

Architecture and the Human Lifespan

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Abstract

For centuries, human beings have strived for only one thing in life: to live a long, happy life. From learning to hunt for food and protection, to developing villages and eventually skyscrapers, the goal has always been to live longer and happier. But what really makes humans live longer? Paper suggests that physical health, alone, is not the only contributing factor towards human lifespan. Living a long life consists of a healthy amalgamation of all aspects of human life: physical, mental and social. Architecture significantly influences the spaces where people live, work, and grow older. As global life expectancy continues to rise, there is increasing interest in how the built environment can contribute to extending human lifespan and enhancing quality of life. The relationship between architecture and human health is complex and multifaceted, impacting physical, mental, and social well-being. Architecture directly influences physical health through the design of spaces that either encourage or inhibit healthy behaviours. Thoughtful design that takes into account spatial psychology can help reduce stress, anxiety, and depression. Human beings thrive on social interactions, and architecture that fosters community engagement and socialisation contributes significantly to emotional and social well-being. By examining the connections between architecture and the various aspects of health, we can better understand how thoughtful design can contribute to a healthier living and thus, a longer life. This study aims to explore this connection in-depth and suggest ways for architects to design spaces which can help people live longer.

Keywords: Human lifespan-built environment health, wellness, ageing, social well-being, mental health, physical health.

INTRODUCTION

The concepts of ageing and death have always fascinated and terrified scientists and biologists. Why do human beings die? And what happens after death? These questions have various theories, but no concrete answers. However, one thing is certain, humans want to live longer. Ancient Greek philosophers like Socrates and Plato pondered the nature of mortality, and their influence shaped Western thought on the soul and life's meaning. In medieval Europe, alchemists sought the "elixir of life", believing it could grant immortality, reflecting a widespread human desire to overcome the limits of biology. Having a long and healthy life is the ultimate goal. Eastern cultures, including Chinese and Indian traditions, emphasized harmony with natural cycles. The Taoist pursuit of "longevity practices", involving meditation, diet, and specific environmental rituals, speaks to how ancient civilizations already saw the importance of surroundings on health and longevity. This study presents the theory that architecture can impact human health enough to affect the process of ageing in human beings and thus, increase their lifespan.

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The design and creation of spaces where people live, work, and interact profoundly affect the health

and well-being of both individuals and communities. The built environment can shape behaviour, influence mental health, foster social connections, and enhance physical activity: factors that are essential for longevity. As global life expectancy continues to rise, the relationship between architecture and lifespan demands more attention. This paper work explores how architecture can positively affect human lifespan by addressing the physical, mental, and social aspects of well-being. By examining historical perspectives, current trends, and future possibilities, this study seeks to understand how architecture can be harnessed to promote longer, healthier lives.

AGEING

Ageing, also known as senescence, describes the gradual deterioration of physiological functions and biological integrity as time progresses. This natural process increases vulnerability to various health issues and ultimately leads to death. The mechanisms of ageing are shaped by a blend of genetic, environmental, and lifestyle factors.

Biological Mechanism of Ageing

- Cellular senescence refers to the state in which cells lose their capacity to divide and perform their functions efficiently. This process can be initiated by various factors, such as DNA damage, telomere shortening, and oxidative stress. As senescent cells accumulate within tissues, they release inflammatory substances that can impair tissue function and contribute to age-related illnesses [1].
- Telomeres, which are repetitive DNA sequences found at the ends of chromosomes, act as protective caps to safeguard chromosomes from deterioration. These telomeres become shorter with each cell division. Once they reach a critically short length, the cell can no longer divide, resulting in either senescence or apoptosis (programmed cell death). The gradual reduction of telomere length is widely recognized as a significant contributor to ageing [2].
- Mitochondrial dysfunction affects the cell's powerhouses, disrupting energy production, and is responsible for energy production but also generates reactive oxygen species (ROS) as byproducts. Over time, the integrity of mitochondrial DNA and membranes can degrade, leading to diminished energy output and heightened oxidative stress [3].

HISTORICAL PERSPECTIVES ON LIFESPAN AND HUMAN DEVELOPMENT

Throughout history, the quest for a longer, healthier life has driven many of humanity's greatest achievements. Early hunter-gatherer societies developed basic tools and shelters to protect themselves from the elements and predators. As agricultural practices emerged, humans began to build permanent settlements, which led to the creation of villages, towns, and cities. The development of architecture was closely tied to the need for protection, sustenance, and social organisation. The shift from nomadic to settled life allowed for the accumulation of resources and knowledge, which in turn led to improvements in health and longevity. For example, agricultural societies could produce a more reliable food supply, reducing the risk of famine and malnutrition. With more stable living conditions, people had more time to develop technologies such as sanitation systems, which further contributed to longer lifespans. During this period, humans began building permanent settlements that allowed for the accumulation of knowledge and resources [4].

The Industrial Revolution marked a significant turning point in human history, particularly regarding public health and architecture. Urbanisation and the growth of cities during this period brought about new challenges, such as overcrowding, poor sanitation, and the spread of infectious diseases. However, these challenges also led to innovations in public health infrastructure. The development of modern sewer systems, clean water supplies, and waste management practices significantly reduced mortality rates in urban areas. Studies such as John Snow's study of cholera in London, which underscored the need for clean water and waste systems helped contribute to the betterment of public health. Advances in medical care, such as vaccines and antibiotics, further contributed to the dramatic increase in life expectancy during the 19th and 20th centuries [5].

While these improvements in public health were critical in extending life expectancy, they primarily addressed physical health. As the modern era progresses, there is growing recognition that mental and social well-being are equally important for living a long, fulfilling life. This is where architecture plays a pivotal role, as it shapes not only the physical spaces we inhabit, but also our mental states and social interactions.

PHYSICAL HEALTH AND THE BUILT ENVIRONMENT

Physical health remains a fundamental component of longevity, and architecture directly influences how people move, exercise, and engage with their environment. The design of cities, neighbourhoods, and individual buildings can either promote or inhibit physical activity, which has a direct impact on health outcomes. One of the most effective ways that architecture supports physical health is through active design. Active design refers to architectural strategies that encourage movement by making physical activity an integral part of daily life. This can be achieved through walkable neighbourhoods, accessible green spaces, and staircases that are prominently featured in buildings, rather than hidden away. Cities such as Copenhagen, Amsterdam, and Tokyo are celebrated for their walkable layouts, bike lanes, and transit-oriented developments, which reduce sedentary behaviour and promote fitness. In contrast, environments that prioritise cars over pedestrians, lack parks or open spaces, and have poor access to public transportation tend to discourage physical activity, contributing to sedentary lifestyles that are linked to obesity, heart disease, and diabetes.

A study published in *The Lancet* demonstrated that residents of walkable neighbourhoods have lower obesity rates and a lower incidence of heart disease. The researchers found that people who lived in areas with access to parks, sidewalks, and bike lanes were more likely to engage in physical activity, leading to better health outcomes [6]. Moreover, the presence of nature in urban areas, such as parks, green roofs, and urban forests, has been shown to lower stress levels, reduce the risk of cardiovascular diseases, and promote overall physical health. The “15-minute city” concept, where residents can reach essential amenities within a 15-min walk or bike ride, encourages daily physical activity [7].

Green spaces serve as ‘urban lungs’, improving air quality by absorbing CO₂ and releasing oxygen. Studies show that access to green spaces lowers cortisol levels, reduces hypertension, and fosters relaxation. Singapore’s Gardens by the Bay brings nature directly into urban spaces. These green spaces offer health benefits by fostering calm, encouraging outdoor activities, and serving as gathering spots for social interaction.

The concept of healthy building materials is also critical for physical health. Traditional building materials can release harmful chemicals, such as volatile organic compounds (VOCs) and formaldehyde, which negatively affect indoor air quality. Poor indoor air quality is associated with respiratory diseases, allergies, and even cancer. The use of non-toxic, sustainable materials in building design can improve air quality, leading to better respiratory health and a lower risk of chronic illnesses. In this regard, architecture that prioritises health-conscious materials can make a significant contribution to extending lifespan.

MENTAL HEALTH AND SPATIAL PSYCHOLOGY

While physical health is a critical factor in longevity, mental health is equally important. The built environment plays a significant role in influencing mental well-being through its impact on emotional states, stress levels, and cognitive functioning. Spatial psychology, a field that examines how environmental design affects human behaviour and emotions, provides valuable insights into how architecture can support mental health. One of the most well-researched concepts in this area is biophilic design, which involves integrating natural elements, such as plants, water, and natural light, into built environments. Biophilic design has been shown to reduce stress, enhance cognitive function, and improve mood. A classic study by Ulrich demonstrated that patients recovering from surgery experienced faster recovery times and required less pain medication when they had a view of nature

from their hospital rooms [8]. Since then, numerous studies have confirmed the benefits of biophilic design on mental health, making it a key consideration in architecture that seeks to promote well-being and longevity.

Natural light, in particular, is essential for regulating the body's circadian rhythms, which affect sleep patterns, mood, and overall mental health. Exposure to natural light during the day helps regulate the production of melatonin, a hormone that promotes restful sleep. Natural light exposure is also crucial for regulating the body's circadian rhythms. Good sleep is critical for mental and physical health, and chronic sleep deprivation is associated with a range of health issues, including depression, anxiety, and a weakened immune system. Buildings designed to maximise exposure to natural light, such as through large windows, skylights, and open floor plans, can significantly enhance mental well-being and support longer, healthier lives.

In addition to biophilic design, the use of colour and lighting in architecture has a profound effect on mental health. Different colours elicit different psychological responses. For example, blue and green tones are associated with calmness and relaxation, while bright red and yellow can stimulate energy and excitement. In environments where people need to focus, such as offices or schools, designers often use cool, calming colours to enhance concentration and reduce stress. Similarly, warm, soft lighting can create a sense of comfort and relaxation in residential spaces, contributing to lower stress levels and better mental health outcomes [9].

SOCIAL WELL-BEING AND COMMUNITY-ORIENTED DESIGN

Humans are inherently social beings, and social connections are crucial for emotional and psychological well-being. Loneliness kills. It is as powerful as smoking or alcoholism [10]. Studies have shown that social isolation is linked to depression, cognitive decline, and even premature death. Close relationships, more than money or fame, are what keep people happy throughout their lives, revealed a study by The Harvard Gazette. Architecture plays a critical role in fostering or hindering social interaction, making it an essential factor in promoting longevity. Community-oriented design emphasises creating spaces that encourage social interaction and community engagement. Public parks, plazas, pedestrian-friendly streets, and communal areas in residential buildings all serve to bring people together. In well-designed urban environments, residents are more likely to interact with their neighbours, engage in community events, and participate in social activities. These social connections not only enhance emotional well-being but also provide support networks that are essential as people age. In contrast, poorly designed environments can contribute to social isolation [11]. Suburban sprawl, where homes are spread out and car-dependent, often limits opportunities for casual social interactions. Similarly, high-rise apartment buildings with limited communal spaces can make residents feel isolated from their neighbours. By prioritising socially inclusive design, architects and urban planners can create environments that foster community bonds and reduce social isolation, especially among vulnerable populations such as the elderly.

The paper has shown that strong social ties contribute to longer life expectancy. A landmark study published in PLOS Medicine found that individuals with strong social relationships had a 50% increased likelihood of survival compared to those with weaker social connections [12]. By designing spaces that encourage social engagement, architecture can play a direct role in promoting emotional well-being and extending lifespan.

BUILT ENVIRONMENT AND HUMAN LIFESPAN

The biological process of ageing is influenced by various factors, including cellular senescence, mitochondrial dysfunction, and telomere shortening. Environmental factors like air pollution, inadequate indoor air quality, and exposure to toxic chemicals can speed up the ageing process. Therefore, the design of the built environment is essential in reducing the impact of these factors on ageing. Some architects and theorists have proposed radical ideas about how architecture can not only



Figure 1. The exterior of the concept design home “Reversible Destiny Lofts MITAKA: In Memory of Helen Keller” in Tokyo, Japan.

enhance well-being but also extend the human lifespan. Arakawa and Gins, for example, developed the concept of “Reversible Destiny” architecture, which challenges traditional notions of comfort and stability [12]. Their designs aim to stimulate the body and mind by creating environments that are intentionally disorienting or physically challenging. By forcing residents to constantly adapt to their surroundings, Arakawa and Gins believed that architecture could keep individuals physically and mentally agile, thereby extending their lifespan.

Recent research has demonstrated that architectural design significantly influences behavioural outcomes in various settings, including schools and workplaces (Figure 1). For example, factors like lighting and spatial arrangement can affect student behaviour and productivity among employees, while stimulating environments have been shown to enhance cognitive function and emotional resilience.

The ideas of Arakawa and Gins resonate with emerging findings across multiple disciplines, suggesting that thoughtfully designed living spaces can lead to improved health outcomes [13]. Cognitive scientist Laura Malinin highlights that complex, visually engaging environments may foster better cognitive performance, particularly among older adults. These insights point to the potential for architecture not just to provide shelter but to actively contribute to enhanced well-being and longevity. While their theories remain speculative and have not been widely adopted, they highlight the potential for architecture to influence biological and psychological processes in profound ways. As our understanding of human health and ageing continues to evolve, it is possible that future architectural innovations could play a role in further extending lifespan.

CONCLUSION

In conclusion, the intricate relationship between architecture and human lifespan underscores the profound influence of the built environment on physical, mental, and social well-being. By exploring how thoughtfully designed spaces can enhance health outcomes, it becomes clear that architecture is not merely about aesthetics or functionality but has the potential to shape the quality and duration of human life.

Architectural designs that promote active lifestyles, such as walkable neighbourhoods, accessible green spaces, and community-oriented layouts, encourage physical movement, reduce stress, and foster social connections, all critical factors for long-term health. Green spaces and exposure to nature within urban environments, biophilic design principles, and natural lighting are especially impactful, helping to regulate sleep patterns, improve mood, and reduce stress. Healthy building materials and indoor air quality further illustrate how architectural choices directly affect respiratory health and mitigate chronic illnesses.

Furthermore, the mental health benefits of architecture are equally significant. From the psychological effects of colour and spatial organisation to the inclusion of biophilic elements that reduce stress, the built environment can actively support mental resilience and cognitive function. By integrating spatial psychology into design, architects can create spaces that foster relaxation, focus, and emotional stability. Moreover, social well-being, often overlooked in traditional architectural practices, is now seen as a cornerstone of public health. The design of spaces that facilitate social interaction and community engagement, such as communal areas, pedestrian-friendly streets, and accessible amenities, provides support networks essential for emotional health and longevity, especially among older adults.

Radical theories and emerging research on architecture's potential to extend human lifespan invite further exploration and challenge traditional notions of comfort and stability. Projects like the "Reversible Destiny" architecture suggest that stimulating environments may support cognitive and physical agility. While these ideas remain speculative, they underscore the vast potential for architectural innovation to enhance not only well-being but also potentially extend lifespan.

As life expectancy continues to rise worldwide, it becomes increasingly essential for architects, urban planners, and policymakers to collaborate in creating health-promoting spaces. Embracing an integrated approach to architectural design, one that supports physical, mental, and social health, has the power to cultivate environments where people can live longer, healthier, and more fulfilling lives. By recognizing and leveraging architecture's impact on human health, we can help shape a future where built environments actively contribute to the happiness and longevity of their inhabitants, fostering healthier and more vibrant communities for generations to come.

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