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Sensory sustainable homes, a study of the healthy happy home (3H) conceptual design model: an explanatory qualitative study

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Sustainable homes support ecological, human, and economic health and vitality. Sensory sustainable homes (SSH) contextually mean creating a dwelling that integrates the concept ideas of the healthy elements, happiness determinants, and home requirements (3H) concept. The study resolved the investigator's question. What is the 3H conceptual design model? The study aims to investigate SSH design that integrates the 3H requirements into the conceptual model to enhance the occupants' quality of life (QoL). The article assessed expert opinions from relevant health and environmental professionals to identify the health elements in an SSH, identify the happiness determinants in SSH, and develop a conceptual framework that encapsulates the 3H design concept. The research employed a qualitative, exploratory-descriptive and contextual technique that leveraged phenomenological and ground theory approaches to create a new theory. A case study was the research design. The data was from 61 experts from the built environment and health professionals. The investigators identified 16 professions for the study. The researchers were the main research instrument in this study. Data collection instruments are an observation schedule, Focus Group Discussion (FGD), and an In-depth semi-structured Interview (IDI) guide to gather expert information to validate the 3H conceptual framework and SSH design checklist. The paradigm is post-positivism and interpretivism. Applying Maslow's hierarchy of needs and Sigmund Freud's pleasure principle, findings showed that architectural elements integrate occupants' health needs and pleasures into the home. It boosts happiness—a sense of aesthetics, security, belongingness, community, comfort, and peace. The 3H conceptual or SSH design results reveal that the architectural elements of a healthy home enhance happiness. Therefore, incorporating human needs and principles into a home can make the 3H design concept practical and hands-on.

KEYWORDS

sensory sustainable homes, 3H design concept, residents' health and happiness, building envelope, residential architecture

1 Introduction

Modern sensory technology and conscious, sustainable practices shaped ideas for building sensory-sustainable homes (St-Jean et al., 2022). The home is an indoor and outdoor setting providing residents love and ownership. Home is a permanent abode with human wants and a title deed (Krista, 2018; Jackson et al., 2020; Pretty and Barton, 2020; Evans, 2021; Pineo, 2022). Recent studies revealed that home is synonymous with a good

feeling (Abid et al., 2021). The energy flow inside a home has a link to the occupants' health (Kouadio et al., 2020). Square or rectangle-shaped structures are a positive-centric energy mode within spaces that enhance good condition (Smith et al., 2019; Sturge et al., 2021). Reflection of positive vibes from flowers, prayer, and the sound of bells and freshwater directly impact health (Zhong et al., 2022). Elements in the home, such as toilets, bathrooms and cluttered and unclean homes, release unhealthy vibes that interfere with occupants' health (Nagib and Williams, 2018). However, a clean home ensures the release of positive energy (Jupp, 2017; Stenning, 2020). Therefore, a Healthy home is not synonymous with a luxurious house with beautiful interior decoration (Roy et al., 2018; Mahmood et al., 2022; Zhang et al., 2022). Likewise, happiness is impossible outside the home (Agathiyar and Sugumar, 2019). Countries and individual happiness begin at home. A home requires love and joy to create light and maintain security (Cheshmehzangi, 2021; Pérez-Urrestarazu et al., 2021). Hence, a sustainable home is a construct where the heart is most happy, loved, safe, protected, adapted, harmonious and balanced (Coburn et al., 2020; Weinberger et al., 2021). However, the home, though often neglected in healthy living discourse, is a critical determinant of health-physical, psychosocial and overall wellbeing. Therefore, the SSH, which this study investigates, is a multidisciplinary construct that combines the healthy-home components, the happy-home elements and the health-happiness ideals to create the 3H conceptual design model. The article presents a unique approach to residential building design and construction that vividly captures the multi-faceted relationship between home, health and happiness. Literature reviews show that several authors have worked on homelessness, homes, green homes, sustainable homes, smart homes, happy homes, and happiness and health as the subject of discussion. Still, none have touched on SSH (3H Concept). Against this background and in line with the UN 2030 Agenda, SDGs 3, 10, and 11 target that by 2030, to ensure access for all to adequate, orderly, safe, regular, responsible and affordable housing and services and premature mortality reduction through the prevention and promotion of health and happiness. The study aims to investigate SSH design to integrate the 3H requirements into the conceptual model to improve the occupants' QoL. The article assesses expert opinions from relevant professionals on the health elements and happiness determinants in SSH. By asking what the health elements are in an SSH, What are the happiness determinants in an SSH? And how can one develop a conceptual framework that encapsulates the 3H concept? From critical review and research experience for this kind of study, it is best to engage the phenomenological and ground theory approach to determine the opinion/size of participants and develop a theory as a qualitative study. Subsequent sections of the study have expanded on beyond-sustainable homes.

Abbreviations: SSH, sensory sustainable homes; 3H, healthy happiness home; QoL, QUALITY OF LIFE; IDI, in-depth interview; FGD, focused group discussions; SDGs, sustainable development goals; PhD, Doctor of Philosophy; TWAS, The World Academy of Science; CUI, COMSATs University Islamabad; ISUH, Society for Urban Health; UF, University of Florida; HHSRS, Housing Health and Safety Rating System; BEPs, Built Environment Professionals; HMPs, Health and Medical Professionals; M.Sc., Master of Science; B.Sc., Bachelor of Science; M. Arch, Master of Architecture; PI, principal investigator; KPK, Khyber-Pakhtunkhwa; VOCs, volatile organic compounds; Max QDA, qualitative data analysis; GDP, gross domestic product; SLB, stabilized laterite bricks; PVC, polyvinyl chloride; 3-D, three-dimensional; UNCTAD, United Nations Conference on Trade and Development; CHREC, Covenant University Research Ethics Committees.

1.1 The research gap and novelty of the study

Home, though often neglected in *healthy living* discourse, is a critical determinant of health (physical, psychological, and social health) and overall occupants' wellbeing. A better understanding of the correlation between buildings and occupants' Health underscores the growing awareness, support and drive toward improved housing conditions. The investigator envisioned a *Healthy Happy-Home* to save lives, prevent diseases, inspire happiness and raise the quality of life. It also alludes to mitigating climate change, the adverse effects of the rapid growth of urban and human populations, and accelerating sustainable development goals for health and sustainable cities—SDG 3 and 11.

The article presents a unique and novel approach to residential building design and construction that vividly captures the multi-faceted relationship between home, health and happiness. Therefore, as a passionate researcher, practitioner and Lecturer in architecture, health and sustainability for over 20 years. I have worked on issues around built environments and homes and their effect on occupants' wellbeing/health. Yours sincerely has a PhD in architecture from Covenant University, Nigeria (Therapeutic and Sustainable Architecture). In addition to this, I have a Certificate in Data and Health Indicators in Public Health Practice from the Johns Hopkins Bloomberg School of Public Health. Certificates in the foundation of Public Health Practice from Imperial College London: Health Protection, Behavior and Behavior Change, The Public Health Toolkit and The Public Health Approach. A certificate in Healing with Art from the University of Florida (UF) and A certificate in A Life of Happiness and Fulfillment from the Indian School of Business.

Similarly, as a therapeutic Architect, urban health influencer, space analyst and educator focused on conceptualizing and organizing space toward addressing comprehensive issues such as the spirit of place/culture, wellbeing/health, happiness, and socio-environmental and regenerative sustainability. I noticed that homes today are just mere shelter spaces that need some architectural elements integrated into them to create a healthy and happy ambience for the occupants. Hence, I developed and worked on a post-doctoral proposal titled "*NOEL 3H-CONCEPT: Occupants' Happiness and Psychosocial Health Determinants Nexus in Prototype Green Residential Home Environment*" for a year in TWAS-CUI Post-Doctoral Fellowship. I also received the International Society for Urban Health (ISUH) Scholarship to present a paper on this subject matter. Therefore, it is difficult to find and cite previous studies that investigated this theme "*The Healthy Happy Home (3H) Conceptual Design Model*" because the idea is a pioneering effort based on long years of experience in practice, teaching and research to develop and adopt the 3H model

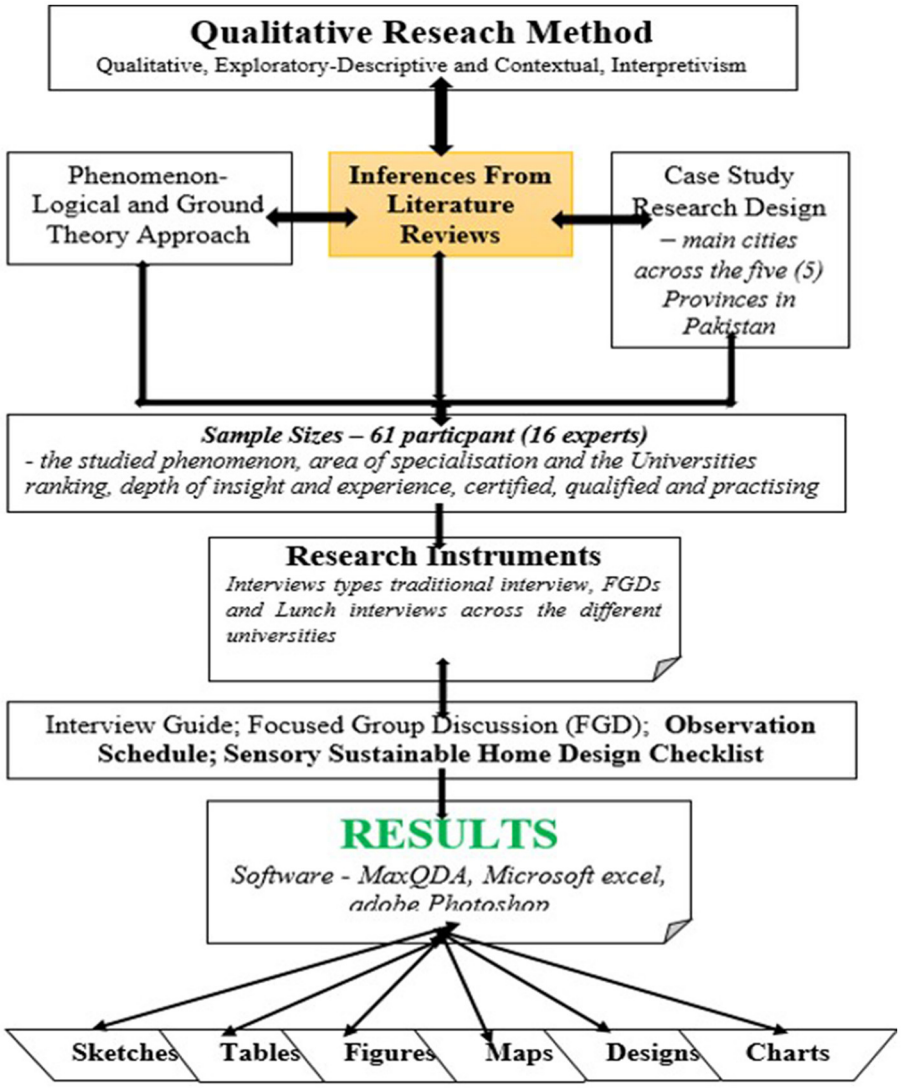

FIGURE 1
Structure flowchart of the research method. Source: Ekhaese et al. (2021).

as a blueprint for sustainable/restorative housing solutions and municipal infrastructure.

2 Literature review

Sharma and Mishra (2021) agreed that the relationship between home and health is multi-faceted. A healthy home has a sound structure, is hazard-free, provides adequate sleeping facilities and personal hygiene, prepares and stores food, is a comfortable environment, and has privacy and quiet and social facilities (Castaño-Rosa et al., 2020). The local environment determines factors such as fear of crime, access to local services/facilities and promotion of social interaction (Mayock and Parker, 2021). Many factors contribute to a healthy home, partly governed by building regulations and design trade-offs. Perhaps higher energy efficiency is good for health—especially for lower-income families that may struggle with bills (Lewis et al., 2020; Memmott et al., 2021).

According to Wilkinson and Ortega-Alcázar (2019), there is a link between homes and mental health. Mental health is improved when a home is safe, comfortable and satisfying by promoting an efficient airflow through spaces—cross ventilation, cooling towers, functional hybrid ventilation system, growing plants, installing locks, hanging pictures, decorative ornaments, providing water bodies, providing adequate spaces, applying relevant colors and ample daylight (Chowdhury et al., 2023; Wen et al., 2023). A cluttered and unkept home may harm occupants' mental health (Krieger et al., 2002). Examples of how mental health might affect the house include—stress and anxiety, relationship problems, sleeping problems, money problems, practical difficulties, loneliness and low self-esteem, physical health problems, working or studying problems and neighborhood effects (Hall et al., 2021).

Knell et al. (2020) state that physical health improves through changes in home features. Two measures of the home require interventions to improve or mitigate health hazards (Allen and

FIGURE 2
Map of Pakistan showing the five central provinces and major cities province.

Barn, 2020; Put and Pasteels, 2022). There are ways to identify home-related defects and defects that contribute to occupants' health and safety (Colenberg et al., 2021). Air pollution is seen as a severe instigator of occupational health hazards and life threats, negatively affecting buildings and persons residing in the vicinity (Etim et al., 2021). The Housing Health and Safety Rating System (HHSRS) is a system that identifies faults in homes and evaluates the potential effects of any defects on occupants' health and safety. This system creates a statutory minimum requirement for homes across all tenures (Ade and Rehm, 2020). HHSRS is used to rate the risk from home hazards relating to dampness and mold, excess cold or heat, pollutants, lack of space, security, lighting, excessive noise, poor hygiene, sanitation, water supply, accidents, collisions, explosions, structural collapse (Rolfe et al., 2020; Laurie, 2022).

Reis et al. (2021) claimed that a healthy home ought to meet several vital criteria—being affordable, discrimination-free, in a reasonable state of sanitation, offering the right amount of independence, meeting physical health needs, mental health needs, psychosocial wellbeing needs, having reasonably modern facilities and services and provide a reasonable degree of thermal comfort. However, the requirement for health needs includes providing a safe and adequate water supply, sanitary disposal of excreta, disposal of solid wastes, drainage of surface waters, ensuring personal and domestic hygiene, safe food preparation, providing structural safeguards against disease transmission, protection against communicable diseases, injuries, poisonings and chronic diseases (structural features and furnishing, indoor air pollution, chemical safety and the home as a workplace), reduce psychosocial

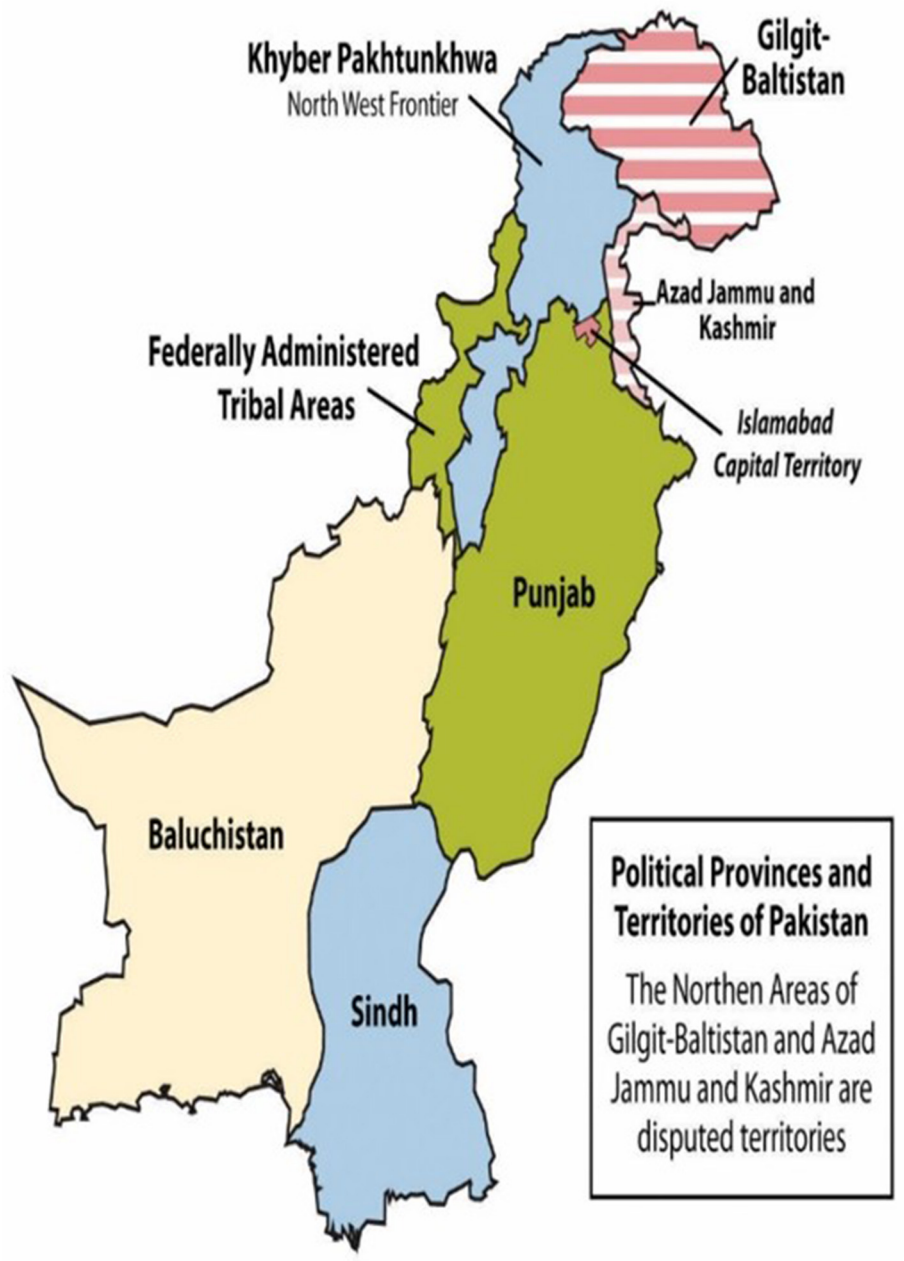

FIGURE 3
Map of Pakistan and Sindh. Source: Kalwar et al. (2018).

stresses to a minimum, improve the housing environment and make informed use of home (Mousa et al., 2021).

Awada et al. (2021) observed that the current public health efforts to improve home conditions include historical activities and new strategies based on emerging issues such as respiratory diseases resulting from poor indoor environmental quality. Many healthy homes have developed a response to initiatives for health concerns in the built environment (Swope and Hernández, 2019). Healthy home initiatives provide education to support household members in taking actions to improve the quality and safety of the home environments. Community health workers use the home environmental checklist to assess exposures, knowledge, and activities related to indoor respiratory disease triggers and indoor chemical hazards (Wimalasena et al., 2021). There is a likelihood for the residents within the vicinity to start experiencing severe effects of the pollutants from operations (Elemile et al., 2019). The checklist guides the development of a specific home environmental action plan for each household. The scope of the Healthy Home initiative includes injury hazards, integrated lead valuation and reduction (Twohig-Bennett and Jones, 2018).

According to Jin et al. (2019), the hierarchy of needs theory is one of Maslow's lasting and most significant contributions to this need-seeking and need-meeting society. In his quest to know the human motivation and pursuit of happiness, he

TABLE 1 Demographic information of the participants (IDI).

S/N	Name	Age	Sex	Marital status	Education	Occupation/area of specialization	Years of experience
1	KH	52	M	Married	M.Sc.	Sustainable architecture	32
2	AE	65	M	Married	M.Arch	Architectural historian	44
3	FM	45	M	Married	M.Sc.	Graphic art and green architecture	30
4	AUH	63	M	Married	PhD	Clinical psychologist	38
5	AR	55	M	Married	PhD	Environmental psychologist	23
6	AAS	57	M	Married	PhD	Builder (building health)	34
7	MJJ	42	F	Married	PhD	Materials and civil engineer	18
8	AI	40	F	Single	PhD	Service engineer	16
9	TO	34	M	Married	PhD	Electrical engineer	10
10	NA	48	M	Married	PhD	Environmentalist chemist	25
11	LM	35	M	Single	PhD	Medical doctor	12
12	RA	36	M	Married	PhD	Estate surveyor	14
13	IK	43	F	Married	PhD	Environmental biologist	20
14	AR	41	F	Married	PhD	Environmental and medical sociologist	17
15	SM	39	F	Single	PhD	Environmental and public health analyst	15
16	RK	44	M	Married	PhD	Town planner	18

Mean age: 42.3, mean years in experience: 25.4. PhD, Doctor of Philosophy; M. Arch., Master of Architecture; M.Sc., Masters of Science; M, Male; F, Female.
Source: Ekhaese et al. (2021).

formulated a hierarchical list of human needs to be fulfilled for maximum psychosocial health and increased life satisfaction (Lara et al., 2020). This theory provides the human needs required in building and neighborhood designs (Desmet and Fokkinga, 2020). Therefore, understanding Maslow's hierarchy of needs may foster the development of residential homes and neighborhoods that meet residents' needs while encouraging increased levels of psychosocial wellbeing, health and happiness. The theory offers a basis for home development with high occupants' motivation to achieve design objectives. The residential feature that satisfies Maslow's principles may result in high resident satisfaction and excellent occupants' health (Abdol, 2021).

3 Materials and methods

The study employed a qualitative method using a case study as the research strategy/design, the phenomenological model to explain the healthy happy home phenomenon, and grounded theory to provide an explanation or philosophy behind the study. The researchers engaged an all-inclusive account to develop a complex picture of the issues under study by involving multiple perspectives reporting, identifying the many determinants involved, and generally sketching the larger image that emerges. The investigators collected data reported on *SSH, A Study of the 3H Conceptual Design Model*. The study identified 61 expert participants drawn from across sixteen 16 professions −26 Built Environment Professionals (BEPs), 12 health and medical professionals (HMPs), four environmentalists, 15 clinical psychologists, and four architectural historians. The research methods engaged were qualitative, exploratory-descriptive and contextual, as shown in Figure 1. The study leveraged an interpretivism paradigm that covers in-depth and qualitative investigation. The research employed phenomenological and ground theory techniques to interpret "SSH" as a phenomenon and determine the participants' size. The researchers also used the ground theory approach to develop a theory from the study. The authors were the main research instrument in this study. However, the authors used FGD and an IDI guide to gather information from experts to validate the author's 3H conceptual intentions. The researchers used an observation guide and checklist to record architectural elements in a home that satisfies the occupants' needs for health and happiness. The authors use tables and figures to organize the data and design an architectural floor plan of prototypical SSH. The authors converted some tables to screen plots, graphs, and charts for better outcomes.

3.1 Study setting

The author conducted IDIs, FGDs and direct observation in major cities across five provinces of Pakistan. These include Kalat in *Baluchistan* province; *Gilgit-Baltistan*-Northern Areas province; *Abbottabad* and *Peshawar* in *Khyber-Pakhtunkhwa-KPK* North-West, Frontier Province; *Rawalpindi* and *Lahore* in *Punjab* province; *Karachi* in *Sindh* province and Islamabad Capital Territory, as shown in Figures 2, 3. The authors distributed assessments to practicing experts from varied professional backgrounds at the University. They selected a representative sample of 61 respondents from the five provinces and the federal capital territory of Pakistan. The research focused on assessing

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expert opinions from relevant professionals on the health and happiness necessities in a prototype SSH.

3.2 Recruitment process

The investigators asked everyone who attended our orientation workshop to participate in the study. Participation entailed sitting through an FGD and IDI for 60–90 min. All attendees signed a consent form to participate and expressed interest in the IDI exercise. Also, the participants across all universities selected in the five provinces of Pakistan agreed to be involved in the FGD in groups. Following the recommendation in qualitative research to ensure a suitable representation of the lived experiences and diversity of experts across the BEPs and HMPs, a purposive sampling method was used with six criteria: age, gender, marital status, education, occupation and years of experience, as shown in Table 1.

3.3 Data collection

The investigators asked participants to share their health, happiness and home experiences. What is your understanding of home, health, wellbeing, and happiness? What do you think are the elements that excite human happiness hormones in residential spaces? What factors do you recommend addressing when designing a home to enhance mental health? Other questions are in Supplementary Appendices 1–3. The investigators obtained informed consent from participants. The choice of experts/professionals as participants for the study depends on the following criteria—the studied phenomenon, the depth of insight and experience of experts, 24 years and above, lived and living in a neighborhood/community, certified, qualified and practicing professionals and have training and experience in wellbeing and built environment-related issues. The authors conducted the interviews in English (a *lingua franca* in Pakistan). Participants are Pakistan residents in related specializations/disciplines and the globally top-ranked universities in Pakistan, as shown in Table 2. All 61 participants participated in the study. The investigators covered seven cities in Pakistan—*Kalat, Abbottabad, Peshawar, Rawalpindi, Lahore, Karachi* and *Islamabad*.

The investigators are the Principal Investigator (PI)-TWAS-CUI post-doctoral researcher, host supervisor and four research assistants-lecturers in the architecture department, Islamabad. The PI and host supervisor conducted the IDIs and FGDs in a controlled, systematic and organized manner on weekends (Friday through Sunday), in the mornings and evenings (9:00–12:00 am and 5:00–8:00 pm) over 6 months, amounting to 432 h. The study employed a narrative method to reconcile conflicting stories and highlight opportunities for innovation in urban health and architecture. The investigators used an observation guide to identify the physical architectural health elements and happiness determinants in indoor and outdoor spaces in SSH. The PI collected all these data through direct and participatory observations of the several homes visited across the provinces of Pakistan.

TABLE 2 Participants across the five provinces of Pakistan.

S/N	The Five (5) provinces of pakistan (cities selected)	BEPs	HMPs	Clinical psychologists	Environmentalists	Architectural historians
In-depth interview (IDI) Participants (16)						
1	Baluchistan Province (Kalat)	1	1	1	1	1
2	Gilgit-Baltistan-Northern Areas Province	1	1	1	0	0
3	Khyber-Pakhtunkhwa-KPK North-West Frontier Province (Abbottabad and Peshawar)	10	3	4	1	1
4	Punjab Province (Rawalpindi and Lahore)	6	2	4	1	1
5	Sindh Province (Karachi)	3	1	1	0	0
6	Islamabad Capital Territory	5	4	4	1	1
Focused group participants (FGD) participants (61)						
7	Kalat, Abbottabad, Peshawar, Rawalpindi, Lahore, Karachi and Islamabad	26	12	15	4	4

Source: Ekhaese et al. (2021).

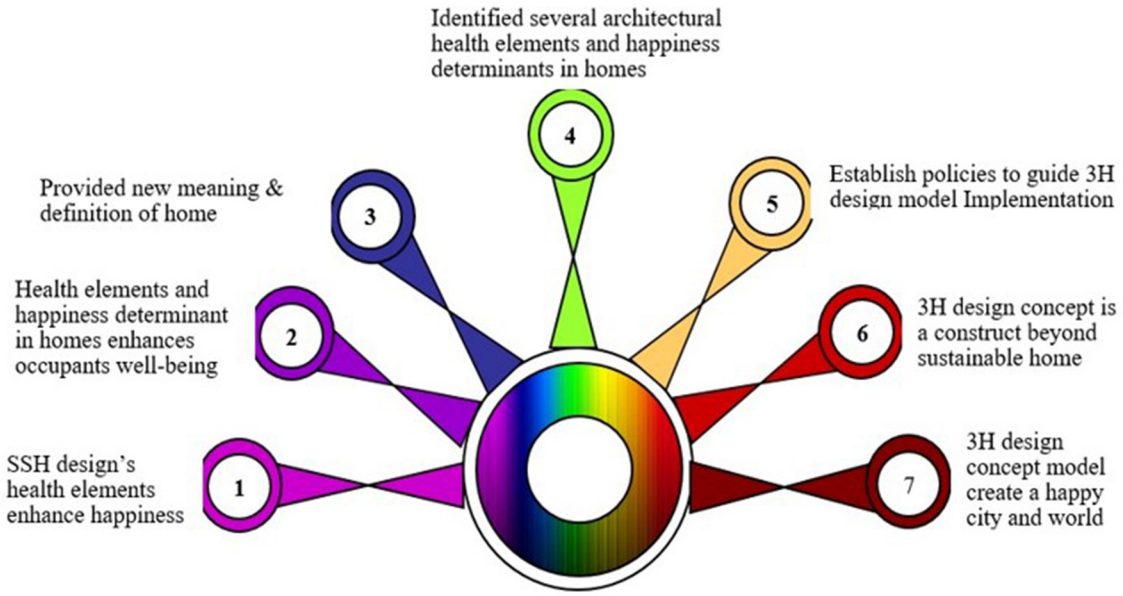


FIGURE 4
Overview of findings.

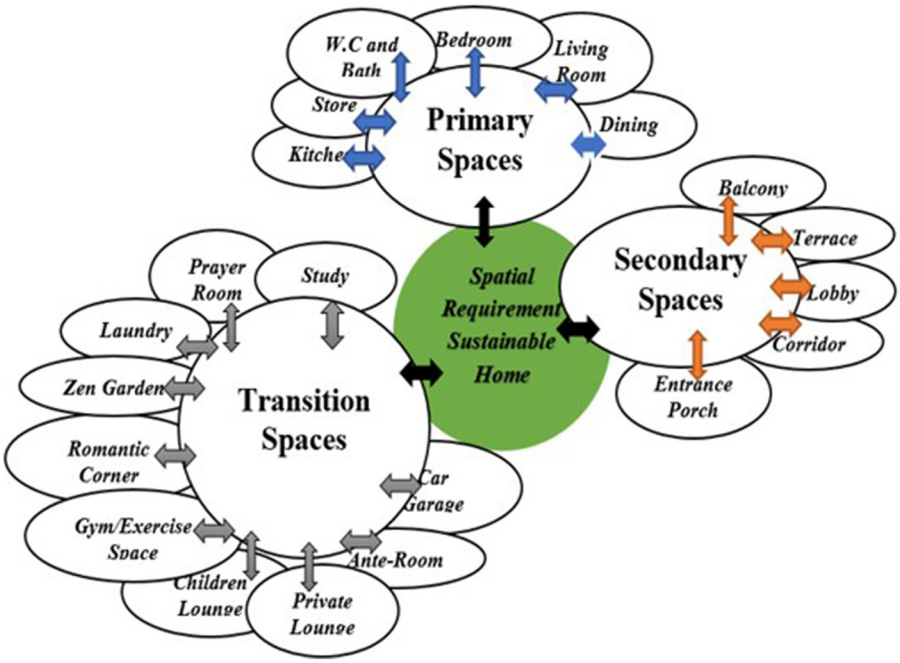


FIGURE 5
Spatial requirement for healthy SSH. Source: Ekhaese et al. (2021).

3.4 Data analysis

The investigators developed observational notes and transcribed and analyzed the data using thematic analysis. The authors deductively coded transcripts under pre-existing themes—the relationship between health and home, home and mental health, health improvement through home elements change, the 3H requirement, public health efforts to improve home conditions and Abraham Maslow's quest for human motivation and pursuit of happiness and the three objectives which are to identify the health elements in an SSH, assess the happiness determinants, and develop a conceptual framework that encapsulates the 3H concepts. The authors presented the participants' construct of their imagined experiences in 3H

TABLE 3 Psychosocial health elements in SSH.

SN	Psychosocial health needs	Space provisions	SSH health elements specification
1	Physiological and biological needs, e.g. food, sleep	• Primary space • Transition space	Sizeable, Privacy; Ceiling, Color, wall decorations, interior finishes and fittings
2	Physical (Security needs), e.g. safety, shelter, security	• Primary space • Transition space • Secondary space	Water purifications, Non-toxic materials, Planters, Monitoring systems, Air quality sensors and Non-VOCs Finishes
3	Social Needs, e.g. relationships	• Primary space • Secondary space	Connectivity, Wi-Fi, Ceiling, Color, green and water bodies
4	Emotional (Esteem needs), e.g. recognition and status	• Primary space • Secondary space • Transition space	Materials and Color Choice, Sound Insulations, User-friendly System, passive cooling system, Heater, s/warmers
5	Mental (Cognitive needs), e.g. knowledge,	• Transition space	Light, colors and Furniture specification
6	Environmental (Aesthetic needs), e.g. beauty, balance, form	• Primary space • Secondary space • Transition space	Sustainable building materials, water, drainage, storage and recycling, Greywater Adequate and power sockets,
7	Intellectual (self–actualisation needs), e.g. peak experiences	• Transition space	Light, bright colors and Furniture specification
8	Spiritual (self- Transcendence needs), e.g. helping others	• Transition space	Religion in mind; specific paintings and wall decorations and water bodies

Source: Ekhaese et al. (2021).

exercises through direct quotes and ethnographic synopses. The ethical approval was by the review committee at the Department of Humanities, COMSATS University Islamabad, Pakistan, following approved ethical principles for qualitative research during and after data collection. However, the reference number is CUI-ISB/HUM/ERC-CPA/2018-014.

3.5 Ensuring the validity and reliability of the data

Ensuring the validity and reliability of the qualitative research method involves following some criteria: Extended involvement, triangulation, creating a robust research design and peer debriefing. *Extended Involvement:* During the study, the PI invested sufficient time (Six-6 months in Pakistan) to understand the setting, test for misinformation, build trust and generally repeat the procedure central to the case study during the workshop and training organized for them. The investigator made sure that the participants' responses were consistent across several samples and provided alternative explanations for what appeared to be research results.

Triangulation: Triangulation is a method that helps increase validity, reliability, and legitimation. Therefore, the investigators engaged the three most dependable qualitative research methods—IDIs, FGDs and observation guides (direct and participants), to collect and analyse the 3H phenomenon.

Creating a robust research design: The investigators enhanced the validity and reliability by creating a case study research design and qualitative method, as presented in the body of the article. The investigators collected data through detailed field notes (to capture non-verbal behavior, reactions and comments) using recording devices (audio and video) and transcribing the digital files. A semi-structured interview guide was used for the IDIs and FGDs, maintaining close eye contact with the participants and using MaxQDA, Microsoft Excel, and Adobe Photoshop to develop the table and figures.

Peer debriefing: During the data collection and the result analysis process, the investigators exposed *SSH, A Study of the 3H Conceptual Design Model* and the conclusion to colleagues and peers consistently for the development of design and analysis of the study (Montgomery, 2017). They also interacted with colleagues and peers regarding data analysis to ensure minimum error in data collection, recording, consistency, and stability over time and under various conditions.

4 Results and discussions

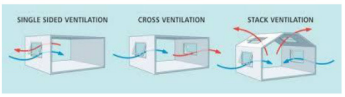
The analyzed data results of this study were arranged and discussed along with these three objectives. Therefore, the results of the findings are in chronological order according to the arrangements of the study objectives. However, the principal and valuable findings are presented clearly and concisely in Figure 4. The investigator presented results in tables, figures, sketches and maps.

4.1 Result of identifying the health elements in SSH

Focus Group Discussion (FGD) with architecture departments, Peshawar, Khyber-Pakhtunkhwa-KPK, Pakistan, agreed that "*An SSH means creating a healthier environment, improving the environment and lowering the cost of running the home, such as saving energy, water, and maintenance on systems and appliances, built with low-impact, high-performance materials and producing less waste" (Architects, FGD).*

Therefore, the researcher recommended spatial requirements for SSH, as shown in Figure 5, which the 61 experts in the

TABLE 4 SSH design checklist.

sn	Sensory sustainable elements	SSH design solutions and description	Illustrations, diagrams and pictures
1	Environmentally Friendly Considerations	Building orientation and layout, maximize access to views and nature, and landscaping, use a balance of soft and hard landscaping, use water-wise plants and therapeutic garden	
2	Health	Natural light and fresh air, non-harmful building materials use, artwork, plants and home healing process and use eco-paints	
3	Ventilation	Use low-running cost appliances, ventilate roofs to renew roof space air compressed and position opening to allow natural cross-ventilation	
4	Insulation	Reevaluate the home's insulation, sensory stimulations and maximum insulation in the roof, walls and floor	
5	Roofing	Use light-colored roofing, fit a cool roof and use a green roof	
6	Energy	Install energy-efficient appliances, design to reduce energy, install a renewable energy source such as a photovoltaic system and design a home layout to reduce artificial heat or cool spaces	
7	Materials Efficiency	Use low-maintenance materials, natural materials, and recycled materials	
8	Windows	Install high-performance and large openable windows, easy-face windows and living room windows oriented for efficient natural lighting all year round	
9	Water	Gray water and rainwater (recollection and reuse), use water-efficient technologies, water to landscape to enhance the natural light and rainwater to reduce the cooling load	

Sources: 1. blueandgreentomorrow.com; 2. theguardian.com; 3. archidaily.com; 4. en.wikipedia.org; 5. olist.ng; 6. mapsofindia.com; 7. neutrinoburst.com; 8. dynamicfenestration.com; 9. shutterstock.com.

building, health, medical and environmental industries validated. The researchers categorized these recommended spaces in the sustainable home into primary, secondary, and transition. Primary Spaces include—a bedroom, living room, dining, kitchen, store and convenience or washroom; Secondary spaces—prayer room, laundry, study, Zen garden or green space, romantic corner, green room, gym, children's area, private or family lounge, ante-room, car garage or porch; and Transition spaces—balcony, terrace, lobby, corridors, entrance porch.

According to the result in Table 3, the psychosocial health domain synchronized well with the eight levels of needs identified in the revised Maslow's hierarchy of needs theory. Given the human needs in an SSH as arranged in a hierarchy according to Maslow, it became logical to recommend space design provisions for each, along with the psychosocial health domain. However, the study specified architectural elements to meet each occupant's health needs in each space provided for in the home. The investigators described these elements in the design spaces as possible health elements because having them creates a healthy atmosphere for the occupants. Therefore, experts /professionals validated every space design provision and specification of SSH health elements during the interviews.

4.1.1 SSH design checklist

These elements include environmentally friendly considerations, Health, Ventilation, Insulation, Roofing, Energy, Materials Efficiency, Windows and Water, as presented in Table 4.

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TABLE 5 Determinants for happiness in SSH.

	Determinants for happiness in SSH	Domain	Measures from experts, BEPs, HMPs and EHPs
1.	Living standard	Social connection and Healthy relationship	% social or affordable home
2.	Health		Mortality rate or Life expectancy
3.	Psychosocial health		% roadways and green space
4.	Time use or work-life balance		Employment rates, % local economy green jobs, and labor force average professional education years
5.	Human services and education		Schools with environmental education programs and adult literacy rates
6.	Social vitality and connection or community vitality		Access to short-distance neighborhoods, Crime rates, income distribution and inequality measures
7.	Art and cultural diversity	Economy–Gross Domestic Product (GDP) per capita	cultural day and native language
8.	Governance		Performance measurement and service index, citizen rights to QoL and political participation
9.	Ecological diversity and resilience	Environmental	% preserved areas/waterways to the land area; % trees, green environments improve mental health

Source: Ekhaese et al. (2021).

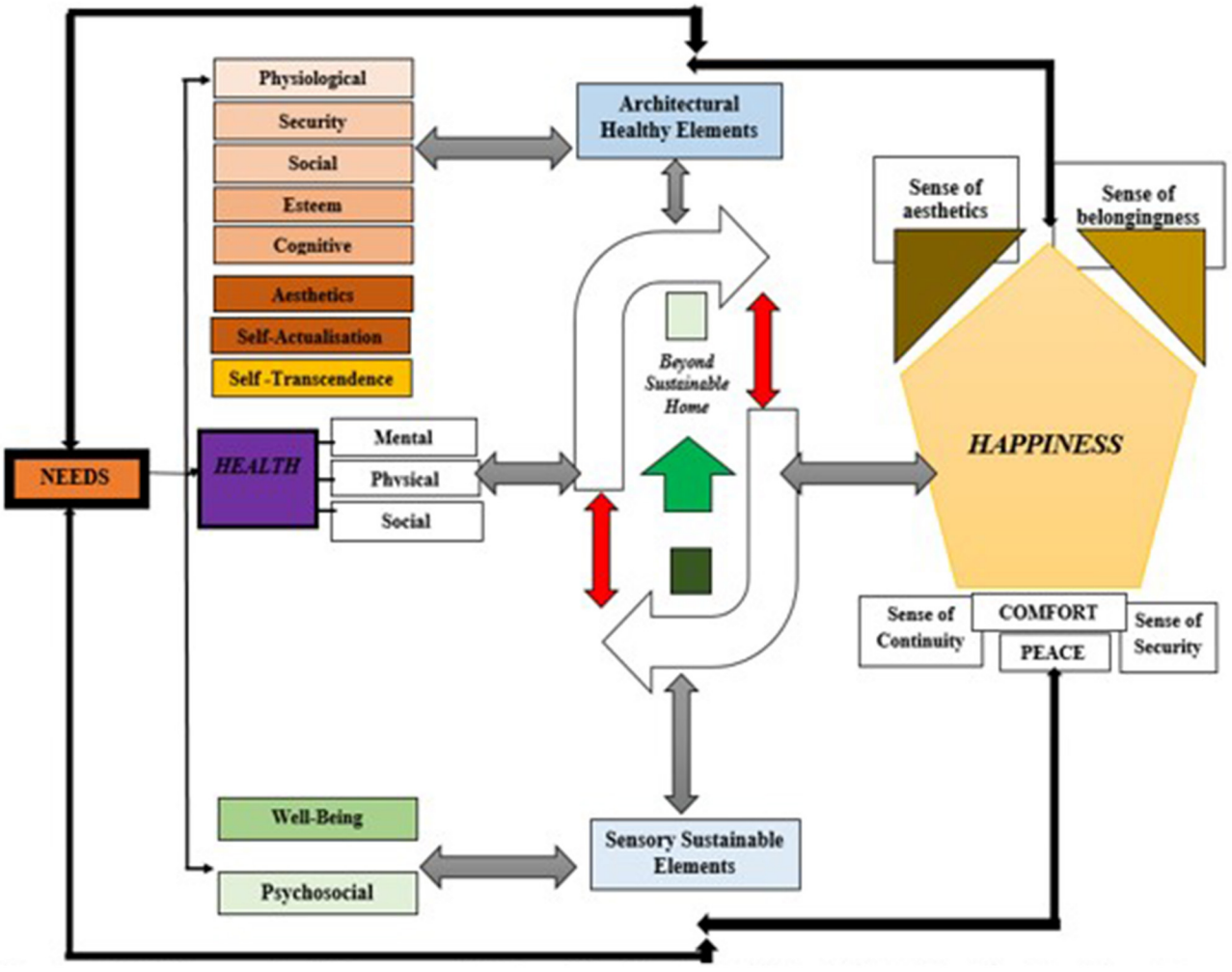

FIGURE 6
3H conceptual model integrating residents' needs into SSH to enhance happiness. Source: Ekhaese et al. (2021).

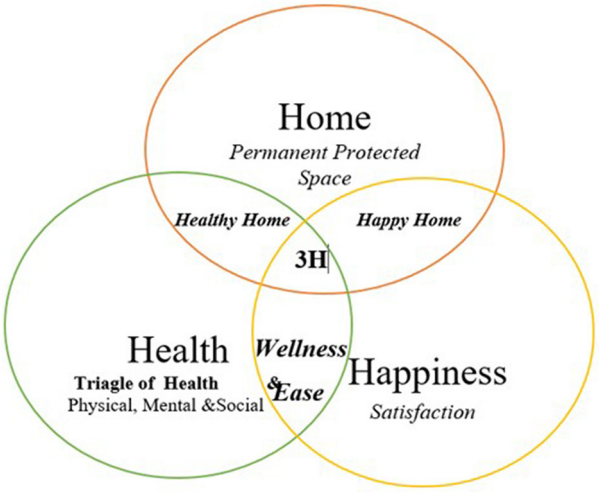

FIGURE 7
Venn diagram of the 3H residential design concept. Source: Ekhaese et al. (2021).

Therefore, it is vital to state that the health elements in a sustainable residential home are sensory architectural health elements and non-sensory architectural health elements.

According to SM in an interview, "*The built environment is a sensory-rich place, and humans are sensory-complex beings. Sensory systems process data from the external environment and the body's internal environment.*" He stated, *"SSH design requires integrating advances in social science, sensory studies, and neo-phenomenology related to theories about humanity, materiality, air and quality into sustainable architecture." "Literature has identified several sensory sustainable elements that should be in an SSH design checklist, and the sixteen experts/professionals confirm the architectural elements" (Environmental and Public Health Analyst, IDI).*

4.2 Result of assessing the happiness determinants in SSH

Table 5 presents the determinants of happiness in an SSH. The investigators categorized the happiness determinants into three domains: Social connection and Healthy relationships, Economy-Gross Domestic Product (GDP) per capita and Environmental (Kaklauskas et al., 2020; Wiesli et al., 2021; Lomas and VanderWeele, 2023). From the FGD and IDI expert interviews, the professionals suggested measures to address the challenges posed by happiness determinants.

However, AR at Faisalabad said

> *"Happiness is more than just a positive attitude or a good mood. Happiness comes from a deep sense of well-being that allows people to be happy regardless of external circumstances. Happiness lowers your risk for cardiovascular disease, lowers your blood pressure, enables better sleep, improves your diet, allows you to maintain normal body weight through regular exercise, and reduces stress, worry, and frustration. However, six determinants contributing to happiness scores are GDP per capita, healthy life expectancy, social freedom, family, trust and generosity. And healthy relationships may be the most important determinant of happiness."*

Therefore, he added,

> *"A happy home is where you feel safe and secure, can relax and can be yourself. Hence, introducing the architectural elements that enhance happiness in a sustainable home design can result in several health benefits, such as improved heart health, the ability to combat stress more effectively, a resilient immune system and an overall healthier lifestyle, which can help reduce pain and increase longevity. (Environmental Psychologist, IDI)*

4.3 Result of developing a conceptual framework that encapsulates the 3H concepts

The data results indicate a need to design and recommend an "SSH" known as a 3H Conceptual Model that integrates the health elements, happiness determinants and sensory sustainable home design requirements. All the literature reviews, theories, and concepts consistently indicate a strong connection between health, psychosocial wellbeing, and happiness.

The 3H residential design concept is also the 3H model. It is a process of conceptualizing a residential design scheme that integrates healthy-home elements (architectural health elements), happy-home determinants and psychosocial-wellbeing components (sensory-sustainable components) in a sensory-sustainable residential neighborhood or built environment. Figure 6 presents the 3H conceptual design framework. The health component of the 3H concept includes the full complement of health—the triangle of health, which is physical, mental and social. The investigator categorized the human sensory system into eight (8) sensory systems—Touch: the tactile system. Hearing: auditory system. Sight is the visual system. Smell is the olfactory system, Taste is the gustatory system, the Vestibular system, the Proprioceptive system and the Interoceptive system. The last three additional sensory systems are foundational for movement and function (Weston, 2019). It implies that health must be wholesome/total, and the architectural elements of a healthy home should meet all the occupants' sensory organ needs of such a home—the sense of smell, sense of sound, sense of sight, sense of touch, and sense of mood.

The happiness components of the 3H concept should meet the eight-level of Maslow's hierarchy of needs of the occupants while trying to answer pertinent questions like—Are the occupants satisfied with the home? Can they feel contentment with the architectural elements of this home? Are the occupants experiencing a sense of fulfillment living? All these and many other questions answered in the affirmative by the occupants would reflect a happy home. However, it is vital to state that a house is not a home. Until there is a home, the 3H concept is an illusion. Therefore, it is safe

to mention that home is a "construct" and a "given." Hence, the home must be locational, protective, relational, comfortable, reflect love, connection, belongingness, security, spacious, resilient, flourishing, aesthetics, clean, colorful, pollution-free, ventilated, lighted, sensory, materially sustainable and free-flow circulation as depicted in the 3H model above. Figure 7 shows that the

FIGURE 8 (Continued)

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FIGURE 8 (Continued)

intersection of home and health would result in a healthy home. In other words, the health provisions as architectural elements in the home produce a healthy home. Also, integrating happiness requirements into a home may result in a happy home. Therefore, the blend of health provisions and happiness requirements may produce psychosocial wellbeing/wellness among occupants of such homes and residential neighborhoods.

5 Recommended SSH typologies specifying the 3H elements

The investigators designed bungalows, maisonettes for lower and upper-middle-income single and joint families, and maisonettes for higher-income multi-family structures. These classes of families are in Pakistan and the global south. These

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FIGURE 8 (Continued)
Top four panels: Site plan showing the building footprint, the roof plan, ground floor plan of 3 bedrooms maisonnette (20ft by 40ft home) and first floor plan. Source: Ekhaese et al. (2021). **Middle three panels:** Roof plan of 3 bedrooms maisonnette (20ft by 40ft home), south elevation, west elevation; Source: Ekhaese et al. (2021). **Bottom twelve panels:** The 3-D visualization of the 3H conceptual design model with visuals of the healthy and happiness architectural elements (clock-wisely from top left to bottom left).

family structures are similar in the global south because of the socio-cultural family system in these climes (Ekhaese et al., 2021). The family system allows for an extended family setting, where there may be multi-generational households comprising several families linked by kinship or marriage. Some of these multi-generational households are great-grandparents, grandparents and parents. This development results in the residential home spaces being cramped, cluttered, unmaintained, unchecked and improperly designed. Families facing new unseen health risks and spending time indoors may be a solution (Wolkoff, 2018; Tähtinen et al., 2019). Hence, the researchers designed and recommended the 3H design concept. Based on the study findings, the authors conceptualized and developed a residential design model to meet the client's health and happiness needs while considering several families' resources in Pakistan and the Global South. The investigators analyzed the recommended design plans along the homes indoors and outdoors to gain an overall impression and sense of continuity. The study identified the design spaces

as formal/informal or horizontal/vertical circulation areas. The indoor information includes space function, interior dimensions and scale, furniture, layout, materials and façade, lighting, human econometrics and anthropometrics, space usage, number of users, color, air quality, decorations and ornamentation, and finishes. The outdoor information includes exterior dimensions, site

FIGURE 9 (Continued)

FIGURE 9 (Continued)

and home orientation, building scale, natural environment and views. Therefore, to achieve a 3H, these architectural elements were integrated into the different spaces in the SSH, as shown in Figures 8 (top), 9 (top), 10 (top).

Rooms/spaces—The sizes were spacious, the specific shape determined, the location was deliberate, and specialized spaces and the selected rooms, spaces, and design corners to contain the identified health elements and happiness determinants.

The living room/hall/drawing room/lounge—A space for socialization and meeting friends, relations and neighbors, so it is a large, deep, spacious area with adequate lighting and proper ventilation to reflect healthy architectural elements and happiness determinants.

Prayer/meditation/yoga—The space is for spiritual functions. Therefore, its location, size, and shape are adequate to excite happiness and healthy vibes.

Study Room—The size, shape, location, and views suit healthy and happy elements.

Walls—Materials used for the walls are mainly stabilized laterite bricks (SLB) because of their cooling property, cost-effectiveness, and locally sourced. For some spaces, the walls have wood (timber) finish, stone, and other PVC tiles, which are sustainable, healthy, and happy.

Floors—The floors were at different levels and finished with healthy flooring materials like timber, PVC tiles, green (grass) finish, and granulated floor finish according to the function of the space.

Windows/openings—The windows/openings were sizable, had suitable shapes and types for continuity of structure, were well-ventilated, and were positioned for maximum views and daylight fit for sustainable, healthy, and happy elements as shown in Figure 9 (middle).

Staircase—The designer used local materials for the construction, the location was adequate, and the type was user-friendly for sustainability, happiness and health requirements.

The roof—Was constructed with concrete materials, a green garden, and a 'sit out' on the rooftop. Green plants are therapeutic for reducing stress and improving air quality as shown in Figures 8 (bottom), 9 (bottom).

Romantic corner—This space meets an emotional need to balance the occupants' psychosocial wellbeing/health and happiness.

Zen garden/planters—The researchers designed this space to bring nature into the home interior for happy and healthy benefits.

Ornamentation means wood carvings, beautiful paints, designs, and patterns introduced into the interior walls and spaces for sustainable, healthy, and happy aids.

Lighting—The spaces in the SSH had adequate dark, gloomy, electric, bright, and natural daylight, depending on the space function.

Terrace—The terraces were green (grass) for good air quality to enhance health and happiness.

Entrance—The researcher designed the size, lighting, location and number to be adequate for the 3H concept.

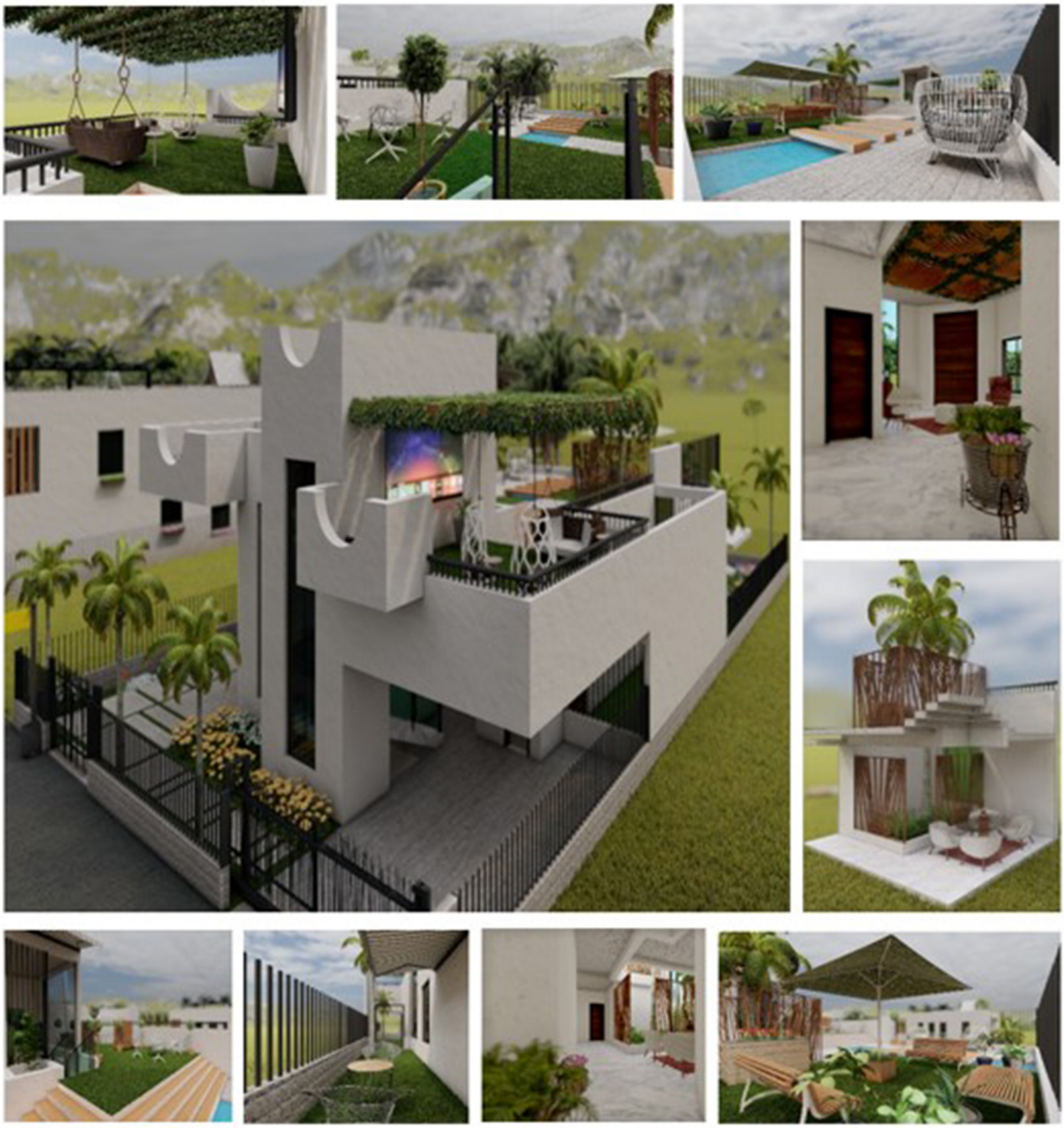

FIGURE 9 (Continued)
Top four panels: Site plan of 3-bedroom bungalow showing the building footprint, roof plan, floor plan of 3-bedroom bungalow (25ft by 50ft Home) and roof plan; Source: Ekhaese et al. (2021). **Middle two panels:** South elevation (approach) and west elevation (right-side); Source: Ekhaese et al. (2021). **Bottom ten panels:** The 3-D visualization of the 3H conceptual design model with visuals of the healthy and happiness architectural elements (clock-wisely from top left to bottom left).

Outdoor/surrounding/yard—Was well landscaped for both therapeutic and food, with grasses, shrubs, shrubbery, vines, trees, and a garden to promote health and happiness in the 3H as shown in Figure 10 (bottom).

The green roof garden with planters and sit-out and the romantic corner with planters and large windows for ventilation will enhance a decent outdoor view that excites happiness. The space shows the study, living room, yoga room, and Zen garden for self-actualisation and self-transcendence needs that inspire health and happiness in the 3H design model, as shown in Figure 8.

The green roof garden has planters, a water body and a sit-out, and the green terraces have potted plants and large windows for ventilation to enhance the good outdoor view that excites happiness, as shown in Figure 9 (middle). In Figure 9 (top), the

space shows the study, living room, yoga room, and Zen garden for self-actualisation and self-transcendence needs that inspire wellbeing/health and happiness in the 3H design model.

In Figure 10 (middle), the green roof garden has planters, a sit-out, a green wooden pergola, and a therapeutic water body. The design also has a terrarium used as a courtyard for ventilation

FIGURE 10 (Continued)

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FIGURE 10 (Continued)

and lighting indoor spaces within the home, as shown in Figure 10 (top). The family lounge has large windows, potted plants, and a green ceiling to excite happiness and health, as shown in Figure 10 (top). A view from the dining area shows the staircase and the terrarium. Next is the bar area in the living room, which has a wooden finish and potted plants to enhance the air quality with the space as health elements. The romantic corner overviews the double wing door with planters and large windows for ventilation to enhance an alluring outdoor view that stimulates happiness. The space shows the bedroom, study, yoga and lounge for self-actualisation and self-transcendence needs that inspire health and happiness in the 3H design model (see Figure 10, middle).

6 Conclusion

The overall findings showed that SSH design's health and psychosocial health elements enhance happiness based on some theories and concepts. Discussions with experts agree that the determinants of health and psychosocial health in a home

FIGURE 10 (Continued)
Top four panels: Site plan showing the building footprint, roof plan, ground floor plan of 5 bedrooms maisonnette (30 ft by 70 ft home) and first floor plan; Source: Ekhaese et al. (2021). **Middle two panels:** Roof plan of five bedrooms maisonnette (30 ft by 70 ft home), south elevation and west elevation; Source: Ekhaese et al. (2021). **Bottom fifteen panels:** The 3-D visualisation of the 3H conceptual design model with visuals of the healthy and happiness architectural elements: **(i)** roof garden sit-out, **(j)** part of the roof garden sit out, **(k)** a pergola over the bar at the roof garden, **(l)** the profile of the pergola with potted plants, **(m)** a panoramic view of the terrarium, **(n)** is a view of the family lounge with a green drop down ceiling, **(o)** a cross section of the living room with green plant adorning the space, **(p)** a view of the terrarium from the living room, **(q)** a view of the bar area in living room adorn with green plants creating healthy space, **(r)** a view of the dining area, **(s)** a view of the entrance into the living room from the outside with potted plants, **(t)** one of the bedrooms with large windows and potted plants for healthy indoor airflow, **(u)** part of the living room with large opening and potted plants, and **(v)** another bedroom with large openings and alluring finishing for good views.

are also happiness enhancers. The study established that using Pakistan as a case study is due to the similarities between countries in the Global South. Therefore, the results might apply to all residential homes across the Global South. The authors supposed that from the research conducted, new ideas, definitions, and theories would result from this study. However, a new meaning of home came to the fore: from the study, the author defines *home as a design intention that integrates the elements of aesthetics, protection, security, peace, comfort, happiness and health/psychosocial wellbeing into indoor and outdoor activity spaces or segments.* The study identified several architectural health elements along Maslow's hierarchy of needs in specific primary, secondary and tertiary places in the home. The author grouped these elements into nine classes—environmentally friendly considerations, health, ventilation, insulation, roofing, energy, materials efficiency, windows and water. The researchers ascertained happiness determinants in a sustainable home as living standard, health, psychosocial wellbeing, time use or work-life balance (work and sleep), human services and education, social vitality and connection or community vitality, art and cultural diversity, good governance and ecological diversity and resilience. The study concluded that the *3H design concept is a construct with the elements of a sustainable home and beyond.* The result shows that a sensory-stainable home is what the authors referred to as the 3H conceptual design framework or 3H conceptual design model, which classifies human needs into three broad groups—Maslow's hierarchy of needs, health needs, and happiness needs.

The investigators classified these needs by architectural elements in the home. These elements/facilities create a sense of aesthetics, belongingness, security, comfort and peace that may enhance the overall happiness in such a home. However, the 3H design concept will create a sensory-sustainable neighborhood, which will become a sensory-sustainable community. This process may eventually snowball into a happy city and a happy world. Therefore, the implication for further research would be to collect data on implementation policies of a sensory-sustainable home or 3H design model and the cost implication of designing the 3H conceptual model for all social strata across the global south countries in the regions such as Africa (Nigeria and South Africa), Latin America and the Caribbean (Brazil, Paraguay and Jamaica.), Asia (India, China and Indonesia) and Oceania (Australia and New Zealand) according to the United Nations Conference on Trade and Development (UNCTAD). Happiness is closely related to Sustainable Development Goals (SDGs). The SDGs' mission is to improve the world, create a better world for all people and promote stability, wellbeing, and happiness, 'leaving no one behind'.

7 Limitations

The study offers robust insights into the investigation of SSH design that integrates the 3H requirements into the conceptual model to enhance the occupants' quality of life (QoL). It explores varied angles on how health elements and happiness determinants in homes enhance occupants' wellbeing. However, the research has some limitations. First, the results from IDIs, FGDs and observation schedules might not wholly explain that architectural elements integrate occupants' health needs and pleasures and boost happiness in the home in the Global South. Purposive sampling could present selection bias and limit the generalisability of the results. Second, lived experiences due to the number of years of residents and the expertise of the professionals might affect the research outcomes. It may lead to underreporting challenges or limitations encountered while applying the 3H framework policy initiatives and practices or a tilted depiction of their experiences. Third, participants may have issues remembering some details related to lived experiences due to when the investigators conducted the interviews. It can affect the data's reliability and validity. Lastly, the study offers a rich understanding but may be deficient in statistical meaning. Quantifying and measuring evidence supporting claims about the efficacy of specific architectural elements in promoting health and happiness in a 3H conceptual design model across the global south can be attractive based on the observation schedule used in the case studies and interview methods. It will also collect data on implementation policies of a sensory-sustainable home or 3H design model and the cost implications of designing the 3H conceptual model for all social strata across the global south countries in regions such as Africa. Therefore, mixed-method research can provide more inclusive data on the research subject.

Data availability statement

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

Ethics statement

Ethical approval was not required for the study involving humans in accordance with the local legislation and institutional requirements. Written informed consent to participate in this study was not required from the participants or the participants' legal guardians/next of kin in accordance with the national legislation and the institutional requirements. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

EE: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Resources, Software, Validation, Visualization, Writing – original draft, Writing – review & editing. WH: Investigation, Project administration, Supervision, Validation, Writing – original draft, Writing – review & editing. ON: Investigation, Methodology, Resources, Writing – original draft. KH: Formal analysis, Investigation, Methodology, Resources, Writing – original draft. AO: Formal analysis, Investigation, Methodology, Resources, Writing – original draft.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/frsc.2025.1506672/full#supplementary-material

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