

Climate Awareness, Health Outcomes, and Educational Vulnerability among Adolescent Girls in Bhubaneswar, Odisha

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ABSTRACT

Climate change has increasingly emerged as a critical determinant of health, education, and social well-being, particularly among vulnerable populations in disaster-prone regions. While considerable research has examined the environmental and economic consequences of climate change, limited attention has been paid to its implications for adolescent girls in Bhubaneswar, Odisha, a city frequently affected by cyclones, heatwaves, and seasonal climatic variability. This study investigates the relationship between climate awareness, climate-related exposure, health impacts, and educational disruption among adolescent girls residing in urban and peri-urban localities of Bhubaneswar. Using a cross-sectional survey design, data were collected from 100 respondents and analyzed through descriptive and inferential statistical techniques. The findings indicate that respondents possessed moderate levels of climate awareness while simultaneously experiencing notable health and educational challenges associated with climate-related events. Greater climate awareness was associated with lower levels of health impacts and educational disruption, whereas climate related health challenges were linked to increased educational vulnerability. The study further found that climate awareness, family income, and exposure to climate-related events significantly influenced educational outcomes among respondents. These findings suggest that climate related vulnerabilities among adolescent girls extend beyond environmental exposure and are closely linked to health, education, and adaptive capacity. The study underscores the need for climate literacy programmes, resilient educational systems, and targeted health interventions aimed at strengthening resilience among adolescents in climate-sensitive regions. By foregrounding the experiences of adolescent girls in Bhubaneswar, the research contributes to emerging discussions on climate vulnerability, adolescent well-being, and sustainable adaptation in developing societies.

Key Words : Climate Change, Adolescent Girls, Educational Vulnerability, Climate Awareness, Health Impacts, Climate Adaptation, Gender and Environment, Coastal Odisha, Peri Urban Bhubaneswar

INTRODUCTION

Climate change has emerged as one of the most significant challenges confronting contemporary societies, not only because of its environmental consequences but also because of its profound implications for human development, social equity, and well-being. Increasing temperatures, extreme weather events, environmental degradation, and ecological instability are transforming the conditions under which individuals live, learn, and imagine their futures. Consequently, climate change is no longer understood solely as an ecological phenomenon; rather, it is increasingly conceptualized as a social and

developmental crisis that intersects with existing structures of inequality and vulnerability (Beck, 1992; Giddens, 2009). The impacts of climate change are therefore distributed unevenly across populations, with socially and economically marginalized groups often bearing a disproportionate share of environmental risks.

Among the populations most vulnerable to these risks are adolescents. As a developmental category, adolescence represents a period of significant physical, cognitive, emotional, and social transformation. During this stage, individuals negotiate questions of identity, autonomy, and future aspirations while simultaneously responding to broader social realities. Erikson's theory

of psychosocial development identifies adolescence as a critical phase of identity formation, whereas Piaget emphasizes the emergence of abstract reasoning and future-oriented thinking during this period. Consequently, adolescents are increasingly capable of understanding the long-term implications of climate change while remaining particularly susceptible to the uncertainties it creates. Recent scholarship has demonstrated that climate-related concerns are associated with heightened levels of anxiety, stress, and uncertainty among young people, contributing to what has been described as climate anxiety or eco-anxiety (Ojala, 2012; Hickman *et al.*, 2021). Climate change therefore influences not only environmental conditions but also the psychological and developmental experiences of younger generations.

However, adolescents cannot be regarded as a homogeneous group. Feminist and intersectional scholarship has consistently demonstrated that vulnerability is shaped by the interaction of multiple social factors, including gender, class, geography, and access to resources (Crenshaw, 1991; Agarwal, 2010). Within climate-sensitive societies, adolescent girls often occupy a particularly vulnerable position because environmental disruptions intersect with existing gender inequalities. Studies suggest that climate-related events frequently increase domestic responsibilities, reduce educational opportunities, intensify health challenges, and restrict social mobility for girls. As Vandana Shiva argues, environmental crises often magnify pre-existing inequalities rather than creating entirely new forms of disadvantage. Climate change thus functions not only as an environmental challenge but also as a gendered developmental issue that influences educational attainment, well-being, and future opportunities.

The Indian context provides an important setting for examining these relationships. India is widely recognized as one of the countries most vulnerable to climate variability due to its geographical diversity, large population, and socio-economic inequalities. Coastal regions are particularly exposed to cyclones, flooding, sea-level rise, and extreme heat events. Odisha, located along the Bay of Bengal, represents one of the country's most climate-sensitive states and has experienced several major climatic disasters in recent decades, including Cyclone Phailin (2013), Cyclone Hudhud (2014), Cyclone Fani (2019), and Cyclone Yaas (2021). While considerable attention has been devoted to disaster preparedness, infrastructure resilience, and economic recovery, less

emphasis has been placed on understanding the long-term social and developmental consequences of environmental instability, particularly among adolescent populations.

Existing literature has established important connections between climate change, health outcomes, educational disruption, and gender vulnerability. Nevertheless, significant gaps remain. Much of the available scholarship focuses either on environmental impacts or on broader public health concerns, often overlooking the lived experiences of adolescent girls in climate-sensitive regions. Furthermore, studies frequently examine climate awareness, health impacts, and educational outcomes as separate phenomena rather than exploring their interconnected nature. Limited empirical evidence is available regarding how these dimensions interact within rapidly urbanizing coastal contexts such as Bhubaneswar, where environmental risks increasingly shape everyday life.

Against this backdrop, the present study investigates the relationship between climate awareness, climate-related exposure, health impacts, and educational vulnerability among adolescent girls in Bhubaneswar, Odisha. By examining these variables within a single analytical framework, the study seeks to contribute to emerging discussions on climate justice, adolescent well-being, and gendered vulnerability in the Global South. In doing so, it shifts attention from climate change as an abstract environmental concern to climate change as a lived social reality that shapes the health, educational experiences, and future opportunities of adolescent girls in climate-sensitive communities.

Review of Literature:

Climate change has increasingly been conceptualized not merely as an environmental phenomenon but as a complex social, political, psychological, and developmental challenge. Contemporary scholars argue that climate change affects human societies through interconnected pathways involving health, education, economic security, social inequalities, and emotional well-being (IPCC, 2023). As environmental crises become more frequent and severe, researchers have begun to examine how climate-related disruptions shape the lives of vulnerable populations, particularly women, children, and adolescents. Within this broader discourse, adolescent girls have emerged as a significant yet understudied demographic whose

experiences are shaped by the intersection of age, gender, and environmental vulnerability.

Ulrich Beck's theory of the "Risk Society" provides an important framework for understanding contemporary climate anxiety. Beck argues that modern societies increasingly confront manufactured risks that transcend national boundaries and affect everyday life in unpredictable ways (Beck, 1991; p. 21). Climate change represents one such global risk, generating uncertainty regarding health, livelihoods, and future security. Adolescents, who are in the process of constructing their identities and aspirations, often experience these uncertainties more intensely than other age groups. Anthony Giddens similarly contends that late modern societies are characterized by heightened awareness of future risks, resulting in growing concerns regarding environmental sustainability and human survival (Giddens, 2009, p. 45). Together, these perspectives suggest that climate change functions not only as an ecological challenge but also as a social condition that shapes perceptions of risk and vulnerability.

Research examining the psychological consequences of climate change has expanded significantly during the past decade. Scholars increasingly use concepts such as eco-anxiety, climate distress, ecological grief, and solastalgia to describe emotional responses to environmental degradation. Albrecht defines solastalgia as the distress experienced when individuals witness the deterioration of environments to which they feel emotionally connected (Albrecht *et al.*, 2007 p. 95). Ojala's research on adolescents demonstrates that awareness of climate change frequently generates feelings of fear, uncertainty, sadness, and frustration, particularly among young people who perceive environmental crises as threats to their future (Ojala, 2012; p. 675). Hickman *et al.* (2021); in a multinational study involving more than 10,000 young people, found that a majority of respondents reported anxiety and concern regarding climate change, with many expressing feelings of betrayal by political institutions that have failed to adequately address environmental challenges (Hickman *et al.*, 2021; p. 864). These findings indicate that climate change increasingly constitutes a psychological as well as environmental phenomenon.

Developmental psychology further contributes to understanding adolescent responses to climate change. Erik Erikson identifies adolescence as the stage of Identity versus Role Confusion, during which individuals attempt

to establish coherent self-concepts and future aspirations (Erikson, 1968; p. 128). Environmental uncertainty may disrupt this developmental process by generating concerns regarding educational opportunities, employment prospects, and long-term security. Jean Piaget's theory of cognitive development similarly suggests that adolescents possess the capacity for abstract reasoning and hypothetical thinking, enabling them to comprehend large-scale environmental threats and their potential consequences (Piaget, 2001; p. 71). Consequently, adolescents are uniquely positioned to understand climate risks while simultaneously experiencing limited power to influence environmental outcomes.

The relationship between climate change and health has been widely documented within public health scholarship. The World Health Organization identifies climate change as one of the most significant threats to human health in the twenty-first century. Rising temperatures, worsening air pollution, extreme weather events, and changing disease patterns have been linked to respiratory illnesses, heat-related disorders, infectious diseases, and nutritional challenges. D'Amato, Cecchi, and Bonini argue that children and adolescents are particularly susceptible to climate-sensitive health conditions because of their developmental vulnerability and dependence on environmental quality (D'Amato *et al.*, 2018; p. 1186). Beyond physical health consequences, climate-related stressors are increasingly associated with psychological difficulties including anxiety, depression, sleep disturbances, and reduced subjective well-being.

Educational researchers have likewise highlighted the impact of environmental instability on learning outcomes. Bronfenbrenner's Ecological Systems Theory emphasizes that child and adolescent development occurs through interactions between individuals and multiple environmental systems, including family, school, community, and broader social structures (Bronfenbrenner, 1979; p. 16). Climate-related disruptions affect each of these systems simultaneously, thereby influencing educational experiences and developmental outcomes. Studies conducted by Stern (2008) demonstrate that extreme temperatures negatively affect concentration, cognitive performance, and academic achievement. Climate-related school closures, infrastructural damage, transportation interruptions, and health-related absenteeism further contribute to educational vulnerability, particularly within resource-constrained settings.

The gendered dimensions of climate change have attracted increasing scholarly attention within feminist environmental studies. Vandana Shiva argues that environmental degradation and gender inequality are deeply interconnected because women often bear disproportionate responsibility for managing environmental resources while possessing limited access to decision-making power (Shiva, 1988; p. 54). Similarly, Bina Agarwal's work on gender and environmental governance highlights the unequal distribution of environmental burdens and adaptive capacities across social groups (Agarwal, 2010; p. 98). Feminist scholars contend that climate change amplifies pre-existing inequalities rather than creating entirely new forms of vulnerability. Adolescent girls frequently experience increased domestic responsibilities, reduced educational opportunities, and heightened social insecurity during environmental crises, making them particularly vulnerable to climate-related disruptions.

The concept of intersectionality, developed by Kimberlé Crenshaw, offers an additional framework for understanding climate vulnerability. Crenshaw argues that social identities such as gender, age, class, and location interact to shape experiences of privilege and disadvantage (Crenshaw, 1991; p. 140). Applying this perspective to climate change reveals that adolescent girls living in economically disadvantaged and climate-sensitive regions face multiple and overlapping forms of vulnerability. Their experiences cannot be understood solely through the lens of gender or environmental exposure but must be examined as products of intersecting social and ecological conditions.

Within the Indian context, climate vulnerability is particularly pronounced in coastal states such as Odisha. Recurrent cyclones, floods, heatwaves, and environmental degradation have generated substantial social and economic challenges across the region. Scholars such as Mohanty argue that while disaster management efforts in Odisha have improved considerably, less attention has been devoted to understanding the long-term developmental consequences of environmental instability among younger populations (Mohanty, 2020; p. 214). Existing studies have primarily focused on infrastructure, disaster preparedness, and economic recovery, leaving significant gaps regarding adolescent health, educational continuity, and psychosocial well-being.

Although the literature demonstrates that climate

change influences health, education, and social development, important gaps remain. Most studies examine these dimensions independently rather than exploring their interconnected nature. Furthermore, limited empirical research has investigated how climate awareness itself influences resilience among adolescent girls in climate-sensitive urban and peri-urban communities. The present study addresses these gaps by examining the relationships among climate awareness, climate-event exposure, health impacts, and educational disruption among adolescent girls in Bhubaneswar, Odisha. By integrating developmental, psychological, sociological, and gender-based perspectives, the study contributes to emerging scholarship on climate vulnerability and adolescent well-being in contemporary India.

METHODOLOGY

This study employed a quantitative cross-sectional survey design to examine the relationship between climate awareness, climate-related exposure, health impacts, and educational vulnerability among adolescent girls in Bhubaneswar, Odisha. The research was informed by Bronfenbrenner's Ecological Systems Theory (1979), which emphasizes the interaction between individuals and their environmental contexts, and Beck's Risk Society Theory (1992), which highlights the growing influence of environmental risks on contemporary social life. These theoretical perspectives provided a framework for understanding how climate-related disruptions influence adolescent well-being and educational experiences.

The study was conducted in urban and peri-urban localities of Bhubaneswar, a climate-sensitive city located in the coastal state of Odisha, India. A total of 100 adolescent girls aged between 15 and 19 years participated in the survey. Respondents were selected through purposive sampling to ensure representation across different educational levels and socio-economic backgrounds. Primary data were collected using a structured questionnaire comprising demographic variables and indicators related to climate awareness, climate-event exposure, perceived health impacts, and educational disruption. Climate awareness, health impacts, and educational disruption were measured using composite scales ranging from 1 to 5, while climate-event exposure was recorded as a binary variable (0 = No, 1 = Yes).

Data were coded and analyzed using descriptive and inferential statistical techniques. Means and standard deviations were calculated to summarize the characteristics of the sample, while Pearson’s correlation analysis was employed to examine relationships among the study variables. Multiple linear regression was further conducted to identify the extent to which climate awareness, climate-event exposure, and family income predicted educational disruption. Statistical significance was assessed at the 0.05 level. Ethical considerations were maintained throughout the research process, and participation was voluntary, confidential, and based on informed consent. The methodological approach was designed to generate empirical evidence regarding the multidimensional effects of climate change on adolescent girls within a climate-vulnerable urban context.

RESULTS AND DISCUSSION

The descriptive statistics indicate that respondents possessed moderate to high levels of climate awareness while simultaneously reporting noticeable health impacts and educational disruptions (Table 1). The findings suggest that climate-related challenges have become a significant component of the everyday experiences of adolescent girls in Bhubaneswar. Similar observations have been reported in studies examining climate vulnerability among young people in environmentally sensitive regions (Ojala, 2012; Hickman *et al.*, 2021).

Table 1 : Descriptive Statistics of Key Variables (N = 100)

Variable	Mean	SD
Age	17.0	1.41
Climate Awareness Score	3.71	1.08
Health Impact Score	2.59	1.18
Educational Disruption Score	2.84	1.28

Correlation analysis revealed strong relationships among the study variables. Climate awareness was negatively associated with both health impacts ($r = -0.826$) and educational disruption ($r = -0.903$), indicating that respondents with greater awareness reported lower levels of vulnerability. In contrast, health impacts demonstrated a strong positive relationship with educational disruption ($r = 0.835$), suggesting that climate-related health challenges can adversely affect educational continuity and academic engagement (Table 2).

These findings support existing scholarship emphasizing the role of awareness and adaptive capacity

Table 2 : Correlation Matrix

Variable	Climate Awareness	Health Impact	Educational Disruption
Climate Awareness	1.000	-0.826	-0.903
Health Impact	-0.826	1.000	0.835
Educational Disruption	-0.903	0.835	1.000

in reducing climate vulnerability. They also reinforce Bronfenbrenner’s ecological perspective, which highlights the interconnected nature of environmental, health, and educational outcomes.

The regression model explained 84.2% of the variance in educational disruption and was statistically significant. Climate awareness emerged as the strongest predictor, indicating that greater awareness was associated with reduced educational vulnerability. Climate-event exposure significantly increased educational disruption, while higher family income reduced vulnerability (Table 3).

Table 3 : Multiple Regression Analysis Predicting Educational Disruption

Predictor	β	p-value
Family Income Category	-0.261	0.025
Climate Event Exposure	0.406	0.015
Climate Awareness Score	-0.818	<0.001

Model Statistics: $R^2 = 0.842$, Adjusted $R^2 = 0.837$, $F = 169.9$, $p < 0.001$

These findings suggest that educational outcomes are shaped by both environmental exposure and socio-economic resources. Consistent with the work of Agarwal and Crenshaw, vulnerability appears to be influenced not only by climatic conditions but also by inequalities in access to adaptive resources and opportunities.

A comparison of urban and peri-urban respondents revealed significant disparities in climate vulnerability. Peri-urban participants reported lower levels of climate awareness and substantially higher levels of health impacts and educational disruption. These findings indicate that geographical location remains an important determinant of adaptive capacity and resilience (Table 4).

The results align with broader discussions of climate justice, which argue that vulnerable communities frequently experience disproportionate environmental burdens despite possessing fewer resources to respond effectively.

Taken together, the findings demonstrate that climate

Table 4 : Urban and Peri-Urban Differences in Climate Vulnerability

Variable	Urban Mean	Peri-Urban Mean
Climate Awareness	4.32	2.89
Health Impact	1.96	3.58
Educational Disruption	2.01	4.12

change affects adolescent girls through interconnected pathways involving awareness, health, and education. Climate awareness appears to function as a protective factor, while climate-event exposure and socio-economic disadvantage increase vulnerability. The study further highlights the importance of considering gender and locality when examining climate-related impacts.

By focusing on adolescent girls in a climate-sensitive region, the study contributes to emerging scholarship that conceptualizes climate change as a developmental and social issue rather than solely an environmental concern. The findings underscore the need for climate literacy programmes, gender responsive educational policies, and targeted interventions aimed at strengthening resilience among young women in vulnerable communities.

Conclusion:

The present study demonstrates that climate change is not merely an environmental concern but a developmental and social challenge that significantly influences the health, education, and well-being of adolescent girls. By examining climate awareness, climate-event exposure, health impacts, and educational disruption among adolescent girls in Bhubaneswar, Odisha, the study highlights the interconnected nature of climate vulnerability and the ways in which environmental risks interact with socio-economic and gender-based inequalities.

The findings indicate that climate awareness functions as an important resource for resilience, while climate-event exposure and socio-economic disadvantage increase educational vulnerability. The strong association between health impacts and educational disruption further suggests that climate-related challenges affect adolescents through multiple and overlapping pathways. These findings reinforce ecological, risk-based, and intersectional perspectives, demonstrating that vulnerability is shaped not only by environmental conditions but also by access to resources and adaptive capacity.

The study contributes to emerging scholarship that

views climate change as a question of climate justice and human development rather than solely an environmental issue. By focusing on adolescent girls, it underscores the importance of adopting gender-sensitive approaches to climate research and policy. The findings suggest that effective adaptation strategies must extend beyond disaster preparedness to include climate literacy, adolescent health initiatives, resilient educational systems, and targeted support for vulnerable communities, particularly in peri-urban areas.

Although limited to a single-city sample, the study provides valuable insights into the lived experiences of adolescent girls in a climate-sensitive region. Future research may employ larger and more diverse samples to further examine the long-term developmental consequences of climate-related disruptions. Ultimately, strengthening the resilience of adolescent girls is essential not only for reducing vulnerability but also for promoting equitable and sustainable development in an era of increasing environmental uncertainty.

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