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OUTDOOR THERMAL COMFORT IN ACTIVITY SPACES: EXAMINING EFFECTS ON CHILDREN'S WELFARE AND WELL-BEING – A REVIEW

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Introduction

Although the assessment of the thermal environment of children within indoor classrooms has been studied since the 1960s, only a few studies have investigated the effects of outdoor thermal comfort (OTC) on children in play spaces. In outdoor activity places, thermal comfort is highly significant especially for youngsters who are identified as a vulnerable group in environmental health risk assessments. In addition, children spend one third of their time outdoors comparing to adults, which increases their exposure to harsh climates and cause heat-related diseases, heat stress, and a decrease in physical activity. The goal of this review is to synthesize the most recent research on OTC in playgrounds, with an emphasis on how it affects children's welfare and wellbeing. By looking into the connections between physical activity, health outcomes, and outdoor thermal comfort, the review's objectives are threefold:

1. Understanding the meteorological factors impacts on children in plays spaces
2. Introducing principles for assessing children's OTC in play spaces
3. Acquainting strategies to enhance OTC in outdoor activity spaces.

Why Study Children's OTC in Activity spaces?

Creating outdoor spaces for children based on adult thermal comfort models may result in areas that are thermally comfortable for adults but not for children, as kids have different thermoregulation (He, Shao, Tang, & Wu, 2023) from adults as we can see the comparison: **Table 1** comparison between children's physical parameters vs adults

Physical Parameters	Kids compared to Adults
Surface Area ,Body mass	Higher
Skin	Higher in heat/ Lower in cold
Metabolic Rate	Higher
Physical Activity	Higher
Thermoregulation	Inferior during extreme heat

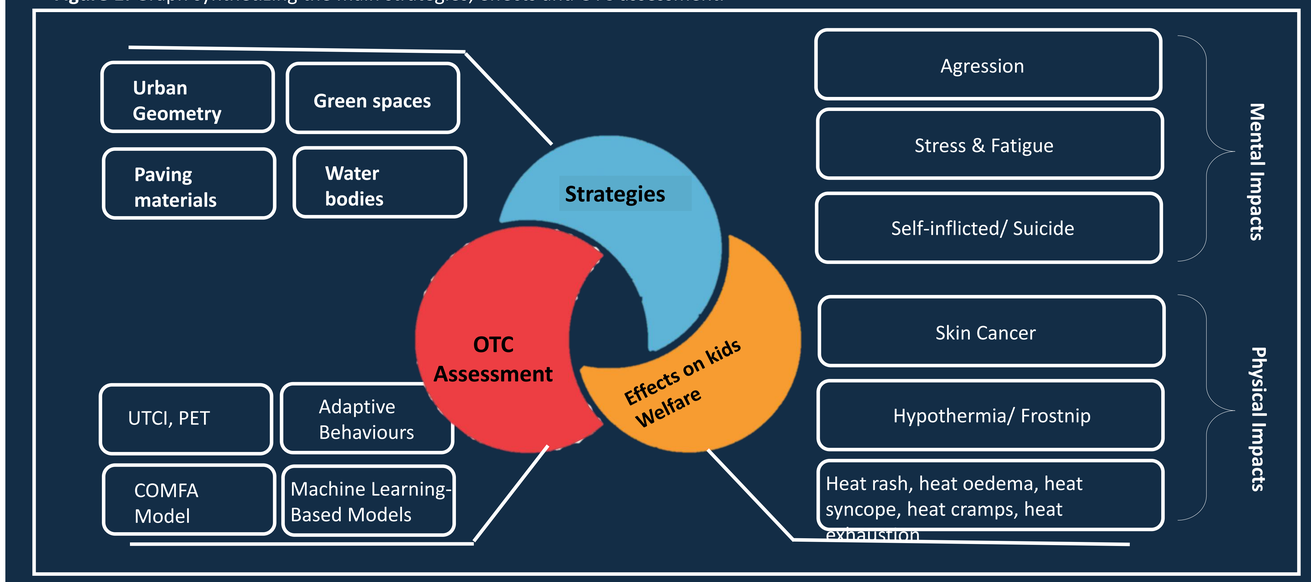
Method

The method involves a review of the latest literature across the world, a synthesis of studies from 2017 to 2023 were examined. A search strategy was developed, and two broad blocks of search phrases were merged to conduct a literature search in multiple databases: OTC (outdoor thermal comfort OR thermal sensation OR heat stress OR climate change") and children (youngster OR youths OR.

Results: **Table 2** Summary of Recent Studies on OTC and Children's Welfare.

Author/s (year)	City and climate	Urban area	Effects on Children's welfare	OTC Assessment	Landscape strategies
(Vanos, Herdt, & Lochbaum, 2017)	Lubbock, Texas, semi-arid climate	playground	/	COMFA (COMfort FormulA)	Implementing bioclimatic architecture principles, designing urban green squares
(Antoniadis, Katsoulas, & Papanastasiou, 2020)	cities and climates worldwide	urban schoolyards	- heat rash, heat oedema, heat syncope, heat cramps, heat exhaustion, skin cancer and life-threatening heatstroke.	PET, UTCI	Vegetation, Using cool materials, Passive cooling techniques, High-albedo materials.
(Lai et al., 2020)	hot and humid climate in Barranquilla, Colombia	playground	-Regulation of body temperature. -Respiratory health	- Subjective benchmarks, Physiological factors and Behavioral factors.	- Design interventions: such as shading structures, greenery, water features. - Behavioral adaptations: such as adjusting clothing, seeking shade, or changing activities
(Gu et al., 2022)	Chongqing, subtropical humid climate	urban residential area	-heat-related illnesses such as heat stroke, coronary heart disease, cerebrovascular disease, and other conditions	UTCI	Considering gender differences in OTC and designing spaces that cater to the specific needs of male and female children.
(Qi, Wang, Zhai, Wang, & Jin, 2022)	Wuhan, China, Humid Subtropical	playgrounds	discomfort, stress, and potential health issues	PET, COMFA, UTCI	Locating sites in waterfront areas, adding water play facilities, increasing greenery, planting deciduous trees
(He, Shao, Tang, & Wu, 2023)	Harbin, China. Harbin belongs to the temperate monsoon climate zone	Urban park	old injuries on body parts such as ears, fingers, or toes and risk of Frostbite	Subjective Thermal Perception Surveys and Activity recording	Proposing the transformation of park open spaces based on children's needs
(Liu, Li, & Xi, 2023)	Korea	Urban outdoor spaces	/	Heat Stress Index (HSI), Wet Bulb Globe Temperature Index (WBGT), Discomfort Index (DI)	Changing urban geometry, rational arrangement of vegetation, road pavements, and water bodies

Figure 1: Graph synthetizing the main strategies, effects and OTC assessment.



Discussion

The reviewed literature (table 2) indicates that children's thermal comfort and health are greatly impacted by urban environment and climate. Significant findings include the following:

- Green spaces and bioclimatic design can reduce the frequency of heat-related illnesses, but urban environments can increase them.
- Children's reactions to heat stress are influenced by a variety of physiological and behavioral factors, including clothing shifts and body temperature regulation.
- Urban design needs to take gender disparities in outdoor comfort into account.
- Healthy outdoor environments can be achieved through the use of landscape techniques like vegetation, urban geometry, water bodies and cool materials.

Conclusions :

The research review emphasizes the necessity to address how urban climates affect children's welfare in play spaces (Fig 1). We can create safer and healthier urban environments for children globally by combining comprehensive health risk evaluations with thermal comfort assessments, and by putting into practice effective interventions in urban design and policy.

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