VIEW POINT

Health Impact of School Built Environment on Children

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ABSTRACT

School-built environment impacts mental health, physical health, obesity, bullying, learning disorder, and respiratory disorders in children. The built environments of schools have a direct implication on the health of children. Indoor air quality in school buildings will play a role in children's exposure to pollution. One of the most consistently reported factors associated with children's active travel rates to school is the distance to school, with children more likely to walk or cycle to school the closer they live to the school. An evidence base regarding the built environment factors that shape decision-making and behaviour related to active modes of travel in adults is emerging for policymakers. Functional aspects of the built environment include the distance between places; street design and geometry; street connectivity; path infrastructure, aesthetic qualities; safety; the mix of land uses; and the proximity and quality of destinations. Regarding architecture, the primary goal should be to create a space that maximizes natural light, airflow, and captivating aesthetics. Students spend their most important and developing years on school campuses; it is essential to consider their mental and physical health to create an environment where they can learn and develop their personalities in comfort. This paper discusses the health impacts that school-built environments have on children from a public health professional's perspective as well as an architect's viewpoint, as both are crucial for children and adolescents to grow up in environments that encourage more active, safe, and sustainable lifestyles.

Keywords: School built environment, Children's health, Environmental health, Indoor air quality, Physical activity, Childhood obesity, Ventilation systems, Sanitation Facilities

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INTRODUCTION

The physical components of places where children and adults live, grow, play, work, and study (such as houses, buildings, streets, open areas, urban spaces, pathways, highways, parks, and infrastructure) are collectively referred to as the built environment. Hence, it refers to the environment humans have built and used for human activity.[1] In general, the term "built environment" (BE) refers to the man-made environment attributed to land use and urban form characterized by population, construction, and employment densities, as well as a mix of land uses, the form of street networks accessibility to neighbourhood facilities like open spaces and green areas, accessibility to transportation infrastructure and public transport systems, and the morphology of the urban fabric. The currently available material indicates that neighbourhood-level built environments, such as parks, streets, playgrounds, walkways, as well as activities that take place in these places, impact children's health subjectively and objectively. Children's environments inevitably broaden as they develop, from the womb to the wider neighbourhood to the farthest ends of the globe.[2] A high-quality environment is crucial for children to attain optimal health and development since the quality and design of their physical environment can either cause or avoid disease, disability, and harm. While paediatricians are used to thinking about the risks of chemical, biological, and physical exposures to health, "built environments" like subpar housing and negligent planning for land use, transportation, and communities have received far less attention. In contrast to the time, they spend indoors, and, in their towns, children spend very little time in natural settings.[3] A child's health is influenced by a variety of factors, including family characteristics like parental support, individual-level psychological factors like self-efficacy, and larger-scale factors like social norms. Built environments play an important role in catering to the above factors that influence children's health.[4] There are many socio-economic advantages to urbanization and the shaping of the built environment, but there are also negative side effects like increased exposure to air pollution, noise, high temperatures, decreased availability of or access to natural environments, and a more sedentary lifestyle.[5,6]

A growing body of research implies that issues with physical health bullying, and mental and social health in children are related to the built environment, including locations that humans have altered such as houses, schools, parks, industrial zones, farms, roads, and highways.[7,8,9] Investigating the school-built environment's significance to public health and children's health is necessary. Given the complexity of the built environment, a community-based, multilevel, interdisciplinary research strategy is necessary to comprehend its impact on human health.[10] Thus, in this article, we discuss the health impacts that school-built environments have on children from a public health professional's perspective as well as an architect's perspective, as both play crucial for children and adolescents to grow up in environments that encourage more active, safe and sustainable lifestyle.

DISCUSSION

The built environments of schools have a direct implication on the health of children. Due to growing concerns within the scientific community about the effects of indoor air quality on health, Indoor Air Quality (IAQ) has been the subject of numerous studies, especially given that children spend more time inside than outside.[11] As children spend at least a third of their time inside school buildings, that is, approximately seven or more hours a day in school, it is anticipated that the indoor air quality (IAQ) in school buildings will play an important role in the assessment of the effects of the children's exposure to air pollution. Academic performance and attendance can be affected by poor IAQ. Due to their undeveloped airways, children are particularly susceptible to pollutants, making them a vulnerable population with a higher risk than adults.[12,13] Additionally, children breathe in more air for their body weight since their tissues and organs are constantly developing. Various global research suggests that school-built environment impacts mental health, physical health, obesity, bullying, learning disorder, and respiratory disorders.[13] Many daily decisions are influenced by how the built environment is designed. How neighbourhoods are built may influence whether people walk to work or school, eat at fast-food restaurants frequently, or take their children to parks.[8,13] Although researchers have discovered numerous links between the built environment and children's physical activity, they are yet to discover conclusive evidence that aspects of the built environment promote obesity.[14] Certain development patterns, such as a lack of sidewalks, long distances to schools, and the need to cross busy streets, discourage students from walking or biking to school.[15] By removing such barriers, active commuting rates can be increased. Children understand that the built environment influences their activity: physical activity is encouraged in some places but difficult, discouraged, or even prohibited in others.[16] Buildings, transportation infrastructure, land use and community design elements, and recreational facilities like parks and trails all impact citizens' physical activity. The built environment influences children's weight by influencing their eating habits and physical activity.[17] Schools, day-care centers, hospitals, psychiatric residences, and playgrounds could be designed giving more regard to or considering children's developmental needs. Homes are typically adult-oriented, with large spaces off-limits to children and limited opportunities for varied, stimulating experiences.[13,18]

Playgrounds are often isolated pieces of single-purpose equipment and fenced-in blacktops; schools

and institutions are often stark, uninviting, and designed for easy supervision and maintenance.[13,18] The relationship between the built environment and physical activity in children has been extensively researched. Evidence suggests that the availability of parks, playgrounds, gyms, and other facilities, as well as other neighbourhood features like walkability and safety, significantly impacts children's daily physical activity patterns.[19] Childhood obesity and asthma have skyrocketed in the last two decades, and factors exacerbate them in the modern built environment.[20] When food energy intake exceeds energy expenditure, one becomes overweight. The obesity epidemic has many causes, including a lack of physical activity.[20] Physical activity declines when children do not have enough time to exercise during or after school and rely on private automobile transportation rather than walking, biking, or taking public transportation.[21] The design of a community or neighbourhood can either encourage or discourage physical activity. Building sidewalks to encourage walking, developing and promoting walk-to-school programs, and reducing traffic speeds are all ways to promote physical activity.[22]

Asthma is caused by a complex and multifactorial process, with risk factors including genetic predisposition and exposure to environmental and infectious triggers.[23] Mold, dust mites, cockroaches, and pets are environmental triggers in the home, as are indoor air pollutants such as tobacco smoke, volatile organic compounds, and combustion by-products.[24] Outdoor triggers include respiratory irritants like ground-level ozone, respirable particulate matter, and allergens like soy dust. According to research, controlling environmental asthma triggers like allergens and air pollutants would significantly reduce childhood asthma.[25] Another rising concern prevalent in schools today is Sick Building Syndrome. The term "sick building syndrome" (SBS) refers to acute health and/or comfort effects that have no known cause but can be attributed to time spent in a specific building.[26] Although SBS is not restricted to any particular kind of building, it is most prevalent in the workplace and frequently occurs in open-plan office buildings, museums, schools, and libraries.[27,28] The signs and symptoms may be found throughout the building or confined to a single room or section. Among the most typical signs of SBS may be; Headaches and vertigo, runny, irritated or blocked nose, redness in the throat and eyes, nausea, fatigue, inability to concentrate, breathing difficulty or tightness in the chest and irritated skin.[29,30] The following are considered the most prevalent risk factors for SBS; Insufficient ventilation, low humidity, fluctuations in room temperature, airborne particles, poor lighting, poor cleanliness.[16,28,29,30,31,32]

The primary causes of structural hazards in homes and schools are faulty construction or neglected maintenance. Building defects caused by faulty construction increase the likelihood of structural hazards and fires, increasing the risk of falls, burns, and other injuries.[33] These flaws also result in insufficient ventilation and moisture accumulation, which increase asthma triggers in the home. Poor ventilation, particularly in tightly sealed homes, can accumulate combustion by-products (for example, CO and nitrogen oxide compounds), mainly when wood-burning stoves, gas cooking stoves, or fuel space heaters are used for heating. Furthermore, synthetic building materials (such as carpet and pressed wood) may emit toxic or respiratory irritant chemicals such as formaldehyde. High moisture levels encourage mold growth, attracting rodents and insect pests like cockroaches.[34] Ventilation can be improved by roof overhangs that block the airflow in a pocket at the wall; thereby increasing the airflow through the opening and the positive pressure outside the window.[35] Cross ventilation, rather than roof openings, can result in greater indoor air movement. Thus, rooftop ventilators ought not to be considered options in contrast to legitimate wall openings yet should be utilized related to appropriate wall openings to acquire all-around ventilated inside spaces. Positive pressure only affects a portion of a steeply pitched roof's windward slope.[35] For buildings, the use of natural ventilation, maintaining adequate building spacing and organizing the site layout to increase interior air velocities can minimize interior heat gain. The conditions inside the building should influence the design of the building as well as the spaces outside, between and around it. Building orientation will determine the intensity of solar radiation falling on the walls and roof of the building, and the effectiveness of ventilation of the building openings.[36] These factors determine the relative amount of thermal transfer through the building envelope and the potential effectiveness of a design's ability to provide cooling through natural ventilation. Light-coloured wall surfaces, locally shaded windows, additional insulation, wing walls, and other design features like these are examples. Similarly, the arrangement of the building's interior plan may be able to partially make up for the building's poor shape and detailed design of the facade and windows, which may also compensate for the building's poor wind orientation.[37]

Students' abilities have been shown to improve in certain kinds of spaces. It has also been demonstrated that having a variety of materials and colours in spaces is stimulating. Additionally, lighting has a significant impact on the effectiveness of a space.[34] To entice a child into the space and instil a sense of warmth and welcome, use warm colours, bright accents, textures, plants, animals, and interesting materials. Varieties in lighting and surfaces, particularly those that are delicate and receptive to the touch, can upgrade a youngster's feeling of solace. However, research demonstrates that the immature brain is easily overwhelmed and overstimulated, despite the widespread belief that infants and young children thrive on a high level of stimulation.[35] An overwhelmed child tends to avoid his surroundings rather than take in and learn from them. It is necessary to carefully plan learning environments so that they

can be stimulated without being overwhelmed.[34,35] Subjects put in a colourful room for a period of three hours showed higher arousal (alpha part of the EEG), lower pulse rate which is believed to be a consequence of higher attention levels, and more elevated levels of emotionality.[36] Although architects typically consider light in terms of aesthetics and visibility, the psychological impact of lighting should also be given some consideration. For instance, a serious mental illness known as seasonal affective disorder (SAD) is brought on by a lack of sunlight.[36] Emotional well-being scores, melatonin, and cortisol levels were lower in people who didn't get enough sunlight. Compared to conventional fluorescent lighting, artificial illumination designed to match daylight caused less strain on the eyes.[37] Studies have shown that large open-plan schools resulted in students having lower test scores, also indicative of the need for smaller spaces.[37]When it comes to the surroundings of a school building a wide range of cutting-edge tools and materials can be used to plan the landscape and functionality of schoolyards. Green plants play a significant and distinctive role; Space and structural planning (the division of functional zones and the creation of a spatial structure), artistic and ornamental (creation of compositional background and accents for buildings and site facilities, decoration of facilities that are not aesthetic), and hygienic and sanitary (the beneficial effects of phytoncides, climate control, anti-anthropogenic pollution protection, and noise reduction) are all examples.[38]

One of the principles that ought to guide the landscape planning of schoolyards is the safety principle, which is closely linked to green plants' sanitary and hygienic function.[37] The definition of safety is the creation of an environment that shields children from undesirable external factors like dust, exhaust gases, and high noise levels, as well as from monotonous and featureless urban areas that encourage aggressive behaviour. A favourable microclimate should be established in such an environment so that children can spend a significant amount of their free time outdoors playing games. Reduced exposure to wind and direct sunlight is an important part of optimizing the microclimatic conditions in schoolyards. On the windward side, a barrier in the form of a hedge or freestanding groups of low trees and shrubs can help slow down the wind. Trees on the southern or southwestern sides can provide shade from the sun at noon and throughout the afternoon.[38] Lattices will likewise add to the production of a good microclimate - coverings, and structures on jungle gyms will take into consideration calm games and outside practices even on warm days. Junipers, spruces, pines, and other conifer species with distinct phytoncide properties can be included in the plantings of schoolyards to improve sanitary, hygienic, and microclimatic parameters. Removing harmful microorganisms in the air will make the area healthier for kids.[19,38]

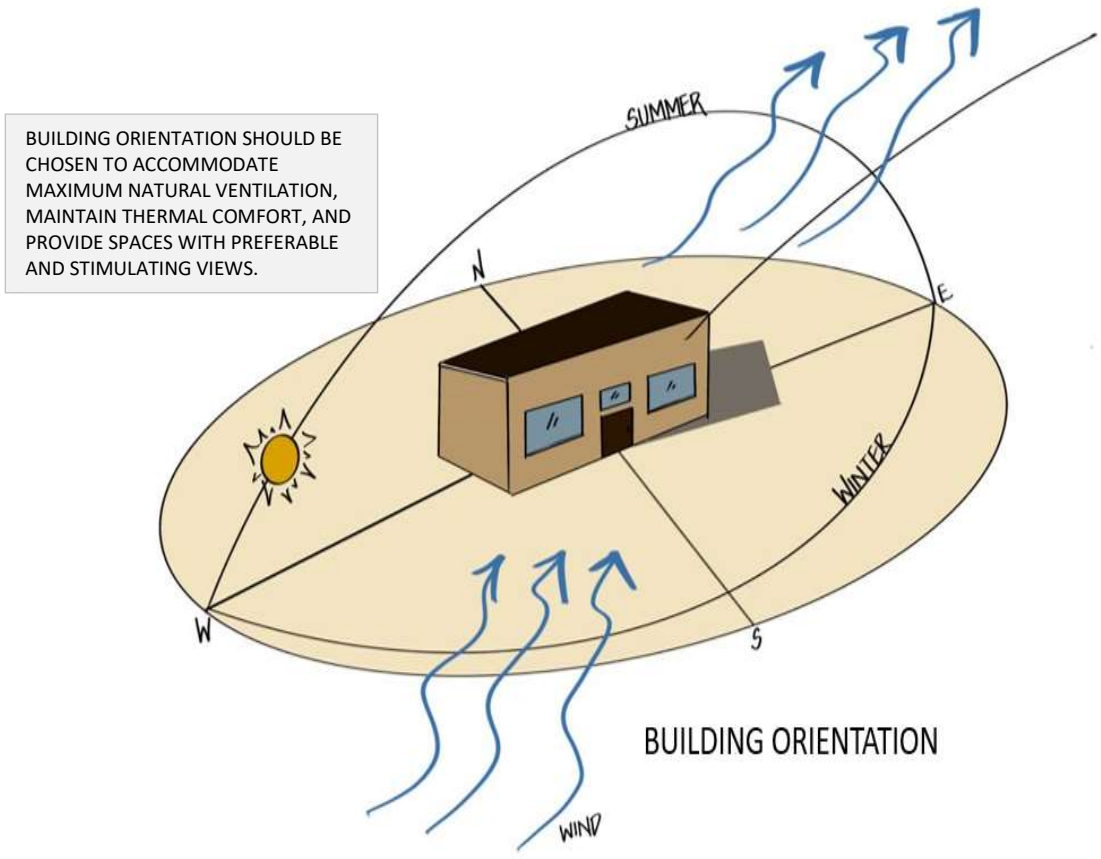

Figure 1: Building Orientation

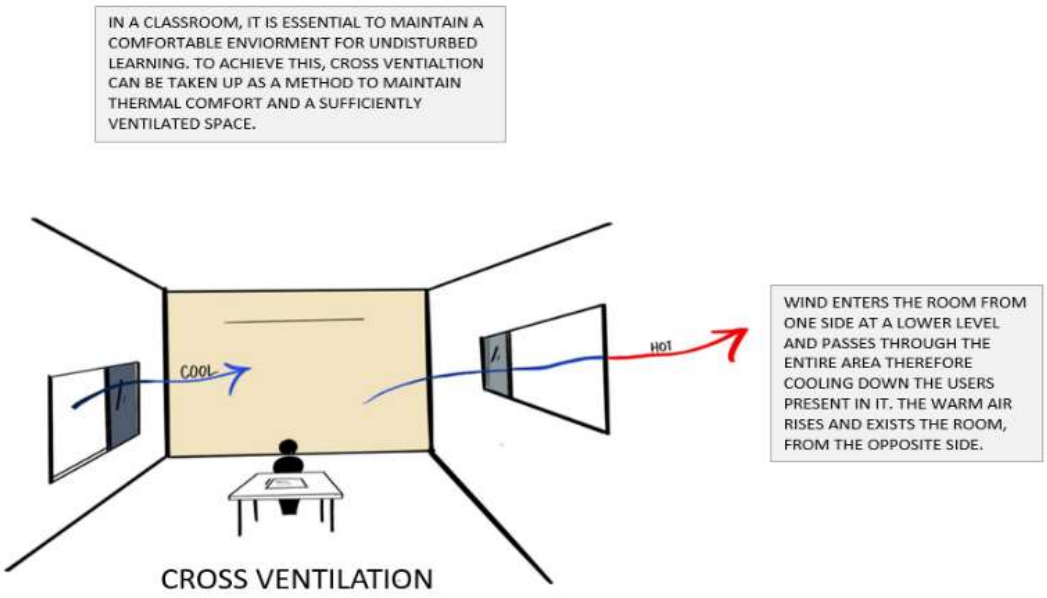

Figure 2: Cross ventilation

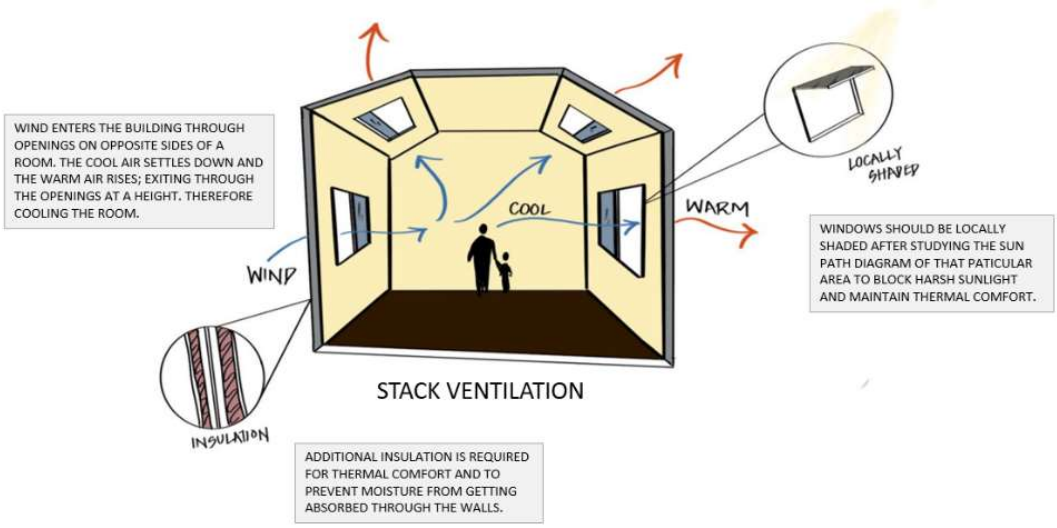

Figure 3: Stack ventilation

Conclusion

Despite the growing recognition of the benefits, it is evident from the previous literature that there is a decline in the rates of children participating in active transportation to school in many developed countries. The quality of the built environment surrounding homes and schools significantly impacts children's rates of school attendance. One of the most consistently reported factors associated with children's active travel rates to school is the distance to school, with children more likely to walk or cycle to school the closer they live to the school. The built environment factors that shape decision-making and behaviour related to active modes of travel in adults is an emerging field. Thereby, it is important for the policymakers to take cognizance of this and initiate some kind of informed intervention at the local level. To conclude, interventions like proper building orientation, cross ventilation and stack ventilation are the need of hour for a better school Built Environment on Children (Figures 1, 2 and 3).

References

1. National Center for Environmental Health, Division of Emergency and Environmental Health Services. Impact of the built environment on health. Healthy community design. Fact sheet series. [Internet]. 2011. Available from: http://www.cdc.gov/nceh/publications/factsheets/impactofthebuiltenvironmentonhealth.pdf.
2. Masoumi HE. Associations of built environment and children's physical activity: a narrative review. Rev Environ Health [Internet]. 2017;32(4). DOI: 10.1515/reveh-2016-0046
3. Cummins SK, Jackson RJ. The built environment and children's health. Pediatr Clin North Am [Internet]. 2001;48(5):1241–52. DOI: 10.1016/s0031-3955(05)70372-2
4. Committee on Environmental Health. The built environment: designing communities to promote physical activity in childre

n. Pediatrics. 2009 Jun;123(6):1591-8.

5. Daniels KM, Schinasi LH, Auchincloss AH, Forrest CB, Diez Roux AV. The built and social neighborhood environment and child obesity: A systematic review of longitudinal studies. Prev Med [Internet]. 2021;153(106790):106790. DOI: 10.1016/j.ypmed.2021.106790
6. Ip JM, Rose KA, Morgan IG, Burlutsky G, Mitchell P. Myopia and the urban environment: findings in a sample of 12-year-old Australian school children. Invest Ophthalmol Vis Sci [Internet]. 2008;49(9):3858–63. DOI: 10.1167/iovs.07-1451
7. Francis J, Strobel N, Trapp G, Pearce N, Vaz S, Christian H, et al. How does the school built environment impact students' bullying behaviour? A scoping review. Soc Sci Med [Internet]. 2022;314(115451):115451. DOI: 10.1016/j.socscimed.2022.115451
8. Robinson T, Nathan A, Murray K, Christian H. Parents' perceptions of the neighbourhood built environment are associated with the social and emotional development of young children. Int J Environ Res Public Health [Internet]. 2022;19(11):6476. Available from: http://dx.doi.org/10.3390/ijerph19116476
9. Evans GW. The built environment and mental health. Journal of urban health. 2003 Dec;80:536-55.
10. Srinivasan S, O'Fallon LR, Dearry A. Creating healthy communities, healthy homes, healthy people: initiating a research agenda on the built environment and public health. Am J Public Health [Internet]. 2003;93(9):1446–50. Available from: http://dx.doi.org/10.2105/ajph.93.9.1446
11. Carmo Freitas M do, Canha N, Martinho M, Almeida-Silva M, Marta S, Pegas P, et al. Indoor air quality in primary schools. In: Advanced Topics in Environmental Health and Air Pollution Case Studies. InTech; 2011.
12. Sadrizadeh S, Yao R, Yuan F, Awbi H, Bahnfleth W, Bi Y, et al. Indoor air quality and health in schools: A critical review for developing the roadmap for the future school environment. J Build Eng [Internet]. 2022;57(104908):104908. DOI: 10.1016/j.jobe.2022.104908
13. Schibuola L, Tambani C. Indoor environmental quality classification of school environments by monitoring PM and CO2 concentration levels. Atmos Pollut Res [Internet]. 2020;11(2):332–42. DOI: 10.1016/j.apr.2019.11.006
14. Patel V, editor. Disease control priorities (volume 7): Injury prevention and environmental health. 3rd ed. Washington, D.C., DC: World Bank Publications; 2017.
15. Huang K-Y, Cheng S, Theise R. School contexts as social determinants of child health: current practices and implications for future public health practice. Public Health Rep [Internet]. 2013;128 Suppl 3:21–8. DOI: 10.1177/00333549131286S304
16. Sallis JF, Glanz K. The role of built environments in physical activity, eating, and obesity in childhood. Future Child [Internet]. 2006 Spring;16(1):89–108. Available from: http://www.jstor.org/stable/3556552 (12)
17. David TG, Weinstein CS. The built environment and children's development. In: Spaces for Children. Boston, MA: Springer US; 1987. p. 3–18.
18. An R, Shen J, Yang Q, Yang Y. Impact of built environment on physical activity and obesity among children and adolescents in China: A narrative systematic review. J Sport Health Sci [Internet]. 2019;8(2):153–69. Available from: https://www.sciencedirect.com/science/article/pii/S2095254618300991
19. Cummins SK, Jackson RJ. The built environment and children's health. Pediatr Clin North Am [Internet]. 2001;48(5):1241–52. Available from: https://www.sciencedirect.com/science/ article/pii/S0031395505703722
20. *Sick building syndrome*. (n.d.). Sick Building Syndrome - Designing Buildings. Available from: https://www.designingbuildings.co.uk/wiki/Sick_building_syndrome
21. JPG. (2013). *An Introduction to Natural Ventilation for Buildings*. Available from: https://www.cedengineering.com/userfiles/An%20Introduction%20to%20Natural%20Ventilation%20for%20Buildings%20R1.pdf
22. Hunter, K. (2005). *Environmental Psychology in Classroom Design*. University of Cincinnati. Available from https://etd.ohiolink.edu/apexprod/rws_etd/send_file/send?accession=ucin1131581482&disposition=inline.
23. *ShieldSquare Captcha*. (n.d.). ShieldSquare Captcha. Available from: https://iopscience.iop.org/article/10.1088/1757-899X/262/1/012145/pdf
24. Huang K-Y, Cheng S, Theise R. School contexts as social determinants of child health: current practices and implications for future public health practice. Public Health Rep [Internet]. 2013;128 Suppl 3:21–8. DOI: 10.1177/00333549131286S304
25. Van Tran V, Park D, Lee Y-C. Indoor air pollution, related human diseases, and recent trends in the control and improvement of indoor air quality. Int J Environ Res Public Health [Internet]. 2020;17(8):2927. DOI: 10.3390/ijerph17082927
26. Sallis JF, Glanz K. The role of built environments in physical activity, eating, and obesity in childhood. Future Child [Internet]. 2006 Spring;16(1):89–108. DOI: 10.1353/foc.2006.0009
27. Peters U, Dixon AE, Forno E. Obesity and asthma. J Allergy Clin Immunol [Internet]. 2018;141(4):1169–79. Available from: http://dx.doi.org/10.1016/j.jaci.2018.02.004
28. Wangzom D, White M, Paay J. Perceived safety influencing active travel to school-A built environment perspective. Int J Environ Res Public Health [Internet]. 2023;20(2). DOI: 10.3390/ijerph20021026
29. Zuniga-Teran AA, Orr BJ, Gimblett RH, Chalfoun NV, Guertin DP, Marsh SE. Neighborhood design, physical activity, and wellbeing: Applying the Walkability Model. Int J Environ Res Public Health [Internet]. 2017;14(1). DOI: 10.3390/ijerph14010076
30. Joshi SM. The sick building syndrome. Indian J Occup Environ Med [Internet]. 2008;12(2):61–4. DOI: 10.4103/0019-5278.43262
31. Spence C. Senses of place: architectural design for the multisensory mind. Cogn Res Princ Implic [Internet]. 2020;5(1):46. DOI: 10.1186/s41235-020-00243-4
32. Jafari MJ, Khajevandi AA, Mousavi Najarkola SA, Yekaninejad MS, Pourhoseingholi MA, Omidi L, et al. Association of Sick Building Syndrome with indoor air parameters. Tanaffos. 2015;14(1):55–62.
33. Yüksek I, Karadayi TT. Energy-efficient building design in the context of building life cycle. In: Energy Efficient Buildings. InTech; 2017.
34. Carmo Freitas M do, Canha N, Martinho M, Almeida-Silva M, Marta S, Pegas P, et al. Indoor air quality in primary schools. In: Advanced Topics in Environmental Health and Air Pollution Case Studies. InTech; 2011.
35. Agnello P, Ryan R, Yusko KP. Implications of modern intelligence research for assessing intelligence in the workplace. Hum Resour Manag Rev [Internet]. 2015;25(1):47–55. DOI: 10.1016/j.hrmr.2014.09.007
36. Yoto A, Katsuura T, Iwanaga K, Shimomura Y. Effects of object color stimuli on human brain activities in perception and attention referred to EEG alpha band response. J Physiol Anthropol [Internet]. 2007;26(3):373–9. DOI: 10.2114/jpa2.26.373
37. Wilms L, Oberfeld D. Color and emotion: effects of hue, saturation, and brightness. Psychol Res [Internet]. 2018;82(5):896–914. DOI: 10.1007/s00426-017-0880-8
38. Kopeva A, Khrapko O, Ivanova O. Landscape planning of schoolyards. IOP Conf Ser Mater Sci Eng [Internet]. 2017;262:012145. DOI: 10.1088/1757-899x/262/1/012145