v. 4, n. 53, 2024

International Journal of Health Science

CRADLE OF COMFORT TO IMPROVE QUALITY OF LIFE IN THE FACE OF CLIMATE CHANGE IN THE BOLIVIAN HIGH LAND

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Abstract: Climate change puts the health of people who live in cold regions at risk, such as: the cities of the Bolivian highlands, where extreme, cold and dry climates occur. Added to this is the lack of equipment in health centers, especially in regions far from the capital cities, where there is a high mortality rate of newborns, due to not having the appropriate conditions for the development of the life cycle. As a consequence of this, the "Construction of a Comfort Cradle" was proposed from commonly used materials, to dampen the percentages of acoustic noise and minimize heat dissipation, existing in environments of the Bolivian highlands, which allows improving the quality of life of the newborn. This used the descriptive methodology evaluating the meteorological variables of the extreme climate in the Potosí region, cross-sectional, taking advantage of recycled materials for this purpose. The results show the development of a comfort neonatal crib, designed to minimize the actions of extreme weather, considering the ergonomics of the newborn, allowing it to provide an adequate temperature, which improves rest time and the development of the baby. In addition, it seeks to provide an innovative solution that allows generating sustainable regions to improve the health and socioeconomic development of families in the Bolivian highlands.

Keywords: Neonatal crib, extreme climate, comfortable sleep, circular economy, thermal comfort.

INTRODUCTION

Reproductive health and maternity have been recognized, globally and regionally, as an issue of human development, the lack of equitable and timely access to quality services is the underlying cause of maternal and neonatal mortality in a large part of developing countries. The Member States of the Pan

American Health Organization (PAHO) have been accelerating the reduction of maternal mortality for a decade, urging the promotion of institutional dialogue, in order to prioritize the lives of women and children (PAHO, 2013). Faced with this situation, PAHO/WHO developed global work regarding Family, Safe Motherhood and the Newborn, within the plurinational state of Bolivia. From this work carried out, the conclusions stand out based on the legal scope and application in the different health centers, describing the following action: *in Bolivia, the bureaucratic apparatus that impacts the economy of the poorest, triggers the difficulty of not having at hand the important documents for the legal constitution of a person born especially in the rural area of the Bolivian highlands* (Loayza Molina & Tejada Guzman, 2020).

Likewise, it is mentioned that Health Centers have a great deficiency in primary care, this due to different factors, mainly in the logistical aspect, which is insufficient to care for maternity and childhood problems. To this situation, we must complement the climate crisis we are going through, considering that Bolivia presents a scenario of a varied climate from the intense cold of the highlands (west) to the high temperatures in the plains (east). These climatic effects alter the proper development of the life cycle, naturally or also in the level of stress of people, which is associated with the current scenarios of the times of the year such as epidemics and/or pandemics in which has been affected by COVID-19 since the beginning of 2020. For this reason, the documents evaluated by UNICEF and the Ministry of Environment and Water of the plurinational state of Bolivia mention the following aspect:

> *The people least responsible for climate change are boys and girls; However, these subjects will suffer the worst consequences over time. That is why in Bolivia, thousands of children and adolescents live in areas highly exposed to the effects of climate change, more than 2.1 million live in places with a high risk of suffering floods, and more than 600 thousand live at high risk of suffering droughts. In addition, the impacts on the family economy give greater responsibilities to boys and girls, increasing the numbers of child labor and school dropouts (MMAyA, 2021).*

This notion allows us to evaluate the real situation of the national territory, since with the COVID-19 pandemic many nations have different priorities regarding health, which must be strategically planned by central governments (UNDP, 2021). In this sense, the city of Potosí is a region that presents several problems due to the lack of planning and development of the region, especially in the area of health and education. Considering that today we live in a globalized world, where a very important issue to consider is Child Health, prioritizing infant mortality rates, where it is evident that: "*the death of a baby that occurs between birth and the first year of age, it is for primary care in much of South America*" (Chavez Zuñiga, 2020).

For this reason, there are different factors to consider, from maternal pregnancy, the planned birth procedure (cesarean section) or others, which cause a life risk in the newborn baby, considering that the death of the child is greater during the neonatal period (the first 28 days of life). According to the World Health Organization (WHO), they show that: "*In 2016, 2.6 million children died in their first month of life. About 7,000 newborns die every day, which means that 46% of deaths in children under 5 years of age take place during the neonatal period*" (Who, 2020). With this consideration in Bolivia, according to the National Institute of Statistics (INE), they affirm that: In the last eight years, infant mortality has been reduced by 50% or more in all its forms and in children under five years of age it has decreased by approximately 55%, *according to data from the Demographic and*

International Journal of Health Science ISSN 2764-0159 DOI https://doi.org/10.22533/at.ed.1594532406068

Health Survey (EDSA) (INE, 2020).

Given these descriptions of mortality, the deep causes of the service that affect child health care are not specified, referring mainly to the equipment, materials and priority supplies for the care of newborns, neonates and pediatrics. In this specific aspect, the lack of equipment in neonatal cribs is a central point of observation for this document, considering the newborn baby and its pediatric development, it must have comfort and comfort in the environment where its cycle is carried out. vital, taking into account that acute problems, including respiratory and cardiocirculatory complications, are due to the difficulty in adapting to a hostile and new environment for their survival (Fundación nene, 2019). Given this situation, the specific problem is the survival mechanism of pediatric children who face climate change in the department of Potosí, where cold days are greater compared to days where the climate is warm. For this reason, there are many neonatal and pediatric cribs of different brands and industries, with a variable and high economic cost for these cold weather conditions. Furthermore, the designs of these cribs are created for environments with climatic conditions below 3,000 meters of altitude. Likewise, it is important that pediatric cribs do not have an acoustic filter that can reduce the noise generated around them by a percentage, since newborns emerge with great sensitivity in their anatomy and physiology.

Thus, when we analyze and focus our attention on the health service in many Latin American and Caribbean countries, it is described: *Although LAC. is struggling to respond to the main challenges of the COVID-19 pandemic, serious reflection not only on how to secure more funds, but also on how to better spend resources on health* (OECD, 2020). However, these actions must be based on structured plans for newborns and pediatrics, taking into consideration that: *basic and universal health care must be associated with changes in the development model that allow citizens to actively participate in the construction of society and thus ensure adequate care* (Pérez O. *et al.* 2020). Therefore, in the Bolivian region, we suffer from poor government management, where contextual evidence shows that: *since October 2019, even without the coronavirus pandemic, tertiary hospitals have been overwhelmed and there is no room for new patients*. (ANF, 2020). This situation leads us to propose different strategies to combat catastrophic events, especially climate change in this region of Potosí, which is located at an average altitude of 4,000 meters, that arise over time. For this reason, the 17 SDGs (UNDP, 2021) are considered, which constitute a bold commitment to address the most urgent problems that the entire society faces today, where meteorological variables present serious health problems. of the residents (Oyarzún G., *et. al*.,20219), showing that in recent years there was intense snowfall and with it the loss of flora, fauna and the death of human beings due to hypothermia, leading to a critical analysis of environmental safety, identifying the news of: Residents of several Lípez ranches in the department of Potosí, ask for help to rescue their animals and people trapped by the white phenomenon in that region of Potosí (El Potosí, 2019).

Therefore, the lack of equipment in the different health centers and hospitals, for the child health of newborns and children under 15 months, in different regions of the department of Potosí, adds to the problem the effects of the change in climate increasing cold days throughout the region. Likewise, other aspects of the children's health of the boys and girls who recover within these hospital environments are considered, for this the noise conflict is another factor that stresses the child in their comfortable environment, where

according to the law of the environment 1333 of April 27, 1992, with its updated version in 2018, in its regulations on air pollution in its articles 52 to 55, establishes that: *Fixed sources that are located in areas near hospital centers, nurseries, schools, nursing homes, and other places of rest, must not exceed the maximum permissible noise emission limit of 55dB (A)* (MMAyA, 2018). These situations put children in a problem in rehabilitation and climatic comfort, where noise and the low temperatures of the region alter their physiology to a certain degree, with the factors of: sound energy, exposure time to these physical factors, characteristics of the sound, the receptor, the activity of the receptor and others that are considered for this study, where the bibliographic evidence demonstrates that: *Environmental noise pollution in Intensive Care Units (ICU) is a serious problem, since it negatively impacts both the sick and the medical and paramedical staff* (Carrillo E. Raúl *et al*. 2017). In addition, these factors also affect patients recovering in different areas of the hospital, where studies describe: *The level of anxiety increases as the sound level increases, on the other hand, the trait anxiety level that is part of of the patient's personality remained, which means that a high sound level will be a threatening situation for the patient* (Vílchez D. Paola *et al*. 2010).

It is evident that these noise actions within hospitals and/or health centers are not quantified in a tangible and permanent way, therefore; The effects of noise are a detriment to the treatment of the individual who is at rest, considering that in pediatric units studies showed that: *The highest peak recorded was 90 dB (A) (pediatrics area), in a hospital it is A level less than 50 dB (A) is recommended. It was observed that the main source of noise comes from medical and nursing staff* (Mendoza-Sánchez., Roque-Sánchez, & Moncada-González, 2018). Particularly, in pediatric children, excessive noise causes changes in their heart rate, as well as in their blood pressure, in addition to the loss of less deep sleep, causing crying, indirectly affecting their comfort environment. According to WHO specialist regulations, it recommends that noise in hospitals must not be greater than 35 dB, where exceeding this value can damage auditory structures and cause adverse physiological and behavioral reactions in addition to pain. On the other hand, it has been shown in experimental animals that exposure to high levels of noise produces cochlear damage and also deterioration of medium and low frequency areas with greater symptoms (Gallegos-Martínez, et al. 2011).

All this evidence shows that children in the pediatric stage suffer indirectly and directly from these actions of noise and the phenomenon of climate change, especially that it disturbs their comfort environment that children need at this stage. For all these reasons, this document presents a development of a structure for these children with the objective of filtering acoustic noise and minimizing the direct actions of climate change, especially in the face of the increase in cold days in the region of the department of Potosí, giving a tangible solution for this region, the same one that is necessary for a good life cycle. Likewise, we must take note that a large majority of cribs do not have a filter for these physical parameters, the same one that is essential for babies, especially those who live in the Bolivian highlands. It is for this reason that this document analyzes and develops a comfort crib system taking into account the physical risk context situation that arises in temperature variation and noise. This action will allow babies under twelve months to minimize external actions that influence their good rest, providing necessary tranquility in the environment. Thus, this way, the Research Directorate of the Faculty of Medicine plans

to develop *The construction of a comfort cradle from commonly used materials to dampen the percentages of acoustic noise and minimize the heat dissipation existing in environments of the Bolivian highlands.*

Based on this description, it is important to take into account some fundamental aspects of the energy that is produced by noise in both closed and/or open environments, based on the physical principles of action, established in aspects of public health such as: *The activity of the receiver*, depending on the activity the person is doing, the same sound can be considered annoying or not. It is evident that noise actions within hospitals are not quantified in a tangible and permanent way, therefore; The effects of noise are a degree of detriment to the treatment of the individual who is at rest. However, we must consider that in pediatric units the studies showed that: *The highest peak recorded was 90 dB (A) (pediatrics area), in a hospital a level lower than 50 dB (A) is recommended. It was observed that The main source of noise comes from medical and nursing staff* (Mendoza-Sánchez., Roque-Sánchez, & Moncada-González, 2018). This high level of noise reaches directly the (sensitive) ears of premature babies, causing changes in their heart rate and blood pressure, which creates a noisy environment, which causes sleep loss. less deep, causing crying, indirectly affecting their comfort environment. According to World Health Organization specialist regulations, it is recommended that in hospitals it must not be higher than 35 dB, since excessive noise can damage auditory structures and cause adverse physiological and behavioral reactions in addition to pain. Noise generally damages the inner ear, although it also damages the middle ear and although the cause seems clear, the effect of dominant, recessive and even mitochondrial Mendelian inheritance obscures the agent-damage relationship. On the other hand, it has been shown in experimental animals that exposure to high levels of noise causes cochlear damage. Pathogenic noises are capable of causing early damage to the basal area of the cochlea, and also deterioration of areas of medium and low frequencies with greater symptoms (Gallegos-Martínez, et al. 2011). All of these actions allow us to focus our attention on the comfort environment that a newborn under twelve months of age needs, in which babies have the ability to develop their vital systems mainly in terms of acoustics and thermal comfort for their pleasant rest. in the Bolivian highland region, preventing low to very low temperature variability from having its consequences on the thermal development of the baby.

Thermoregulation is a natural process of the body that consists of the activation of central and peripheral mechanisms to maintain body homeostasis and constant vital functions. The importance of this physical phenomenon is related to the stability of the cardiovascular, respiratory, renal, endocrine, and nervous processes and the functioning of the muscles. In addition, it presents complex pathways that allow a close link between stimulus and response where the pathways are involved. afferents and efferents. It includes mechanisms controlled by the hypothalamus, it works through a feedback system that allows the increase or decrease in temperature in response to environmental conditions thanks to the information received from the different thermal sensors (specialized neurons sensitive to cold and heat), which have the ability to detect variations in the internal temperature of the organism and compare it with that of the environment. Therefore, it is important to take into account that in the spinal cord, in the internal organs and especially in the posterior region of the hypothalamus, there is a reference value of 37°C, which allows thermal regulation of the body, therefore It is

important to take into account the following aspects.

Organs involved in the increase and detriment of temperature: There are multiple organs and systems of the body that are affected when thermoregulation does not function correctly, which are:

- *Skin blood vessels:* In response to an increase or decrease in ambient or internal temperature, skin blood flow is modified through sympathetic vasodilation and vasoconstriction mechanisms, respectively. Heat is dissipated from the body when blood is brought very close to the surface of the skin, this is achieved through vasodilation. Skin with hair follicles is innervated by the noradrenergic system that produces vasoconstriction and by cholinergic nerves that produce vasodilation, while skin without follicles, present on the palms, soles, and lips, is innervated only by vasoconstrictor nerve fibers that, in normothermia, maintain a basal tone of vasoconstriction. In skin with hair follicles, the primary response to heat is to increase cutaneous blood flow through passive vasodilation of blood vessels and by blocking sympathetic nerve activity.
- *Sweat glands:* Cooling by perspiration is the only heat loss mechanism when ambient temperature exceeds body temperature. Exposure to a hot environment or exercise raises trunk and skin temperatures, both of which contribute to an increased sweat rate 17,24. Sweat is released by sweat glands (eccrine and apocrine) that are distributed in large numbers (1.6 to 4 million) on the body surface. They are distributed in such a way that, where there are eccrine glands (simple sweat glands), there is no presence of apocrine glands.
- *Brown adipose tissue* (BAT): It is a phenomenon of thermogenesis in the BAT, which can be modulated by a number of non-thermal factors, including hypoxia, infection, hypoglycemia, and psychological stress.
- *Skeletal muscle:* It is the last system involved in the thermoregulatory response to cold, especially if the other mechanisms fail to compensate for the drop in temperature. The activation of this effector is given by the action on the alpha and gamma motor neurons of the anterior horn - of the spinal cord - which produce serial and repetitive muscle contractions known as tremor, increasing the generation of heat due to increased muscle cell activity.
- *Endocrine system:* One of the main hormonal mechanisms for temperature regulation occurs when the thyroid gland secretes thyroxine, which is transformed into triiodothyronine, which is responsible for regulating body temperature by increasing cellular metabolism. The hypothalamus detects the drop in temperature and secretes thyrotropin-releasing factor, which stimulates the anterior pituitary gland to produce and release thyrotropin, which, in turn, generates the secretion of thyroxine in the thyroid. This hormone, as explained above, is transformed into its active form, acting at the cellular level and causing a metabolic increase that produces energy in the form of heat, where, on the contrary, the increase in body temperature stops this process.

Alterations in thermoregulation: Sometimes, the central temperature control suffers variations that cause certain conditions to occur that are detailed below:

- Hypothermia: It is the abnormal decrease in body temperature, the World Health Organization (WHO) defines it

as a rectal temperature below 35.5°C or an axillary temperature below 35.0°C. It occurs when heat losses increase or its production decreases with a drop in body temperature. Pathological thermal decreases, independent of external conditions, can be caused by a decrease in heat production, in the excitation of the cold center, in the decrease of activity in the heat center, in the paralysis of all thermal regulation. central and also by slowing blood flow to the heat-producing organs. Prolonged exposure to the outdoors with very cold air – as in the case of the department of Potosí Bolivia – is a determining factor in heat loss; however, exposure to cold water, due to its conduction capacity, is the main causative factor. of these events, especially if there is no compensation through metabolism, muscle tone, and peripheral vasoconstriction. Furthermore, it is important to consider that: in shock, the harmful drop in temperature is easily perceived and is important because it is often a parameter of mortality, especially when the thermal curve that drops deeply intersects with that of the pulse that rises sharply. Both are the result of increased sympathetic activity, causing peripheral vasoconstriction and tachycardia: one mediated by alpha 1 receptors and the other by beta 1 receptors.

- If body temperature drops below 30°C, profound functional and degenerative alterations occur in the liver., myocardium and kidneys that quickly lead to death.
- Hyperthermia: It is a disorder of body temperature regulation that is characterized by an elevation in core temperature greater than 38.3 °C. Regardless of the etiological factors, whether due to an excess in heat production or a defect in its loss, an increase in body temperature occurs that exceeds the capacity of the body's thermoregulation mechanisms. It may present with sweating, flushing, tachycardia, fatigue, dizziness, headache and paresthesia, progressing to hypotension, syncope, confusion, delirium, seizures and coma. Changes in mental status and core temperature distinguish potentially fatal heat stroke from heat exhaustion.
- All these physiological actions allow us to understand the state of the body where the function of thermoregulation is an important factor for climatic conditions, especially in the Bolivian highlands. (UNAB, 2021)

Physical Principles of thermoregulation: Based on the descriptive conditions of the Potosí region, it is important to consider a physical-mathematical analysis for which it is considered: Newton's Law of Cooling, which is a physical principle that describes how it occurs. the cooling of an object in an environment with constant temperature. According to this law, the cooling rate of an object is directly proportional to the temperature difference between the object and its surroundings. When a hotter object is in contact with a colder environment, it will lose heat and cool down. The cooling rate will depend on the temperature difference between the object and its surroundings, as well as the properties of the object, such as its size, shape, and thermal conductivity (Barragán, 2019).

Newton's law of cooling is expressed mathematically by the following equation:

$$\frac{dT}{dt} = -k(T - T_a)$$

In which:

$\frac{dT}{dt}$; is the rate of heat change of the object as a function of time.

K; is a proportionality constant that depends on the characteristics of the object and its environment.

T; is the temperature of the object.

T_a; is the room temperature.

This law is applicable in various fields, such as physics, engineering and medicine, where it is used to understand and predict the cooling of objects and systems. In the field of health, this law can be used to understand how the cooling of injured or inflamed tissues occurs. For example, in physical therapy, cold compresses can be applied to an injury to reduce inflammation and pain. Newton's law of cooling helps explain how heat is transferred from the injured tissue to the cold compress, thus allowing cooling of the affected area. Likewise, Newton's cooling law in health is only a conceptual tool to understand the cooling processes in the human body (Tejeda Martínez, 2018).

MATERIALS AND METHODOLOGY

Currently, there are various pediatric cribs on the market, but many of them have prices that are inaccessible to people who live in rural regions, in addition to the lack of them in inpatient health centers, where emergency deliveries and cesarean sections are performed. For this reason, the project seeks to provide a scientific and technical alternative that takes into account the socioeconomic aspects and also provides the newborn with an optimal climatic environment, for their rest in the first months of life, allowing them to combat the extreme cold experienced in the southeast and northeast regions of the department of Potosí.

The materials used in this project are in common use, which allows the development and innovation of the structure to be carried out, under a concept of circular economy that considers cognitive aspects of science and contributes to a paradigm shift in the use of unconventional resources., such as construction and recycled materials. These materials are used under a strict cleaning and sterilization protocol for the assembly of the crib design, ensuring the health of the boys and girls in their early stages. The design and construction of the crib are subject to the ergonomics of the newborn and the climatic conditions of noise attenuation and thermal comfort, two physical phenomena that are crucial for the boy or girl to have a peaceful rest in their early stages.

This design provides information on the temperature and humidity variables both inside and outside the crib, in order to evaluate the most important characteristics and demonstrate the real situation of comfort that the crib offers. Therefore, this procedure allows the development of a comfort crib that seeks to provide an accessible and scientific alternative to protect newborns from extreme cold in the rural regions of the department of Potosí.

To this end, a descriptive methodology has been applied (Hernández Sampieri, Fernández Collado, & Baptista Lucio, 2019), with an innovative development procedure and a quantitative analysis in the design of the crib. All this under a strict cleaning and sterilization protocol, taking into account the structure and design that are subject to the ergonomics of the newborn and the climatic conditions, offering optimal comfort for their rest.

RESULTS

Based on the planned objective as a strategy of a proposal to minimize the physiological problems of newborn boys or girls in their first stage, in the face of the cold weather that occurs in the Potosí region, especially in the fall and winter season, where according to weather forecasts these two seasons are the most detrimental to the thermal comfort of newborns, this being the great detriment to contracting respiratory diseases and thereby harming the development of the boy or girl in

this stage of development and adaptation.

As it can be seen in this figure 1, the meteorological variables are demonstrated throughout the year, evidencing a cold and dry climate, which influences human beings, especially newborn boys and girls. Therefore, these climates, although they can be classified as extreme to cold in the periods from May to August (quarter), it is evident that temperatures can fall below zero, in some regions of the department of Potosí, such as the case of south-east and north-west, with extreme temperatures affecting boys and girls who contract respiratory diseases, altering their health and affecting their development. It is impotent to note that newborns exposed to extremely cold climates can experience a series of physiological changes to maintain their adequate body temperature, developing pathologies that can influence the increase in heart and respiratory rate, the construction of blood vessels. peripheral blood vessels and energy production through brown fatty tissue.

It is important to note that in this region of the Andean culture, different adaptation mechanisms have been created, which anthropologically tend to combat extreme cold climates, in order to protect the newborn from diseases during the period of their birth. development. Although these cold protection mechanisms have been adapted to care for children's health, it must be taken into account that covering up with enough clothing generates pressure on the baby, which becomes a problem of muscle numbness that can cause different problems over time. It is for this situation that the present project takes these characteristics into account, where the care of the newborn is prioritized, giving it an adequate environment of climatic comfort and thereby avoiding or minimizing exposure to extremely low temperatures for long periods of time, which They can develop hypothermia, which can lead to breathing problems, hypoglycemia, and other serious health problems. Furthermore, based on these meteorological results, we must consider that in winter, exposure to extreme cold increases the risk of respiratory infections in babies, this being the main action of proposing mitigation measures to protect newborns from the extreme cold, and provide them with adequate care and thereby avoid long-term complications in terms of acute respiratory diseases (HAI).

Based on technological innovation of social and community application, the main causes of HAIs are assumed, to provide the solution to this climate change, which today is evidence that influences the entire planet. In addition, this considers economic factors of low-income families, as well as the low budget of health centers that exist in each community far from the capital city or intermediate cities. Therefore, the design and construction mechanisms of the comfort crib consider different parameters, assuming the physical variables of temperature and relative humidity (RH) mainly, for this purpose different design schemes were made which, depending on the geometry and percussion acoustics (noise), they must be damped and thus provide a comfort design, avoiding heat dissipation and minimizing noise intensity. These actions allowed us to find an appropriate design for the proposed use in the exhibition and during the baby's stay, considering the priority of rest that the newborn must have in its early stages.

Within this figure 2, the scheme (a) and the design of the comfort crib (b) are evident, which is systematically made from accessible recyclable materials, in order to control the temperature parameters and the dampening of noise, which originates in the environment naturally. This design presents three fundamental types of mechanism:

Formwork or surrounding system: The comfort crib is a structure used to contain

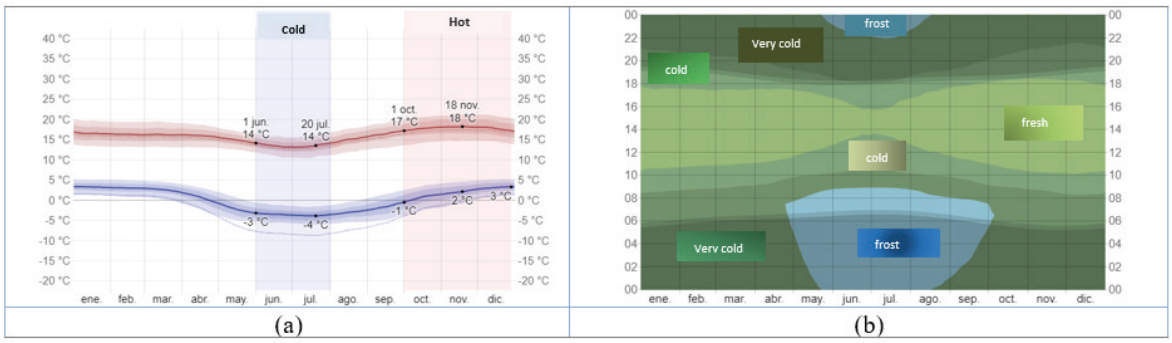

Figure 1: Behavior of the meteorological data of the City of Potosí (a) annually and (b) hourly
Source:https://es.weatherspark.com/y/27973/Clima-promedio-en-Potos%C3%AD-Bolivia-durante-todo-el-a%C3%B1o#google_vignette

Figure 2: Design scheme (a) and (b) prototype model of the comfort crib
Source: Directorate of the Faculty of Medicine-UATF Research Institute

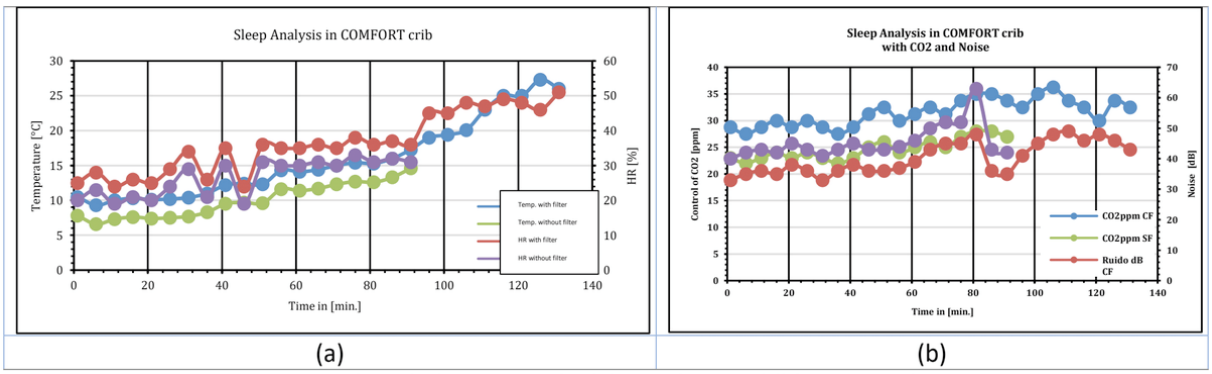

Figure 3: Sleep behavior graphs (a) T and HR and (b) Noise and CO2
Source: Directorate of the Faculty of Medicine-UATF Research Institute

and protect the newborn. It is composed of panels or side walls that surround the baby, with a material made of wood that provides safety and stability. This design allows the thermal characteristics not to dissipate easily, considering that the temperature in its surroundings is maintained and prevents the rapid drop in temperature in winter times, which is why the selected materials are those that avoid this dissipation of energy, where the following aspects are considered:

- *Thermal insulation:* The formwork or perimeter system is designed with recycled refractory materials from the region, which help maintain a stable temperature inside the crib, avoiding sudden changes in temperature and protecting the baby from cold or excessive heat, for this Thermodynamic aspects are considered with the application of

Newton's law of cooling among the most important.

- *Adequate ventilation:* The formwork system has a concave design, this allows adequate air circulation to avoid the accumulation of heat and humidity, for this reason the fluid dynamics in this system allows the air flows to have sufficient rotation energy of the air, generating optimal ventilation when the baby is resting and when cleaning it to avoid the accumulation of any pathogen that could be detrimental to the baby's health. In this phase, the laws of fluid flow are applied considering the conditions of extreme cold temperatures.

These aspects allow us to face the extreme cold weather conditions that arise in the Bolivian highland region.

System of control: This prototype incorporates a temperature control system and a structure that allows the noise incident in the crib to be dampened. To this end, the crib has an electronic recording system that allows evaluating the physical conditions of both internal and external temperature, to find a proper balance point, which are designed to observe and maintain optimal comfort for the baby. On the other hand, the design presented has a natural noise damping layer or system, this material allows noise to be absorbed, a model similar to that of reverberance chambers, which have the ability to reduce unwanted sounds by blocking and/or reducing the transmission of external noise to the interior of the crib, where the baby increases rest time.

System of visualization: The system implements an emerging technology such as the Internet of Things (IoT), which benefits this prototype by improving the quality of service and care, especially in the health area. Based on this, a surveillance camera is incorporated that allows you to view and hear the baby inside the comfort crib, being very helpful for parents where they can monitor it from their cell phone and thereby monitor the baby. with the necessary precautions that the baby needs.

These parameters allow the proposed design to have control over the most important variables that affect or intervene in the newborn, for this reason; This comfort crib has an exclusive design to minimize the effects of climate change, especially in the extreme cold climate that occurs in regions where temperatures drop below 0°C in the autumn and winter, being that in During these times, respiratory diseases in the newborn can cause a high risk to their health with exposure to these climates that directly or indirectly affect the comfort of the human body. Based on this description, the results of the application of the comfor crib with a baby are the following:

The graphs in Figure 3 (a) and (b) show the temporal behavior of a newborn baby's rest, where the quality of climatic comfort is evident, which is especially present when the design has all the mechanisms that allow conserving temperature and dampen noise. It is important to note that the temporal behavior of the analysis of Temperature and Relative Humidity (RH) in Figure 3(a) shows that there is greater rest comfort with the filters compared to another crib that does not have these filters that prevent heat dissipation. In the same way, Figure 3(b) describes the crib that has a noise filter which allows a longer time for the baby to rest, compared to another crib that does not have these characteristics. Given this evidence, it is ignored that the comfort crib implemented allows the quality of rest to improve in a time of 35 minutes on average, this being favorable for the baby's growth and development physiology. Likewise, it is important to mention that the noise filter is acceptable for the newborn's rest, considering that many times external noise is

a determining factor, so that the baby does not complete the sleeping time and this is the source of the discomfort that It can cause a baby to cry.

Therefore, the application of this work demonstrates that the structure of the comfort crib allows improving the quality of the newborn's rest, taking into account that these results of this prototype are a parameter for serial development, which They can contribute to health centers and the most needy families in the department of Potosí, as well as in the Bolivian highlands where the climate is cold, which influences the proper development of the newborn, for this reason; This design allows for a social and economic contribution at a regional level.

DISCUSION OF RESULTS

Under the research and entrepreneurship framework of the Research Institute of the Faculty of Medicine of the UATF, this technological development is presented, which is based on scientific procedures and seeks to address the health needs in the Bolivian highlands. To this end, a strategic business plan has been developed that stands out for the following characteristics:

- *Solution strategies:* The project focuses on addressing health problems in newborns caused by climate change and low temperatures in the highlands. The aim is to minimize these problems in the short term through the implementation of the comfort neonatal crib..
- *Improving quality of life:* The incorporation of this crib model in the most vulnerable areas of the highlands will improve the quality of life and physiological development of newborns in their early stages. This will positively impact the execution of healthcare resources and the reduction of respiratory diseases, which are common due to extremely low temperatures, which are usually lower than -3°C..
- *Social and economic relationship*: Demographic growth in the Potosí region has generated the need for adequate health services, especially for pregnant women. The lack of adequate infrastructure and equipment to provide optimal conditions for newborns has contributed to the increase in infant mortality. This project seeks to minimize these situations by providing technology adapted to the characteristics of the local environment. The comfort neonatal crib offers an optimal environment for the development of the newborn, overcoming the limitations of conventional neonatal cribs.

These aspects allow us to develop a strategic business plan for the comfort crib project, which focuses on solving health problems, improving the quality of life of newborns and strengthening the social and economic relationship in the region. Below is a comparative table between the conventional neonatal crib and the proposed comfort crib to highlight their differences.

These aspects show that the implementation of this has great socioeconomic benefits for the region of the department of Potosí, which provides a solution and minimization of the problem of HAIs in babies who can be harmed by the extreme climates that today in days are recorded due to climate change, and this also improves the state of health in the development of each baby. Given this situation, the work also carried out an analysis of a strategic development plan in some communities considering the 17 sustainable development goals of the UNDP 2030 agenda, which allow families to improve the quality of life and thereby directly and indirectly support to health centers, to improve the quality of life of newborns in the face of the extreme cold

Name	features	Cost in Bs /Unit.	Factors
NEONATAL CRIB (COMMERCIAL)	Common structure without thermal or acoustic filter where the newborn spends its first stages.	1650 Bs	The crib is spacious with space, with extreme ventilation. The crib has a greater incidence of sudden changes in temperature and does not have an acoustic filter. A baby's rest time is on average 90 minutes. The newborn wakes up disturbed by noises or discomfort in the environment.
Cuna de CoMfort	Comfort crib with thermal, acoustic and home automation filter control, visual control for newborn assistance.	1105 Bs	It has special features for optimal ventilation. The structure is designed to provide thermal comfort, it dampens noise by reducing up to 25% of the common environment, this allows the baby not to wake up suddenly or desperate but rather the tests show a calmness after his sleep. The baby's rest time ranges between 125 to 135 minutes, improving her rest, which allows for better development in the first stages of life.

Table number 1: Cost-Benefit Analysis of the Comfort Crib Project, Potosí

Source: Preparation of the project under a financial cost in the year of 2023

To whom	Problem	Solution	Aspect of difference
Project aimed at: **Rulers** **Health area planners** **Health centers with limited resources** **Families of the Bolivian highlands**	How to improve the quality of life of a newborn in the face of a cold and dry climate that generally occurs in the Bolivian highlands and worsens in the fall and winter season?	Function It improves the quality of service, care and climatic comfort in the face of the extreme cold climates that occur in the Bolivian highlands, and also improves the baby's rest time, providing a peaceful environment for their evolution of life. Social Families in the highland region suffer a lot because babies tend to catch colds more frequently, causing greater expenses, for this reason the comfort crib improves these aspects where parents would reduce their expenses because their baby would be in a better environment.	The comfort crib offers and guarantees a better rest climate, which improves the evolution of babies in their life cycle. With the implementation of these comfort cribs in different first-level health centers, respiratory diseases are reduced and the development of a newborn is improved.

Table number 2: Summary of the action plan for implementation in communities of Potosí

Source: Preparation of the project under the 17SDG-UNDP

climate experienced in the Bolivian highlands.

This description allows the development of a social and economic enterprise in order to combat the effects of climate change, especially in the Bolivian highland region under the context in which they are currently found, considering regional sustainability. The impact that will be had with this model to be implemented in the Bolivian highlands, will allow to protect the health and better physiological development of newborns, improving their quality of life and minimizing the expense incurred with different diseases that occur at this stage. of life, mainly colds that are caused by exposure to cold environments in the Bolivian highland region. Likewise, the comfort crib offers greater comfort and safety for babies, which can reduce stress and anxiety for both parents and medical staff. Therefore, this plan will generate employment and business opportunities for local people dedicated to its manufacturing and distribution, considering that it reduces long-term health care costs by preventing diseases and complications that could require expensive treatments, improving quality. of life of babies and their families, under the principle of productivity and the general well-being of society.

CONCLUSIONS

Within the framework of scientific and technological development promoted by UATF researchers, this project highlights aspects of social and economic need. The climatic and acoustic comfort crib offers important benefits for the healthy development of newborns in the first stages of life, especially in an environment characterized by extremely cold climatic conditions. By mitigating the risks of respiratory diseases associated with this climate, the project contributes significantly to improving the quality of life of the population in the Bolivian highlands.

In addition to its impact on society, this project also has academic value and university social responsibility. It can be developed in collaboration with government strategies that promote job creation and strengthen the Bolivian industry. Likewise, its potential for technological transfer to countries where it has not yet been implemented, according to bibliographic reviews, makes it a local and national strategy to share scientific knowledge.

Finally, the application of this comfort cradle, made with everyday materials, can promote the creation of companies in the highland region, generating employment and adapting instruments and supplies to the specific environmental conditions of the area. This represents an opportunity to improve the quality of life of the local population and take advantage of available resources in a sustainable way.

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