

Chapter 3

Neuroarchitecture strategies for maternal and child healthcare in Coahuila, México

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Introduction

The World Health Organization defines maternal health as "the health of women during pregnancy, childbirth, and the postpartum period" (para.1). Maternal health is increasingly recognized as a multidimensional aspect of public health that extends beyond the biological process of procreation. The perinatal period is a critical stage in which a series of physiological, psychological, social, and economic changes combine, requiring specific adaptations and care to ensure the well-being of both mother and baby.

Becoming a mother transforms a woman, leading her to readjust her priorities, daily activities, and goals. However, it wasn't until the first decade of the 21st century that the term *matrescence* was introduced to describe and understand the complex process of transformation by which a woman adapts to motherhood. This process involves physical, emotional, and social changes that lead her to rediscover herself and rebuild her identity. Matrescence and other concepts related to motherhood, such as postpartum depression, have spurred further study of the neural processes associated with the entire maternity journey. These processes are linked to the hormonal and behavioral changes that accompany this stage, enabling a comprehensive understanding of the transformation women undergo as they become mothers. Understanding the brain areas involved and the functions modified during this process opens the possibility of intentionally intervening in neural plasticity, thereby improving the mother's experience and fostering the bond between mother and newborns (Carmona, 2024).

During pregnancy, childbirth, and the postpartum period, significant hormonal and neurotransmitter changes occur in women, including oxytocin, cortisol, progesterone, estrogen, serotonin, dopamine, and endorphins. These biochemical changes are linked to emotional and behavioral changes during pregnancy, regulating mood, stress response, and attachment behaviors that support newborn care. Estrogen and progesterone levels increase during pregnancy due to placental production; however, this increase can cause drowsiness and fatigue, raise cortisol levels, and increase vulnerability to stress (Hendrick et al., 1997). On the other hand, childbirth is characterized by peaks in oxytocin that facilitate contractions and the mother-newborn bond, as well as endorphins, which act as natural analgesics, followed by a sudden decrease in estrogen and progesterone after the expulsion of the placenta.

Although these adaptations are necessary and occur naturally, they can also lead to a neuroendocrine imbalance that can make women more vulnerable to external stressors. For example, the hormonal drop after childbirth can trigger depressive and anxious symptoms in the postpartum period because serotonin regulation is affected. At the same time, elevated cortisol levels (which can be aggravated by the mother's socioeconomic situation) prepare the body for childbirth, but can worsen stress, depression, and anxious symptoms (Trifu et al., 2019). These physiological changes are therefore closely linked to well-being, as hormonal fluctuations can affect sleep quality, circadian rhythm, emotional stability, and cognitive functions. In some cases, these changes are associated with mental health problems such as anxiety and postpartum depression. Postpartum depression affects 10-15% of new mothers, with higher prevalence in low- and middle- income countries due to socioeconomic stress and limited maternal healthcare" (Chamanara et al., 2026).

A comprehensive review of the neurobiology of motherhood highlights that pregnancy and childbirth trigger coordinated hormonal, structural, and functional changes in the maternal brain that facilitate the transition to motherhood. These neurobiological adaptations are closely linked to maternal behaviors, caregiving, and mother-infant bonding, demonstrating that pregnancy naturally promotes mechanisms that support maternal well-being and resilience. From a salutogenic perspective, these adaptive processes represent internal health resources that

help women successfully navigate the transition to motherhood. The findings emphasize the importance of maternity care environments that minimize stress and support the physiological and psychological adaptations that underlie positive maternal health (Servin-Barthet et al., 2023).

For this reason, women require environments that promote the positive regulation of the hormones and neurotransmitters, as well as social support and security. In recent years, research has begun to explore how the built environment influences human physiology, psychology, and emotional states. The science of neuroarchitecture studies incorporates design principles grounded in neuroscience, exploring the relationship between neural processes and stimuli generated by spatial characteristics such as lighting, acoustics, materials, scale, and spatial organization, as well as their impact on user regulation and behavior. Studies have shown that vegetation, appropriate lighting (tailored to each space), texture selection, and form geometry can influence cognitive processes. For example, a design that allows for natural light and access to vegetation can stimulate the production of endorphins and serotonin, fostering motivation and joy. At the same time, space that lacks order or is sensory-overloaded can intensify stress and exhaustion (Medhat et al., 2023). Another study that evaluated women's neuroplasticity during gestation, childbirth, and postpartum, scores for maternal attachment, depression symptoms, and perceived stress were higher after giving birth, and sleep quality worsened during the postpartum period (Paternina-Die et al., 2024).

A review of neuroimaging research indicates that the transition to motherhood is accompanied by significant and long-lasting structural adaptations in the maternal brain that support caregiving, emotional regulation, and mother-infant attachment. These changes are considered part of a normal physiological process and may contribute to maternal resilience and psychological well-being during the perinatal period. From a salutogenic perspective, recognizing motherhood as an adaptive biological transition highlights the importance of maternity care environments that reduce stress and promote conditions that support these natural neurobiological processes, fostering positive maternal health rather than focusing exclusively on preventing pathology (Martínez-García et al., 2021).

In the context of perinatal care, this suggests that the physical environment should not be understood merely as a neutral setting for medical procedures, but as an active component that influences the experience of motherhood. Therefore, examining the relationship between motherhood and architectural design is a promising area of research, as it can inform the development of maternal care spaces that prioritize the well-being of both mother and newborn. Each Mexican state has a different situation regarding maternal and child health care. Moreover, although this study is in the northeast of the nation, it is evident that strategies adapted to the local context and evidence-based practices are urgently needed, without neglecting the continuous evaluation of innovations from other countries. (Ramírez-Palacios et al., 2026). A 2022 study in Mexico (Unar-Munguía et al., 2023) showed that 18.4% of children did not attend all eight well-child visits during their first year of life, and that only 27.1% of children under five years old had an early childhood development assessment. Maternal and child health care indicators are particularly low. It reminds us that access to services must be strengthened nationwide. According to Saturno Hernandez (2025), pregnant women are a critical population group and are considered vulnerable. They are at the beginning of continuous maternal, neonatal, and child health care, and events during pregnancy can affect their health throughout their lives. Therefore, the role of prenatal care in quality health services is paramount.

Actual situation and significance of the research

Through historical analysis, the authors trace hospital design from medieval isolationist models and spiritual care, through the 19th-century pavilion system's emphasis on ventilation and spatial organization to reduce infection, to contemporary hospitals that integrate biophilic elements and smart technologies. Today, contemporary facilities incorporate advanced technology alongside natural design elements to optimize both medical efficacy and patient experience. The findings show how hospital design has continually adapted to enhance healthcare outcomes (Aykut, B., & Aykut, B., 2026). This evolution also applies to maternal healthcare structures.

Although support for women during the perinatal period is a fundamental need, in Mexico, according to Brenes-Monge et al. (2023), the quality of perinatal care is deficient, and there are various limitations in the health spaces dedicated to maternal and child health. Some world data points show that 9.3-18% of pregnant and postpartum individuals meet diagnostic criteria for at least one anxiety disorder. Prevalence increased worldwide during the COVID-19 pandemic, with a pooled prevalence of 25.6 % for prenatal depression and 30.5 % for anxiety" (Singh et al., 2025, p. 1).

As a first point, we can say that there is limited access to health services in socioeconomically vulnerable sectors, and that clinical outcomes are prioritized, with spaces designed for medical efficiency, while relegating the emotional, psychological, and sociocultural factors that also impact maternal wellbeing to the background. The challenge of integrating these factors is particularly relevant in regions of the country undergoing rapid urban and economic transformation, such as the state of Coahuila. As one of the northeastern states with a growing population due to internal migration, it has also generated a new form of social vulnerability, particularly among women who lack stable support networks and access to health services, thereby presenting opportunities for public health and perinatal care spaces.

While neuroarchitecture research has suggested that spatial features can influence neurocognitive and emotional responses, the literature has examined these principles only in limited ways with respect to well-being during pregnancy, childbirth, and the postpartum period. The regulations used to develop the architectural project include the World Health Organization's recommendations for positive pregnancy, childbirth, and postpartum care, as well as the guidelines for humanized childbirth proposed by the Spanish architect Marta Parra. However, these have not been fully integrated into Mexican architecture, nor have they been applied to facilities that support both pregnancy and postpartum care. Therefore, the research team decided to delve deeper into the relationship between maternal care and architectural design.

This research aims to identify and systematize neuroarchitectural design strategies that contribute to the development of spatial guidelines or directives to promote the physiological, social, emotional, and psychological well-being of women in vulnerable situations during pregnancy, childbirth, and postpartum, with a focus on reducing stress and depressive symptoms associated with postpartum depression through architecture.

Some of the secondary objectives of the research are to identify and analyze the conditions and care systems of existing perinatal health centers in Coahuila, as well as their impact on users. A second aim was to gather interior and exterior design strategies to support vulnerable women during the perinatal period through architecture, incorporating perspectives from social work and psychology. Moreover, finally, the third objective was to develop an architectural program and zoning plan that comprehensively integrates support services for pregnant women, women in labor, and postpartum women.

On the other hand, this research hypothesizes that incorporating neuroarchitectural strategies into perinatal health spaces can positively influence maternal and infant well-being by supporting emotional regulation, reducing stress, and fostering conditions conducive to the mother-infant bond.

This research contributes to the growing public and maternal-child health infrastructure by exploring how the built environment supports the well-being of women and newborns across the three perinatal stages. The topic is relevant in Mexico, where public perinatal health infrastructure is limited: only 30% of pregnant women have access to prenatal health services (Secretaría de Salud, 2023), and 49.5% of women attend postnatal check-ups (Contreras-Sánchez et al., 2021). Furthermore, one of the states where this issue is particularly relevant is Coahuila de Zaragoza (commonly known as Coahuila), where there is a lack of spaces and support institutions for pregnant and postpartum women. Additionally, between 15% and 20% of mothers experience postpartum depression, 24% of the population lives in poverty with limited access to healthcare services (Secretaría de Bienestar, 2023), 4% of mothers do not have a basic education, and there are approximately 20 maternal deaths per year (INEGI, 2020). However, this is a state in which government efforts have been directed towards addressing this issue, making it relevant to this study.

By identifying architectural strategies that address the neurological, psychological, and sensory aspects of motherhood, this research seeks to contribute to the formulation of design guidelines to follow the planning and design of perinatal care spaces, with a focus on comprehensive well-being and recovery.

The document is organized into five sections. The first is the introduction and the context in which the research was conducted. The second section describes the methods used in the study. This section explains the design instrument, data sources, and analytical procedures used to identify architectural strategies relevant to the design proposal. Section three presents the main findings of the analysis. The fourth section presents the implications of the findings in relation to existing literature and examines the strengths and limitations of the research. The final section summarizes the conclusions and describes the possible implications for the architectural design and the potential future comprehensive perinatal care environment in northern Mexico.

Materials and Methods

The study was conducted using a mixed-methods approach, combining quantitative and qualitative methodologies and projective research. The analysis integrated statistical analysis, fieldwork, and evidence-based architectural development, specifically aimed at formulating neuroarchitectural strategies applicable to maternal and child healthcare spaces.

This research involved reviewing national and international case studies on perinatal care, official health statistics, and literature on maternal health, matrescence, and neuroendocrine regulation. This framework allowed the identification of environmental variables that can influence hormonal and emotional processes during pregnancy, childbirth, and the postpartum period. The study was conducted in the Saltillo and Ramos Arizpe Metropolitan area of Coahuila, Mexico, because it was identified as having low indicators of perinatal care. Data collection took place at the end of 2024 at a public health institution providing maternal and child healthcare in both Monterrey, Nuevo León, and Saltillo, Coahuila, both located in Mexico, allowing for comparison with similar regional contexts in northeastern Mexico.

The quantitative sample consisted of 50 women aged 18-45 who were pregnant or postpartum and attended public health institutions in the region. The information obtained was used to identify or address emotional and spatial needs during the maternity process. For the qualitative phase, interviews were conducted with professionals, including two center managers dedicated to maternal health care, a lawyer, and two psychologists working in the same field. These interviews were recorded using structured notes and subsequently

analyzed to gain a deeper understanding of the psychological, social, and spatial needs of pregnant women from an interdisciplinary perspective. In addition, existing physical spaces in perinatal care were considered units of analysis and evaluated through architectural inspections and field visits, with a focus on environmental variables related to well-being.

The instruments used for data collection and analysis were in-person surveys, online interviews, and site visits to existing facilities. These instruments enabled the linking of empirical information to neuroarchitecture-based design criteria, taking into account factors such as natural lighting, ventilation, spatial scale, privacy, connection with nature, and sensory stimulation.

The research was conducted in four phases. The first was a theoretical framework study on maternal and child health, maternal development, neuroendocrinology, and neuroarchitecture, identifying environmental variables that influence pregnant women's hormonal and emotional regulation. This phase defined the basic principles for constructing neuroarchitectural strategies to modulate cortisol, oxytocin, and serotonin through the physical environment.

The second phase consisted of regional, statistical, and information analysis. Official maternal health indicators in Coahuila were examined to contextualize the problem and critical issues. Subsequently, quantitative and qualitative findings were integrated into matrices for emotional, environmental, and special variables to identify opportunities for architectural intervention. Regarding the fieldwork, 50 in-person surveys were carried out in hospital waiting rooms. In-person and online interviews were conducted with healthcare professionals specializing in maternal and child health. Finally, several site visits were made to facilities, during which the team surveyed existing buildings and evaluated lighting, layout, privacy, circulation, and sensory stimulation. These visits allowed the team to gather information on elements considered best practices for inclusion in the design proposal and to identify and avoid poor practices.

The fourth and final phase involved developing an architectural proposal. Based on the results, design criteria were established to focus on neuroendocrine regulation and strengthening the mother-child bond. Spatial, programmatic, and environmental guidelines were formulated, constituting a set of neuroarchitectural strategies for maternal health care buildings in a vulnerable context. The design team used mood-boosting hormones and neurotransmitters as a reference to develop design strategies that naturally help new mothers regulate their hormonal balance. This is achieved by linking each hormone to its effects in motherhood; for example, oxytocin is associated with comforting and bonding. During childbirth, adrenaline levels are through the roof, while oxytocin production stops. Birth and post-natal spaces need to support low-stress, undisturbed labor and privacy to promote calm feelings in the stressful situation of giving birth. Oxytocin production can be encouraged by low warm lighting, as well as soothing sounds, natural materials, views, and soft warm textures (Balabanoff, 2023)

Quantitative data were analyzed using descriptive statistics, employing frequencies and percentages to identify patterns in users' emotional and spatial needs. This data was derived from surveys and interviews and examined using thematic analysis, which categorized the information into psychological, social, spatial, and economic dimensions. The team elaborated an integrative cross-tabulation between regional statistical indicators and survey results. This process enabled the translation of scientific evidence and experimental findings into neuroarchitectural strategies to reduce emotional burden, minimize environmental stress, and promote neuroendocrine regulation in perinatal environments, thereby establishing a replicable methodological basis for the design of maternal and child health infrastructure.

Although the research identified relevant findings regarding maternal and child healthcare needs in the Saltillo Metropolitan Area, it is important to acknowledge some limitations encountered during the study. First, the number of surveys administered represents a limited sample of the total population. Hence, the results reflect general trends but do not necessarily encompass all women's experiences during pregnancy, childbirth, and the postpartum period.

Finally, given the project's academic nature, the architectural proposal is developed at the conceptual and preliminary design levels. Therefore, its actual implementation would require additional technical, regulatory, financial, and operational studies to assess its construction and administrative feasibility better.

Results

As mentioned previously, the research results stem from a mixed-methods approach that combined quantitative and qualitative methods to understand the spatial, social, and emotional needs of vulnerable women during pregnancy, childbirth, and the postpartum period in the Saltillo Metropolitan Area of Coahuila. Interviews with professionals and institutions revealed limitations in the existing infrastructure, especially the fragmentation of services, as many users must travel between different institutions to receive medical, psychological, or legal support. Likewise, a lack of specialized spaces providing support during pregnancy, childbirth, and postpartum was identified, particularly for women who lack family or economic support networks. The importance of complementary services, such as childcare, job training, and emotional support programs, was also highlighted.

To facilitate understanding of the data obtained during the research, the results were organized into tables, graphs, maps, and diagrams to visualize better the statistical information, territorial analysis, and the architectural strategies derived from the findings. The tables and graphs summarize survey results from women in the Saltillo

Metropolitan Area, covering variables such as age, education level, occupation, access to health services, psychological well-being, and perceptions of maternal care facilities. This data allowed for the identification of relevant problems, such as the lack of psychological support during pregnancy and postpartum, economic difficulties in accessing medical services, and perceived discomfort in some care facilities. Maps were also used to analyze the social determinants of maternal and child health in the state of Coahuila, using data from the National Institute of Statistics and Geography and the National Council for the Evaluation of Social Development Policy. This analysis identified territorial patterns associated with factors such as poverty, population distribution, migration, teenage pregnancy, and maternal and infant mortality.

The results showed that the southeastern region of the state, particularly the Saltillo Metropolitan Area, has demographic and social conditions that justify implementing the project. In addition, maps were developed showing the existing network of perinatal care services, which enabled evaluation of the proximity of potential intervention sites to the nearest hospitals, assuming a maximum transfer time of 20 minutes for obstetric emergencies.

From a psychological and social perspective, specialists indicate that problems such as anxiety and depression are common during the perinatal period, especially in vulnerable contexts associated with violence, workplace discrimination, and economic dependence. These findings highlight the need for spaces that integrate psychological care, legal advice, and community support networks. The survey results also allowed for the identification of relevant characteristics of the user population. 30.2% of the participants were between 26 and 35 years old, followed by women between 18 and 25, who accounted for 27.9%. Regarding educational level, secondary education predominated, accounting for 46.5% of participants, while the most frequent occupation, with 48.8%, was housewife, reflecting socioeconomic conditions that can influence health services.

Finally, 69.8% of the women felt that a comprehensive care model would have better met their needs during pregnancy and the postpartum period. Based on these findings, the aim is to create a Comprehensive Maternity Support Center that integrates medical, psychological, legal, and community services under one roof. The design also proposes incorporating gardens and open areas, training spaces, and a spatial organization that integrates public, private, and service areas to improve users' physical and emotional well-being.

Considering all the information gathered, the research team synthesized the project's main constraints and the proposed design guidelines to address them, summarizing this in a table that maps each constraint to its corresponding architectural strategies. (See table 1)

Design Constraint	Applied Design Strategies
Regulations and accessibility	Compliance with the accessibility requirements established in Mexican regulations for assistance centers, incorporating wide circulation areas, ramps, and adequate spaces for the movement of women with strollers or with reduced mobility.
Sustainable strategies	Implementation of overhangs and lattices on the southwest facade to control thermal incidence, as well as a passive ventilation and natural lighting strategies to improve environmental comfort.
Cultural identity	Incorporation of regional materials, such as local stone, a warm color palette, and the configuration of patios and communal gardens that strengthen users' sense of belonging and cultural connection to the space.
Sustainable maintenance	Strategic location of the central facilities, selection of durable materials, and use of endemic vegetation to reduce maintenance requirements and optimize the operation of the building.
Safety and psychosocial well-being	Application of neuroarchitectural principles through natural lighting, vegetation, natural textures, and controlled access that promote privacy, reduce stress, and contribute to the emotional well-being of users.
(Neuroarchitectural strategies)	Natural light for emotion and circadian rhythm regulation. Natural hypoallergenic textiles and materials for serotonin production (happiness). Vegetation for cortisol (stress) reduction and endorphin regulation Open communal spaces for dopamine regulation.

Table 1. Constraints and Strategies (Developed by Authors).

Statistical Analysis

Statistical analysis of the surveys identified trends in maternal care conditions and users' spatial needs during pregnancy, childbirth, and the postpartum period. Data was analyzed using descriptive statistics, employing

frequencies and percentages to interpret responses and identify patterns within the study population. Demographic results show that most participants are of early to middle reproductive age, and that a significant proportion face socioeconomic conditions that may limit their access to specialized health services. Regarding prenatal care, some women reported not receiving the recommended number of medical appointments or experiencing financial difficulties accessing health services. Furthermore, more than half indicated they did not receive psychological support during pregnancy or childbirth, highlighting the need to integrate emotional support into maternal services.

Regarding access to healthcare, 25.2% of women reported not receiving the recommended number of prenatal visits, while 11.6% had no access to these services at all. Furthermore, 44.2% reported financial difficulties in accessing healthcare during pregnancy. In the area of mental health, 55.8% indicated that their psychological well-being was not addressed during pregnancy or childbirth, highlighting a significant gap in comprehensive maternal healthcare.

The results show that factors such as privacy, environmental comfort, and the possibility of interaction with family members significantly influence users' perception of well-being. Among the main sources of discomfort identified were small spaces (41.9%) and a perceived lack of privacy (23.3%). Furthermore, 32.6% felt that the spaces did not facilitate family accompaniment. Respondents also expressed a preference for environments with natural lighting, adequate ventilation, exposure to nature, and pleasant sensory stimuli, such as natural aromas. These results reinforce the importance of incorporating principles of environmental well-being and neuroarchitecture into the design of spaces intended for maternal and childcare. Regarding perceptions of care spaces, users mentioned the importance of privacy, environmental comfort, and the possibility of family support. Users also preferred environments with natural light, adequate ventilation, and access to green spaces.

In addition to the quantitative analysis, qualitative information from a literature review, site analysis, and interviews with institutions involved in the care of women in vulnerable situations was integrated, enabling a better understanding of the project's social and territorial context. Finally, some quantitative data enabled quantification of the project's scale and an estimate of capacity for 52 female residents with their babies, as well as external users. This information helped define the center's spatial requirements, including consultation rooms, specialized care areas, community spaces, residential areas, and complementary services. Taken together, these results enabled the establishment of a programmatic organization that integrates medical care, psychological support, legal advice, temporary housing, and training spaces within a single architectural complex.

The environmental and site data

The research and the gathered information were classified into different categories based on the nature of the data. These categories include site environmental data, urban and planning data for the complex, and programmatic data related to the project's architectural organization. This classification enabled clear structuring of the results. It established a direct relationship between the research findings and the architectural design strategies implemented in the proposal for the Comprehensive Maternity Support Center.

The site's environmental analysis identified climatic and physical factors that directly influence the project's architectural design. One of the most relevant aspects was the high solar incidence on the southwest facade, which is considered the most critical area for heat gain during the afternoon hours. Given the region's climatic conditions, it is necessary to incorporate passive design strategies to reduce heat buildup and improve thermal comfort in interior spaces. These strategies include incorporating shading elements, using natural ventilation, and integrating green areas and therapeutic gardens within the architectural complex. These environmental considerations influence design decisions regarding the building's orientation, facade treatment, and the integration of exterior spaces, aiming to create more comfortable, sustainable, and supportive environments for the center's users. (See Figure 1)

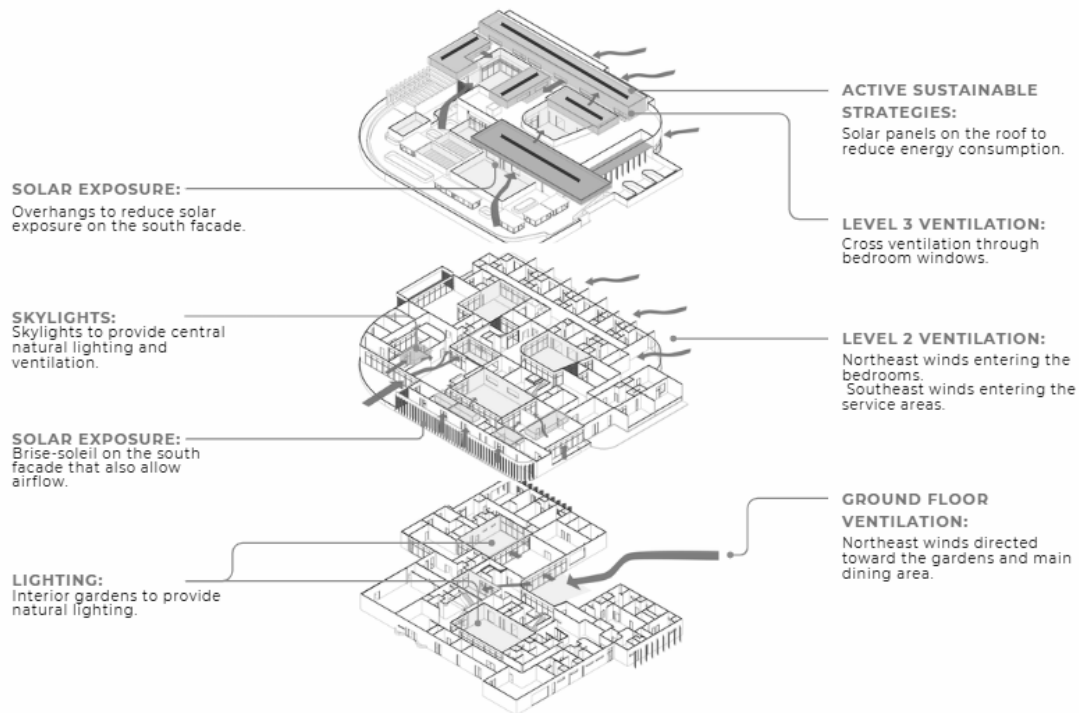


Figure 1. Sustainable strategies (Developed by Authors).

Master plan and programmatic data

The urban and territorial analysis identified the spatial and mobility conditions that influence the organization of the architectural complex. Based on this study, the site is oriented along a north-south axis, which allows for better use of natural light and reduces direct sunlight in interior spaces. Based on these criteria, the master plan organizes the project considering different levels of accessibility and privacy. Public areas face the main roads to facilitate access for visitors and external users. In contrast, residential areas are located at the rear of the site, providing greater security and tranquility for residents. It is important to consider the context because urban areas and walkable communities are found to be associated with a lower risk of postpartum depression; on the other hand, living in underdeveloped neighborhoods with inadequate public services shows an increased risk of depression among women (Zhang et al., 2021).

Furthermore, the complex's planning seeks to ensure efficient circulation by separating pedestrian, vehicular, and service entrances. The project includes a main pedestrian entrance on the site's front facade and the relocation of the bus stop to Mariano Matamoros Street, maintaining its position at the same corner to respect the existing traffic flow. Similarly, two vehicular access points are proposed: a Guadalupe for rapid vehicle entry and exit, and a secondary access point in the area designated for parking and service. Finally, perimeter vegetation barriers and interior gardens are integrated to enhance privacy, environmental comfort, and the presence of greenery within the architectural complex.

The programmatic data (See Figure 2) comes from needs identified through interviews, surveys, and theoretical analysis related to maternal care and support for women in vulnerable situations. These findings provided an understanding of both the functional and emotional needs of the users and were translated into an architectural program that combines public, semi-private, and private spaces, organized according to their functional relationships, levels of privacy, and use dynamics within the center. The public spaces include a reception area, auditorium, multipurpose rooms, and a daycare center. These areas serve to facilitate access to the center's services and foster interaction with the community. They can also be used for workshops, community events, conferences, or educational activities, helping generate income to support the center's sustainability and strengthen its connection with the surrounding community.

Furthermore, the project incorporates medical, psychological, and legal consultation rooms that provide care to both resident women and external users who require specialized advice or support. (See table 2) These spaces enable a comprehensive approach to care across pregnancy, childbirth, and the postpartum period, promoting women's physical, emotional, and social well-being. Finally, the private areas are reserved exclusively for women who are temporarily residing at the center. These include dining rooms, common rooms, kitchens, exercise areas, training workshops, and bedrooms. These spaces are designed to provide a safe, comfortable, and supportive

environment where residents can carry out daily activities, strengthen their skills, and build support networks during their motherhood journey.

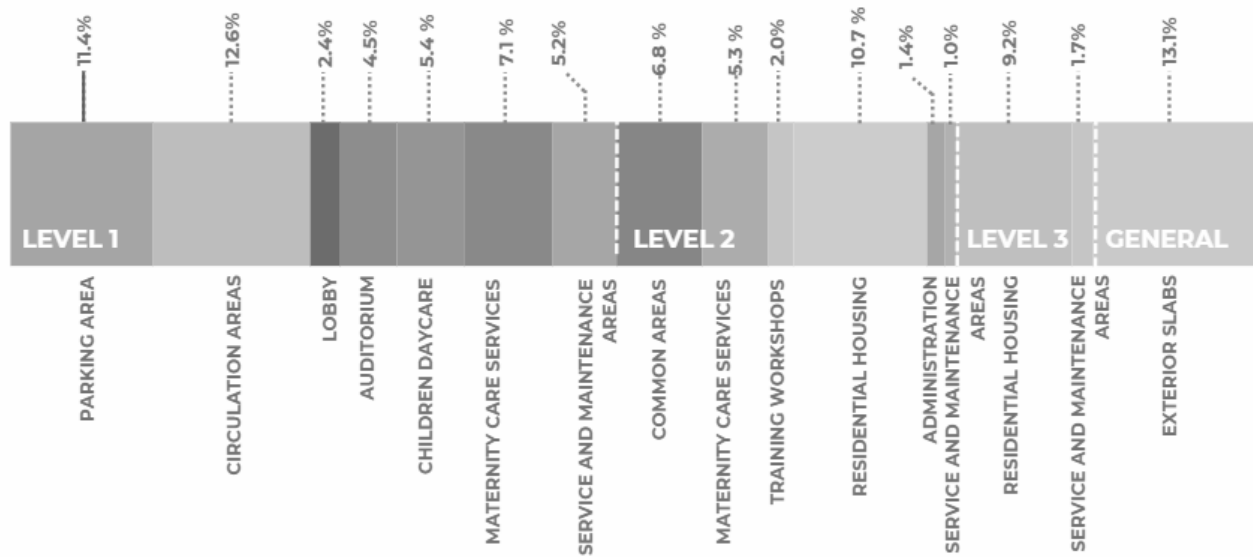


Figure 2. Percentages of architectural program (Developed by Authors).

Section	Main Spaces	Function
Public areas	Reception, auditorium, multipurpose rooms, nursery	Customer service and community activities
Semi-private areas	Medical, psychological, and legal offices	Specialized care and support
Private areas	Bedrooms, dining room, kitchen, common room	Accommodations and daily activities of the residents.

Table 2. Categorization of spaces. (Developed by Authors).

The spatial organization of these components aims to promote both the center's functional efficiency and users' emotional well-being, enabling access to professional services while providing safe, comfortable spaces that support recovery, personal development, and the strengthening of support networks. (See Figure 3)

Hospital lobbies are high-exposure public spaces where occupants experience peak anticipatory anxiety. Drawing on Stress Recovery Theory, environmental influences are directly reflected in physiological responses, and this study examines the effect of visual-only versus audiovisual biophilic elements in a hospital lobby on physiological stress recovery. Due to infection-control constraints, the study excluded live vegetation and instead used natural analogs, such as wood textures and biomorphic motifs, as visual elements, combined with forest soundscapes as an auditory component. Using a between-subjects virtual reality experiment with 168 participants, the researchers found that the combined audiovisual condition produced the most pronounced reductions in blood pressure, demonstrating that biophilic analogs facilitate autonomic stress recovery and serve as a vital component of restorative design (Liu, Y.T. & Lee; S.Y., 2026).

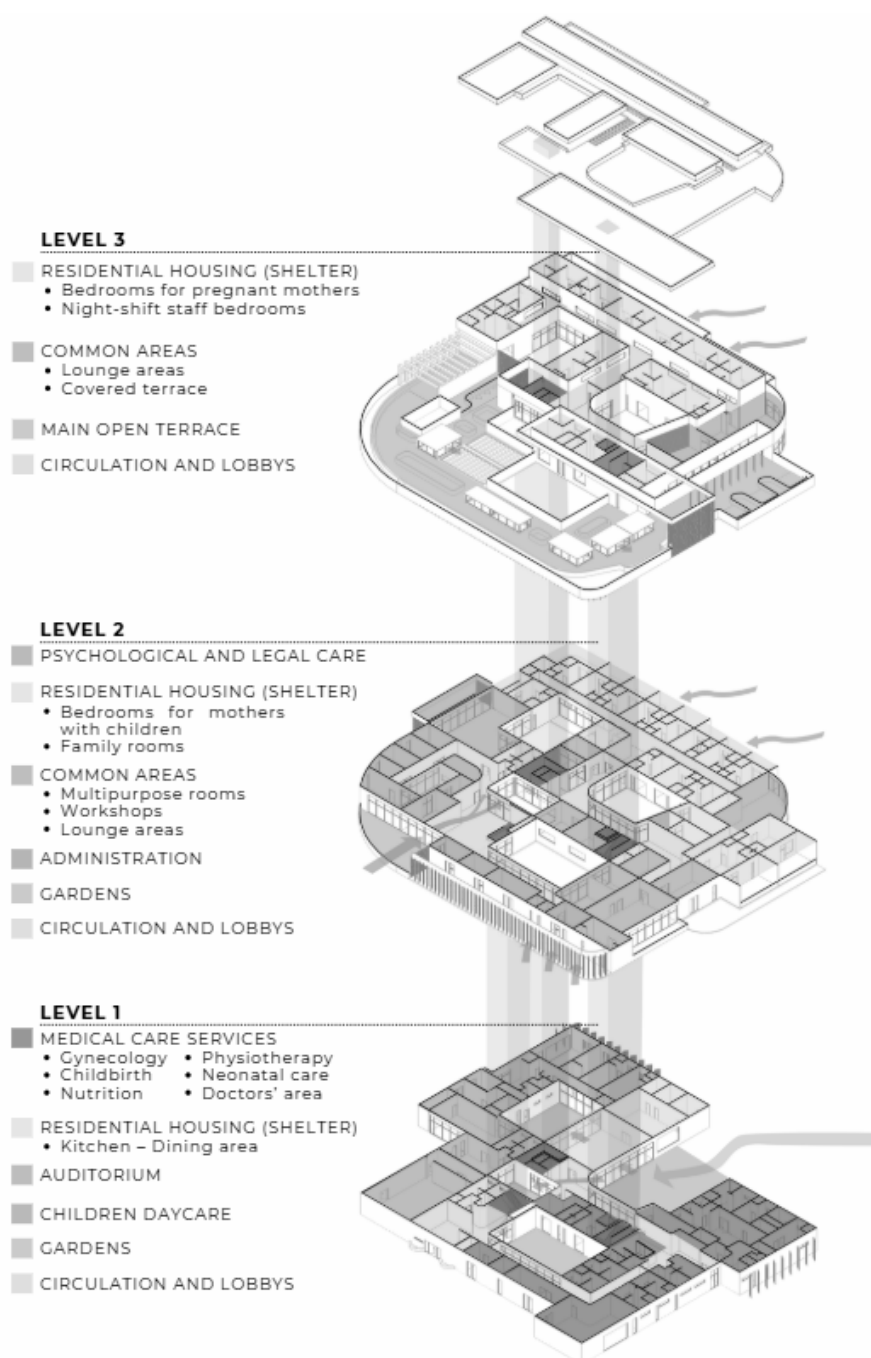


Figure 3. Architectural program (Developed by Authors).

Discussion of the results of the research

The findings of this study partially support the initial hypothesis that the built environment can influence women's emotional and psychological experience during the perinatal period. They also suggest that the relationship between architectural space and maternal well-being is complex and affected by multiple social, institutional, and environmental factors. One of the most significant findings is the high proportion of women who report a lack of psychological support during this process. While these results highlight a gap in maternal healthcare, architecture cannot replace professional psychological care; however, it can help create dedicated spaces and environments that promote emotional stability by reducing stressors. This situation also underscores the need for women to have access to spaces with a comprehensive maternal health system to reduce logistical stressors in contexts of socioeconomic vulnerability and improve access to services.

Furthermore, the reported spatial discomfort – such as limited spaces, lack of privacy, and the absence of family rooms - highlights the structural challenge of healthcare infrastructure, where public institutions in the state prioritize standardization and profitability over user-centered special conditions. On the other hand, the interviewees' preference for natural lighting, vegetation, and sensory comfort reinforces the argument that environmental qualities influence perceptions of safety and emotional well-being during pregnancy, childbirth, and the postpartum period. In this context, the results also support the relevance of integrating neuroarchitectural guidelines into the design of maternal healthcare spaces. Elements such as warm tones and the introduction of natural light can help regulate the circadian rhythm and serotonin secretion, contributing to emotional stability.

Likewise, incorporating vegetation, especially plants with calming aromas, using natural, chemical-free materials, and creating spacious areas with varying ceiling heights can reduce the perception of stress and promote feelings of freedom and well-being. Similarly, avoiding abrupt geometric breaks within the interior and prioritizing welcoming spatial configurations can reinforce a sense of security. Finally, organizing shared rooms with adequate privacy and family living areas can strengthen the sense of community and social support, key aspects for maternal well-being during the perinatal period.

Another important decision was about the use of colors and materials. Color is a key element in healthcare space design because it can affect patients' physical, psychological, and emotional well-being. Different colors produce distinct effects: red increases energy, confidence, and circulation, but can also raise heart rate and blood pressure, making it unsuitable for birthing and examination rooms. Blue promotes relaxation, improves sleep, and reduces anxiety, although excessive use may cause fatigue and worsen depressive symptoms. Yellow stimulates optimism and cognitive function; however, it may overstimulate nervous individuals. Green is associated with stress reduction and emotional balance, while orange encourages happiness and social interaction. Neutral tones can provide a sense of calm and reduce stress, but can become monotonous during long stays in healthcare centers (Khaleghimoghaddam, 2023). Combining these colors appropriately with natural light can enhance comfort, reduce stress, and support the perinatal period.

Comparison with other studies

The results align with existing research in environmental psychology and neuroarchitecture, which suggests that built environments influence human emotional and cognitive responses. Previous studies have shown that exposure to natural light and vegetation can reduce stress and improve mood, aligning with participants' preferences. Among these proposals, we can mention the maternity ward architecture of Müller and Parra (2015), which similarly emphasizes the need to replace traditional hospital maternity spaces – frequently described as cold and impersonal with warmer, more flexible, free-moving, and user-centered environments. In this sense, the findings of this research align with these proposals, demonstrating that factors such as privacy, natural light, and the presence of companions influence mothers' perceptions of well-being.

Furthermore, the results show similarities with contemporary design projects of this type, such as postpartum care centers in Asia inspired by traditional cultural and familial support (Vidal, 2024), which integrate communal spaces, natural ventilation and lighting strategies, and a close relationship with the cultural and environmental context. These initiatives, like this research, suggest that architecture can help create emotionally and socially supportive environments for women during the maternity process. However, some differences are also evident: these centers prioritize highly controlled, sophisticated experiences to promote emotional recovery, which can limit accessibility and capacity, as they are focused on a high-end environment. In addition, these existing centers focus primarily on the birth or postpartum period, whereas the present research broadens this perspective to encompass the entire perinatal process.

A nationwide cohort study of French midwife-led birth centers demonstrated that low-intervention maternity care can achieve salutogenic outcomes for healthy women and newborns. The study found high rates of spontaneous vaginal birth, very low rates of medical interventions such as episiotomy and artificial rupture of membranes, and favorable maternal and neonatal outcomes when women were appropriately selected as low risk. Although some mothers and newborns required transfer to obstetric units, the overall findings support midwife-led birth centers as environments that promote physiological birth, minimize unnecessary interventions, and contribute to positive health outcomes consistent with a salutogenic model of maternity care (Chantry et al., 2025).

Also exploring childbirth through a salutogenic perspective, several studies found that women's birth experiences exist on a continuum ranging from positive to traumatic rather than being defined solely by adverse outcomes. The study highlighted that previous birth narratives, women's expectations, and the quality of continuous, compassionate midwifery support strongly influenced how childbirth was perceived. Women who felt emotionally supported and continuously accompanied during labor reported more positive experiences, whereas those who felt neglected or forgotten were more likely to describe their birth negatively. These findings emphasize the importance of designing maternity care environments and care models that promote emotional well-being, resilience, and a sense of coherence throughout childbirth (McKelvin et al., 2024).

A scoping review on the application of salutogenesis in maternity care found that research has traditionally focused on morbidity, mortality, and adverse outcomes, even though most pregnancies and births involve healthy women and babies. The authors argue that maternity care should adopt a salutogenic approach by emphasizing health promotion, well-being, and the maintenance of positive health rather than concentrating solely on risks and pathology. The review highlights that strengthening women's internal and external resources, such as social support, knowledge, and access to appropriate care, enhances their Sense of Coherence, enabling childbirth to be experienced as more comprehensible, manageable, and meaningful. The authors (Perez-Botella et al., 2015) conclude that expanding salutogenic research could help reduce unnecessary medicalization and promote healthier maternity care practices.

Another consideration in the project was biophilic design; the design team integrated natural elements such as daylight, vegetation, and views of nature because they have been widely shown to improve patient outcomes in healthcare settings, primarily in Western countries, with little empirical research on their application in sub-Saharan African facilities. Grounded in Stress Reduction Theory and Attention Restoration Theory, this study investigated the extent to which patients and caregivers were satisfied with biophilic design features in four secondary-level maternal and pediatric hospitals in Lagos State, Nigeria. Using semi-structured interviews with twenty respondents, the study found that natural light was the most dominant determinant of patient satisfaction, followed by visual access to greenery, and concludes that biophilic features are fundamental to patient satisfaction in maternal and pediatric healthcare settings (Sholanke, A. B., & Adebisi, A. S., 2026).

Green space exposure has been shown to influence human physical and psychosocial health, but its specific relationship with maternal mental health outcomes remains poorly established in the Ghanaian context. This hospital-based cross-sectional study interviewed 420 mothers to explore the relationship between self-reported green space exposure and maternal perceived stress, anxiety, and depression. Higher levels of perceived stress, anxiety, and depression were reported by 58.1%, 42.5%, and 58.9% of respondents, respectively. Multiple regression analysis showed that perceived stress was significantly associated with mothers' use of green spaces for leisure and physical exercise, and that mothers' belief that time spent in green spaces improves overall well-being was also significantly related to their mental health outcomes (Boakye, S. K., Danquah, L., & Antwi, M., 2025).

Strengths, limitations, and implications for future research

This study presents several strengths that contribute to research in healthcare architecture and maternal health in northeastern Mexico. The current situation served as the starting point for developing feasible and viable proposals. Furthermore, the interdisciplinary approach links users' perception with spatial analysis and neuroarchitecture. The surveys and interviews were crucial for understanding the needs of both direct and indirect users. However, the research also presents some limitations. While the small sample size was ideal for delving deeper into mothers' routines, their perceptions of space, and interactions between healthcare providers and users, it also limited the generalizability of the results to larger populations. Nevertheless, it is a methodology that can be replicated with a larger sample, as the study is based on self-reported perceptions of spatial experience, which individual or sociocultural factors may also influence.

Despite the identified limitations, this research's findings highlight important implications for the planning and design of maternal care environments. The results suggest that maternal care centers should move beyond strictly clinical models and consider the experiential dimension of space, incorporating elements such as privacy, better connections between areas, sensory comfort, and opportunities for social and medical support. In this context, architectural design can improve the overall care experience by reducing environmental stressors and promoting well-being during the perinatal period. Furthermore, the study indicates that isolated architectural interventions cannot solve the structural challenges in the maternal care system, as health policies, service organizations, and social support networks are also required. Therefore, the guidelines presented in this document should be understood as part of a comprehensive strategy to strengthen maternal care infrastructure. Overall, the results reinforce the importance of integrating user-centered design principles into the planning of maternal health environments. Instead of focusing exclusively on medical efficiency, future planning processes can benefit from recognizing the emotional, social, and cultural dimensions of motherhood and acknowledging architecture as a complementary tool in efforts to improve maternal well-being and support systems.

Conclusions

In conclusion, the results identified multiple problems in maternal and child health care in the Saltillo Metropolitan Area, particularly among socially and economically vulnerable populations. Through survey analysis, interviews with specialists, and field visits, the team observed that many women face difficulties accessing comprehensive care during pregnancy, childbirth, and the postpartum period. One of the main findings was the fragmentation of the maternal support services, which forces users to travel long distances to receive medical, psychological, or legal assistance. This situation is exacerbated by socioeconomic factors such as economic dependence, lack of support networks, difficulties accessing services, and extreme poverty.

The results revealed the presence of psychological and emotional needs in women that are frequently not addressed within traditional models of maternal care. Problems such as anxiety, depression, and stress during pregnancy and postpartum were discussed by the specialist interviewed, emphasizing the importance of integrating emotional and community support services. The results also demonstrated that factors such as privacy, environmental comfort, and the possibility of family accompaniment significantly influence users' perceptions of well-being within the care centers. Elements such as natural lighting, adequate ventilation, and contact with nature were identified as desirable characteristics in spaces designed for maternal and childcare.

As mentioned in item 4.4, the results of this research suggest that the design of spaces intended for maternal and child health care should consider not only the functional requirements of the medical field, but also the psychological, social, and emotional dimensions of the motherhood process. The evidence obtained underscores the importance of developing more comprehensive care models that integrate medical, psychological, legal, and community services in a single setting. In this sense, the proposed architectural project envisions creating a Comprehensive Maternity Support Center that would consolidate these services and facilitate users' access to support networks during pregnancy and the postpartum period. Furthermore, the results reinforce the relevance of incorporating neuroarchitectural principles into the design of maternal health infrastructure. Elements such as natural lighting, adequate ventilation, and green spaces can improve the care experience and reduce the emotional burden associated with the perinatal process.

The final proposal offers solutions that link the built environment to emotional well-being and maternal health, opening the door to further exploration of the application of neuroarchitectural strategies in the design of healthcare spaces. In this way, the research and architectural proposal provide a conceptual framework that contributes to the development of more humanized infrastructures that respond to the real needs of women during motherhood.

Based on the results, it is recommended that future research delve deeper into the social, economic, and psychological conditions affecting women during the maternity process, particularly in vulnerable contexts. Studies with larger samples and more diverse population groups could contribute to a more comprehensive understanding of maternal care needs in northeastern Mexico. Likewise, it would be pertinent to conduct interdisciplinary research integrating architecture, public health psychology, and social work to develop more comprehensive care models that address the multiple dimensions of maternal and child well-being. In the fields of architecture and interior design, future research could explore the application of design principles grounded in environmental psychology and neuroarchitecture within spaces intended for maternity care. It would also be relevant to evaluate the actual impact these environments have on users' emotional and physical well-being once the projects are implemented. Finally, it is recommended to continue studying sustainable design strategies and management models to ensure the economic and operational viability of maternity support centers and expand access to comprehensive services for women and their families.

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The authors report no conflicts of interest.

Institutional Review Board Statement

This section does not apply to our research.

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