

Little Bodies, Big Heat: Health Impacts and Household Coping Gaps among Children during Heatwaves in South India

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Abstract

Heatwaves in India are growing more frequent and intense, yet their effects on children remain under-studied. This mixed-methods study examines heatwave impacts on pregnant women and children aged 0–18 years in five heatwave-affected districts of Andhra Pradesh, Odisha, Puducherry, Tamil Nadu and Kerala. A structured household survey of 1,500 respondents (300 per district) was supplemented by five focus group discussions. Most children reported moderate discomfort (54 percent), while 19 percent experienced severe or life-threatening effects. Heat-related illness affected 77 percent of respondents, with the highest burden in Andhra Pradesh (98 percent), where heat stroke (35 percent) and heat cramps (40 percent) were also most common. Dehydration (59 percent) was the leading health problem. Adverse pregnancy outcomes, including preterm birth, miscarriage and stillbirth, were reported mainly in Andhra Pradesh. Protective practices were inadequate: only 44 percent ensured hydration, 22 percent kept children indoors at peak heat, 14 percent used cooling methods, 3 percent used light clothing and 1 percent sought medical advice. The study recommends child-centred Heat Action Plans, summer pediatric clinics, cooling centres, climate-resilient housing, and awareness programmes.

Key words: Heatwaves, Child health, Climate change adaptation, South India, Heat Action Plans

1.Introduction

Heat waves in India have become more frequent and severe over the past few decades. This trend is expected to continue due to ongoing climate change, with severe implications for public health and the economy. India has experienced a notable increase in the frequency, duration,

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and intensity of heat waves over the past few decades. A study by Murari et al. (2015) found that the frequency of heatwaves in India has increased by about 50 percent from 1961 to 2010. Historical data from 1981 to 2020 shows a significant rise in heat wave occurrences, with future projections under various climate scenarios suggesting further intensification (Goyal et al., 2023). The health impacts of heat waves in India are profound, with numerous studies documenting increased morbidity and mortality during these events. Heat waves are often referred to as “silent killers” due to their delayed but severe effects on human health, including increased mortality rates, heat strokes, and exacerbation of pre-existing health conditions (Debnath et al., 2023).

Heatwave Impact on Children in South India

Heatwaves are becoming increasingly frequent and intense due to climate change, posing risks, especially to vulnerable populations such as children. They are increasingly becoming a significant public health concern with profound impacts on vulnerable populations, particularly children. Around 559 million children are exposed to high heatwave frequency and around 624 million children are exposed to one of three other high heat measures - High heatwave duration, High heatwave severity or extreme high temperatures (UNICEF, 2022).

South India, characterized by its tropical climate and high population density, is highly susceptible to the adverse effects of extreme heat. This literature review explores the existing body of research on the impact of heatwaves on children's health, well-being, and development.

2.Objectives of the Study

The increasing frequency and intensity of heatwaves due to climate change pose significant risks to vulnerable populations, particularly children. South India, with its unique climate, demographic diversity, and varying socio-economic conditions, is notably susceptible to the adverse impacts of extreme heat. Hence, understanding the multifaceted impacts of heat waves on children is crucial for developing effective interventions and policies. This research paper aims to comprehensively investigate the various dimensions of heatwave effects on children's physical health, daily activities and measures for mitigating the impact of heat waves.

3.Research Methodology

The study adopted a mixed-methods research design, integrating quantitative and qualitative approaches to comprehensively examine the impact of heatwaves on children from the prenatal

stage to 18 years of age. The quantitative component involved a structured household survey to generate empirical data on heatwave exposure, health-related concerns, daily activities, care and practices. The qualitative component comprises Focus Group Discussions (FGDs) with community members and in-depth interactions with relevant stakeholders to understand lived experiences, perceptions, level responses to heatwaves.

The study conducted across five South Indian States/Union Territory—Andhra Pradesh, Odisha, Puducherry, Tamil Nadu, and Kerala. One district from each state/UT has been purposively identified based on reported heatwave mortality during 2023 and 2024, namely Prakasam in Andhra Pradesh, Sundargarh in Odisha, Mahe in Puducherry, Kancheepuram in Tamil Nadu, and Palakkad in Kerala. From each selected district, one block identified based on the reported incidence of heatwave-related deaths, followed by the selection of one village panchayat using simple random sampling.

The target population comprises pregnant women and children across different stages of the life cycle, covering pregnancy, infancy (0–2 years), early childhood (3–5 years), and childhood/adolescence (6–18 years), along with their families. A stratified random sampling approach adopted to ensure representation across age groups and relevant socioeconomic and geographic characteristics. Sampling frames for pregnant women and children aged 0–5 years prepared using records from Anganwadi Centres, while information on children aged 6–18 years obtained from schools. A total sample of 1,500 respondents, comprising 300 respondents from each of the five selected study areas were covered. Overall, female children constitute a higher proportion of the sample (60 percent) compared to males (40 percent). In addition, one FGD conducted in each selected district to capture community-level perspectives on heatwave impacts on children, resulting in five FGDs overall.

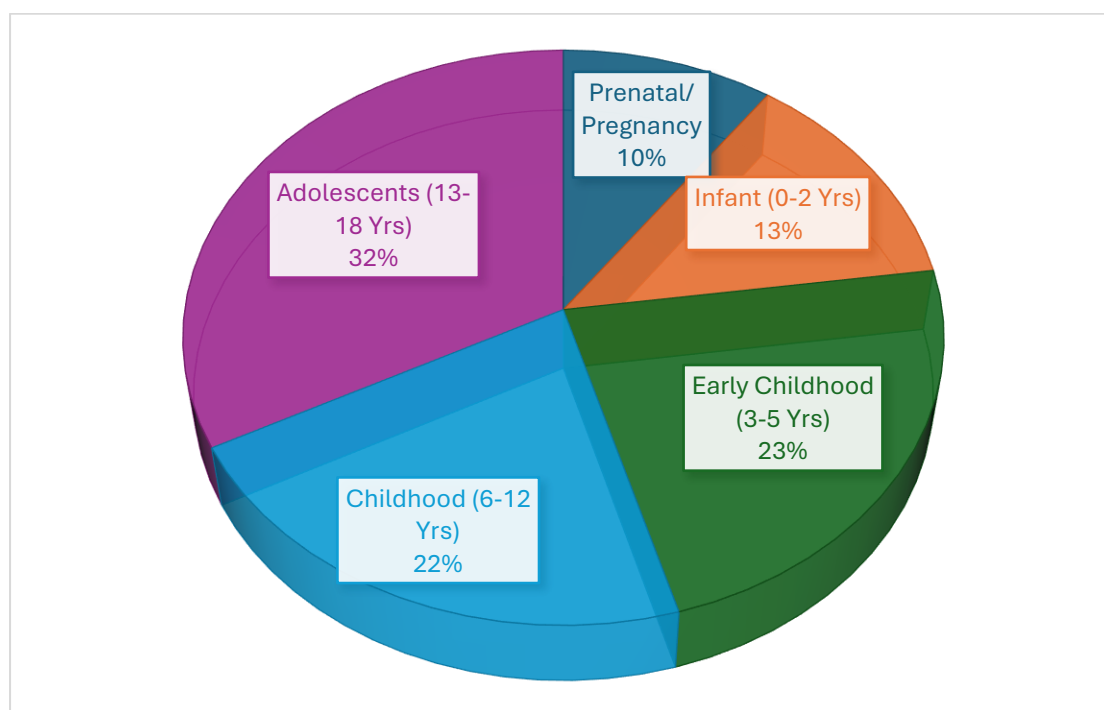
4.Results and Discussion

Age: Life Cycle approach

The chart shows the life cycle-wise distribution of the 1500 children sampled in the study on the impact of heat waves on children in South India. It shows a life cycle wise representation across different age groups. The highest proportion of the sample falls under the Adolescents category (13-18 years), accounting for 33 percent (496 children), followed by Early Childhood (3-5 years) and Childhood (6-12 years) at 23 percent (338 children) and 22 percent (335

children) respectively. Infants (0-2 years) represent 13 percent of the sample, while the Prenatal/Pregnancy group comprises the smallest proportion at 10 percent (144 cases).

Chart -1: Age category wise respondents



Impact of heat wave on life of children

Table reveals children's experiences during heat waves. A majority of respondents (54 percent children) reported moderate discomfort that was manageable, indicating that while heat waves posed challenges, they were not incapacitating for most. This suggests a degree of adaptation or access to minimal coping mechanisms such as shade, water, or intermittent rest. However, 16 percent reported experiencing severe discomfort accompanied by health issues, such as heat rashes, dehydration, headaches, or fatigue, which points to more serious physiological effects. Alarming, 3 percent children faced life-threatening conditions and significant disruptions, which could include instances of heat stroke, fainting, or disruption to essential services like schooling or medical care these are critical red flags that underscore extreme vulnerability in specific contexts.

Furthermore, 27 percent children reported no significant impact, which may reflect better living conditions, access to cooling, or geographic variation in heat intensity. However, this does not diminish the broader concern that one in five children (19 percent) experienced either severe health complications or life-threatening conditions during heat waves. This statistic is particularly concerning given that children are physiologically more vulnerable to heat than adults due to their higher surface area to body mass ratio, lower sweating capacity, and developing thermoregulation systems (Bouchama et al., 2007). Children from low-income households or those living in poorly ventilated or overcrowded environments are especially at risk, as supported by UNICEF (2021), which emphasizes that climate change disproportionately affects the poorest and youngest.

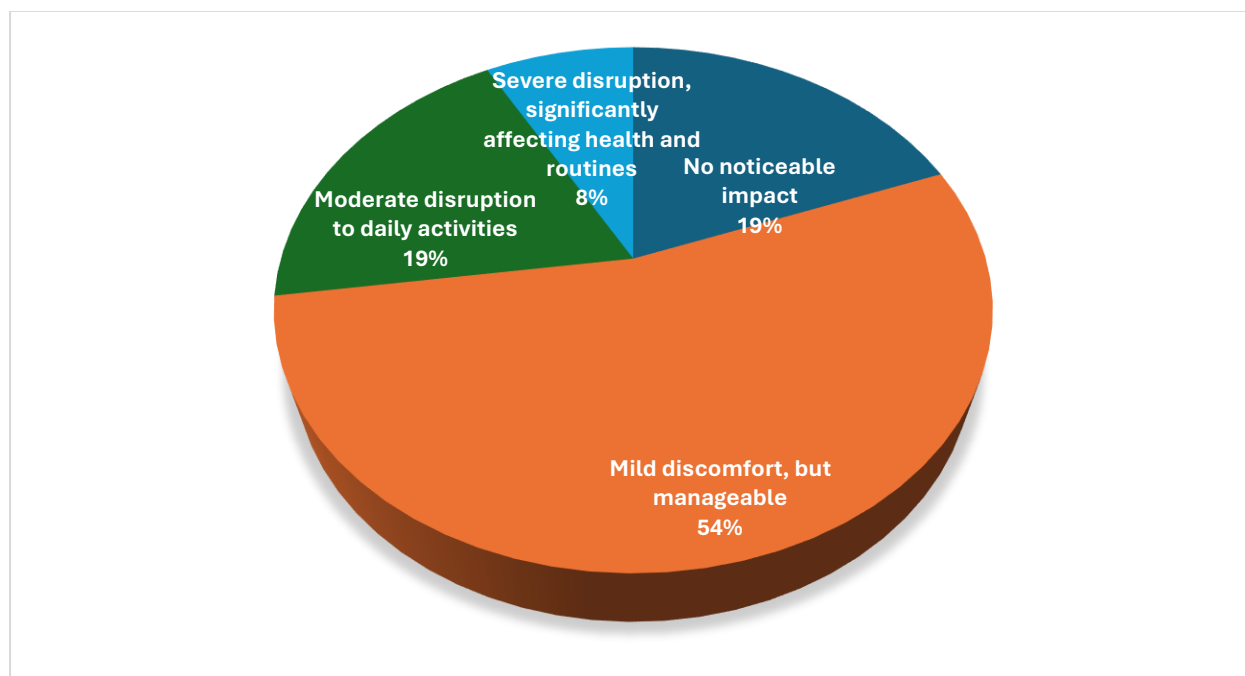
Table-1: Impact of heat waves

Experiencing heat waves	Frequency	percent
No significant impact	410	27
Moderate discomfort but manageable	812	54
Severe discomfort with health issues	237	16
Life-threatening conditions and significant disruptions	41	3
Total	1500	100

Heat Wave impact on daily life

The data on how heat waves affect children's daily lives reveals that while many can manage the effects, a substantial portion faces disruption and health-related challenges. The largest group 53 percent reported experiencing mild discomfort that is manageable, indicating some level of adaptation or coping. However, 19 percent noted moderate disruption to their daily activities, and 8 percent experienced severe disruption, with significant effects on their health and daily routines. Only 19 percent reported no noticeable impact, suggesting that for the majority (81 percent), heat waves negatively influence daily functioning to varying degrees. These disruptions may include reduced concentration in school, limited outdoor play, increased fatigue, or even school absenteeism. According to the World Health Organization (WHO, 2018), heat stress in children can impair cognitive performance, increase the risk of illness, and hinder physical development, especially in hot climates without adequate adaptation infrastructure.

Chart - 2: Impact of heat waves on daily life



Impact on physical Health

Placental Abruptio: Placental abruptio was reported by 1 percent of pregnant women, with Andhra Pradesh accounting for the vast majority (3 percent). This serious complication, in which the placenta detaches prematurely from the uterus, may be exacerbated by heat stress, dehydration, or elevated maternal blood pressure triggered by extreme temperatures. Although rare in the sample, its concentration in one region underscores the need for targeted maternal care during heat waves (Bekkar et al., 2020).

Cardiovascular Events: A total of 2 percent of pregnant women reported cardiovascular events, with Andhra Pradesh (5 percent) again showing the highest burden. Such events during pregnancy can be linked to increased physiological strain from heat exposure, particularly among women with underlying vulnerabilities. These findings highlight the heightened cardiovascular risk pregnant women may face in extreme heat, demanding proactive monitoring and care (Kuehn & McCormick, 2017).

Preterm Birth: Only 0.5 percent (n=7) of pregnant respondents reported preterm births, all of whom were from Andhra Pradesh. Although the incidence is low, prior studies have shown

that heat exposure during pregnancy is associated with a greater risk of premature labor, especially in areas lacking adequate cooling infrastructure or prenatal support (Chersich et al., 2020).

Miscarriage: About 1 percent (n=9) of women experienced miscarriage during heat waves, with most cases again concentrated in Andhra Pradesh. Heat-related physiological stress, dehydration, and oxidative stress may play a role in pregnancy loss, emphasizing the need for public health measures that prioritize maternal health under rising temperatures (Abdou et al., 2021).

Stillbirth: Stillbirths were reported by 1 percent of respondents, with small numbers across Andhra Pradesh, Tamil Nadu, Puducherry, and Kerala. Evidence suggests that maternal heat exposure, especially during the third trimester, may increase the risk of stillbirth through placental dysfunction or fetal stress (Sun et al., 2019). This pattern reinforces concerns around heatwave impacts on fetal outcomes.

Other Conditions: Other pregnancy-related complications were reported by 2 percent of the respondents, most notably in Andhra Pradesh (6 percent). Though unspecified, these could include issues like gestational hypertension or infections, which can be aggravated by heat exposure and weakened immunity. These findings advocate for broader health surveillance and tailored maternal services during heat events (WHO, 2018).

Table 2: Impact on physical Health

Placental Abruptio						
State/UT	Yes		No		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Andhra Pradesh	10	3	290	97	300	100
Odisha	1	0	299	100	300	100
Tamil Nadu	0	0	300	100	300	100
Puducherry	0	0	300	100	300	100
Kerala	0	0	300	100	300	100
Total	11	1	1489	99	1500	100
Cardiovascular Events						

State/UT	Yes		No		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Andhra Pradesh	16	5	284	95	300	100
Odisha	1	0	299	100	300	100
Tamil Nadu	0	0	300	100	300	100
Puducherry	1	0	299	100	300	100
Kerala	7	2	293	98	300	100
Total	25	2	1475	98	1500	100
Preterm Birth						
State/UT	Yes		No		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Andhra Pradesh	7	2	293	98	300	100
Odisha	0	0	300	100	300	100
Tamil Nadu	0	0	300	100	300	100
Puducherry	0	0	300	100	300	100
Kerala	0	0	300	100	300	100
Total	7	0	1493	100	1500	100
Miscarriage						
State/UT	Yes		No		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Andhra Pradesh	8	3	292	97	300	100
Odisha	1	0	299	100	300	100
Tamil Nadu	0	0	300	100	300	100
Puducherry	0	0	300	100	300	100
Kerala	0	0	300	100	300	100
Total	9	1	1491	99	1500	100
Stillbirth						
State/UT	Yes		No		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Andhra Pradesh	7	2	293	98	300	100
Odisha	0	0	300	100	300	100
Tamil Nadu	3	1	297	99	300	100

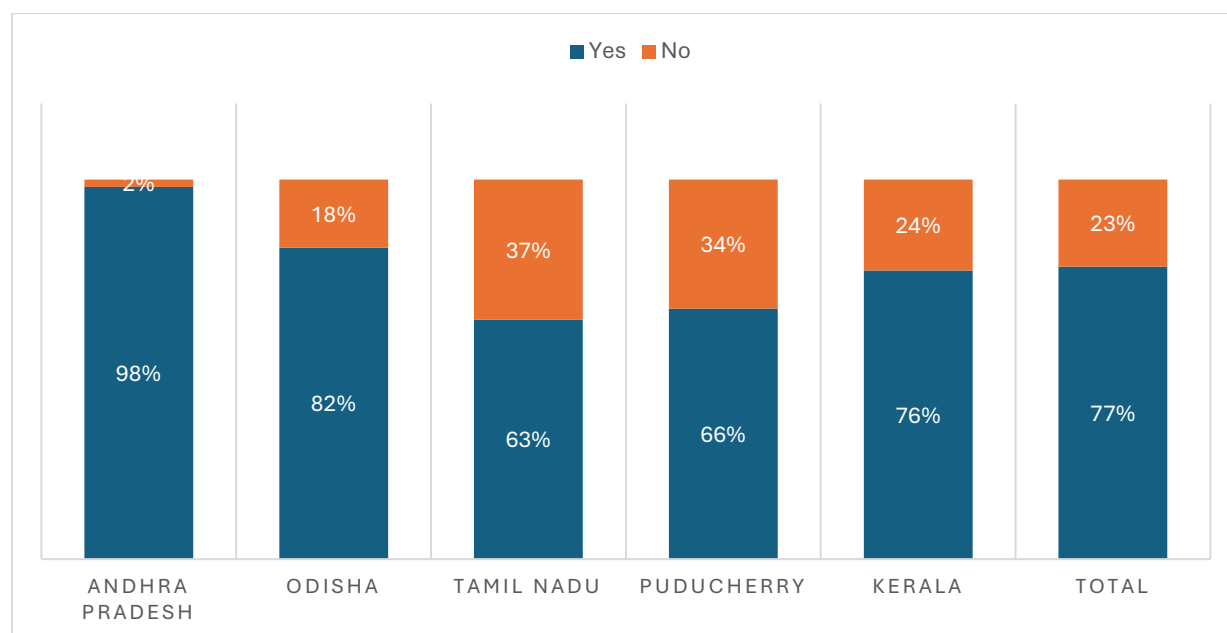
Puducherry	1	0	299	100	300	100
Kerala	3	1	297	99	300	100
Total	14	1	1487	99	1500	100
Other Conditions						
State/UT	Yes		No		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Andhra Pradesh	18	6	282	94	300	100
Odisha	3	1	297	99	300	100
Tamil Nadu	1	0	299	100	300	100
Puducherry	4	1	296	99	300	100
Kerala	4	1	296	99	300	100
Total	30	2	1470	98	1500	100
Not Applicable						
State/UT	Yes		No		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Andhra Pradesh	11	4	287	96	300	100
Odisha	3	1	297	99	300	100
Tamil Nadu	18	6	282	94	300	100
Puducherry	10	3	290	97	300	100
Kerala	25	8	275	92	300	100
Total	67	4	1431	96	1500	100

Heat illness

The data reveals a concerning prevalence of heat-related illnesses among children in South India, with 77 percent of the 1,500 respondents reporting such experiences. Andhra Pradesh shows the highest incidence, with 98 percent of children affected, suggesting extreme vulnerability or possibly limited adaptive infrastructure in the region. In contrast, Tamil Nadu and Puducherry report relatively lower rates at 63 percent and 66 percent respectively, which might reflect better public awareness or more effective heat mitigation strategies. Kerala (76 percent) and Odisha (82 percent) also exhibit substantial exposure. These disparities underscore the need for region-specific public health interventions and climate resilience

programs, especially in highly affected states like Andhra Pradesh and Odisha (Choudhary et al., 2021).

Chart 3: Heat Illness



Types of illness

Heat Stroke: Heat stroke, the most severe form of heat illness, affected 13 percent of respondents, with Andhra Pradesh (35 percent) and Odisha(23 percent) reporting the highest incidence. This condition, marked by core body temperatures above 40°C and neurological dysfunction, can be fatal without immediate medical intervention. Its high prevalence in Andhra Pradesh signals an urgent need for public awareness and emergency preparedness during extreme heat events (Bouchama & Knochel, 2002).

Heat Exhaustion: Reported by 15 percent of respondents, heat exhaustion was notably high in Tamil Nadu (32 percent) and Andhra Pradesh (25 percent), indicating considerable physiological stress due to heat exposure. Symptoms such as heavy sweating, dizziness, and weakness suggest that individuals in these regions may be particularly vulnerable due to humidity, workload, or inadequate hydration (CDC, 2022). This highlights the necessity of workplace and community cooling strategies.

Dehydration: Dehydration affected 16 percent of the population, with Andhra Pradesh (37 percent) and Tamil Nadu (25 percent) again showing elevated rates. Dehydration during heat waves compromises thermoregulation and increases the risk of other heat illnesses. These findings underscore the importance of promoting hydration and access to drinking water, especially in rural and labor-intensive settings (Sawka et al., 2011).

Heat Cramps: Heat cramps were experienced by 15 percent of participants, with a striking 40 percent in Andhra Pradesh. These painful muscle spasms, often due to electrolyte loss, are an early warning of heat stress. Their prevalence suggests a need for health education regarding salt balance and fluid intake during physical activity in hot environments (Armstrong et al., 2007).

Heat Rash: Heat rash, affecting 12 percent, was more evenly distributed, though Andhra Pradesh (17 percent) reported the highest rates. Typically caused by blocked sweat ducts, this condition is common in hot and humid climates and can lead to secondary infections if not managed. Preventive strategies like wearing breathable fabrics and staying in shaded areas can mitigate its occurrence (Sharma et al., 2014).

Sunburn: Sunburn was reported by 9 percent overall, with Andhra Pradesh (18 percent) and Odisha (14 percent) showing higher vulnerability. Prolonged UV exposure without protection is a major contributor, and frequent sunburns increase the risk of skin cancer. Public education campaigns promoting sunscreen use and sun-protective clothing are essential, particularly in agricultural communities (Diffey, 2004).

Other Heat-Related Illnesses: Other unspecified heat illnesses affected 5 percent of respondents, with Puducherry (10 percent) standing out. These could include heat syncope, heat edema, or exacerbation of chronic illnesses. Their presence signals the broad and sometimes underrecognized health impacts of heat waves, requiring robust surveillance and healthcare training (Kovats & Hajat, 2008).

Table 3: Types of heat illness experienced by children

State/UT	Heat Stroke		Total
	Yes	No	

	Frequency	Percent	Frequency	Percent	Frequency	Percent
Andhra Pradesh	105	35	195	65	300	100
Odisha	68	23	232	77	300	100
Tamil Nadu	13	4	287	96	300	100
Puducherry	5	2	295	98	300	100
Kerala	10	3	290	97	300	100
Total	201	13	1299	87	1500	100
Heat Exhaustion						
State/UT	Yes		No		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Andhra Pradesh	76	25	224	75	300	100
Odisha	9	3	291	97	300	100
Tamil Nadu	97	32	203	68	300	100
Puducherry	14	5	286	95	300	100
Kerala	21	7	279	93	300	100
Total	217	15	1283	85	1500	100
Dehydration						
State/UT	Yes		No		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Andhra Pradesh	111	37	189	63	300	100
Odisha	37	12	263	88	300	100
Tamil Nadu	75	25	225	75	300	100
Puducherry	9	3	291	97	300	100
Kerala	14	5	286	95	300	100
Total	246	16	1254	84	1500	100
Heat Cramps						
State/UT	Yes		No		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Andhra Pradesh	120	40	180	60	300	100
Odisha	27	9	273	91	300	100
Tamil Nadu	30	10	270	90	300	100

Puducherry	19	6	281	94	300	100
Kerala	24	8	276	92	300	100
Total	220	15	1280	85	1500	100

Heat Rash

State/UT	Yes		No		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Andhra Pradesh	50	17	250	83	300	100
Odisha	36	12	264	88	300	100
Tamil Nadu	31	10	269	90	300	100
Puducherry	29	10	271	90	300	100
Kerala	37	12	263	88	300	100
Total	183	12	1317	88	1500	100

Sunburn

State/UT	Yes		No		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Andhra Pradesh	55	18	245	82	300	100
Odisha	41	14	259	86	300	100
Tamil Nadu	9	3	291	97	300	100
Puducherry	8	3	292	97	300	100
Kerala	25	8	275	92	300	100
Total	138	9	1362	91	1500	100

7. Other Heat-Related Illnesses

State/UT	Yes		No		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Andhra Pradesh	14	5	286	95	300	100
Odisha	9	3	291	97	300	100
Tamil Nadu	5	2	295	98	300	100
Puducherry	31	10	269	90	300	100
Kerala	16	5	284	95	300	100
Total	75	5	1425	95	1500	100

Health Issues

The data reveals that a significant majority of children across South India experienced some level of health issues due to heat waves, with only 16 percent reporting no health problems. Mild to moderate issues are most common, affecting 34 percent and 31 percent of respondents respectively, highlighting widespread but generally manageable health effects. Andhra Pradesh and Odisha exhibit the highest rates of mild and moderate cases, with a combined 73 percent and 77 percent respectively, suggesting consistent exposure to heat-related discomforts. Tamil Nadu shows a concerning 29 percent reporting severe health issues, the highest among all states, possibly indicating more intense or prolonged heat exposure in urbanized or densely populated regions. Interestingly, Puducherry stands out with 30 percent of children reporting no health issues—the highest among the surveyed regions—suggesting possible protective environmental or socio-economic factors. Overall, the data underscores the urgent need for adaptive health strategies and protective measures tailored to local contexts to mitigate the escalating health impacts of heat waves on children (Sharma & Joshi, 2021).

Table 4: Health Issues experienced by children

State/UT	Mild Issues		Moderate Issues		Severe Issues		No Health Issues		Total	
	Fre	Per	Fre	Per	Fre	Per	Fre	Per	Fre	Per
Andhra Pradesh	125	42	94	31	56	19	25	8	300	100
Odisha	124	41	107	36	38	13	31	10	300	100
Tamil Nadu	68	23	118	39	87	29	27	9	300	100
Puducherry	116	39	59	20	34	11	91	30	300	100
Kerala	72	24	90	30	71	24	67	22	300	100
Total	505	34	468	31	286	19	241	16	1500	100

Types of health issues faced by children

Dehydration: The data shows that dehydration is a widespread health issue among children during heat waves across South India, with 59 percent of respondents reporting such cases. Tamil Nadu stands out with the highest proportion (75 percent), followed closely by Kerala (66 percent) and Puducherry (54 percent), indicating a potentially greater vulnerability due to higher ambient temperatures, humidity, or limited access to hydration facilities during extreme

heat. Andhra Pradesh and Odisha show a relatively balanced distribution, with 47 percent and 50 percent of children affected respectively. These figures suggest that heat-related dehydration is not confined to one region but is a pervasive concern, especially in states with dense populations and urban heat island effects.

Fatigue or Lethargy: Fatigue or lethargy was reported by 32 percent of respondents, indicating a widespread though often under-acknowledged impact of heat waves on children's energy levels and overall functioning. Andhra Pradesh and Tamil Nadu both reported nearly half of children experiencing fatigue (49 percent), in stark contrast to Kerala (13 percent) and Odisha (17 percent), suggesting regional variations in environmental conditions and coping capacities. Fatigue in children can affect learning outcomes, physical development, and mental well-being, making it a key indicator of the broader developmental effects of climate stress (Gupta & Mehta, 2021).

Heat Rash or Skin Irritation: Nearly one-third (29 percent) of children across the surveyed regions reported heat rash or skin irritation, with Andhra Pradesh again leading at 37 percent. This condition, while not life-threatening, can cause considerable discomfort, disrupt daily activities, and signal broader thermal distress. Tamil Nadu, Puducherry, and Kerala reported lower incidences (25 percent, 23 percent, and 26 percent, respectively), possibly due to differences in humidity, hygiene practices, or protective clothing. As a visible and often immediate response to heat, skin irritation serves as an important early warning sign for heat related stress in children (Narayanan et al., 2019).

Breathing Difficulties: Breathing difficulties were reported by 10 percent of the children overall, with Andhra Pradesh (25 percent) showing the highest rate, possibly linked to elevated air pollution levels or high humidity that compounds the effects of heat. Other states reported much lower incidences, including Puducherry (3 percent) and Kerala (5 percent). While less common, respiratory distress during heat waves can be particularly dangerous for children with underlying conditions like asthma, emphasizing the need for clean air and shaded environments as part of climate adaptation strategies (Reddy et al., 2021).

No Health Issues: Interestingly, only 14 percent of the total sample reported experiencing no health issues during heat waves, highlighting the widespread physical toll of rising temperatures on children. Puducherry and Kerala reported the highest rates of unaffected

children (23 percent and 17 percent, respectively), suggesting potentially better mitigation strategies, such as shaded school environments, availability of fluids, or parental awareness. However, the low proportion overall underlines the urgent need for targeted health interventions, public education, and infrastructure improvements to protect children from the adverse effects of extreme heat (Thomas et al., 2020).

Table 5: Types of Health Issues faced by Children

Dehydration						
State/UT	Yes		No		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Andhra Pradesh	142	47	158	53	300	100
Odisha	151	50	149	50	300	100
Tamil Nadu	225	75	75	25	300	100
Puducherry	162	54	138	46	300	100
Kerala	199	66	101	34	300	100
Total	879	59	621	41	1500	100
Fatigue or Lethargy						
State/UT	Yes		No		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Andhra Pradesh	148	49	152	51	300	100
Odisha	50	17	250	83	300	100
Tamil Nadu	147	49	153	51	300	100
Puducherry	93	31	207	69	300	100
Kerala	39	13	261	87	300	100
Total	477	32	1023	68	1500	100
Heat Rash or Skin Irritation						
State/UT	Yes		No		Total	

	Frequency	Percent	Frequency	Percent	Frequency	Percent
Andhra Pradesh	111	37	189	63	300	100
Odisha	93	31	207	69	300	100
Tamil Nadu	75	25	225	75	300	100
Puducherry	70	23	230	77	300	100
Kerala	79	26	221	74	300	100
Total	428	29	1072	71	1500	100
Breathing Difficulties						
State/UT	Yes		No		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Andhra Pradesh	75	25	225	75	300	100
Odisha	26	9	274	91	300	100
Tamil Nadu	22	7	278	93	300	100
Puducherry	9	3	291	97	300	100
Kerala	15	5	285	95	300	100
Total	147	10	1353	90	1500	100
No Health Issues						
State/UT	Yes		No		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Andhra Pradesh	24	8	276	92	300	100
Odisha	30	10	270	90	300	100
Tamil Nadu	27	9	273	91	300	100
Puducherry	70	23	230	77	300	100
Kerala	52	17	248	83	300	100
Total	203	14	1297	86	1500	100

Mitigating the health effects of heat waves on children

Ensure Proper Hydration: Only 44 percent of respondents across South India reported ensuring proper hydration for their children during heat waves, with Puducherry (53 percent) and Odisha (47 percent) leading. The relatively low adoption rate of this fundamental preventive measure is concerning, especially in Tamil Nadu, where just 28 percent follow it

despite a high incidence of dehydration. Proper hydration is essential in preventing heat-related illnesses, particularly among children, who are more vulnerable due to their higher surface-area-to-body-mass ratio and reduced thermoregulation efficiency. This suggests a critical need for awareness programs and school-level interventions to encourage consistent fluid intake during high-temperature periods (Srinivasan et al., 2022).

Keep Children Indoors During Peak Heat: Only 22 percent of respondents kept children indoors during peak heat hours, despite it being a highly effective mitigation strategy. Tamil Nadu had the highest adherence (35 percent), while Puducherry (6 percent) and Kerala (13 percent) reported very low rates. These findings suggest a lack of awareness or practical constraints such as inadequate indoor space or the necessity of outdoor labor.

Use Cooling Methods: Only 14 percent of respondents reported using cooling methods such as fans, wet cloths, or air conditioning. Usage was slightly higher in Puducherry (18 percent) and Andhra Pradesh (15 percent), while Tamil Nadu reported the lowest (6 percent). The limited adoption is likely due to economic barriers or power shortages, especially in rural areas. This highlights disparities in adaptive capacity and suggests a need for community cooling centers and the promotion of low-cost strategies like ventilation and hydration (Patelet al., 2020).

Dress Children in Light, Breathable Clothing: A mere 3 percent of respondents across regions reported dressing children in appropriate clothing during heat waves. This is alarming, given the simplicity and cost-effectiveness of this measure. Andhra Pradesh had the highest rate at just 5 percent, while Tamil Nadu reported only 1 percent. Lightweight, breathable clothing helps reduce body heat retention, lowering the risk of heat rashes and overheating. This points to a significant gap in public awareness about practical, non-costly adaptations (Kumar et al., 2019).

Seek Medical Advice or Assistance: Only 1 percent of participants reported seeking medical advice for heat-related health issues in children, with Kerala reporting no cases at all. This could indicate underestimation of heat-related symptoms or accessibility barriers to healthcare. Prompt medical consultation can prevent complications from common heat ailments like dehydration, heatstroke, and respiratory distress. These findings reflect the urgent need to

improve healthcare outreach and awareness regarding the seriousness of heat wave impacts (Deshmukh et al., 2021).

No Specific Measures Taken: Worryingly, 6 percent of respondents admitted to taking no specific measures to protect their children during heat waves, with Puducherry showing the highest proportion (12 percent). This inaction highlights critical gaps in awareness, resource availability, or behavioral adaptation. Children in such households are at higher risk of experiencing preventable health issues. Comprehensive community-based programs are essential to educate and empower families about affordable, actionable steps to safeguard child health amid rising temperatures (Jha et al., 2022).

Table 6: Mitigating the health effects of heat waves on children

Ensure Proper Hydration						
State/UT	Yes		No		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Andhra Pradesh	137	46	163	54	300	100
Odisha	142	47	158	53	300	100
Tamil Nadu	83	28	217	72	300	100
Puducherry	160	53	140	47	300	100
Kerala	133	44	167	56	300	100
Total	655	44	845	56	1500	100
Keep Children Indoors in Peak Heat						
State/UT	Yes		No		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Andhra Pradesh	81	27	219	73	300	100
Odisha	83	28	217	72	300	100
Tamil Nadu	104	35	196	65	300	100
Puducherry	19	6	281	94	300	100
Kerala	38	13	262	87	300	100

Total	325	22	1175	78	1500	100
Use Cooling Methods						
State/UT	Yes		No		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Andhra Pradesh	45	15	255	85	300	100
Odisha	41	14	259	86	300	100
Tamil Nadu	19	6	281	94	300	100
Puducherry	54	18	246	82	300	100
Kerala	44	15	256	85	300	100
Total	203	14	1297	86	1500	100
Dress Children in Light, Breathable Clothing						
State/UT	Yes		No		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Andhra Pradesh	16	5	284	95	300	100
Odisha	11	4	289	96	300	100
Tamil Nadu	3	1	297	99	300	100
Puducherry	5	2	295	98	300	100
Kerala	13	4	287	96	300	100
Total	48	3	1452	97	1500	100
Seek Medical Advice or Assistance						
State/UT	Yes		No		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Andhra Pradesh	4	1	296	99	300	100
Odisha	2	1	298	99	300	100
Tamil Nadu	3	1	297	99	300	100
Puducherry	4	1	296	99	300	100
Kerala	0	0	300	100	300	100
Total	13	1	1487	99	1500	100
No Specific Measures Taken						
State/UT	Yes		No		Total	

	Frequency	Percent	Frequency	Percent	Frequency	Percent
Andhra Pradesh	13	4	287	96	300	100
Odisha	10	3	290	97	300	100
Tamil Nadu	7	2	293	98	300	100
Puducherry	35	12	265	88	300	100
Kerala	18	6	282	94	300	100
Total	83	6	1417	94	1500	100

5.Recommendations for Heat Wave Preparedness and Mitigation

- The study recommends urgent investment in pediatric care infrastructure, particularly in rural and peri-urban areas. Temporary summer clinics equipped to manage heat-related conditions like dehydration, heat stroke, and respiratory distress should be established.
- Community-level Heat Action Plans (HAPs) must be developed with a child-centered approach. These should include early warning systems, pre-identified cooling centers such as temples, community halls, and schools, and a protocol for school closures during extreme heat.
- To counteract the nutritional challenges posed by heatwaves, government-run feeding programs must be expanded and fortified. Mid-day meals should include hydrating foods and be available during school breaks. Community kitchens and mobile food vans can supplement food supply in remote areas.
- Public housing schemes should mandate climate-resilient designs, including improved ventilation, reflective roofing, and insulation. In rural areas, beneficiaries of schemes like the Pradhan Mantri Awas Yojana should receive support to upgrade from kachha to pakka housing.
- The establishment of dedicated child resilience units within State Disaster Management Authorities can ensure that children's needs are not sidelined in climate adaptation plans.

Conclusion

The paper presents a compelling case for immediate, multi-sectoral action to address the escalating threat of heat waves on children in South India. Protecting children from the harsh impacts of rising temperatures is not just an environmental issue. it is a developmental imperative and a moral responsibility. The time for passive observation has passed. It is now crucial to act boldly, inclusively, and urgently to safeguard the well-being of future generations in an increasingly warming world.

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