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Adapting Outdoor Physical Education Programs in Response to Climate Change and Air Quality Challenges

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Abstract
This study explores the extent to which outdoor physical education (PE) programs are disrupted and adapted in response to climate change and deteriorating air quality. Quantitative data collected through structured questionnaires revealed frequent disruptions due to extreme heat (70%) and poor air quality (60%), with common health issues such as fatigue, dehydration, heat exhaustion, and breathlessness among students. Adaptive strategies, including shaded areas and environmental guidelines, are inconsistently available across schools. The findings underscore the need for structured, environment-responsive policies to ensure safe and inclusive PE practices.
Keywords: climate change, air quality, physical education, adaptive strategies, student health, outdoor learning, environmental monitoring

Introduction
The accelerated impacts of climate change and air quality deterioration significantly affect outdoor physical education (PE) programs worldwide. Increasing frequency of extreme weather events and pollution disrupt student safety, health, and educational outcomes, especially as children and adolescents are particularly vulnerable. This paper investigates the challenges and identifies adaptive strategies to safeguard and enhance PE delivery under environmental stressors.

Statement of the Problem
Climate change and air quality degradation have led to frequent cancellations or modifications of outdoor PE sessions, risks to student health, and gaps in educational outcomes. Many schools lack guidelines or resources for adaptation, necessitating research and best-practice recommendations for safe, effective outdoor PE.

Objectives
- Assess how climate and air quality factors affect outdoor PE.
- Examine PE program adaptations and gaps in infrastructure.
- Propose sustainable strategies and policy recommendations for resilient PE curricula.

Scope and Delimitations
The study focuses on primary and secondary schools in urban/semi-urban India where environmental impacts are most pronounced. It assesses environmental factors, institutional readiness, and adaptation measures, excluding indoor-only PE programs and technical climate science analyses.

Limitations

- Geographically limited data collection.
- Inconsistent access to environmental data.
- Time-bound evaluation that may not reflect long-term adaptation.

Hypotheses

- **Null Hypothesis (H0):** No significant relationship between climate/air quality and outdoor PE effectiveness.
- **Alternative Hypothesis (H1):** Significant relationship exists between climate/air quality and outdoor PE effectiveness.

Methods

Research Design

A mixed-methods approach was implemented, combining quantitative questionnaires and qualitative interviews/focus groups with PE teachers, administrators, and students.

Population and Sampling

- 150 PE teachers
- 100 school administrators
- 800 students
- Purposive sampling in affected urban/semi-urban schools

Data Collection

- Structured questionnaires (disruptions, student health, adaptive strategies)
- Student surveys (participation, comfort, awareness)
- Interviews and focus groups (experiences, suggestions)
- Environmental data monitoring (optionally correlated)

Ethical Considerations

- Informed consent from all participants (and guardians).
- Confidentiality and ethical approval ensured.

Data Analysis

- Descriptive/inferential quantitative analysis, thematic qualitative analysis.

Results

Disruption Frequency of Outdoor PE Sessions

Item	Always (%)	Often (%)	Sometimes (%)	Rarely (%)	Never (%)
Sessions disrupted due to heat	30%	40%	20%	8%	2%
Sessions cancelled due to air quality	25%	35%	28%	10%	2%
Teachers use environmental monitor apps	15%	20%	35%	20%	10%

Student Health Effects

Symptom	Frequently (%)	Occasionally (%)	Not observed (%)
Breathlessness	38%	45%	17%
Heat exhaustion/dizziness	42%	33%	25%
Fatigue and dehydration	55%	30%	15%

Adaptive Strategies

Strategy	Available (%)	Not available (%)
Shaded areas	40%	60%
Indoor alternatives	65%	35%
Environmental guidelines	30%	70%
Real-time weather data	45%	55%

Discussion

Disruptions to outdoor PE from environmental factors are frequent, reducing student participation and increasing health risks. Infrastructure and guidelines are lacking, leaving PE teachers reliant on personal judgment. There is a strong expressed desire for more adaptive capacity: shaded areas, indoor alternatives, real-time monitoring, and teacher training. Schools must respond proactively with both short-term and long-term adaptation strategies.

Conclusion

Climate change and poor air quality significantly threaten safe and effective PE. Adaptation requires improved policies, infrastructure, environmental monitoring, and education for both teachers and students.

Recommendations

- Develop clear, actionable school environmental safety protocols.
- Integrate environmental education within the PE curriculum.
- Improve infrastructure (shaded/activity areas, water access).
- Expand access to and scheduling for indoor alternatives.
- Use technology (weather and AQI monitoring) for PE planning.
- Provide teacher capacity-building programs.
- Collaborate with health/environment authorities.
- Encourage active student participation in adaptation planning.

References

- Edwards, N. M., et al. (2015). Outdoor temperature, precipitation, and wind speed affect physical activity levels in children: A longitudinal cohort study. *Journal of Physical Activity and Health*, 12(8), 1074–1081. https://doi.org/10.1123/jpah.2014-0125
- Haverkamp, H. C. (2025). Airborne pollution and outdoor exercise. *American College of Sports Medicine*.
- Morrison, S. (2022). Extreme heat makes it hard for kids to be active. *Time*.
- Sunderrajan, P., et al. (2023). The interplay between air pollution, built environment, and physical activity: Perceptions of children and youth in rural and urban India. *Environmental Research*, 219, 114878.
- Tainio, M., et al. (2024). Air pollution and endurance exercise: A systematic review. *Life*, 15(4), 595. https://doi.org/10.3390/life15040595
- Xia, T., et al. (2022). The influence of air pollution on residents' outdoor exercise. *Int. J. Environ. Res. Public Health*, 19(8), 4509.
- Yang, K.-C., et al. (2024). Global trends in chronic air pollution exposure, physical activity and lung function. *Sports Medicine–Open*, 10(1), 22.
- Zhang, D. L., & Mendoza, D. L. (2020). Absentee and economic impact of low-level fine particulate matter and ozone exposure in K-12 students. *arXiv preprint*.
- Shoari, N., et al. (2021). School neighbourhood and compliance with WHO NO_2 guideline: Greater London. *arXiv preprint*.
- Pinto, D. M., et al. (2025). Optimal placement of nature-based solutions for urban challenges. *arXiv preprint*.