, and exposure to environmental hazards.

The relationship between planetary health awareness and patient care outcomes is mediated by employee resilience. When FLHWs possess strong ecological, personal, and behavioural awareness, they are more likely to adopt sustainable practices that improve patient outcomes while minimizing environmental harm. Resilience further amplifies this effect by enabling workers to overcome systemic challenges such as resource shortages or inadequate training. For instance, a resilient nurse who understands the link between air pollution and respiratory illnesses can educate patients on preventive measures while advocating for cleaner hospital environments.

Despite its potential benefits, there remains a significant gap in integrating planetary health awareness into the training and practice of FLHWs in Pakistan. Addressing this gap requires targeted interventions that enhance ecological literacy among healthcare workers while fostering resilience through supportive policies and resources. By doing so, Pakistan's healthcare system can not only improve patient outcomes but also contribute to broader sustainability goals in an era of escalating environmental challenges.

Research objectives

Based on the research problem, the following research objectives have been formulated.

1. To examine the influence of frontline healthcare workers' environmental awareness of planetary health (ecological, personal, and behavioural dimensions) on the quality of patient care.
2. To evaluate the mediating effect of employee resilience on the relationship between environmental awareness of planetary health and patient care quality.

Research questions

Based on the research problem and objectives, the following research questions have been derived.

- Do the employee planetary-health environmental awareness (ecological, personal, and behavioural) has a positive impact on patients' quality of care?
- Does employee resilience has a mediating role between employee planetary-health environmental awareness and patients' quality of care?

SIGNIFICANCE OF THE STUDY

The core idea is that a frontline healthcare workers (FLHW) understanding and internalization of planetary health principles reflected in ecological, personal, and behavioural awareness positively influences the care they provide to patients. Crucially, this relationship is strengthened by the FLHW's resilience, which helps them overcome challenges and maintain high standards of care.

This study significantly contributes to advancing sustainable healthcare practices in Pakistan by exploring the pivotal role of frontline healthcare workers (FLHWs) and their awareness of planetary health principles. It provides a framework for integrating ecological, personal, and behavioural dimensions of environmental consciousness into routine healthcare delivery, thereby enhancing the quality and sustainability of patient care. Empirically, the research has offered evidence-based strategies for optimizing resource utilization within healthcare facilities, promoting community resilience against climate-sensitive health threats, and developing integrated care models that address both clinical and environmental determinants of health.

Furthermore, the study's findings directly inform policy and training interventions aimed at empowering FLHWs. It provides critical insights for designing standardized planetary health curricula and targeted training programs that enhance FLHWs' competency in sustainable healthcare practices. By demonstrating the importance of ecological literacy, this research can guide the creation of practical exercises, case studies, and mentorship opportunities tailored to the unique challenges faced by Pakistani healthcare workers. Finally, the evidence generated from this study can serve as a strong basis for advocating policy changes that incentivize green technologies in healthcare facilities, regulate pollution from healthcare operations, and support community-based environmental health initiatives. By emphasizing the role of resilience, the study also calls for supportive policies that help FLHWs cope with work-related stress and resource limitations, ultimately ensuring that planetary health awareness translates into improved patient care outcomes.

Thesis structure

The current research thesis examine the frontline healthcare environmental awareness on patients' quality of care, in order to present research work, researcher has followed the propose layout;

- **Chapter-1:** The foundation of research has been lay-down in this chapter. This chapter further sub-divided into brief introduction, research background, problem statement, objective, research questions and scope of the research work.
- **Chapter-2:** Literature review chapter starts with operational definitions of all the study constructs. Then systematical review the research work of previous researchers to intensely study the variables. Theoretical support has also been discussed in this chapter.

• **Chapter-3**: As the name indicate "research framework", the graphical representation of the research model followed by hypothesis formation and variables descriptions. Moreover, research design or research methodology chapter elaborate the philosophy, design and research choice. Then study population, sampling method and technique were discussed. Measurement of study variables and their scale were also written down followed by data collection techniques. The pilot study of numerical data was conducted and written in this section.
• **Chapter-4:** Data analysis chapter described the meaningful result of the collected data that explain the association among variables. Constructs reliability and validity were analyzed through statistical methods.
• **Chapter-5:** In this section, empirical results were discussed and formulate the association of current research findings with past research outcomes and draw the conclusion of the research. Practical and managerial implication were also the part of this section. Research limitations and future directions were given at the end of this section.

LITERATURE REVIEW

Introduction

The previous chapter discussed in introduction, background, research problem and RQs & ROs. This chapter highlight the past literature review. The definition of study variables have outline then association with variables have also discussed. Then literature gaps have conversed with justification. Theoretical framework has formulate, research model and hypotheses generation have also part of this chapter.

Planetary health

The concept of planetary health encompasses the interdependent relationships between living organisms and their ecosystems, emphasizing the need for urgent action to preserve sustainable living conditions on Earth (Mago et al., 2024). Key principles of planetary health include recognizing the risks to civilization and human health at a global scale, understanding the critical erosion of ecosystem services, and advocating for fairer global social justice and rapid decarbonisation (Mago et al., 2024). Planetary health is closely related to environmental sustainability, as it emphasizes the interconnectedness of the environment, society, and the health of all beings, highlighting the need for transformative changes across various sectors such as energy, housing, transport, food, and healthcare (Verweij and Richie, 2023). Planetary health is a critical concept that underscores the intricate relationship between human well-being and the integrity of the Earth's ecosystems. It emphasizes that human health is inextricably linked to the health of the planet, highlighting the need for sustainable practices that protect both. The importance of planetary health lies in its ability to address pressing global challenges such as climate change, biodiversity loss, and pollution, which are increasingly threatening public health outcomes. By integrating ecological considerations into healthcare delivery, planetary health encourages a holistic approach to patient care that not only treats diseases but also prevents them by addressing environmental determinants. This paradigm shift is crucial for building resilient healthcare systems capable of adapting to climate-induced health risks while minimizing their ecological footprint. Ultimately, planetary health awareness empowers healthcare professionals to become stewards of both human and environmental health, fostering a future where healthcare systems support, rather than harm, the planet (Zhou et al., 2023).

Planetary health, a globally recognized and rapidly evolving field, highlights the interdependence of human health and the Earth's natural systems. It addresses the urgent need to combat environmental degradation and its cascading impacts on global health. The Rockefeller Foundation–Lancet Commission on Planetary Health underscores that human-induced disruptions, such as climate change, biodiversity loss, and pollution, are not only altering disease patterns but also increasing the likelihood of new and unknown diseases emerging. These challenges demand transformative actions that integrate environmental sustainability into health systems to protect current and future generations (Gonzalez et al., 2022).

Globally, planetary health emphasizes both local and trans-boundary solutions. Rising global temperatures, for example, have expanded the range of mosquito-borne diseases like malaria and dengue, illustrating how environmental changes directly affect public health. While international collaboration is essential for addressing such issues, local interventions—such as improving urban air quality or promoting sustainable agricultural practices—can have immediate benefits for communities (Prescott et al., 2022). Initiatives like the C40 Cities Climate Leadership group demonstrate how urban areas worldwide are taking meaningful steps to reduce carbon emissions and mitigate climate risks. The field also promotes a holistic perspective by recognizing that human health depends on balanced ecosystems. This approach encourages governments, organizations, and individuals to adopt integrated strategies that address interconnected issues such as food security, water access, and biodiversity conservation. For example, programs like USAID's SIBOL Activity in the Philippines apply planetary health principles to manage natural resources sustainably while fostering economic development. Similarly, transitioning away from fossil fuels toward clean energy can yield immediate health benefits through reduced air pollution while mitigating long-term climate risks (Valentine et al., 2025).

However, achieving planetary health requires systemic changes in policy and practice. The George Institute's Planetary Health Initiative emphasizes the importance of evidence-based policies that address ecological change while improving equity in healthcare delivery. Investments in research, education, and cross-sectoral collaboration are critical to advancing this field globally (Chen et al., 2022; Cohen et al., 2025). Ultimately, planetary health

presents an opportunity to redefine global health frameworks by integrating environmental stewardship into healthcare systems, ensuring a resilient future for both people and the planet.

Environmental awareness among employees

Environmental awareness among employees plays a crucial role in fostering sustainable practices, enhancing organizational culture, and addressing global environmental challenges. From an ecological perspective, it enables employees to understand the impact of their actions on the environment, promoting behaviors that reduce carbon footprints, conserve resources, and minimize waste (Zhang et al., 2021). For example, workplace initiatives such as energy-saving plans, recycling programs, and water conservation efforts empower employees to actively contribute to sustainability goals while reducing operational costs (Galvan-Mendoza et al., 2021). This collective effort not only benefits the environment but also strengthens the organization's commitment to corporate social responsibility (Saifulina et al., 2023).

From a personal perspective, environmental awareness transforms employees' attitudes and lifestyles by instilling a sense of responsibility toward ecological stewardship. It enhances their well-being by encouraging sustainable commuting methods, healthier consumption patterns, and participation in community-driven environmental projects. Such engagement fosters a positive work culture where employees feel aligned with their organization's values, boosting morale and job satisfaction (Galvan-Mendoza et al., 2021). Moreover, employees who are environmentally aware often experience improved productivity as they adopt efficient practices that streamline workplace operations. Behaviourally, environmental awareness drives proactive actions such as advocating for eco-friendly policies or participating in sustainability campaigns (Saifulina et al., 2023). Employees equipped with knowledge about environmental issues are more likely to champion green initiatives within their organizations, creating ripple effects that extend beyond the workplace into broader societal impacts. This advocacy helps organizations comply with environmental regulations while building a reputation as sustainability leaders, attracting eco-conscious customers and stakeholders (Zhang et al., 2021).

Ecological awareness

Ecological awareness, as defined within the provided study on Turkish nursing students, represents an understanding of environmental issues and a recognition of the interconnectedness between human actions and ecological systems (Luque-Alcaraz et al., 2024). It is one of the three subscales of the Environmental Awareness Scale (EAS) used in the research, alongside self-awareness and behavioural awareness. In this context, ecological awareness specifically relates to the students' comprehension of environmental problems, their causes, and their potential consequences (Dönmez & Yardımcı, 2024). It encompasses recognizing the importance of preserving natural resources, minimizing pollution, and protecting biodiversity.

Personal awareness

The concept of personal ecological awareness refers as self-awareness. It reflects an individual's understanding of their own impact on the environment and their sense of responsibility towards environmental protection (Saifulina et al., 2023). Personal environmental awareness plays a vital role in promoting the well-being of both employees and patients by fostering a deeper understanding of the interconnectedness between individual actions and environmental health (Zhang et al., 2024). For employees, personal environmental awareness enhances their ability to recognize how workplace practices and behaviors impact their immediate surroundings and the broader ecosystem (Kollmuss & Agyeman, 2002). This awareness encourages sustainable actions, such as reducing waste, conserving energy, and adopting eco-friendly practices, which contribute to a healthier and safer work environment (Bleys et al., 2018). A cleaner, more sustainable workplace reduces exposure to harmful pollutants and creates a sense of purpose and responsibility among employees, thereby improving their mental and physical well-being (Wallnoefer & Riefler, 2022). Studies have shown that access to clean air, water, and green spaces within healthcare facilities can significantly reduce stress levels among workers and enhance their productivity (Saifulina et al., 2023; Kollmuss & Agyeman, 2002).

For patients, the benefits of personal environmental awareness among healthcare workers extend to the quality of care they receive. Healthcare professionals who are environmentally conscious are more likely to adopt practices that minimize environmental hazards in clinical settings, such as proper waste disposal or using non-toxic cleaning agents (Wallnoefer & Riefler, 2022). These practices not only reduce the risk of healthcare-acquired infections but also create a safer and more welcoming environment for patients (Kollmuss & Agyeman, 2002). Additionally, healthcare workers with high personal environmental awareness can educate patients on sustainable health behaviors, such as reducing exposure to air pollution or adopting water conservation practices at home (Zhang et al., 2024). This dual focus on care delivery and patient education fosters long-term health improvements while contributing to environmental sustainability.

Behavioural awareness

The behavioural awareness reflects the extent to which individuals engage in environmentally friendly behaviors and practices. It assesses whether people translate their environmental knowledge and values into concrete actions that contribute to sustainability (Li et al., 2022). Behavioural environmental awareness plays a critical role in promoting the well-being of both employees and patients by fostering sustainable practices that benefit health, reduce environmental harm, and create a culture of ecological responsibility (Yang et al., 2022). Behavioural environmental awareness refers to the active application of environmental knowledge and values through tangible actions, such as waste reduction, energy conservation, and sustainable purchasing decisions. In healthcare settings,

this awareness drives employees to adopt practices that minimize the environmental footprint of their workplaces while simultaneously improving the quality of care delivered to patients (Miller et al., 2022).

For employees, engaging in environmentally conscious behaviors enhances workplace well-being by creating a cleaner, healthier, and more sustainable environment. For example, reducing exposure to pollutants through proper waste disposal or adopting energy-efficient systems can lower stress levels and improve physical health (Hong et al., 2024). Additionally, participating in sustainability initiatives fosters a sense of purpose and alignment with organizational values, which boosts morale and job satisfaction. Behavioural environmental awareness also encourages collaboration among staff members, as seen in initiatives like Green Teams, where employees collectively work toward shared sustainability goals. This collaborative effort builds a supportive workplace culture that promotes resilience and teamwork (Yang et al., 2022; Miller et al. 2022; Hong et al., 2024).

For patients, the impact of behavioural environmental awareness is equally significant. Healthcare professionals who actively engage in sustainable practices contribute to safer clinical environments by reducing hazardous waste and ensuring proper sanitation (Höpfl et al., 2024). Moreover, environmentally aware healthcare workers are better positioned to educate patients on adopting eco-friendly health behaviors, such as reducing exposure to air pollution or conserving water at home. These practices not only improve individual patient outcomes but also contribute to broader public health goals by addressing environmental determinants of health (Miller et al. 2022; Hong et al., 2024).

In summary, environmental awareness (ecological, personal and behavioural) dimensions bridges the gap between knowledge and action, empowering healthcare employees to create sustainable workplaces that enhance their own well-being while delivering high-quality care to patients. By embedding these factors into daily practices, healthcare systems can achieve dual goals of ecological stewardship and improved health outcomes.

Employee resilience

Employee resilience refers to the capacity of employees to adapt, manage, and thrive in the face of adversity, change, and stress within the workplace (Obeng & Atan, 2024). This concept encompasses several key elements.

- Adaptability and Flexibility: Employee resilience involves the ability to adjust to new conditions and challenges effectively. This includes being able to modify one's approach and behavior in response to changing circumstances.
- Positive Adaptation: It is characterized by the ability to bounce back from setbacks, failures, or potentially threatening situations, maintaining a positive outlook and continuing to perform well.
- Behavioral Capability: Resilient employees exhibit adaptive, learning, and network-leveraging behaviors, which help them navigate and recover from difficult situations 1.
- Emotional Intelligence and Problem-Solving: Strong emotional intelligence, creative problem-solving skills, and the ability to manage stress are critical components of employee resilience.
- Support Systems: The presence of supportive leadership and co-worker support significantly enhances employee resilience, especially under high work pressure.

Employee resilience plays a vital role in addressing environmental challenges and promoting patient quality of care in healthcare management. Resilience enables healthcare workers to adapt to the growing complexities posed by climate change, such as extreme weather events, resource shortages, and increasing environmental health risks (Wut et al., 2022). Resilient employees can maintain high levels of performance and well-being despite these challenges, ensuring that essential health services remain uninterrupted (Liang & Cao, 2021). For instance, during extreme weather events like floods or heat-waves, resilient healthcare workers are better equipped to manage surges in patient demand while maintaining the safety and efficiency of care delivery (Filges et al., 2024).

In the context of environmental challenges, resilience fosters proactive problem-solving and innovation among employees. It allows them to integrate sustainable practices into their daily routines, such as optimizing resource use, managing waste effectively, and adopting eco-friendly technologies (Galy et al., 2023). These practices not only reduce the environmental footprint of healthcare facilities but also create safer and healthier environments for patients (Rees et al., 2015). For example, resilient employees may implement green infrastructure strategies like improved storm water management or energy-efficient systems, which mitigate climate risks while enhancing clinical care environments. Moreover, resilience supports healthcare workers in navigating systemic barriers like inadequate infrastructure or limited training on planetary health principles (Filges et al., 2024; Galy et al., 2023). By fostering adaptability and emotional strength, resilience enables employees to address both immediate patient needs and long-term environmental goals. This dual focus enhances patient outcomes by creating a care environment that is both responsive to individual health needs and aligned with broader sustainability objectives (Liang & Cao, 2021).

Ultimately, employee resilience acts as a bridge between environmental awareness and patient care quality. It empowers healthcare workers to address climate-related challenges while maintaining their capacity to deliver compassionate, high-quality care (Wut et al., 2022). By investing in resilience-building initiatives, such as training programs and supportive policies, healthcare organizations can ensure a workforce capable of meeting the demands of a changing environment while safeguarding patient well-being.

Quality of patients care

Patients' quality of care encompasses various aspects, including patient-reported experience measures, patient-reported outcome measures, and patient satisfaction (Oh et al., 2015). Generally, the patient’s quality of care has two key components.

• Patients' views on their care are essential in assessing its quality, and this includes patient-reported experience measures and patient-reported outcome measures.
• The "QUality Of care Through the patients' Eyes" (QUOTE) instruments for measuring care quality include the participation of the client in the tool development process, evaluation of the importance and performance of care based on the client's needs, and reflection of multidimensional care in diverse settings (Oh et al., 2015).

Quality in healthcare is a cornerstone for ensuring positive health outcomes and enhancing the overall well-being of patients. It refers to the degree to which health services improve desired health outcomes by adhering to evidence-based practices and addressing patient needs effectively (Karaca and Durna, 2019). High-quality care is characterized by being safe, effective, patient-centered, timely, efficient, and equitable. These dimensions collectively ensure that healthcare not only meets clinical standards but also aligns with the individual preferences and values of patients. For example, safety focuses on minimizing harm during treatment, while patient-centered care emphasizes tailoring services to unique patient needs (Oh et al., 2015). In modern healthcare systems, quality plays a dual role: improving individual patient experiences and contributing to population health outcomes. At the micro-level, quality care reduces complications, enhances recovery rates, and improves patient satisfaction (Lee et al., 2008). At the macro-level, it strengthens healthcare systems by promoting preventive measures, reducing disease burden, and ensuring equitable access to services (Karaca and Durna, 2019). For instance, timely interventions for chronic diseases or preventive screenings can significantly reduce mortality rates and improve life expectancy. Furthermore, quality healthcare fosters trust between patients and providers by ensuring transparency and responsiveness. Engaging patients as active participants in their care—through effective communication and shared decision-making—empowers them to take ownership of their health. This collaborative approach not only improves adherence to treatment plans but also enhances long-term health outcomes.

THEORETICAL FRAMEWORK

Introduction

Research framework

Base on the research gaps, the following research framework has been developed. Figure 3.1 shows the research framework. The research framework consist of exogenous / independent, mediating and endogenous/ dependent variables. Employee planetary health environmental awareness is the independent variable and has three sub-dimensions; ecological awareness, personal awareness and behavioural awareness. Moreover, the employee resilience play a mediating role between independent and dependent variables. Finally, the patients' quality of care is the dependent variable.

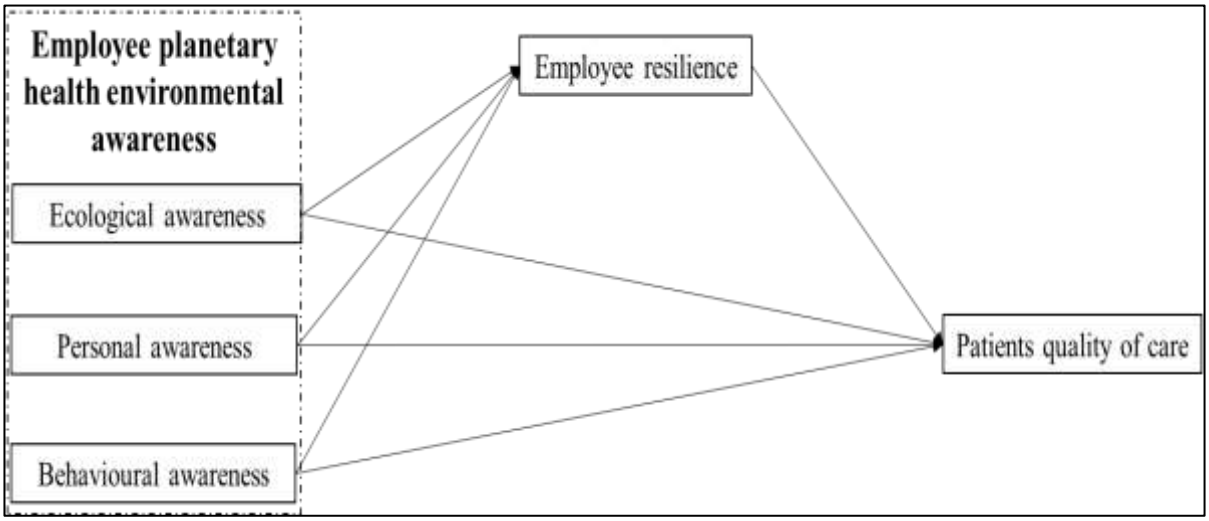

Figure 3.1. Research framework

Underpinning theory

Social Cognitive theory

Social Cognitive Theory (SCT), developed by Albert Bandura, emphasizes the dynamic interplay between personal factors, environmental influences, and behavior. The theory posits that individuals learn and adopt behaviors through observation, imitation, and reinforcement within their social and environmental contexts. Key constructs of SCT include self-efficacy (belief in one's ability to act effectively), observational learning (learning through others), and reciprocal determinism (the mutual influence of personal, behavioural, and environmental factors). SCT is particularly relevant for understanding how individuals adapt their behaviors in response to external challenges, such as environmental stressors, and internal motivations, like resilience and awareness.

The framework highlights the influence of employee planetary health environmental awareness (independent variable) on patients' quality of care (dependent variable). SCT provides a theoretical lens to explain this

relationship by emphasizing how healthcare workers' awareness of ecological, personal, and behavioral dimensions shapes their actions in clinical settings. For instance:

- Ecological Awareness: Healthcare workers who understand the impact of environmental factors on health (e.g., air pollution or climate-induced diseases) are likely to adopt preventive measures that enhance patient care outcomes. Observational learning within their workplace may reinforce these practices as they see colleagues implementing eco-friendly strategies.
- Personal Awareness: Employees who recognize their individual role in promoting sustainability may exhibit greater self-efficacy in making environmentally conscious decisions, such as reducing waste or conserving energy. These actions contribute to safer and healthier clinical environments for patients.
- Behavioral Awareness: SCT explains how healthcare workers translate knowledge into action by observing sustainable practices within their organizations and applying them in patient care. For example, healthcare workers might educate patients about adopting eco-friendly health behaviors like avoiding exposure to pollutants or conserving water.

Through reciprocal determinism, SCT highlights how healthcare workers' planetary health awareness interacts with the organizational environment to create a feedback loop. Their sustainable actions not only improve patient outcomes but also reinforce the importance of environmental consciousness within healthcare systems.

The framework introduces employee resilience as a mediating variable between planetary health awareness and patient quality of care. SCT underscores the role of self-efficacy in fostering resilience among employees. Healthcare workers with high planetary health awareness are likely to develop stronger self-efficacy as they perceive themselves capable of addressing environmental challenges effectively. This belief enhances their resilience, enabling them to adapt to stressors like resource shortages or climate-induced health risks while maintaining high standards of care. Resilient employees act as agents of change by integrating planetary health principles into patient care despite systemic barriers. For instance, a resilient healthcare worker with ecological awareness might implement strategies to manage heatstroke cases during extreme weather events while advocating for greener hospital infrastructure. Personal awareness fosters resilience by helping employees manage workplace stress through sustainable practices like energy-efficient workflows or waste reduction initiatives. Behavioural awareness amplifies resilience by encouraging proactive engagement with patients and communities on sustainable health behaviors. SCT explains how resilience mediates the relationship between awareness and patient care quality by enabling employees to overcome challenges while maintaining focus on delivering compassionate and effective care. Resilient healthcare workers are better equipped to translate their planetary health knowledge into actionable strategies that improve patient outcomes.

In conclusion, Social Cognitive Theory provides a robust theoretical underpinning for understanding the relationships within the framework. It highlights how healthcare workers' planetary health awareness influences their behavior through observational learning and self-efficacy while emphasizing the critical role of resilience in bridging environmental challenges with improved patient care quality.

Hypotheses development

Social Cognitive Theory (SCT) provides a robust framework for understanding the relationship between ecological awareness and patients' quality of care. SCT emphasizes reciprocal determinism, where personal factors (ecological awareness), environmental influences, and behaviors interact dynamically to shape outcomes. Healthcare workers with high ecological awareness possess the knowledge and understanding of how environmental factors like air pollution, water contamination, or waste management impact health outcomes. This awareness influences their attitudes and behaviors toward adopting sustainable practices in clinical settings. SCT highlights self-efficacy as a critical construct, wherein healthcare workers with strong ecological awareness feel confident in their ability to implement eco-friendly practices that enhance patient safety and care quality. For instance, observing peers or organizational leaders engaging in environmentally conscious behaviors (observational learning) reinforces these actions, creating a feedback loop that improves the overall care environment. Through this lens, ecological awareness not only informs healthcare workers' decisions but also drives behaviors that positively influence patient outcomes.

The relationship between ecological awareness and patients' quality of care is well-supported by existing research. Studies emphasize that ecological care a multidimensional concept encompassing ecological thinking, awareness, sensitivity, and literacy plays a critical role in improving patient outcomes while promoting sustainability (Scholz et al., 2024). For example, nurses who integrate ecological practices into their routines help reduce hospital-acquired infections by minimizing waste and optimizing resource use (Moghbeli et al., 2024). These practices contribute to safer clinical environments and better patient recovery rates (Waele et al., 2024). Furthermore, literature highlights that healthcare systems adopting environmentally sustainable practices not only reduce their carbon footprint but also enhance patient satisfaction by creating cleaner and healthier care settings (Cohen et al., 2025). Based on above discussion the following hypothesis has been proposed.

H1: Ecological awareness has a positive and significant relationship with patients' quality of care.

Social Cognitive Theory (SCT) provides a strong foundation for explaining the relationship between ecological awareness and patients' quality of care. The relationship between ecological awareness and patients' quality of care is well-supported by existing research. Studies emphasize that incorporating ecological practices into healthcare delivery enhances patient safety and satisfaction by creating cleaner, safer environments. For example, ecological care in nursing has been shown to reduce hospital-acquired infections, optimize resource utilization,

and minimize exposure to pollutants, all of which directly improve patient outcomes (Moghbeli et al., 2024). Additionally, sustainable healthcare practices such as waste reduction, energy efficiency, and water conservation align with environmental stewardship while simultaneously fostering healthier clinical spaces for patients (TRG, 2024). Research also highlights that patients increasingly value environmentally conscious healthcare systems. A German survey revealed that 88.2% of patients supported eco-friendly initiatives in hospitals, provided quality standards were maintained. This indicates that ecological awareness among healthcare workers not only addresses environmental challenges but also meets patient expectations for high-quality care (Scholz et al., 2024).

In conclusion, both theoretical insights from SCT and empirical evidence underscore the positive relationship between ecological awareness and patients' quality of care. By fostering ecological literacy among frontline healthcare workers, healthcare systems can enhance patient outcomes while contributing to broader sustainability goals. This hypothesis reflects the growing recognition that environmental stewardship is integral to delivering high-quality, holistic healthcare in an era of increasing planetary health challenges.

H2: Personal awareness has a positive and significant relationship with patients' quality of care.

H3: Behavioural awareness has a positive and significant relationship with patients' quality of care.

Social Cognitive Theory (SCT) provides a robust framework for understanding the mediating role of employee resilience in the relationship between planetary health environmental awareness and patients' quality of care. Healthcare workers' awareness of planetary health principles—comprising ecological, personal, and behavioural dimensions serves as a foundation for their attitudes and actions toward sustainability. However, resilience acts as a crucial resource that enables employees to translate this awareness into effective patient care despite systemic barriers such as resource shortages or environmental stressors. SCT highlights self-efficacy as a key construct in fostering resilience, wherein healthcare workers with strong planetary health awareness perceive themselves as capable of implementing eco-friendly practices confidently. Resilience amplifies this self-efficacy by enabling healthcare workers to adapt to challenges while maintaining high standards of care delivery.

Numerous studies support the mediating role of resilience in healthcare settings. Research indicates that resilience positively influences work engagement and stress management among healthcare workers, enabling them to maintain productivity and focus on patient care even during crises like the COVID-19 pandemic (Groschke et al., 2022; Chen et al., 2022). For instance, resilience has been shown to mediate the relationship between organizational support and work engagement (Zhou et al., 2023; Okojie et al., 2023). Similarly, studies highlight that resilient healthcare workers demonstrate better coping mechanisms when faced with environmental challenges, such as extreme weather events or resource shortages (Baluszek et al., 2023; Kose et al., 2021). These findings align with SCT's emphasis on self-efficacy and adaptive capabilities as critical components of resilience.

Resilience also facilitates the integration of planetary health principles into clinical practice. For example, resilient healthcare workers are more likely to adopt sustainable strategies like proper waste disposal or energy-efficient workflows despite systemic barriers (Cabrera-Aguilar et al., 2023). This adaptability ensures that planetary health awareness is effectively translated into actions that enhance patient safety and satisfaction (Kose et al., 2021). Moreover, resilience fosters emotional strength and problem-solving skills among employees, enabling them to address both immediate patient needs and long-term environmental goals (Zhou et al., 2023; Okojie et al., 2023; Baluszek et al., 2023).

H4: Employee resilience has a mediating role between planetary health environmental awareness (ecological, personal, and behavioural) and patients' quality of care.

RESEARCH METHODOLOGY

Introduction

This study employed a quantitative research approach grounded in the positivist philosophy and deductive reasoning. A survey strategy was adopted to collect numerical data through a structured questionnaire from frontline healthcare workers (FLHWs) in primary healthcare facilities across three districts of Punjab (Okara, Pakpattan, and Sahiwal). The methodology was designed to empirically test the hypothesized relationships among environmental awareness dimensions (ecological, personal, and behavioural), employee resilience, and patients' quality of care.

The selection of this methodological approach aligns with the study's objective of statistically examining cause-and-effect relationships between the constructs. According to Saunders et al. (2019), the positivist and deductive paradigms are appropriate for studies that begin with theory-driven hypotheses and test them using measurable data. This chapter therefore outlines the research philosophy, approach, strategy, sampling design, instrument development, and data collection procedures adopted to ensure validity and reliability of findings.

Research design

The main objective of this study is to investigate the impact of frontline healthcare planetary health awareness on patient's quality of care. Moreover, this study examined the mediating role of employee resilience between planetary health awareness and patient's quality of care. The research design explain the philosophy, research approach, strategy, choice, type and setting.

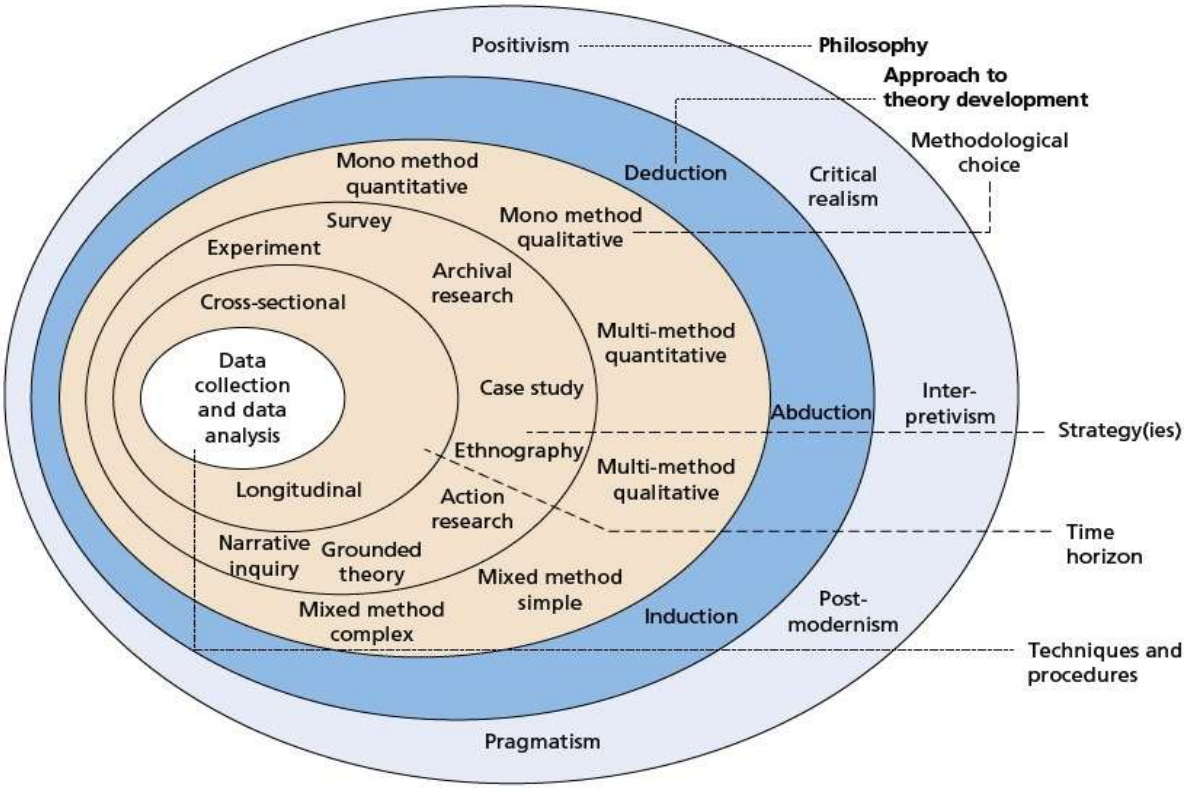

Figure 1. Research onion

Research philosophy

According to Saunders et al., (2019) research philosophy is the set of techniques toward data gathering of any event or phenomenon. Research philosophy is concerning with the study of basic and common problems and their systematic investigation of matters like values, knowledge, language, reasons and existence. The role of philosophy in business research is very important and based on assumption regarding the ways in which researcher outlook the world, on the basis of assumption research strategy and choice will decided (Saunders et al., 2019). The research philosophies were broadly classified into interpretivism/anti-positivist, positivism, realism and pragmatism. The pragmatism philosophy was incorporated when researcher has continuum positions rather than opposite position. In positivist research philosophy, researcher observed existing problems than gathered reliable data from different sources. The research formulate strategy for data collection, hypotheses were generate from existing theory, and then these hypotheses were test and confirmed the results. In the final stage further recommendations were given for future research work (Saunders et al., 2019).

In the current study, researcher developed the constructs from existing theories, generate hypotheses, adopt strategies for data collection and perform test to prove the proposed hypothesis. Therefore, the research philosophy adopted in this study is positivism.

Research approach

In research approach, researcher make procedures and plans to transform broad hypotheses into meaningful data format. Research approaches are useful to create a link between hypotheses and philosophies. The research approaches are divided into; deduction (testing theory) and induction (building theory). The induction approach is appropriate when sample size is small and develop theory on the basis of observations. In contrast, deduction approach test the existing theory and the large samples were collected. Robson (2002) described that deduction approach has five sequential stages;

- Formulate testable assumptions about association between two or more variables
- Defining operational terms of variables
- Hypotheses testing
- Analysis the results
- In the light of findings, modifying the theory if necessary.

The current research work was follow the all above sequential stages to analysis the association between frontline healthcare environmental awareness and patients care, and suggest directions for future research work. Thus, a deduction research approach was follow.

Research strategy

The selection of strategy was based on number of factors like research questions and objectives, available knowledge and theories, available resources and time, and researcher philosophical underpinning. Saunders et al. (2019) discussed the various strategies; experiment, survey, case study, action research, grounded theory, ethnography and archival research. The deductive research approach usually associated with survey strategy. Survey strategy allow the researcher to gathered numerical data that can be analyzed using inferential and descriptive statistics. Furthermore, survey strategy describe the possible reasons for particular association among variables.

The survey strategy was divided into questionnaire, interview or combination of both. The self-developed or adapted questionnaires/ interview questions were used. This was mainly depend on nature of research work. In current research setting, researcher used survey strategy with adapted questionnaires from reliable sources.

Research choice

The nature of research work has decided the research choice. The current nature of study is based on existing theory to analysis the association between healthcare employee environmental awareness and patient care with mediating role of resilience. The research choice is classified into qualitative and quantitative. When naturally occurring events and facts are gathered, the qualitative research was use. In contract, quantitative research choice was applied when social responses and facts were collected. In this research, human behavior responses were collected through adapted questionnaires, so research choice is quantitative.

4.2.5 Study type and setting

The nature of current study is causal which explain the cause and effect relationship among study variables. The research data was gathered in one time setting i.e. from January 2025 to February 2025 from frontline healthcare workers performing their duty in primary healthcare units in three districts of Punjab (Okara, Pakpatten and Sahiwal) at their place of working during official timing.

Population and sample

Study population

The term population in research means that all the study items in any field of investigation comprise population or universe (Kothari, 2004). According to Saunders et al. (2009) define the term population, it is the complete set of cases from which sample is drawn known as population of research study.

In the present study, the unit of analysis are healthcare employees working in the primary healthcare hospitals in Punjab. All the employees perform their duty at primary and secondary healthcare level. The primary healthcare sectors is comprise of district headquarter hospitals (DHQ's) at district level, tehsil headquarter hospitals (THQ's) at tehsil level, rural health centers (RHC's) and basic health unit (BHU) at town level in remote areas. In the current study, researcher selected primary healthcare units operating in division Sahiwal of Punjab; Okara, Pakpattan and Sahiwal. The following tables describe the detail of population.

Table 1. Research population

Name of District	No. of DHQ's	No. of THQ's	No. of RHC's	No. of BHUs
Okara	2	2	10	96
Sahiwal	1	2	10	75
Pakpattan	1	1	04	53
Total	**4**	**5**	**24**	**224**

Source: https://health.punjab.gov.pk/directory/reports/Division_and_district_wise_facilities.pdf

The researcher select primary healthcare sectors because for the last two years government revamp the primary hospitals and implement performance base reward system. Furthermore, new and improve techniques are introduce with information technology support to enhance the patients quality of care and monitoring system. In the presence of these techniques, the primary healthcare sector gives perfect atmosphere to confirm the proposed hypotheses.

Study sample

Sample is the representation of population. It is not possible to collect responses from entire population, sample provide constructive outcomes than cense study. Sampling technique is valid alternative when study of entire population is impracticable, budget constraints, time constraints and require quick results (Saunders et al., 2019). In order to determine the exact sample of the population, there are pre-define tables, formulas and online sites. The basic purpose of sample is that it represent the characteristic of entire population from which sample is taken. There are two errors attached with sampling; sampling errors and non-sampling errors. Sampling errors occurs due to selecting sample randomly and selection bias. Whereas data collection and processing problems are associated with non-sampling errors.

Inclusion criteria

Inclusion criteria define the study population in a uniform, consistent, reliable and objective manner. Inclusion factors may be confounder the outcomes parameter (Garg, 2016). On the bases of this criteria, other researchers make verdicts regarding its impact on external and internal validity of the outcomes. Such verdicts required in-

depth knowledge of the constructs as well as direction of each constructs (Patino & Ferreira, 2018). The inclusion criteria of this research study is as follow;

- The targeted population is frontline healthcare employees (nurses, LHV, midwife and others) working in government hospitals at primary levels (District, Tehsil & Rural).
- Employees appointed on regular and contracts basis at primary levels.
- Employees having experience of more than one year are included in the study.

The details of employee in above hospitals are acquired from district health information system (DHIS) and human resource management systems.

4.3.2.2 Sample size

The population is further divided into target population. In statistical context, sample mean the further subset of target population. Hence, sample is a segment of target population that is representative of the whole population (Kadam & Bhalerao, 2010). The sample size is generally depends on the factors like; level of significance (p), expected effect size, power of the study, event rate in the population and standard deviation in the population.

In the current research study, the sample is calculated through an online website "Raosoft". The recommended final simple size is 210 at 95% confidence level, 5% error of margin and 50% response distribution.

Sampling technique

The purpose of sampling technique is to provide series of techniques that enable researcher to reduce the amount of responses or data, needed for valid results of any research. The process in which samples are collected is termed as sampling technique. In sampling technique, the researcher gives considerable time for developing sample design. In sample design, researcher stay focus on type of universe, sampling units, source list, size of sample, parameters of interest, budgetary constraint and sampling procedures. The selection of sample design are based on two factors; representation basis (probability and non-probability) and element selection technique (restricted or unrestricted) (Kothari, 2004). According to Saunders et al. (2019) sampling technique is divided into probability or representative sampling and non-probability or judgmental sampling.

In probability sampling each element has an equal of being selected from the study population and chance for element selection in non-probability sampling is not known. The experimental and survey strategies are often associated with probability sampling. Furthermore, probability sampling achieve the research objectives, gives possible answers to questions and estimate the characteristics of population through sample (Saunders et al., 2019).

In the current research study, researcher adapt probability sampling technique which has four stages; 1. Sampling frame, 2. Suitable sample size, 3. Appropriate sampling technique and 4. Sample is the representative of population. Probability sampling has five main sampling techniques; simple random, systematic, stratified random, cluster and multi-stage sample.

In this research work, researcher used simple random sampling technique to select the sample from sampling frame using computer generated list of employees. The list of the staff is generated from website or spreadsheet, to ensure the selection of every item the repeated person will be ignored and replaced. A complete list of population are stored in computer and possible to select sample of randomly selected cases.

Although the data were collected from multiple districts and healthcare units (DHQ, THQ, RHC, and BHU), the study employed a simple random sampling technique instead of stratified sampling. This choice was made because all respondents regardless of district or healthcare unit shared similar job characteristics, professional duties, and exposure to environmental awareness training, thereby representing a relatively homogeneous population. According to Etikan and Bala (2017), simple random sampling is appropriate when subgroups within the population do not differ substantially in characteristics related to the study variables.

Furthermore, a stratified sampling approach was not feasible due to unequal staff distributions across healthcare units and the absence of complete sampling frames for each stratum. Therefore, simple random sampling ensured that every eligible frontline healthcare worker had an equal and independent chance of being selected, minimizing selection bias while maintaining practicality in the field context.

Research instruments and measurement scale

Research instruments

The researcher applied survey strategy to achieve the current objectives and measure the hypotheses that provide base for the possible acceptance or rejection of those hypotheses. In business and management research, study constructs are measured through questionnaire and interview.

In current research, researcher adapted questionnaire as an instruments to measure the proposed association between constructs. The questionnaires must cover all the aspects of main and sub constructs. Questionnaire was divided into two parts; demographic and questionnaire related to constructs. In demographic section, respondents give responses to their gender, length of services, education and department. In the second section, questions related to study constructs i.e. employee planetary health environmental awareness, employee resilience and patients' quality of care.

Employees environmental awareness

In the study, the employee environmental awareness constructs is sub-divided into ecological awareness, personal awareness and behavioural awareness. A four items scale related to ecological awareness was adapted from Dönmez and Yardımcı, (2024). Moreover, three items related to personal awareness dimension was adapted from

Dönmez and Yardımcı, (2024). Finally, the four items of behavioural awareness dimension was adapted from Dönmez and Yardımcı, (2024).

This study specifically focuses on one dimension of planetary health, namely environmental awareness. It has been operationalized through three key sub-dimensions; ecological awareness, personal awareness, and behavioural awareness adapted from Dönmez and Yardımcı (2024). The study did not include other planetary health dimensions (e.g., biodiversity conservation, food security, or social equity); therefore, all analyses and inferences are confined to the environmental-awareness aspect of planetary health.

Employee resilience

In the study, employee resilience has a mediating role between employee environmental awareness and patients' quality of care. The items related to employee resilience was adapted from past studies. A five items scale was adapted from Obeng and Atan, (2024).

Patients quality of care

In the study, patients' quality of care has an outcome / endogenous variable. Again, items related to patients' quality of care were adapted from prior studies. A seven items scale of patient quality of care was adapted from L. Salomon et al. (1999). Moreover, all items were reworded to reflect healthcare workers' viewpoint to ensure alignment between the construct and the respondent group.

Measurement of the scale

The research strategy applied in current research work is survey and research choice is quantitative. Quantitative survey is divided into nominal and categorical scale. The measurement of categorical variable is not possible through numerically but nominal survey method can be measure numerically (Saunders et al., 2019). To predict the relationship among study variables, the researcher used nominal measurement of scale. In survey strategy, to collect the respondents' opinion through well-administrated adapted questionnaires as attached in appendix. This questionnaire's used to predict the level of relationship among study variables. The questionnaire was divided into background and variables questions. The respondents give the basic details relating to their age, education, experience and designation in first section of the questionnaire. The second portion is the soul of questionnaire where study variables questions are write down. To measure the respondents response there are various scale, research used Likert rating scale. The Likert rating scale also categorized into three, four, five and seven point Likert rating scale. The most cited Likert rating scale is 5-point Likert rating scale, evidences available from previous research work, where 01 indicate that respondents are strongly disagree with the statement and 05 indicated that respondents are strongly agree with statement.

Data collection

Primary data collection

In business and management research, primary data are collected through interview, observations, experiments and questionnaire techniques. In the survey study researcher used questionnaire as a primary source of data collection. The nature of these questionnaires are self-administered are generally completed by respondents. The response collected through internet is known as internet-mediated questionnaire. All the questionnaire are measured through Likert-style rating scale with agreement rating type. Primary data is serve as the original source of data because data are collected by firsthand. But the collection of primary data is quite expensive and time consuming activity.

Data were collected from four types of primary healthcare units, District Headquarter Hospitals (DHQ), Tehsil Headquarter Hospitals (THQ), Rural Health Centers (RHC), and Basic Health Units (BHU) operating under the Government of Punjab. To ensure proportional representation, respondents were recruited using stratified convenience sampling. Each healthcare unit type represented a stratum, and participants were selected based on their availability and willingness to participate during official working hours.

Specifically, data were collected from approximately 40% of respondents from BHUs, 30% from RHCs, 20% from THQs, and 10% from DHQs, reflecting the relative size and staffing structure of these facilities within the selected districts. In each unit, the researcher approached nurses, lady health visitors (LHVs), midwives, and dispensers who met the inclusion criteria (i.e., one year or more of continuous service). This approach ensured adequate representation of healthcare workers from both basic and secondary healthcare tiers while maintaining feasibility in data collection.

Data analyze

The collected data were analyzed using IBM SPSS Statistics (Version 26). A series of statistical procedures were applied to ensure accuracy, reliability, and validity of the dataset prior to hypothesis testing. Descriptive statistics, including mean, standard deviation, and frequency distribution, were used to summarize respondents' demographic characteristics and responses to each construct.

To test the hypothesized relationships among variables, simple linear regression analysis was performed. This method was selected because the study aimed to examine the direct effect of environmental awareness dimensions (ecological, personal, and behavioural) on patient care quality, and the mediating role of employee resilience. Regression analysis is appropriate for identifying the strength and direction of associations between independent and dependent variables (Field, 2013).

The statistical significance level was set at $p < 0.05$, indicating that relationships with a probability value below this threshold were considered statistically significant. Results were presented through standardized coefficients (β-values), R^2 values, and significance levels to evaluate the proposed hypotheses.

Pilot study

Before executing the final survey, the adapted questionnaire must undergo pretesting and pilot testing. A pilot study or testing is a limited study to refine the questionnaire so that respondents have no problems answering the questions (Saunders et al., 2019). Figure 4.2 shows the steps involved in pilot testing. Furthermore, it also helps to obtain the reliability and validity of the data.

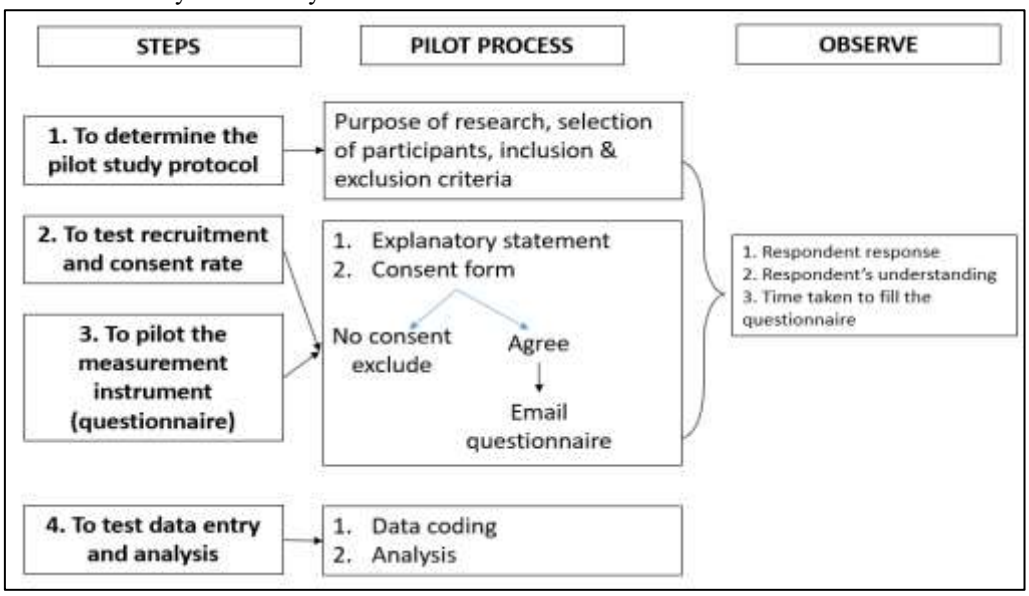

Figure.2. Pilot test process

Research Ethics

Ethics has become a keystone in conducting effective and meaningful research. According to Saunders et al. (2019), research ethics refers to the "standards of behavior that guide researcher conduct in relation to the rights of study subjects or are affected by it." In any research study, the researcher is primarily responsible for complying with research ethics. If this is not done, it is considered a scholarly crime that brings disrepute to the research community. Saunders et al. (2015) indicated general categories of ethical issues recognized as codes of ethics. In general, the ethical considerations are that the researcher should maintain integrity and fairness during the research process. Moreover, the researcher should give respect to respondents and maintain their privacy during and after the research process. It is the researcher's ethical responsibility to maintain data confidentiality and autonomy. Additionally, respondents don't need to give responses, and their participation in the research process is entirely voluntary, and they have the right to withdraw at any time. Figure 4.3 shows the research ethics during different stages of research.

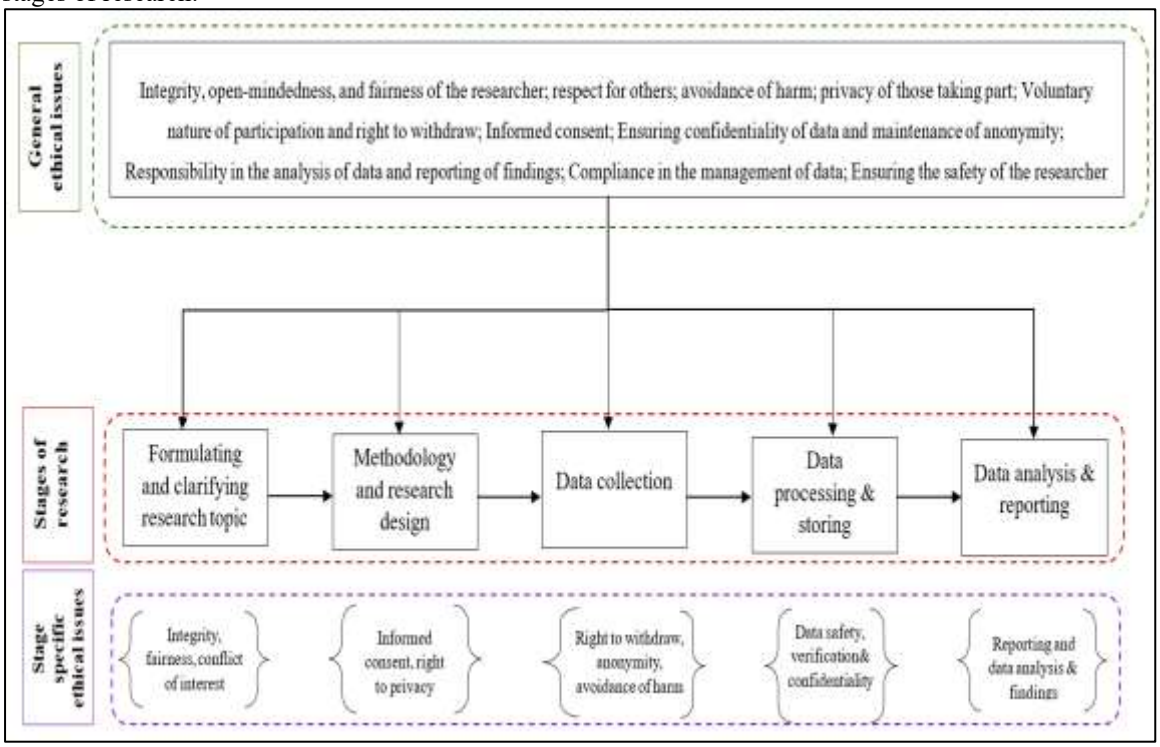

Figure 3: Research Ethics in different stages of Research

Source: Saunders et al. (2015)

Data Analysis

Introduction

A total of 250 questionnaires were distributed among frontline healthcare workers (FLHWs) across District Headquarter Hospitals (DHQs), Tehsil Headquarter Hospitals (THQs), Rural Health Centers (RHCs), and Basic Health Units (BHUs) located in three districts of Punjab; Okara, Pakpattan, and Sahiwal. Out of these, 217 valid responses were received and retained for analysis after data screening and validation. This represents an overall response rate of 86.8%, which is considered satisfactory for survey-based research in social and healthcare settings (Baruch & Holtom, 2008). The following sections present the demographic characteristics of the respondents and the results of descriptive, reliability, and hypothesis-testing analyses.

Demographic analysis

The demographic section was divided into gender, experience, position, institution, and shift analysis as shown in Table 5.1. In a nutshell, the female frontline employees having experience 11-15 years and working on LHV position in the evening shift actively participated in the survey.

Table 2. Demographic analysis

Items		**Frequency**	**Percent**
Gender	Male	19	8.80
	Female	198	91.20
Experience	Less than 5 years	44	20.30
	10-15 years	82	37.80
	11-20 years	69	31.80
	More than 20 years	22	10.10
Position	Staff Nurse	64	29.50
	LHV	76	35.00
	Midwife	58	26.70
	Others	19	8.80
Institution	DHQ	64	29.50
	THQ	62	28.60
	RHC	49	22.60
	BHU	42	19.40
Shift	Morning	24	11.10
	Evening	90	41.50
	Night	26	12.00
	Rotating	77	35.50

Gender analysis

In the survey questionnaire, the respondents complete their gender identify with three options; male, female, no to say. Figure 5.1 shows the gender frequency. From the figure more than 91 percent (198) respondents fall under female category. Whereas, only 8.80% (19) respondents fall under male category. All the respondents reveal their gender identity. Thus, no response in third category.

The results indicated that a large proportion of respondents were female. This distribution accurately reflects the gender composition of Pakistan's frontline healthcare workforce, where the majority of primary-level service providers such as nurses, lady health visitors (LHVs), midwives, and community health workers are women (WHO, 2022; Pakistan Bureau of Statistics, 2021). These roles are traditionally female-dominated due to historical patterns in health service staffing and cultural expectations surrounding caregiving professions. Therefore, the higher percentage of female respondents does not represent sampling bias but rather mirrors the actual demographic structure of government primary healthcare facilities in the study districts.

Moreover, female healthcare workers play a central role in implementing preventive and community-based health programs, which makes their responses particularly relevant to understanding environmental awareness and quality of care. This gender composition, therefore, strengthens the representativeness of the sample rather than limiting it.

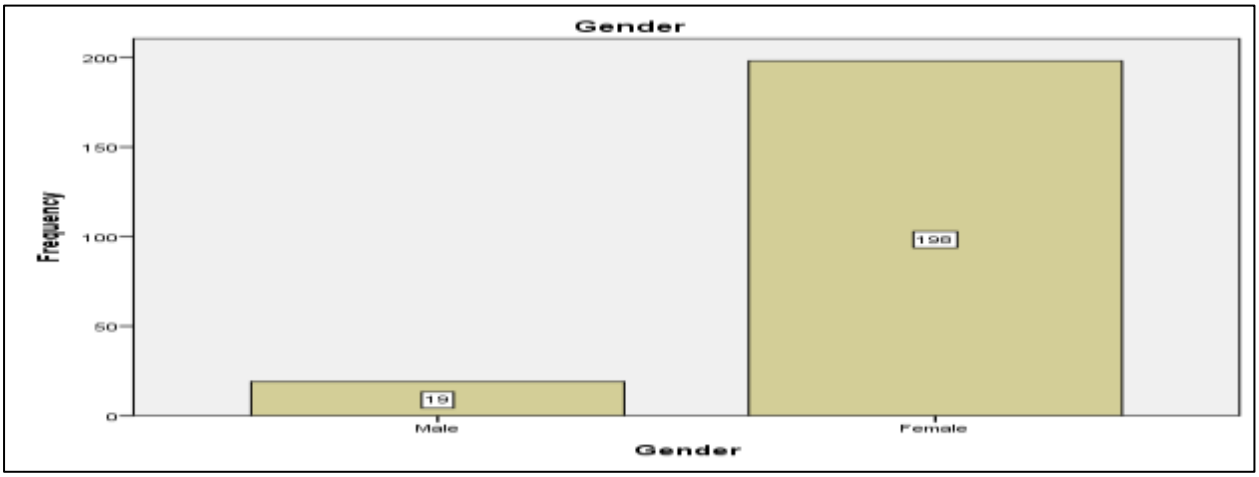

Figure 4. Gender analysis

Working analysis

In the survey questionnaire, the respondents complete their working experience with four options; less than 5 years, 10-15 years, 11-20 years and more than 20 years. Figure 5.2 shows the experience frequency. From the figure more than 20 percent (44) respondents fall under 1st category, 37.80% (82) in 2nd category, 31.80% (69) in 3rd category and only 22 (10.10%) fall under fourth category.

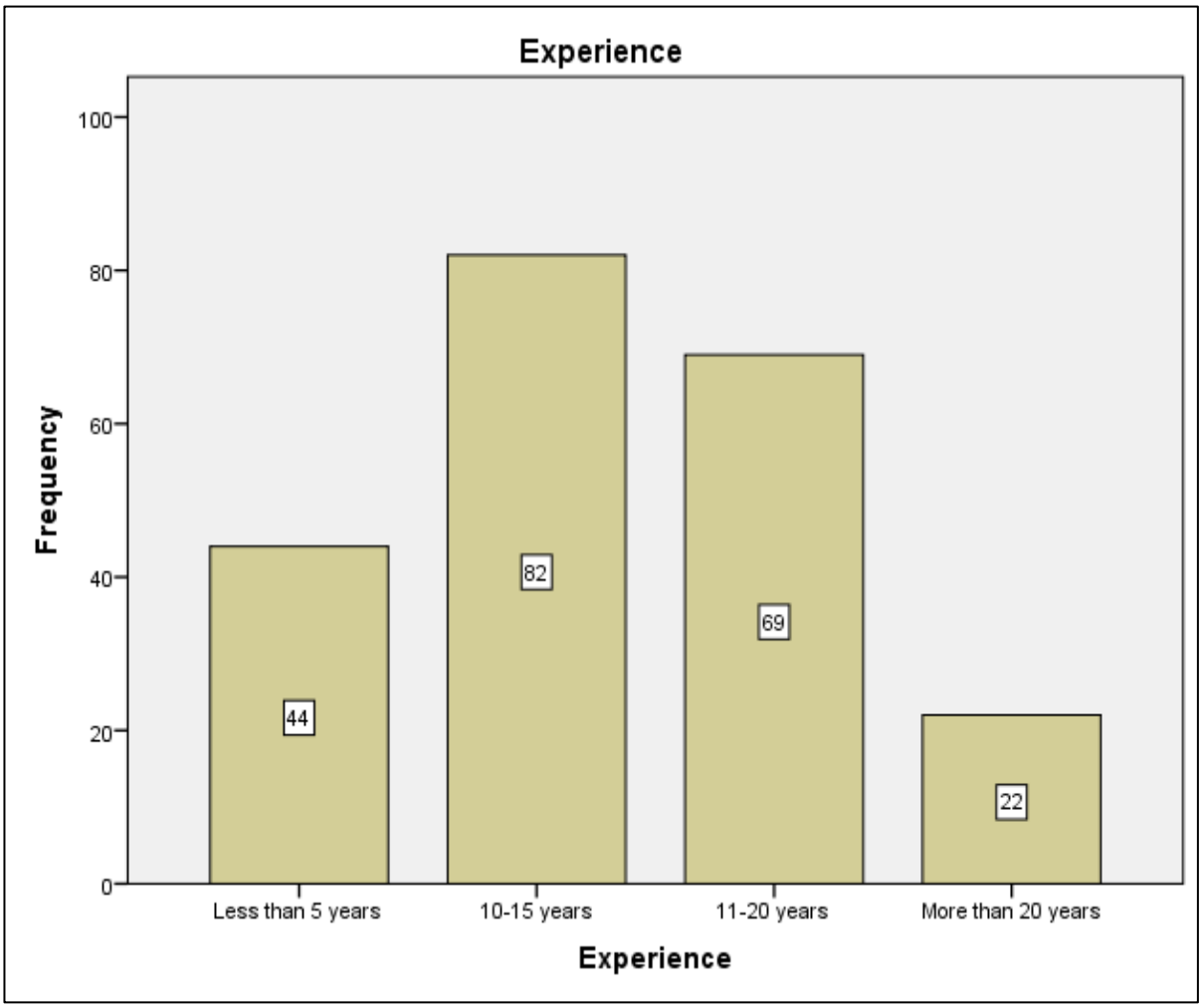

Figure 5. Working experience analysis

Position held analysis

In the survey questionnaire, the respondents complete their position/designation background with four options; staff nurse, LHV, midwife, and others. Figure 5.3 shows the position frequency. From the figure, 29.50 percent (64) respondents fall under 1st category, 35% (76) in 2nd category, 26.70% (58) in 3rd category and only 19 (8.80%) fall under fourth category.

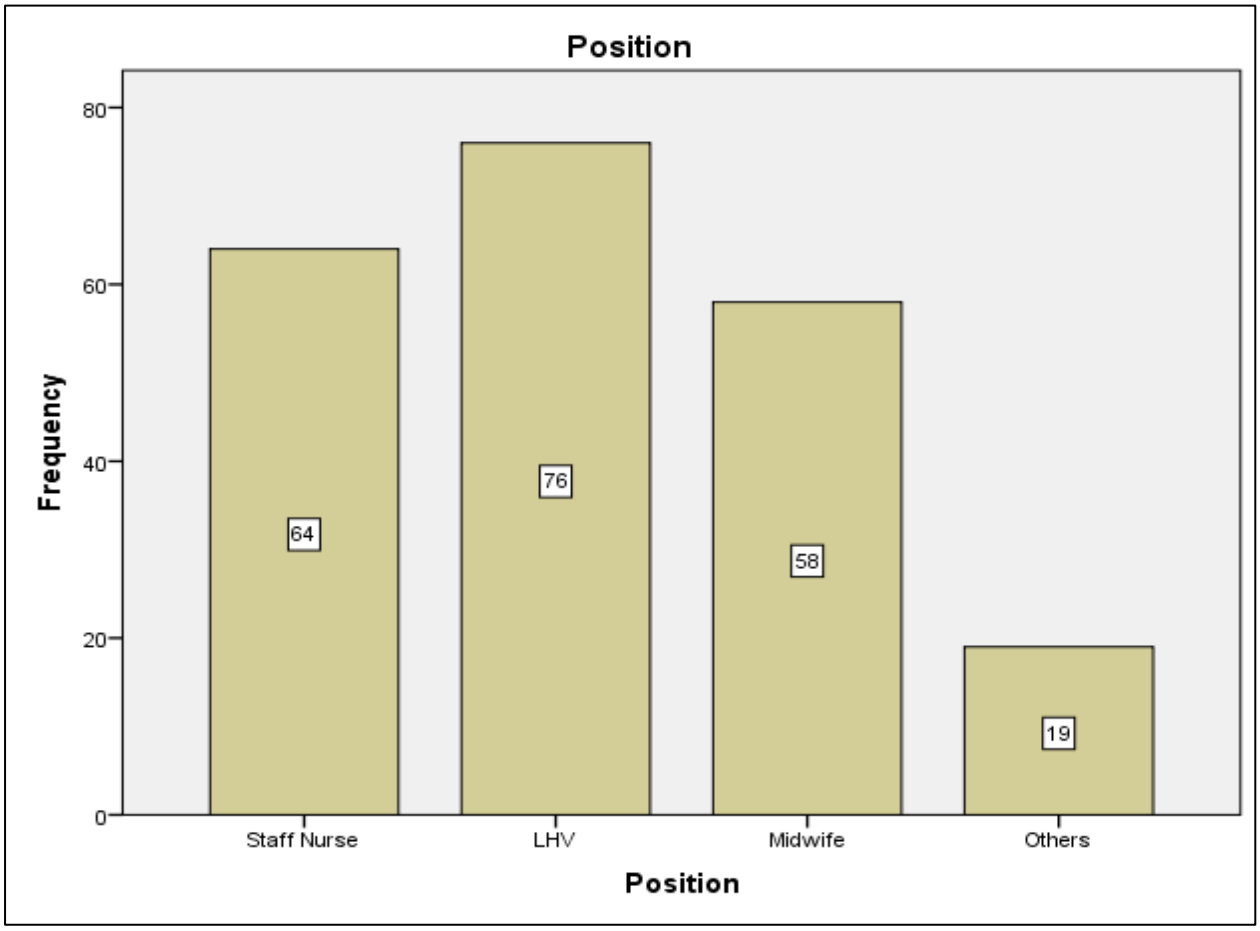

Figure 6. Respondent's position analysis

Institution analysis

In the survey questionnaire, the respondents complete their institution background with four options; DHQ, THQ, RHC and BHU. Figure 5.4 shows the institution frequency. From the figure, 29.50 percent (64) respondents fall under 1st category, 28.60% (62) in 2nd category, 22.60% (49) in 3rd category and only 42 (19.40%) fall under fourth category.

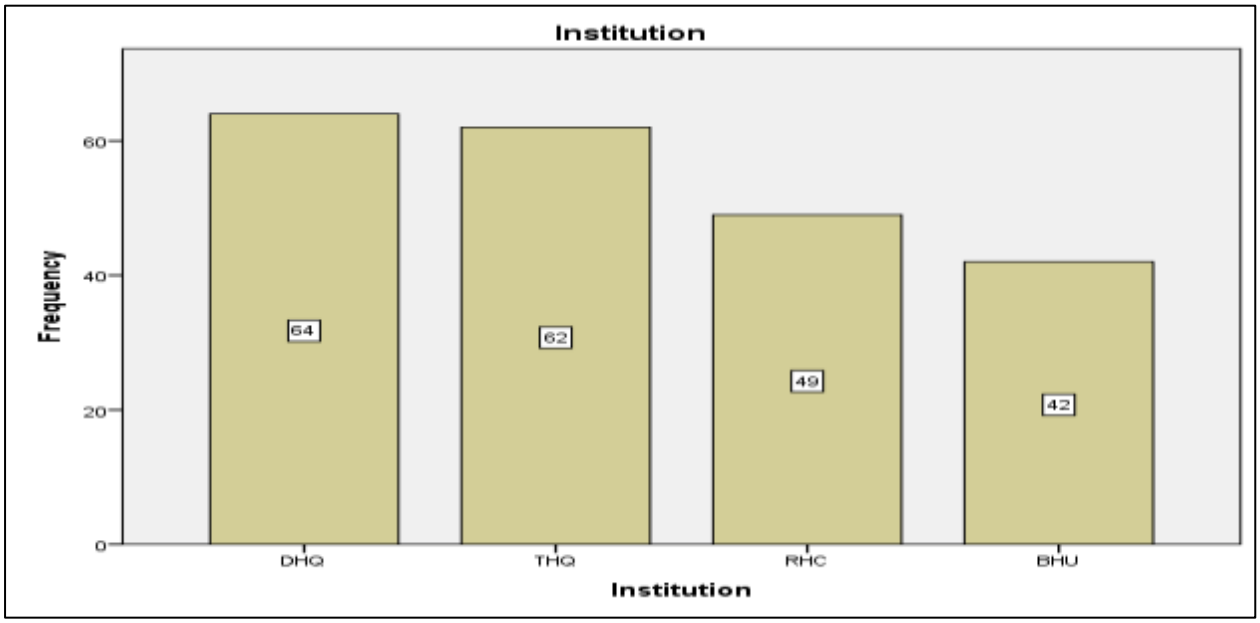

Figure 7. Respondent's institution analysis

Shift analysis

In the survey questionnaire, the respondents complete their shift analysis with four options; morning, evening, night and rotating. Figure 5.5 shows the shift frequency. From the figure, 11.10 percent (24) respondents fall under 1st category, 41.50% (90) in 2nd category, 12% (26) in 3rd category and only 77(35.50%) fall under fourth category.

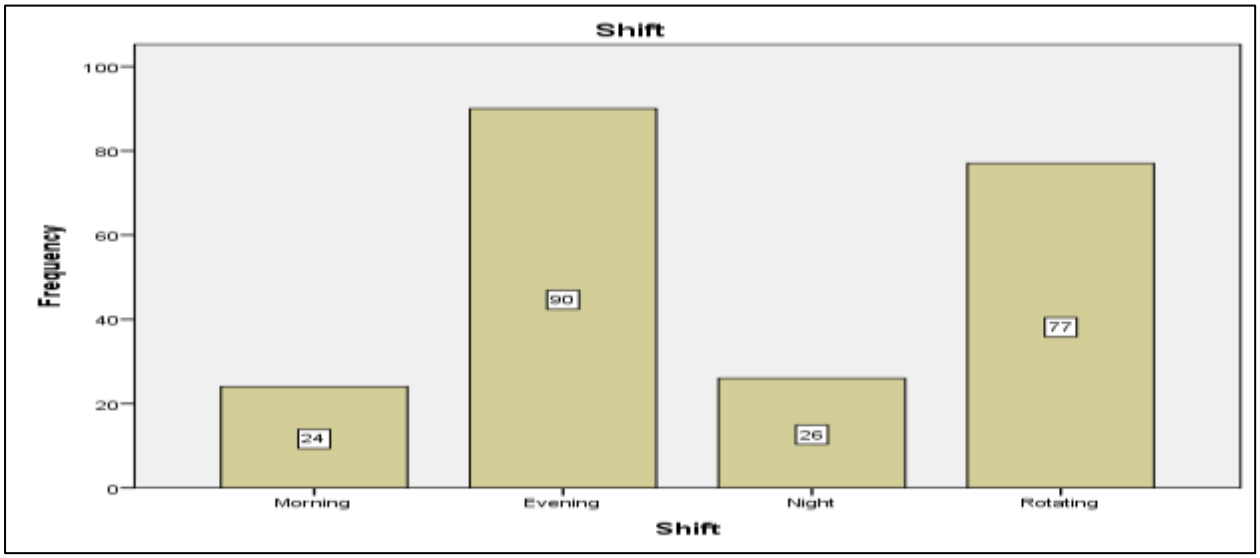

Figure 8. Respondents shift analysis

Descriptive analysis

The descriptive statistic table describe the development of certain indices from raw data. This statistical measure used to summarize the research data in the form of measure of central tendency (mean, median or mode), measure of dispersion (SD, variance) and measure of asymmetry (Skewness and Kurtosis).

Table 5.2 shows the data of 217 responses with minimum, maximum, mean, standard deviation (S.D), skewness and kurtosis. From the table the mean value of all study variables range from 3.081 to 3.399. On the other hand the S.D value of EA is 0.971, PA is 0.829, BA is 0.849, ER is 0.931 and PQC is 1.128. On the other hand, the skewness and kurtosis tell the shape of probability distribution. Skewness measure the asymmetry and kurtosis measure the flatness or tallness. All constructs are negatively skewed which means left tail is more skewed. Likewise, the kurtosis values of all variables are negative, which mean that the distribution is light tail and called platykurtic.

Table 3. Descriptive analysis

Variables	N	Min	Max	Mean	S.D	Skewness	Kurtosis
EA	217	1	5	3.210	0.971	-0.082	-0.787
PA	217	1.5	5	3.233	0.829	-0.043	-0.680
BA	217	1	5	3.251	0.849	-0.187	-0.264
ER	217	1	5	3.399	0.931	-0.322	-0.284
PQC	217	1	5	3.081	1.128	-0.010	-0.978

Reliability analysis

The most frequent method to calculate the reliability or internal consistency of the constructs is Cronbach's Alpha. This technique required that scale items must be at a regular intervals (Sreejesh et al., 2014). The value of alpha vary between 1 (perfect) and 0 (no reliability). As the rule of thumb, the Cronbach's Alpha value 0.80 is consider as the acceptable level of internal reliability but many researchers emphasized that 0.60 is the minimum value of internal reliability.

Table 5.3 shows the reliability analysis of all study variables. The reliability of four items of EA is 0.693, three items of PA is 0.701, four items of BA is 0.698, five items of ER is 0.820, and seven items of PQC is 0.882. All the constructs have achieved the minimum threshold value of Cronbach's Alpha.

Table 4 Reliability analysis

Variables	Items	Cronbach's Alpha
EA	4	0.693
PA	3	0.701
BA	4	0.698
ER	5	0.820
PQC	7	0.882

Validity analysis

According to Bryman and Cramer (2012) describe the term validity that refer to the issue whether the set of constructs that is develop to estimate a concept really measures that concept. The sample adequacy was measured through Kaiser-Meyer-Olkin (KMO) and Bartlett's test. As general guideline, value 0.60 is the minimum acceptable limit, value greater than 0.70 depicted good, greater than 0.80 depict very good and greater than 0.90 depict excellent results. The greater value describes that chance that correlation matrix is not an identity matrix is greater and null hypothesis will be rejected (Sreejesh et al., 2014).

Table 5.4 indicates the value of KMO is 0.846, which means that sampling adequacy is very good and correlation matrix is not identity matrix with significance value 0.00. The validity results is acceptable for further analysis.

Table 5 KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.846
Bartlett's Test of Sphericity	Approx. Chi-Square	367.954
	df	10
	Sig.	0.000

Table 5.5 shows the component matrix analysis. This table describe the level of association among all research items from a large set of variables to a small set of factors for additional analysis like correlation and regression analysis. The variables components are extracted through principal component analysis. All the variables achieved the minimum threshold values.

Table 6. Component Matrix analysis

Variables	**Component**
	1
EA	0.776
PA	0.711
BA	0.717
ER	0.819
PQC	0.827

Extraction Method: Principal Component Analysis.

a 1 components extracted.

Correlation analysis

The relationships among study variables are determined through correlation test. Correlation test measure the association level and direction of the variables. The correlation range from -1 to +1, the positive sign indicated that positive correlation whereas negative sign depicted that negative correlation between variables. The most cited correlation method is Pearson correlation.

Table 5.6 shows the correlation among independent, mediating and dependent variables. The direction of all the study variables is positive. When correlation fall between ± 0.10 to ± 0.29, means weak relationship, ± 0.30 to ± 0.49 indicated that moderate correlation and ± 0.50 to ±1.0 depicted that strong correlation (Cohen, 1988). From table, all the independent EA (0.577), PA (0.469), & BA (0.489), and mediating variable ER (0.615) have strong correlation with dependent variables.

Table 7. Correlation analysis

Variables	**EA**	**PA**	**BA**	**ER**	**PQC**
EA	1				
PA	.462**	1			
BA	.398**	.402**	1		
ER	.542**	.455**	.513**	1	
PQC	.577**	.469**	.489**	.615**	1

N= 217, ** Correlation is significant at the 0.01 level (1-tailed)

Regression analysis

Direct-path analysis

To measure the direct association between independent variables (EA, PA & BA) and PQC, liner regression analysis was performed.

In the model-1 the value of R2=0.577, which describe that model-1 explain 57% variance in the data. Moreover, un-standardized coefficient is 0.670 with level of significance is 0.00. This indicates that EA has positive relationship with PQC. Thus, H1 has accepted.

In the model-2 the value of R2=0.220, which describe that model-2 explain 22% variance in the data. Moreover, un-standardized coefficient is 0.638, and t-value is 7.779 with level of significance is 0.00. This indicates that PA has positive relationship with PQC. Thus, H2 has accepted.
In the model-3 the value of R2=0.239, which describe that model-3 explain 23.9% variance in the data. Moreover, un-standardized coefficient is 0.650, and t-value is 8.219 with level of significance is 0.00. This indicates that BA has positive relationship with PQC. Thus, H3 has accepted.

Table 8. Direct analysis

Model	Path	R	R^2	Unstandardized beta	Standardized beta	t-value	Sig.
1	EA→PQC	0.577	0.330	0.670	0.577	10.365	0.00
2	PA→PQC	0.469	0.220	0.638	0.469	7.779	0.00
3	BA→PQC	0.486	0.239	0.650	0.489	8.219	0.00

Indirect analysis
An informal way is adapted to measure effect of mediation on independent and dependent variables. The most cited method for testing the mediation was illustrated by Barron & Kenny (1986). To establish the mediation, this informal method has four steps (Baron and Kenny, 1986; Judd and Kenny, 1981; James and Brett, 1984).
• Significant relationship between predictor and criterion variables (Path C).
• Predictor construct significantly connected with mediating variables (Path A).
• Significant association between mediating and criterion variables (Path B).
• The effect of predictor and criterion variables is not significant (Path C'), when control the effect of mediating variables on the criterion.
Table 8 shows the mediation analysis between frontline healthcare employee's environmental awareness (EA, PA, & BA) and patients' quality of care (PQC) with employee resilience (ER) as mediating variable. Based on the Baron and Kenny (1986), the direction association between all sub-dimensions of environmental awareness (EA, PA, & BA) and positive and significant (1st step, path c). In the 2nd step, the relationship of EA→ER (β= 0.542, t-value= 9.393, p= 0.000), PA→ER (β= 0.455, t-value= 7.174, p= 0.000), and BA→ER (β= 0.513, t-value= 8.758, p= 0.000) are positive and significant. In the 3rd step (path b), the relationship of ER→PQC (β= 0.615, t-value= 11.436, p= 0.000) are positive and significant. Finally, the 4th step (path c`) indicates a positive and significant relationship. Thus, ER has partial mediating role between frontline healthcare employee's environmental awareness (EA, PA, & BA) and patients' quality of care (PQC).

Table 9. Mediation analysis

Input	Mediator	Model	Beta (β)-value	t-value	p-value
EA	ER	EA→ER (path a)	0.542	9.393	0.000
		ER→PQC (path b)	0.615	11.436	0.000
		EA→ER (path c`)	0.428	7.174	0.000
PA		PA→ER (path a)	0.455	7.491	0.000
		ER→PQC (path b)	0.615	11.436	0.000
		PA→ER (path c`)	0.507	8.691	0.000
BA		BA→ER (path a)	0.513	8.758	0.000
		ER→PQC (path b)	0.615	11.436	0.000
		BA→ER (path c`)	0.494	8.144	0.000

DISCUSSION AND CONCLUSION

Introduction
In this chapter, the researcher discussed the statistical results with the support of previous research work. The researcher develop logical linkages with research questions, hypotheses and statistical outcomes. Then researcher draws a conclusion on the basis of results. The research limitations, implications and recommendations for future researcher are also part of this chapter.
Discussion on findings
The main purpose of this study is to investigate the role of frontline employee environmental awareness to promote patients' quality of care through the mediating role of employee resilience. Based on the social cognitive theory, the logical relationships were developed and analyse through regression analysis. The following sections discuss the empirical findings in detail.
RO1: To analyse the role of employee planetary-health environmental awareness (ecological, personal, and behavioural) to promote patients' quality of care.

To achieve this research objective, three hypotheses were developed (H1-3). The H1 suggests that when FLHWs understand the connections between environmental factors and health outcomes (e.g., air pollution and respiratory diseases), they are better equipped to provide effective patient care. This could manifest in various ways, such as educating patients about environmental risks, implementing preventive measures, or advocating for healthier environments within healthcare facilities. The literature highlights that globally, nurses and community health workers are increasingly recognized as planetary health innovators, capable of mitigating environmental risks and educating communities on climate-resilient practices. This is further supported by Asaduzzaman et al., (2022), which indicates the potential for environmental awareness to improve the patients' quality of care.

The hypothesis H2 posits that when FLHWs are conscious of their own environmental impact and responsible behaviors (e.g., reducing waste, conserving energy), they are more likely to translate this into improved patient care practices. For instance, they might be more diligent about proper medical waste disposal or advocate for more sustainable resource use within their facilities. Prior literature highlight the issue that Pakistan's National IPC Guidelines are narrowly focused on biomedical protocols, neglecting ecological health synergies. Also, the importance of sustainable medication disposal programs and the integration of environmental awareness into disaster preparedness education highlight the potential influence of personal awareness on the quality of patient care.

The H3 hypothesis suggests that when FLHWs actively promote sustainable health practices among patients and communities (e.g., advising on clean cooking fuels, promoting water conservation), it leads to better patient outcomes. The literature highlight that FLHWs' localized knowledge positions them to implement interventions with environmental co-benefits. It also mentions that FLHW's awareness of planetary health principles includes promoting sustainable health practices among patients and communities, such as advising on clean cooking fuels or preventive measures against heat stress.

Conclusively, the findings indicate that employee planetary-health environmental awareness (ecological, personal and behavioural) has positive and significant impact on patients' quality of care. Thus, H1, H2 and H3 were accepted.

RO2: To analyse the mediating role of employee resilience between employee planetary-health environmental awareness and patients' quality of care.

To achieve the RO2, a single hypothesis (H4) has been developed. The H4 hypothesis proposes that resilience is the mechanism through which the positive effects of planetary health environmental awareness are transmitted into practice, enhancing the quality of care patients receive. It recognizes that FLHWs often operate in challenging conditions, and their resilience is crucial for translating awareness into tangible improvements in patient care. The document mentions that resilience enables FLHWs to adapt to challenging working conditions, manage stress effectively, and maintain high standards of care despite systemic barriers.

The literature indicates that FLHWs operate under resource-constrained and environmentally vulnerable conditions, which are compounded by a lack of awareness and integration of planetary health principles into healthcare delivery. The literature also affirmed that resilient healthcare workers are better equipped to integrate ecological considerations into their clinical decision-making processes while coping with the psychological and physical demands of their roles. Based on above discussion, H4 was accepted.

Theoretical contributions

This research makes notable theoretical contributions by integrating Social Cognitive Theory (SCT) into the under-explored intersection of planetary health, healthcare delivery, and workforce dynamics, especially within resource-constrained contexts like Pakistan. First, it validates SCT's applicability by demonstrating how ecological, personal, and behavioural dimensions of environmental awareness among frontline healthcare workers (FLHWs) influence their patient care practices, emphasizing the roles of self-efficacy and observational learning in promoting sustainable healthcare. Second, the study contributes to resilience literature by empirically establishing employee resilience as a mediator, showing how it enables FLHWs to translate environmental awareness into improved patient outcomes despite systemic barriers.

The research also enhances planetary health environmental awareness literature by contextualizing it within a developing nation, Pakistan, where FLHWs can serve as key planetary health stewards. The existing literature lacks context on what is important to the healthcare workforce while providing patient care. The study underscores the importance of integrating environmental determinants of health into patient care literature, highlighting the potential for empowered FLHWs to deliver quality care through innovative and sustainable methods. Finally, by acknowledging systemic challenges faced by FLHWs in resource-scarce settings, this study contributes to the need for resilient healthcare workforce in Pakistan to ensure the sustainability and quality of their practices. Through these insights, the research provides a foundation for empowering FLHWs to integrate environmental consciousness into their patient care practices, promoting better health outcomes while advancing environmental sustainability.

Practical implications

The research findings, hold several practical implications for improving healthcare delivery and promoting planetary health principles within the context of frontline healthcare workers (FLHWs) in Pakistan;

- Curriculum Enhancement: Health managers should advocate for integrating planetary health concepts into FLHW training programs. This can be achieved through revising existing curricula to include modules on environmental determinants of health, sustainable healthcare practices, and community engagement strategies.

- Resource Allocation: Allocate resources to support FLHW-led initiatives focused on environmental sustainability. This might involve providing funding for community-based projects, procuring eco-friendly supplies for healthcare facilities, or establishing systems for proper medical waste management.
- Empowerment: Invest in resilience-building programs for FLHWs. These programs can enhance their ability to cope with stress, adapt to challenging work environments, and deliver high-quality care despite resource limitations.
- Monitoring and Evaluation: Implement robust monitoring and evaluation systems to track the impact of planetary health interventions on patient outcomes and environmental sustainability. This data can inform evidence-based decision-making and guide future resource allocation.
- Policy Reform: Advocate for policy reforms that align Pakistan's National Health Vision with planetary health principles. This can include setting targets for reducing healthcare carbon footprints, incentivizing sustainable practices in healthcare facilities, and promoting cross-sectoral collaboration on environmental health issues.
- Community Engagement: Engage communities in participatory processes to identify their environmental health needs and co-design sustainable solutions. This approach ensures that interventions are contextually relevant, culturally appropriate, and aligned with community priorities.
-

Limitations and future research direction

This research, while valuable in exploring the intersection of planetary health awareness and patient care among FLHWs in Pakistan, is subject to certain limitations. One key limitation stems from the study's design, which employs a quantitative research approach across three districts of Punjab province. The quantitative analysis provides valuable insights into the relationships between FLHWs' environmental awareness, resilience, and patient care quality. However, it may not fully capture the nuanced experiences and perspectives of FLHWs in diverse contexts. The cross-sectional nature of the study further limits the ability to establish causal relationships definitively, as it only captures data at a single point in time. The study is also limited by relying heavily on data about FLHWs who are lady health workers. While that helps limit the pool of external factors that influence the study, it potentially limits the scope of its conclusions. Additionally, the study's focus on FLHWs in Punjab province may limit the generalizability of findings to other regions of Pakistan or low-resource settings with different socio-ecological contexts and healthcare infrastructure. Measurement issues may arise from reliance on self-reported data, which may be subject to social desirability bias or recall bias, affecting the accuracy of the assessment of FLHWs' awareness, resilience, and patient care quality. Finally, the study may not fully account for other organizational and systemic factors that influence FLHWs' behaviors and patient outcomes, such as the availability of resources, leadership support, or policy frameworks.

To address these limitations and advance knowledge in this field, future research should pursue several avenues. Longitudinal studies tracking changes in FLHWs' environmental awareness, resilience, and patient care quality over time would provide stronger evidence of causality. Mixed-methods designs combining quantitative analysis with qualitative interviews or focus groups would offer richer insights into the experiences and challenges faced by FLHWs in integrating planetary health principles into their practice. Comparative studies across different regions of Pakistan or low-resource settings would help identify contextual factors influencing the relationship between environmental awareness, resilience, and patient care quality. Intervention studies evaluating the effectiveness of training programs or policy interventions aimed at enhancing FLHWs' environmental literacy and resilience would provide valuable guidance for policymakers and healthcare managers. Future research should also explore the organizational and systemic factors that facilitate or hinder the integration of planetary health into healthcare delivery, such as the role of leadership, organizational culture, and inter-sectoral collaboration. Finally, research could examine the impact of specific environmental health interventions on patient health outcomes and the overall sustainability of healthcare systems. By addressing these research gaps, we can build a more comprehensive evidence base for empowering FLHWs as planetary health stewards and improving the quality and sustainability of healthcare in Pakistan and similar settings.

REFERENCES

1. Asaduzzaman, M., Ara, R., Afrin, S., Meiring, J. E., & Saif-Ur-Rahman, K. M. (2022). Planetary health education and capacity building for healthcare professionals in a global context: current opportunities, gaps and future directions. International journal of environmental research and public health, 19(18), 11786.
2. Baluszek, J. B., Brønnick, K. K., & Wiig, S. (2023). The relations between resilience and self-efficacy among healthcare practitioners in context of the COVID-19 pandemic–a rapid review. International Journal of Health Governance, 28(2), 152-164.
3. Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. Journal of personality and social psychology, 51(6), 1173.
4. Bleys, B., Defloor, B., Van Ootegem, L., & Verhofstadt, E. (2018). The environmental impact of individual behavior: self-assessment versus the ecological footprint. Environment and Behavior, 50(2), 187-212.
5. Briggs, S. (2023). Building climate resilient and low carbon health systems. bmj, 383.

6. Brown, M. J., Forster, B. B., McInnes, M. D., Komar, M. A., Amin, P., Atwal, S., ... & Hanneman, K. (2025). Canadian Association of Radiologists statement on planetary health education in radiology. Canadian Association of Radiologists Journal, 76(2), 212-220.
7. Bryman, A., & Cramer, D. (2012). Quantitative data analysis with IBM SPSS 17, 18 & 19: A guide for social scientists. Routledge.
8. Cabrera-Aguilar, E., Zevallos-Francia, M., Morales-García, M., Ramírez-Coronel, A. A., Morales-García, S. B., Sairitupa-Sanchez, L. Z., & Morales-García, W. C. (2023). Resilience and stress as predictors of work engagement: the mediating role of self-efficacy in nurses. Frontiers in Psychiatry, 14, 1202048.
9. Chen, J., Ghardallou, W., Comite, U., Ahmad, N., Ryu, H. B., Ariza-Montes, A., & Han, H. (2022). Managing hospital employees' burnout through transformational leadership: the role of resilience, role clarity, and intrinsic motivation. International Journal of Environmental Research and Public Health, 19(17), 10941.
10. Cohen, E. S., Kringos, D. S., Grandiek, F., Kouwenberg, L. H., Sperna Weiland, N. H., Richie, C., ... & Aarts, J. W. (2025). Patients' Attitudes Towards Integrating Environmental Sustainability Into Healthcare Decision-Making: An Interview Study. Health Expectations, 28(1), e70155.
11. De Waele, J. J., Hunfeld, N., Baid, H., Ferrer, R., Iliopoulou, K., Ioan, A. M., ... & Azoulay, E. (2024). Environmental sustainability in intensive care: the path forward. An ESICM Green Paper. Intensive care medicine, 50(11), 1729-1739.
12. Dönmez, R. Ö., & Yardımcı, E. (2024). Environmental awareness and sustainable consumption behaviours of Turkish nursing students. PeerJ, 12, e17366.
13. Filges, T., Mølgaard, A. B., Smedslund, G., Kildemoes, M. W., & Bengtsen, E. (2024). Protocol: Proactive resilience programmes for improving resilience and psychological adaptation in employees in high-risk occupations: A systematic review. Campbell Systematic Reviews, 20(4), e70007.
14. Galván-Mendoza, O., González-Rosales, V. M., Leyva-Hernández, S. N., Arango-Ramírez, P. M., & Velasco-Aulcy, L. (2022). Environmental knowledge, perceived behavioral control, and employee green behavior in female employees of small and medium enterprises in Ensenada, Baja California. Frontiers in psychology, 13, 1082306.
15. Galy, A., Chênevert, D., Fouquereau, E., & Groulx, P. (2023). Toward a new conceptualization of resilience at work as a meta-construct?. Frontiers in Psychology, 14, 1211538.
16. Garg, R. (2016). Methodology for research I. Indian journal of anaesthesia, 60(9), 640-645.
17. Gonzalez-Holguera, J., Gaille, M., del Rio Carral, M., Steinberger, J., Marti, J., Bühler, N., ... & Senn, N. (2022). Translating planetary health principles into sustainable primary care services. Frontiers in Public Health, 10, 931212.
18. Gonzalez-Holguera, J., Gaille, M., del Rio Carral, M., Steinberger, J., Marti, J., Bühler, N., ... & Senn, N. (2022). Translating planetary health principles into sustainable primary care services. Frontiers in Public Health, 10, 931212.
19. Gröschke, D., Hofmann, E., Müller, N. D., & Wolf, J. (2022). Individual and organizational resilience—Insights from healthcare providers in Germany during the COVID-19 pandemic. Frontiers in Psychology, 13, 965380.
20. Hong, Y., Al Mamun, A., Masukujjaman, M., & Yang, Q. (2024). Sustainable consumption practices among Chinese youth. Humanities and Social Sciences Communications, 11(1), 1-17.
21. Höpfl, L., Grimlitza, M., Lang, I., & Wirzberger, M. (2024). Promoting sustainable behavior: addressing user clusters through targeted incentives. Humanities and Social Sciences Communications, 11(1), 1-12.
22. James, L. R., & Brett, J. M. (1984). Mediators, moderators, and tests for mediation. Journal of applied psychology, 69(2), 307.
23. Judd, C. M., & Kenny, D. A. (1981). Process analysis: Estimating mediation in treatment evaluations. Evaluation review, 5(5), 602-619.
24. Kadam, P., & Bhalerao, S. (2010). Sample size calculation. International journal of Ayurveda research, 1(1), 55.
25. Karaca, A., & Durna, Z. (2019). Patient satisfaction with the quality of nursing care. Nursing open, 6(2), 535-545.
26. Kollmuss, A., & Agyeman, J. (2002). Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior?. Environmental education research, 8(3), 239-260.
27. Köse, S., Baykal, B., & Bayat, İ. K. (2021). Mediator role of resilience in the relationship between social support and work life balance. Australian Journal of Psychology, 73(3), 316-325.
28. Kothari, C. R. (2004). Research methodology: Methods and techniques. New Age International.
29. Lee, D. S., Tu, J. V., Chong, A., & Alter, D. A. (2008). Patient satisfaction and its relationship with quality and outcomes of care after acute myocardial infarction. Circulation, 118(19), 1938-1945.
30. Levett-Jones, T., Leach, K. J. T., Rogers, H. H., Richards, C., Best, O., & Ward, A. (2025). Interconnected health: A concept analysis of planetary empathy for healthcare professionals. Nursing Outlook, 73(1), 102337.
31. Li, X., Liu, Z., & Wuyun, T. (2022). Environmental value and pro-environmental behavior among young adults: the mediating role of risk perception and moral anger. Frontiers in psychology, 13, 771421.
32. Liang, F., & Cao, L. (2021). Linking employee resilience with organizational resilience: The roles of coping mechanism and managerial resilience. Psychology Research and Behavior Management, 1063-1075.

33. Lugten, E., & Hariharan, N. (2022). Strengthening health systems for climate adaptation and health security: key considerations for policy and programming. Health security, 20(5), 435-439.
34. Luque-Alcaraz, O. M., Aparicio-Martínez, P., Gomera, A., & Vaquero-Abellán, M. (2024). The environmental awareness of nurses as environmentally sustainable health care leaders: a mixed method analysis. BMC nursing, 23(1), 229.
35. MacNeill, A. J., McGain, F., & Sherman, J. D. (2021). Planetary health care: a framework for sustainable health systems. The Lancet Planetary Health, 5(2), e66-e68.
36. Mago, A., Dhali, A., Kumar, H., Maity, R., & Kumar, B. (2024). Planetary health and its relevance in the modern era: A topical review. SAGE open medicine, 12, 20503121241254231.
37. Martins, F. P., Paschoalotto, M. A. C., Closs, J., Bukowski, M., & Veras, M. M. (2024). The Double Burden: Climate Change Challenges for Health Systems. Environmental health insights, 18, 11786302241298789.
38. Miller, L. B., Rice, R. E., Gustafson, A., & Goldberg, M. H. (2022). Relationships among environmental attitudes, environmental efficacy, and pro-environmental behaviors across and within 11 countries. Environment and Behavior, 54(7-8), 1063-1096.
39. Moghbeli, G., Soheili, A., Ghafourifard, M., Shahbazi, S., & Karkan, H. A. (2024). Ecological care in nursing practice: a Walker and Avant concept analysis. BMC nursing, 23(1), 614.
40. Mosadeghrad, A. M., Isfahani, P., Eslambolchi, L., Zahmatkesh, M., & Afshari, M. (2023). Strategies to strengthen a climate-resilient health system: a scoping review. Globalization and health, 19(1), 62.
41. Muhammad, Q., Eiman, H., Fazal, F., Ibrahim, M., & Gondal, M. F. (2023). Healthcare in Pakistan: navigating challenges and building a brighter future. Cureus, 15(6).
42. Naser, K., Haq, Z., & Naughton, B. D. (2024). The impact of climate change on health services in low-and middle-income countries: a systematised review and thematic analysis. International Journal of Environmental Research and Public Health, 21(4), 434.
43. Obeng, H. A., & Atan, T. (2024). Understanding Turnover Intentions: The Interplay of Organizational Politics, Employee Resilience, and Person-Job Fit in Ghana's Healthcare Sector. Sustainability (2071-1050), 16(22).
44. Oh, J., Cho, H., Kim, Y. Y., Park, H. J., & Kim, H. K. (2015). An integrative review on development of "QUality Of care through the patients' Eyes"(QUOTE) instruments. Journal of nursing care quality, 30(4), E26-E31.
45. Okojie, G., Ismail, I. R., Begum, H., Ferdous Alam, A. S. A., & Sadik-Zada, E. R. (2023). The mediating role of social support on the relationship between employee resilience and employee engagement. Sustainability, 15(10), 7950.
46. Patino, C. M., & Ferreira, J. C. (2018). Inclusion and exclusion criteria in research studies: definitions and why they matter. Jornal Brasileiro de Pneumologia, 44, 84-84.
47. Prescott, S. L., Logan, A. C., Bristow, J., Rozzi, R., Moodie, R., Redvers, N., ... & Berman, B. (2022). Exiting the Anthropocene: Achieving personal and planetary health in the 21st century. Allergy, 77(12), 3498-3512.
48. Rees, C. S., Breen, L. J., Cusack, L., & Hegney, D. (2015). Understanding individual resilience in the workplace: the international collaboration of workforce resilience model. Frontiers in psychology, 6, 73.
49. Robson, C. (2002). Real world research (Vol. 2). Oxford: Blackwell.
50. Saifulina, N., Carballo-Penela, A., & Ruzo-Sanmartín, E. (2023). Effects of personal environmental awareness and environmental concern on employees' voluntary pro-environmental behavior: a mediation analysis in emerging countries. Baltic Journal of Management, 18(1), 1-18.
51. Salomon, L., Gasquet, I., Mesbah, M., & Ravaud, P. (1999). Construction of a scale measuring inpatients' opinion on quality of care. International journal for quality in health care, 11(6), 507-516.
52. Saunders, M.N.K., Lewis, P. and Thornhill, A. (2019) Research Methods for Business Students. 8th Edition, Pearson, New York.
53. Scholz, F., Börner, N., Schust, S. A., Schardey, J., Kühn, F., Renz, B., ... & Jacob, S. (2024). Focus on patient perspectives in climate action policies for healthcare. A German survey analysis on what patients are willing to do. Frontiers in Public Health, 12, 1477313.
54. Sreejesh, S., Mohapatra, S., & Anusree, M. R. (2014). Business research methods: An applied orientation. Springer.
55. Sue-Chue-Lam, C., Bhopal, A., Parker, J., & Xie, E. C. (2024). Net Zero is not enough: ratcheting ambition for sustainable health systems through Reduce and Support. BMJ Global Health, 8(Suppl 3).
56. TDG Network. (2024, January 2). Balancing patient care and environmental stewardship. The Daily Guardian. https://thedailyguardian.com/medically-speaking/balancing-patient-care-and-environmental-stewardship/
57. Urslak, R., Ladhar, S., Gauthier, G., Sajwani, S., Kanji, S., Pammett, R., ... & Landry, C. (2025). A Scoping Review of Planetary Health Education in Pharmacy Curricula. American Journal of Pharmaceutical Education, 101374.
58. Valentine, N., Ajuebor, O., Fisher, J., Bodenmann, P., Baum, F., & Rasanathan, K. (2022). Planetary health benefits from strengthening health workforce education on the social determinants of health. Health Promotion International, 37(3), daac086.
59. Verweij, M., & Richie, C. (2023). The moral ideal of planetary health: ethical implications for healthcare. Nederlands Tijdschrift Voor Geneeskunde, 167, D7443-D7443.

60. Viveros-Uehara, T. (2023). Climate Change and Economic Inequality: Are We Responding to Health Injustices?. Health and Human Rights, 25(2), 191.
61. Wallnoefer, L. M., & Riefler, P. (2022). Concepts describing and assessing individuals' environmental sustainability: An integrative review and taxonomy. Frontiers in Psychology, 12, 770470.
62. Wut, T. M., Lee, S. W., & Xu, J. (2022). Role of organizational resilience and psychological resilience in the workplace—Internal stakeholder perspective. International journal of environmental research and public health, 19(18), 11799.
63. Yang, L., Fang, X., & Zhu, J. (2022). Citizen environmental behavior from the perspective of psychological distance based on a visual analysis of bibliometrics and scientific knowledge mapping. Frontiers in Psychology, 12, 766907.
64. Zhang, B., Yang, L., Cheng, X., & Chen, F. (2021). How does employee green behavior impact employee well-being? An empirical analysis. International Journal of Environmental Research and Public Health, 18(4), 1669.
65. Zhang, J., Xue, C., & Hou, G. (2024). The Impact of Chinese Public Environmental Awareness on Environmental Behavior: An Analysis Based on China National Surveys in 2003, 2010 and 2021. Land, 13(9), 1418.
66. Zhou, F., Long, K., Shen, H., Yang, Z., Yang, T., Deng, L., & Zhang, J. (2023). Resilience, organizational support, and innovative behavior on nurses' work engagement: a moderated mediation analysis. Frontiers in Public Health, 11, 1309667.

Questionnaire

Part-A: Demographic

Gender	1. Male 2. Female 3. Non-binary
Working experience	1. Less than 5 years, 2. 10-15 years, 3. 11-20 years, 4. More than 20 years
Position Held	1. Staff nurse, 2. LHV, 3. Midwife, 4. Others
Institution	1. District headquater (DHQ), 2. Tehsil headquater (THQ), 3. Rural Health center (RHC), 4. Basic health unit (BHU)
Shift	1. Morning, 2. Evening, 3. Night 4. Rotating

Part-B Survey Questionnaire

Dimensions	**1.Strongly Disagree**	**2. Disagree**	**3. Neutral**	**4. Agree**	**5. Strongly agree**
Employee planetary health environmental awareness (Dönmez and Yardımcı, 2024)					
Ecological Awareness					
People abuse the environment excessively					
The balance of nature is very delicate and can be easily disrupted.					
Man must understand nature and act accordingly.					
We must be in harmony with nature.					
Personal awareness					
I can contribute to solving environmental problems.					
Social responsibility campaigns can have a positive impact on me being environmentally conscious when purchasing products.					
I think I can contribute to natural resources by saving water and energy.					

Behavioral awareness					
Before purchasing a product, I am interested in its environmental consequences.					
I see myself as an environmentalist.					
To protect the environment, I also use the back side of the paper when writing.					
Environmental issues are very important to me.					
Employee resilience (Obeng and Atan, 2024)					
I tend to bounce back quickly after ecological issues.					
I have a hard time making it through stressful environment events.					
It does not take me long to recover from a stressful environment event.					
It is hard for me to snap back when something bad happens.					
I tend to take a long time to overcome environmental setbacks in my job.					
Patients quality of care (L. Salomon et al., 1999)					
I provide patients with clear information about the purpose and results of medical tests.					
I ensure that patients' families or relatives are properly informed about the					
I take all possible measures to relieve patients' pain and discomfort.					
I respond promptly and clearly to patients' questions and concerns.					
I ensure that patients have sufficient privacy during medical examinations					
I provide emotional and psychological support to patients when needed.					
I help maintain a positive and supportive atmosphere in the department for					