Impact of Extreme Climate Events on Early Childhood Development in Pakistan

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List of Acronyms

Acronym	Full Form
°C	Degrees Celsius
BMI	Body Mass Index
ComIndex	Composite Development Index
EA	Enumeration Area
ECD	Early Childhood Development
GB	Gilgit-Baltistan
IPCC	Intergovernmental Panel on Climate Change
Lernin_INDEX	Learning Approaches Index
MICS	Multiple Indicator Cluster Survey
MICS4	MICS Round 4
MICS6	MICS Round 6
NUM_LI_INDEX	Numeracy & Literacy Index
Phy_INDEX	Physical Development Index
PSU	Primary Sampling Unit
SDGs	Sustainable Development Goals
Soci_emo_INDEX	Social and Emotional Development Index
SPSS	Statistical Package for the Social Sciences
Stata	Statistical Software
UNICEF	United Nations International Children's Emergency Fund
Z-scores	Standardized Scores

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1. Introduction

Climate change has emerged as one of the most pressing global challenges of the 21st century, profoundly affecting ecosystems, economies, and human health. Among the most vulnerable to the adverse effects of extreme climatic events (such as floods, droughts, heatwaves, storms and displacements) are young children, whose early development can be significantly compromised by environmental stressors (United Nations International Children's Emergency Fund, 2017). Pakistan is highly susceptible to climate variability and natural disasters where the frequency and intensity of such extreme events have increased in recent decades (Germanwatch, 2021), posing serious risks to the health and development of its youngest population.

Early childhood is a critical period characterized by rapid physical, cognitive, and socio-emotional growth. Exposure to adverse environmental conditions during this formative stage can have lasting impacts on a child's development trajectory, influencing health outcomes, educational attainment, and social well-being (ibid). Despite the growing recognition of climate change as a determinant of public health, limited research has specifically examined how extreme climatic events affect early childhood development (ECD) in Pakistan (Davenport et al. 2020).

This study analyzes the impact of extreme climatic events on ECD indicators across Pakistani provinces. Utilizing data from the Multiple Indicator Cluster Surveys (MICS) such as Pakistan Bureau of Statistics & UNICEF, this study assesses how exposure to climate stressors correlates with developmental outcomes among children under five years of age. By understanding these relationships, it seeks to inform policy interventions that can mitigate the negative effects of climate change on vulnerable child population and promote resilient and healthy development.

Pakistan falls among those countries that are most vulnerable to climatic impact. Despite contributing less than 1% to global greenhouse gas (GHG) emissions, the country has repeatedly borne the brunt of devastating weather events, including crippling heatwaves and catastrophic floods, in recent years (Germanwatch, 2021; World Bank, 2022).

In 2022, Pakistan endured its deadliest floods, which submerged nearly one-third of the country, affecting more than 33 million people and destroying over 22,000 schools, housing units, and critical infrastructure (United Nations International Children's Emergency Fund 2022). These floods did not only disrupt access to education and healthcare but also severely compromised food safety, sanitation, and child nutrition, creating a fertile ground for developmental setbacks among children (Save the Children, 2023). In 2025, the same episode was repeated severely affecting multiple sectors, including vulnerable groups especially women and children.

Heatwaves too have surged with alarming frequency and intensity, posing another serious threat to child health and development. The 2024 heatwave, particularly in Sindh, spiked temperatures to 49°C, claimed over 568 lives, and triggered heat-related illnesses for thousands. Concurrently, UNICEF and International Rescue Committee (2024) have reported massive disruptions to schooling, increased food insecurity affecting approximately 8.6 million people, and the exacerbation of vulnerabilities like child labour and early marriage.

Emerging research highlights a worrying link between climatic extremes and child growth. A sustained rise in temperature and erratic rainfall patterns are found to significantly reduce early growth indicators such as length-for-age Z-scores, aggravating stunting and wasting-especially among children under two years of age (Davenport et al. 2020). In this study, the indicators like the impact of rainfall and temperature have also been studied.

The consequences of these climate-driven disasters extend beyond physical health. Floods and heatwaves have disrupted education for millions of children. Save the Children (2023) estimated that in the Punjab alone, about 26 million students missed classes due to extreme heat and displacements because access to learning and essential services was severely limited in camps.

These extreme events do not impact all populations equally. Children from poorer households, already marginalized by poverty, are disproportionately affected and forced into early labour or marriage as families seek coping mechanisms in crisis (Save the Children, 2023).

1.1. Rationale and Objectives

Given the escalating frequency of extreme climatic events and their potential to derail critical early developmental stages, understanding their implications for young children in Pakistan becomes imperative. Early childhood (0–5 years) is a period of rapid physical, cognitive, and socio-emotional development, thus adverse conditions during this window can have long-term consequences on health, education, and well-being (United Nations International Children's Emergency Fund, 2017).

This study seeks to systematically investigate how exposure to extreme climatic events, particularly floods and heatwaves, correlates with early childhood development (ECD) outcomes across Pakistan. Leveraging the Multiple Indicator Cluster Surveys (MICS) data (Pakistan Bureau of Statistics & United Nations International Children's Emergency Fund, 2019), the study aims to:

- quantify the association between climate shocks and ECD indicators (such as growth, cognitive milestones, and school readiness);
- explore regional and socio-economic disparities in the impact of these climate events; and
- provide evidence-based insights to inform climate-resilient child health and development policies.

Through this approach, the study contributes to bridge the critical knowledge gaps in climate and child development literature in Pakistan, offering data-driven guidance for building resilience and safeguarding the developmental future of its youngest citizens.

1.1.1. Extreme Climatic Events and ECD

Early Childhood Development (ECD) is a foundational process that encompasses the physical, cognitive, social, and emotional growth of children from their birth to the age of five. This period is recognized as a critical window of opportunity during which the brain undergoes rapid development, laying the groundwork for lifelong learning, behaviour, and health (UNICEF, 2017). Disruptions during this sensitive stage (whether biological, environmental, or social) can have irreversible consequences on a child's potential. Increasingly, climate change and its associated extreme events are being identified as serious disruptors of

healthy child development (Nguyen, Doan & Tran 2021; Intergovernmental Panel on Climate Change [IPCC] 2023).

1.1.2. Understanding Extreme Climatic Events

Extreme climatic events refer to severe, unusual, or unseasonal weather patterns intensified by global warming. These include:

Heatwaves: Extended periods of excessively hot weather, often accompanied by high humidity.

Floods: Caused by intense rainfall, glacial melt, or river overflows, leading to submergence of large areas.

Droughts: Prolonged periods of low rainfall, leading to water scarcity and agricultural failure.

Storms and Cyclones: High-intensity winds and rains, which can damage infrastructure and displace populations.

In Pakistan, these events have grown more frequent and intense over the past two decades. According to the Global Climate Risk Index (Germanwatch, 2021), Pakistan was among the top 10 countries most affected by climate-related disasters between 2000 and 2019. The 2022 floods, for example, directly affected 33 million people, including over 16 million children, in addition to destroying more than two million homes and thousands of schools and health facilities (UNICEF Pakistan, 2022).

1.1.3. Pathways Linking Climatic Events to ECD

Extreme climatic events can affect early childhood development through multiple interconnected pathways.

1. Health and Nutrition

Heatwaves increase the risk of dehydration, heatstroke, respiratory infections, and water-borne diseases, especially in infants and toddlers with underdeveloped immune systems (Davenport et al. 2020).

Flooding and water contamination raise the incidence of diarrhea diseases and malnutrition, which can lead to stunting and wasting - key indicators of developmental delays (UNICEF Pakistan, 2022).

Food insecurity caused by droughts and crop failure can lead to reduced dietary diversity, micro-nutrient deficiencies, and low birth weights (World Bank, 2022).

Research from South Asia, including Pakistan, shows strong links between high temperature exposure during pregnancy and early infancy and poor anthropometric outcomes such as low length-for-age and weight-for-age scores (Davenport et al. 2020).

2. Psychosocial and Emotional Stress

Natural disasters displace families and disrupt support systems. Children living in temporary shelters or disaster-affected areas often face heightened levels of toxic stress, which can impair brain development (Nguyen et al. 2021).

Maternal stress during and after extreme events is also linked to preterm birth and postpartum depression, which influence childhood development negatively (ibid).

3. Loss of Learning Opportunities

Floods and heatwaves frequently result in school closures and reduced access to early childhood education services. In rural and low-income communities, prolonged exposure to climate stressors may push children into child labour or early marriage, cutting short their developmental and educational opportunities (Save the Children, 2023).

In 2024, Pakistan experienced severe heatwaves that led to the closure of over 26,000 schools in the Punjab and Sindh, directly impacting millions of children's learning continuity.

4. Displacement and Insecurity

Climate-induced displacement results in unstable living conditions, where children face overcrowding, poor sanitation, and increased risk of abuse or neglect (UNICEF Pakistan, 2022; Save the Children, 2023).

These environments are not conducive to healthy stimulation, caregiver bonding, or early learning, all of which are essential for ECD (UNICEF, 2017).

1.2. Vulnerability of Children in Pakistan

Children in Pakistan are especially vulnerable due to a combination of socio-economic fragility, poor infrastructure, and limited access to health and education services. The situation is worse in marginalized areas such as southern Punjab, interior Sindh, Balochistan, and parts of Khyber Pakhtunkhwa, where poverty and exposure to climate risks often overlap (Pakistan Bureau of Statistics & UNICEF, 2019).

According to MICS 2018–19 data, significant proportions of children under five in these areas already exhibit developmental delays, with stunting rates exceeding 40% in some districts. When overlaid with data on climate exposure, a clear intersection emerges between environmental stress and poor child outcomes (Davenport et al., 2020; Save the Children, 2023).

This study analyzes the impact of extreme climatic events on ECD. Section 2 provides a comprehensive review of literature. Sections 3 and 4 comprise the conceptual framework and methodology respectively. In section 5, results and discussions are presented. The study concludes with last section covering the policy recommendations based on empirical findings.

2. Review of Literature

The table below shows the systematic review of recent literature that mainly focuses the impact of climate change on ECD.

Table 2.1. Systematic Review of Literature

Country	Objectives/ Problems	Methodology & Data	Key Findings	Criticism	Research Gaps
Pakistan	Assess the condition of children in Pakistan across health, education, protection, and climate vulnerabilities. /Children face multiple deprivations worsened by floods, heatwaves, and air pollution, impacting survival and development.	Secondary data analysis from govt, UNICEF, WHO, and NCRC reports; quantitative indicators.	45.7M students enrolled (2022–23), gender parity (54% boys, 46% girls). - 2022 floods: 33M people affected, 27,000 schools destroyed, 2M children's education disrupted, stunting spiked to 44%. - Heatwaves in 2024 (4–6°C above baseline) closed schools, affecting 52% of students. - Air pollution: 98% of children exposed to hazardous PM2.5; ~68,100 under-5 deaths in 2021 linked to it. - Smog-related closures affected 16M children. - Severe nutrition crisis (44% stunting, 15% wasting).	Relies on secondary data; lacks primary/community-level evidence. Heavy descriptive reporting without strong causal inferences. Does not propose concrete policy pathways or economic modelling.	- Localized, micro-level data on children's exposure to floods, heat, and air pollution missing. - Cost-effectiveness of adaptation strategies not assessed. - Weak integration of economic modelling with child rights frameworks.

Global	Develop composite index measuring exposure/vulnerability of children to climate/environmental hazards./Over 1B children globally at extreme climate risk; limited country-level evidence linking risk to outcomes.	Composite index combining hazard exposure, vulnerability, and outcomes; subnational datasets.	- 1B children globally at “extremely high risk.” - 850M exposed to 4+ climate hazards. - Pakistan among top 15 “extremely high risk” countries. - Hazards include floods, heat, drought, cyclones, pollution. - Children contribute least to climate change but face the greatest burden. - Subnational disparities highlight fragile contexts at higher risk.	Aggregates global data, may mask intra-country disparities. Lacks longitudinal causality evidence. Relies on secondary datasets with gaps in LMICs.	- Pakistan-specific, localized disaggregation missing. - Lack of longitudinal studies linking climate exposure with specific health/education outcomes. - No integration of child-centred adaptation models or economic analysis.

Global (focus on LMICs)	Review progress and gaps in preterm birth reduction; propose strategies./Preterm birth remains leading cause of under-5 mortality, but climate/environmental links underexplored.	Systematic review of epidemiological data, global databases, case studies.	- ~13.4M babies born preterm annually (1 in 10). - Preterm = leading cause of under-5 mortality (~900,000 deaths in 2019). - Climate risks (heat, air pollution) exacerbate preterm risks but under-integrated in programmes. - South Asia & Sub-Saharan Africa carry >60% burden. - Socioeconomic disparities: poorest quintiles face double the risk. - Calls for antenatal care, integrated maternal strategies.	Weak quantification of economic impact of preterm births under climate stress. Limited cost/adaptation modelling. Strong advocacy but weaker on trade-off analysis.	- Need for country-level evidence linking climate change and preterm risk. - Lack of adaptation/resilience strategies within maternal & newborn health systems. - No costing/economic evaluation of interventions in high-risk countries like Pakistan.

Pakistan	Examine how family socioeconomic factors shape ECD outcomes./Large gaps persist in Pakistan's child development indicators, with poverty, malnutrition, and limited access to education/healthcare driving inequalities.	Cross-sectional analysis of UNICEF MICS6 survey (2018); ~110,000 children aged 3–5; logistic regressions controlling for parental education, household wealth, region, gender, stunting, disability, household practices.	- Mother's education strongly improves ECD (children of educated mothers far more likely to be "on-track"). - Father's education also positive, but less than mothers. - Wealth quintiles: richest households have much higher probabilities of ECD attainment. - Regional disparities: Punjab > Sindh > KP > Balochistan. - Stunting and disability strongly negative (stunted children had ~0.7 odds of being on-track vs non-stunted peers). - Violence-free, nurturing households boost development. - Gender gap small but boys slightly outperform girls.	Observational design → associations only, not causal. No IVs to correct for endogeneity (e.g. parental ability bias). Wealth index may not reflect shocks or local price levels. Excludes direct climate/environmental mediators.	- No integration of climate-linked shocks (food insecurity, floods, heat stress) that may shape nutrition and ECD. - No dynamic or longitudinal analysis (only cross-section). - Lacks cost-effectiveness or economic evaluation of policy interventions (e.g. maternal education vs nutrition vs poverty relief).

Global	Provide a framework linking climate change risks with early child development. /Climate change threatens children through acute shocks (heatwaves, floods) and chronic stresses (pollution, degradation) but rarely integrated in ECD research.	Conceptual review; bioecological & dynamic systems theories; no empirical dataset.	- Climate exposures occur in two-time frames: acute shocks (storms, floods, heatwaves) and chronic degradation (resource scarcity, pollution). - Risks affect both prenatal and early childhood development, undermining brain and physical growth. - Disruptions include reduced caregiver attention (e.g. migration), malnutrition (crop failure), and reduced stimulation (unsafe environments). - Framework highlights multi-level ecological impacts – from households to systems. - Calls for integration of climate change into ECD research & policy.	Entirely conceptual – no empirical tests, no effect sizes, no regional comparisons. Lacks economic costing or trade-offs analysis. Does not distinguish by socioeconomic status or institutional resilience.	- Absence of quantitative evidence on climate-ECD linkages (e.g. how a 1°C increase affects outcomes). - No analysis of cost-effectiveness of adaptation policies. - Ignores supply-side economics (health/education systems capacity). - Lack of heterogeneity: doesn't differentiate impacts by poverty, geography, or service access.

Pakistan	Evaluate whether integrating ECD counselling into routine maternal-child health services improves child outcomes./Pakistan faces high ECD delays; little evidence on effectiveness of public health–based interventions.	Cluster RCT: 22 rural health facilities randomized (11 intervention, 11 control); ~804 mother-child pairs (12–24 months old); intervention = quarterly ECD counselling sessions by Lady Health Visitors; outcomes measured at 24 months via ASQ-3.	- Major reduction in developmental delays: 13% (intervention) vs 41% (control). OR ≈ 0.21 (95% CI 0.11–0.42). - Intervention children also had improved anthropometric outcomes. - Demonstrates high effectiveness of low-cost, facility-based counselling integrated into maternal services.	Strong RCT evidence but limited external validity (only 2 districts). No cost-effectiveness data reported (cost per child, sustainability). Only short-term outcomes (to 24 months), not long-term schooling or earnings. Possible workload strain on LHVs not discussed.	- Lack of cost-benefit/economic evaluation of intervention. - No analysis of scalability or sustainability at national level. - Climate resilience not tested (intervention under normal conditions – what if clinics disrupted by floods/heat?). - No follow-up on long-term human capital outcomes.

India & Pakistan	Test whether monthly home visits by community workers (SPRING model) improve child growth and ECD./Nearly 250M children in LMICs risk not reaching developmental potential (Lancet ECD framework). Home visiting is seen as a scalable solution, but evidence is mixed.	Parallel cluster RCTs: 20 clusters Pakistan, 24 clusters India; 2,459 infants (1,443 India; 1,016 Pakistan). Intervention = monthly home visits up to 18 months. Outcomes: Bayley III cognitive/motor scores, height-for-age z-scores.	- Null impacts: No effect on growth or Bayley-III developmental scores at 18 months. - Positive dietary effect: Proportion of children meeting WHO "minimum acceptable diet" ↑ by 35% in India (95% CI 4–75%) and 45% in Pakistan (95% CI 15–83%). - Implementation burden: Lady Health Workers (Pakistan) were overstretched; NGO-driven model (India) more consistent. - Feeding behaviour improved but did not translate into anthropometric or cognitive gains in short run.	Strong RCT, large sample, real-world delivery. But outcomes only measured to 18 months → may miss lagged effects. No cost-effectiveness data. Possible measurement error in Bayley-III. Intervention intensity may have been too low.	- No economic evaluation (cost per child, cost per DALY saved). - No long-term follow-up (schooling, earnings). - Climate shocks (seasonal hunger, food price fluctuations, floods) not factored in. - No heterogeneity by socioeconomic subgroup or baseline nutrition status.

Pakistan	Explore how classrooms can be made more child centered./Pakistan's ECE often teacher-dominated, rote-based, with limited materials; holistic child development neglected.	Qualitative case study: classroom observations, teacher interviews, focus groups with parents/admins. Sample size not specified.	- Most classrooms teacher-led, cramped, lacking play/learning materials. - Where child-friendly approaches existed, they depended on individual teacher initiative/school support (e.g. library corners, games). - Emphasizes need for play-based learning, supportive infrastructure, teacher training.	Evidence anecdotal, not generalizable. No quantitative metrics or child outcome data. No cost analysis. Dated (2011).	- No estimates of resource gaps (e.g. % schools lacking play materials). - No ROI or cost-benefit analysis of interventions. - Ignores external shocks (climate, sanitation, poverty) affecting classroom environments.
Pakistan	Review ECE reforms, challenges, and innovations in Pakistan./ECE faces low access, shortage of trained teachers; NGOs and ICT initiatives emerging but fragile without policy support.	Systematic literature review (studies, reports, policy docs).	- Key challenges: limited access, lack of trained staff, weak policy continuity. - Innovations: ICT in classrooms, community-based preschools. - Success depends on sustained govt investment + multi-sector partnerships.	Review is descriptive, not quantitative. Risk of publication bias (innovations > failures). No demand-side perspective (parents' willingness to enroll).	- No fiscal costing of reforms or ROI estimates. - No analysis of enrollment elasticity (how parents respond to costs/fees). - Limited equity focus (urban vs rural, poor vs rich). - No integration of health/climate shocks in ECE reform needs.

Pakistan	Diagnose developmental vulnerability among young children using EDI./High inequality in Pakistan's child outcomes; limited large-scale diagnostic data.	Survey of 9,372 children (5–7 yrs) in 397 schools, Karachi; Urdu Early Development Instrument (EDI). Logistic regressions controlling for SES, gender, ethnicity.	- 28% vulnerable in ≥1 developmental domain. - ~10% vulnerable in each domain (physical, social-emotional, cognitive). - Boys, low-income children, and ethnic minorities significantly more vulnerable. - Poverty strongly correlated: lowest wealth quintile children had highest odds of vulnerability.	Large sample, standardized tool. But only urban Karachi (not nationally representative). Cross-sectional → no causality. Reverse causation possible (child disability → lower household income).	- No rural/remote coverage (where climate shocks stronger). - No environmental variables (heat, floods, sanitation). - No costing of interventions for vulnerable groups. - No estimates of lifetime earnings/productivity loss from early vulnerabilities.
Pakistan	Examine pedagogical practices in Pakistan's ECE system./Pakistan's ECE is framed in a didactic, teacher-centered approach emphasizing rote learning, with neglect of social, emotional, and physical domains of child growth.	Qualitative: interviews with educators, policymakers; policy review; classroom observation.	- ECE framed as rote and obedience-driven, children treated as passive learners. - Holistic dimensions (socio-emotional, cultural, physical) largely ignored. - Contrasted with international child-centered pedagogy where children drive learning. - Narrative evidence, no metrics.	Lacks quantitative measures (enrollment, outcomes, costs). No link to labour market/productivity outcomes. No discussion of systemic constraints (teacher training bottlenecks, budget limits).	- No costing of shifting to child-centered curriculum. - No estimates of GDP/earnings gains from improved pedagogy. - Lacks analysis of supply constraints (teacher skills, infrastructure). - Climate/environmental shocks excluded (school disruptions, disaster recovery).

Pakistan	Measure quality of home stimulation for 0–3 yrs children./Poor stimulation at home contributes to early developmental delays, but little quantified evidence from Pakistan.	Cross-sectional survey (Dec 2009–May 2010). N=1,097 mother–child pairs; IT-HOME inventory (6 subscales).	- Mean HOME score: 31.7 (SD 7.2) in Tando Jam, 29.7 (SD 6.9) in Mastung (out of ~45). - 50% (Tando Jam) & 75% (Mastung) in lowest quartile on "Learning Materials". - 41% (Mastung) & 18% (Tando Jam) in lowest quartile for "Organization". - 23% overall at risk of delay (multiple low subscales).	Rigorous household tool but limited to 2 rural sites; descriptive only. No causal links to child outcomes. No cost analysis of interventions. No socioeconomic breakdown.	- No linkage between HOME scores and later school/earnings outcomes. - No analysis of poverty, education, or shocks as determinants. - No costing of parenting/learning material interventions. - Climate stressors (drought, floods) not integrated despite location vulnerability.
Pakistan	Compare policy progress in nutrition vs. ECD governance./Nutrition has advanced via multisectoral coalitions; ECD remains siloed, mainly education-focused.	Policy document review + expert interviews.	- Nutrition leveraged policy windows, broad coalitions (health, agriculture, women's ministries), co-financing, central platforms. - ECD vague, confined to education, lacking cross-sector support. - Lessons: seize windows, define actions, co-finance, create coordination structures.	Rich governance insight but qualitative only; no economic modelling of costs/returns. Does not quantify outcomes (e.g., stunting ↓ from governance shifts).	- No analysis of financial needs for ECD governance platforms. - No cost-benefit comparison of nutrition vs ECD investments. - Ignores climate shocks as drivers of nutrition/ECD needs. - Treats nutrition and ECD in silos instead of integrated frameworks.

Global	Map evidence on climate impacts, mitigation, adaptation for children (0–18)./Climate change threatens health, education, nutrition, resilience of children; evidence base unclear.	Evidence & gap map of 1,127 studies across multiple domains.	- 84% (948/1127) focus on health; only 15% (171) on education, 14% (160) on food/nutrition. - Understudied: child agency, displacement, socioeconomic stress, resilience. - Mitigation/adaptation studies: mostly education/behaviour change (45%/31%); very few on finance, infrastructure, or policy.	Identifies gaps but no new causal evidence; excludes grey literature; no cost analysis.	- Lack of economic evaluation of adaptation/mitigation interventions. - No regional or SES disaggregation. - Gaps in linking climate shocks to long-term human capital. - Few studies on finance/policy design for child-focused adaptation.
Global	Assess global threats to children's wellbeing and propose new "movement for children."/Climate, pollution, conflict, migration, inequality as existential threats to children.	Expert synthesis; draws on published studies, UNICEF indices, global trends.	- Climate: unchecked warming could hit +4.8°C by 2100. - Children disproportionately vulnerable to floods, food/water insecurity, displacement. - ROI: investing in child health/education can yield up to 20x returns ($1→$20 societal benefit). - Children largely excluded from policy, need greater voice.	Visionary but broad; lacks granular economic modelling. ROI figure cited but not demonstrated in report. No details on financing pathways for LMICs.	- No cost-effectiveness comparison of adaptation strategies. - No modelling of climate-human capital channels. - No analysis of trade-offs for low-income countries (e.g. fiscal space vs child welfare).

Global	Explore synergies between ECD and climate policies./ECD and climate often handled separately though both impact child future.	Policy commentary; draws on reports (Lancet Commission, urban planning, pollution).	- Urban planning (parks, walkability) benefits both ECD & climate goals.	Conceptual, lacks data or quantified impacts. Mostly high-income urban focus; little on LMIC contexts.	No measurement of ECD–climate synergies. No costing of integrated interventions (e.g. green schools, clean energy). No feasibility or trade-off analysis for governments with scarce budgets Limited evidence from LMICs where climate risk is highest.No feasibility or trade-off analysis for governments with scarce budgets
Global	Provide advocacy tools to integrate ECD into climate policy agendas./Climate change undermines child rights and development, yet ECD often overlooked in climate plans/NDCs.	Advocacy toolkit; compiles UNICEF, WHO, IPCC evidence; bullet points, case examples; no original data.	- States 750M children exposed to water scarcity, 1 in 5 child deaths due to air pollution. - Frames ECD as essential to climate policy: health, nutrition, education, social protection sectors must integrate climate resilience. - Provides messages and “entry points” for advocates, e.g. integrating children into NDCs.	Lacks methodological rigor; not peer-reviewed; prescriptive but not analytical. No costing, no prioritization of interventions, no local tailoring.	- No ROI analysis of integrating ECD into climate plans. - No country-specific pathways. - Does not evaluate cost-effectiveness of adaptation strategies. - Leaves unanswered: which interventions governments should prioritize first under fiscal constraints.

Global	Review scientific evidence on impacts of extreme heat on young children; suggest mitigation./2023 hottest year on record; heatwaves rising in duration/frequency; infants and toddlers especially vulnerable.	Narrative synthesis of WHO, IPCC, epidemiology, case studies; expert consensus; no new data.	- Heat stress harms fetal development (preterm birth, low birth weight), infant dehydration, cognitive/mental health, sleep, learning. - Secondary impacts: worsened air quality, food insecurity. - Inequities: poor households lack cooling; children disproportionately exposed. - Policy: community cooling centers, heat alerts, green infrastructure.	Non-peer-reviewed working paper; descriptive, lacks quantitative projections or economic analysis. No modelling of disease burden or cost-benefit of adaptations.	- No empirical causal studies linking heat exposure to child learning/earnings outcomes. - No quantification of future burden (DALYs, costs) under warming scenarios. - No cost-effectiveness analysis of cooling interventions. - Long-term human capital impacts unmeasured.
Asia-Pacific	Frame ECD as a climate resilience strategy for the region./Asia-Pacific = ~60% of world's young children; 65% exposed to ≥4 climate/environment shocks vs 37% globally.	Advocacy brief; UNICEF Climate Risk Index + regional stats; no new data.	- 1B children globally at "extremely high climate risk". - In Asia-Pacific, multiple overlapping shocks (storms, floods, pollution). - Argues ECD investment supports SDGs and climate resilience. - Recommends 4 strategies: knowledge, partnerships, awareness, services.	Strong narrative but no empirical testing. Lacks intervention evaluation, costs, or country-specific breakdowns.	- No quantification of how shocks affect ECD outcomes (stunting, cognition, school readiness). - No economic losses estimated from inaction. - No cost-benefit analysis of proposed strategies. - Regional-only; no cross-region comparison.

Global	Review known impacts of climate on child health; highlight research needs. /Climate drives multiple risks: air pollution, disasters, malnutrition, disease.	Literature review (PubMed, Scopus, 2012 cut-off).	- Lists multiple risk pathways (heat, malnutrition, pollution, disasters). - Children more vulnerable to all compared to adults. - Calls explicitly for research on cost-effectiveness of adaptation/mitigation.	Now dated (2012); broad overview but not deep. Lacks quantitative projections or updated threats (e.g. Zika, new pandemics, latest heat science).	- No estimation of burden by SES/region. - No cost-effectiveness modelling (despite calling for it). - No quantification of health/education losses from climate. - Gaps in gender/age-specific vulnerability.
Philippines	Test links between rainfall/temp and child stunting/underweight. /Climate change + undernutrition = key dual challenge in farming communities.	Household survey on child nutrition + 36 yrs local climate data; regression analysis.	- Rainfall/temperature not directly assoc. with stunting. - Location mattered: Infanta children more stunted/underweight than Los Baños. - Interpretation: higher rainfall → more infectious disease → worse nutrition.	Very limited generalizability; only 2 sites; confounding of climate with socioeconomic/local factors. Cross-sectional only.	- Cannot isolate climate effect from other local conditions. - No longitudinal tracking of climate shifts and nutrition trends. - No costing of health/sanitation interventions. - No analysis of long-term cognitive/human capital losses.
USA	Examine how preschool teachers integrate sustainability + moral reasoning. /Climate/sustainability are moral issues, but unclear	Qualitative: interviews/surveys with 19 US nature-based preschool educators.	- Teachers include nature/sustainability activities (recycling, nature walks). - Rarely prompt children to reason morally (justice, fairness, equity). - Teachers assume children too	Very small sample, US-only, teacher self-reports. No measurement of actual child outcomes.	- No evidence on child learning/behaviour outcomes. - No intervention testing (e.g. teacher training). - No economic/long-term modelling of sustainability education

	if taught as such in early years.		young for abstract moral reasoning.		benefits. - Limited cross-country insight.
Bangladesh	Explore climate's role in shaping child development/well-being. /Climate hazards (floods, storms, heat) undermine child rights & opportunities.	Likely literature synthesis + qualitative/secondary data (full text unavailable).	- Likely highlights climate's adverse impacts on health, safety, education. - May link climate change to SDGs and child rights framework. - No publicly available quantified results.	Unknown rigor; thesis not peer-reviewed; findings inaccessible. Likely descriptive, no formal data analysis.	- Lack of accessibility itself a gap. - Unclear if empirical evidence was gathered. - Probably lacks economic modelling, ROI, or causal estimates. - Narrow geographic scope (Bangladesh).

2.1. Gaps in existing literature

Researchers across the globe agree that climate hazards threaten young children, but there are knowledge gaps in quantifying these effects and the return of interventions. Much of the literature is descriptive. Studies typically use climatic events (storms, heatwaves, drought, etc.) without measuring impacts on child nutrition, growth or development. A recent review finds that research often focuses on rainfall while overlooking heat extremes, socio-economic mediators, and timing of exposure. In short, global analyses warn of climate-related harms to children but lack the quantitative data. In South Asia, particularly in Pakistan, all the gaps are even huge. The region has high number of under nutrition children and is exposed to severe floods, heatwaves and storms, yet region-specific studies are scarce. The current study is an effort to fill these gaps.

3. Conceptual Framework

This conceptual framework illustrates how extreme climatic events impact the development of young children. These events affect health, nutrition, emotional well-being, learning opportunities, and security that ultimately lead to adverse early childhood development (ECD) outcomes (Nguyen et al. 2021).

Figure 1 presents the conceptual framework guiding this study. Extreme climatic events, including floods and heatwaves, affect households through multiple ways such as income disruption, reduced food security, and compromised housing or health conditions. These household-level impacts, in turn, influence early childhood development outcomes across cognitive, physical, and socio-emotional dimensions. The framework also accounts for moderating factors such as household socio-economic status, parental education, and resilience strategies, which can buffer or exacerbate the effects of climate shocks. Behavioural outcomes and psychosocial stressors are included to reflect indirect and mental health-related consequences. This framework provides a theoretically grounded pathway linking climate stressors to child development outcomes, addressing potential confounding and enhancing causal plausibility.

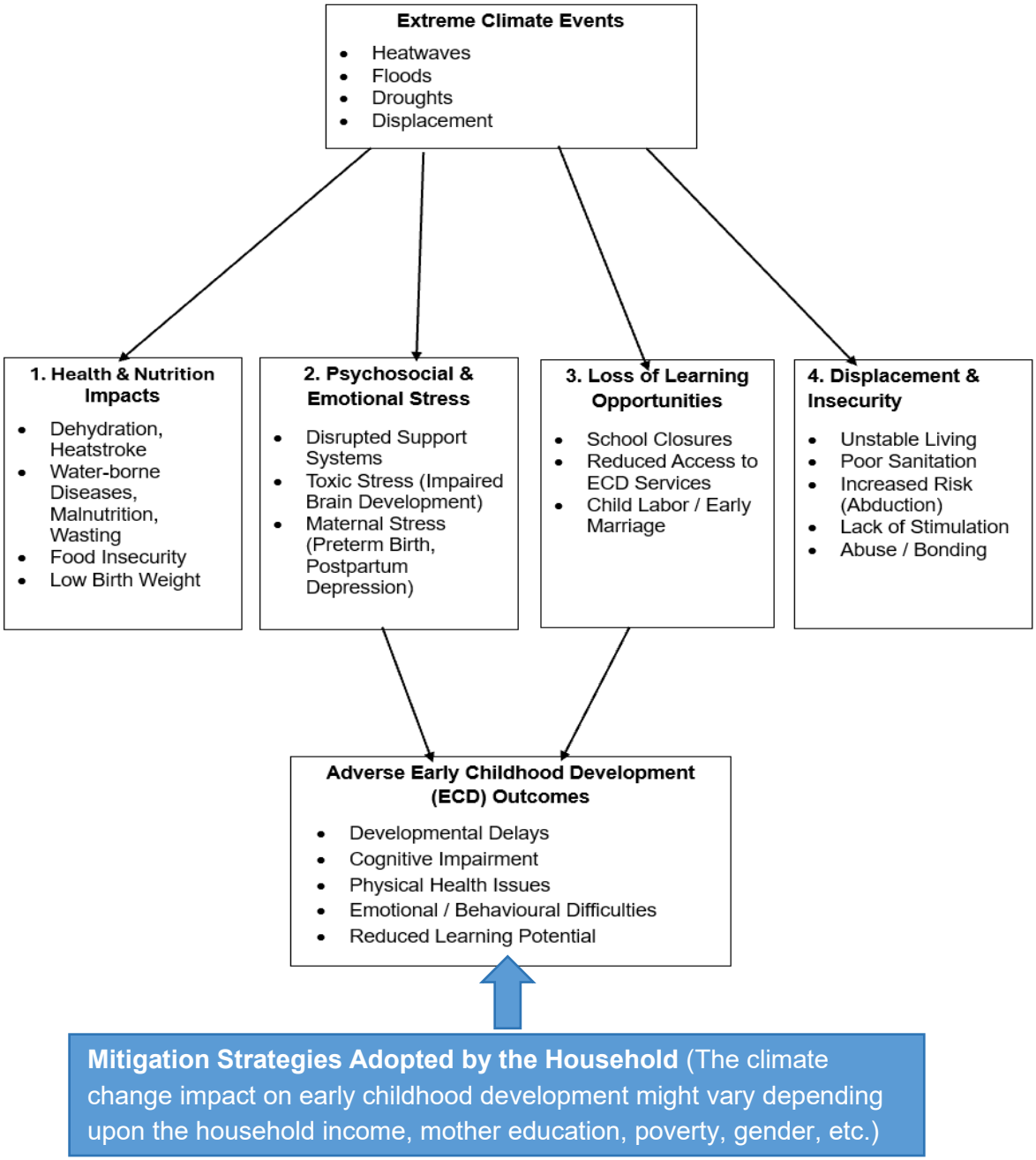


Figure 1: Conceptual Framework

4. Methodology

4.1. Research Design

This study employs a quantitative research method to examine the impact of extreme climatic events on early childhood development (ECD) in Pakistan. It is based on secondary data derived from the Multiple Indicator Cluster Surveys (MICS), a globally standardized, nationally representative household survey administered in collaboration with the Pakistan Bureau of Statistics and UNICEF. MICS provides comprehensive data on key indicators related to children's health, education, nutrition, and overall development, making it well-suited for assessing the influence of environmental stressors on ECD outcomes. For early childhood development, children of the age group between 36-59 months (3-5 years) were considered as target population because this age is crucial for ECD.

4.2. Data Source

For the current study, MICS data was used, covering all the provinces (Punjab, Sindh, Khyber Pakhtunkhwa, Balochistan) as well as Gilgit-Baltistan. These datasets include detailed modules on child development, health, nutrition, household demographics, and environmental conditions. MICS surveys typically target children under five years of age and women aged 15–49, with sample sizes ranging from 50,000 to 80,000 households, thereby providing robust provincial and national estimates. Key features of the MICS data that is relevant to this study include ECD indicators such as cognitive, language, socio-emotional development, physical development, and learning approaches. Data quality was ensured through rigorous training of enumerators, standardized instruments, and quality control protocols.

4.3. Study Population

The population of interest includes children under five years of age residing in both urban and rural settings across Pakistan’s provinces and territories. Standardized MICS modules were used to assess various dimensions of early childhood development, including Literacy-numeracy skills, Physical development, Socio-emotional development, Approaches to learning. This stratification allows for dis aggregation of results by province, region, and socioeconomic status.

To evaluate the relationship between extreme climatic events and ECD, the MICS data set was cross-referenced with province-level climate data, including the frequency and intensity of rainfalls and temperatures. These events were temporally and geographically matched with the survey periods and locations to ensure alignment between environmental exposure and developmental outcomes.

4.4. Data Analysis

Data were analyzed using softwares such as Stata and SPSS. Descriptive analysis mainly focused y on correlation and regression analysis to document the impact of extreme climatic events on ECD. The study calculates the ECD index by using this methodology.

To quantify early developmental outcomes, an early childhood development (ECD) Index was constructed using data from the ECD module of the MICS data set. This module assesses developmental status across multiple domains for children aged between 36–59 months. The

construction of ECD index followed standardized procedures as recommended by MICS guidelines of UNICEF, with adaptations for the study's analytical objectives.

4.5. Domains of ECD

Domain	Indicator
Literacy–Numeracy	Can identify at least 10 letters of the alphabet Can read at least four simple words Knows at least 10 numbers
Physical Development	Can pick up small objects with two fingers Is not reported to be too sick to play
Socio–Emotional Development	Gets along well with other children Does not kick, bite, or hit other children Is not easily distracted
Learning Approaches	Follows simple directions Is able to complete tasks independently

4.6. Index Construction Methodology

Each domain was evaluated based on binary indicators (1 = meets developmental benchmark; 0 = does not). A child was considered "developmentally on track" in a given domain if they met the criteria for that domain as defined by MICS. The overall ECD Index is calculated as a composite score, summing the number of domains in which a child is on track (ranging from 0 to 4). In some analyses, a binary ECD indicator was also used: 1 (on track) if the child is developmentally on track in at least three out of four domains. 0 (not on track) otherwise. This binary classification aligns with UNICEF's standard threshold for international comparisons and facilitates regression and stratified analyses.

Observations with missing values in any of the four domains were excluded from the index calculation. Weights provided in the MICS data set were applied to ensure national and provincial representatives. Consistency checks and validation were performed to align with MICS methodology documentation.

The constructed ECD index served as the primary outcome variable in the statistical analyses assessing the impact of extreme climatic events. Both the composite score (0–4) and the binary classification (on track/not on track) were used in different regression models, depending on the analysis type.

For empirical analysis, robust econometric analysis was carried out by employing the correlation and regression approaches. In regression, both OLS and probit estimates were carried out. Owing to data limitations, however, the causality analysis mainly focused on propensity score matching, instrumental variable approach and difference in different methods.

4.7. Ethical Considerations

This study is based on publicly available anonymized secondary data from the MICS surveys. Ethical approval for data collection was obtained by UNICEF as well as the authorities concerned prior to data release. No additional ethical clearance was required for this secondary analysis, as it does not involve any direct interaction with human subjects.

5. Results and Discussion

5.1. Early Childhood Development [Gilgit-Baltistan]

5.1.1. Age of child

Table 5.1.1. Age of child

Age of Child	Frequency	Per cent
3 Years	1315	48.8
4 Years	1378	51.2
Total	2693	100

The dataset is almost evenly split between 3 years old (48.8 %) and 4 years old (51.2%). This equal split will be useful in comparing development indicators with age group.

5.1.2. Descriptive Analysis

Overall Descriptive Analysis of Early Childhood Development Indicators in GB

Table 5.1.2. Overall Descriptive Analysis

Indicator	**% Achieved**	**% Not Achieved**	**ECD Domain**	**Interpretation**
Identifies at least 10 letters of the alphabet	20.3	79.7	Emergent Literacy	Most children struggle with early letter recognition; literacy development is low.
Reads at least 4 simple popular words	23.1	76.9	Emergent Literacy	Reading readiness is limited; few children recognize basic words.
Recognizes numbers 1–10	19.8	80.2	Early Numeracy	Very few children have number symbol recognition skills; numeracy is underdeveloped.
Picks up small object with two fingers	96.1	3.9	Fine Motor Skills	Nearly all children demonstrate age-appropriate fine motor coordination.
Sometimes too sick to play	55.6 (Yes)	44.4 (No)	Health & Wellbeing	Over half of the children are often unwell, affecting participation in activities.
Follows simple directions	84.4	15.6	Cognitive/ Social Skills	Most children understand and respond to basic instructions.

Able to do something independently	83.4	16.6	Self-help/Autonomy	Strong independence levels: majority can act without assistance.
Gets along well with other children	87.9	12.1	Social-Emotional	Majority of children have positive peer relationships.
Kicks, bites, or hits others	46.9 (Yes)	53.1 (No)	Social-Emotional	Nearly half show aggressive behaviour; emotional regulation may need support.
Gets distracted easily	67.6 (Yes)	32.4 (No)	Attention/Executive Function	Attention spans are short; many children are easily distracted.

The table shows that while many children demonstrate strong motor, social, and self-help skills, there are critical challenges in early literacy, numeracy, attention, and behaviour. These findings suggest the need for a): early interventions in language and math readiness, b): health programmes to reduce illness, c): social-emotional learning support, and e): activities that strengthen focus and self-regulation.

5.1.3. Early Childhood Development Indexes in GB

Table 5.1.3. Early Childhood Development Indexes in Gilgit-Baltistan

Index	**% Achieved**	**% Not Achieved**	**ECD Domain**	**Interpretation**
NUM_LI_INDEX	19.1	80.9	Numeracy & Literacy	Very low proportion of children meet basic early literacy and numeracy milestones.
Phy_INDEX	53.6	46.4	Physical Development	About half of the children show age-appropriate physical development.
Lernin_INDEX	75.3	24.7	Approaches to Learning	Majority of children are developmentally on track in learning behaviour and readiness.
Soci_emo_INDEX	79.2	20.8	Social & Emotional Skills	High proportion show healthy emotional and social behaviour.

ComIndex	42.3	57.7	Composite ECD Development	Less than half of the children meet the overall developmental benchmark.

Numeracy & Literacy (NUM_LI_INDEX): Only 19.1% of children meet expected early literacy and numeracy milestones, which indicates a critical gap in foundational academic skills.

Physical Development (Phy_INDEX): 53.6% of children are physically on track, which suggests moderate development, with nearly half potentially needing support.

Approaches to Learning (Lernin_INDEX): 75.3% demonstrate positive learning behaviour (e.g., focus, independence), which indicates readiness for structured learning environments.

Social & Emotional Development (Soci_emo_INDEX): 79.2% show healthy social andemotional skills (e.g. getting along with others), which is a strong domain for most children.

Composite Development Index (ComIndex): Only 42.3% of children meet overall ECD expectations across all domains.

Majority of children (57.7%) are not on track in terms of their overall development.

Most children are socially and emotionally ready for group settings and show good learning behaviours. However, literacy, numeracy, and physical development remain weak areas. Less than half meet the composite developmental benchmark, that signals the need for early interventions, particularly in cognitive and academic readiness domains.

5.1.4. ECD Analysis

Table 5.1.4. ECD Analysis (Gender, Mother's education, and BMI)

Sex					
	Not On Track (0)	**On Track (1)**	**Total**	**% On Track**	**% Not On Track**
Male	835	573	1,408	40.70	59.30
Female	719	566	1,285	44.00	56.00
Total	**1,554**	**1,139**	**2,693**	**42.30**	**57.70**
Mother's Education Level					
None / Pre-school	1,039	647	1,686	**38.40**	61.60
Primary	149	118	267	**44.20**	55.80
Middle	112	85	197	**43.10**	56.90
Secondary	137	136	273	**49.80**	50.20
Higher	116	153	269	**56.90**	43.10

Missing / Don't Know	1	0	1	-	-
Total	**1,554**	**1,139**	**2,693**	**42.30**	57.70
BMI and ECD					
Mean BMI (WHO)	18.17	18.01			

Overall, only 42.3% of children are developmentally "on track" based on the Composite Index. By gender, females perform slightly better, i.e. 44.0% are on track. Males are slightly behind, i.e. 40.7% on track. The difference is modest (approx. 3.3 percentage points), but consistent with research showing that, on average, girls tend to develop certain early cognitive and social-emotional skills earlier than boys.

Both genders show low developmental readiness overall, with more than half not meeting composite developmental milestones. Programmes should address both boys and girls, with possible extra support for boys, especially in areas like attention, behaviour, and language where gaps are commonly observed. Gender-responsive early childhood interventions can help fill these developmental gaps before school entry.

There is a clear-cut positive relationship between a mother's level of education and the likelihood that her child is on track in terms of development. Mothers with higher education (secondary and above) are significantly more likely to meet ECD milestones: About 56.9% of children with mothers who have higher education are on track - the highest among all groups. In contrast, only 38.4% of children with mothers having no formal education are on track. This trend reflects the strong impact of maternal education on child development, that is likely through better knowledge of health, nutrition, and early stimulation.

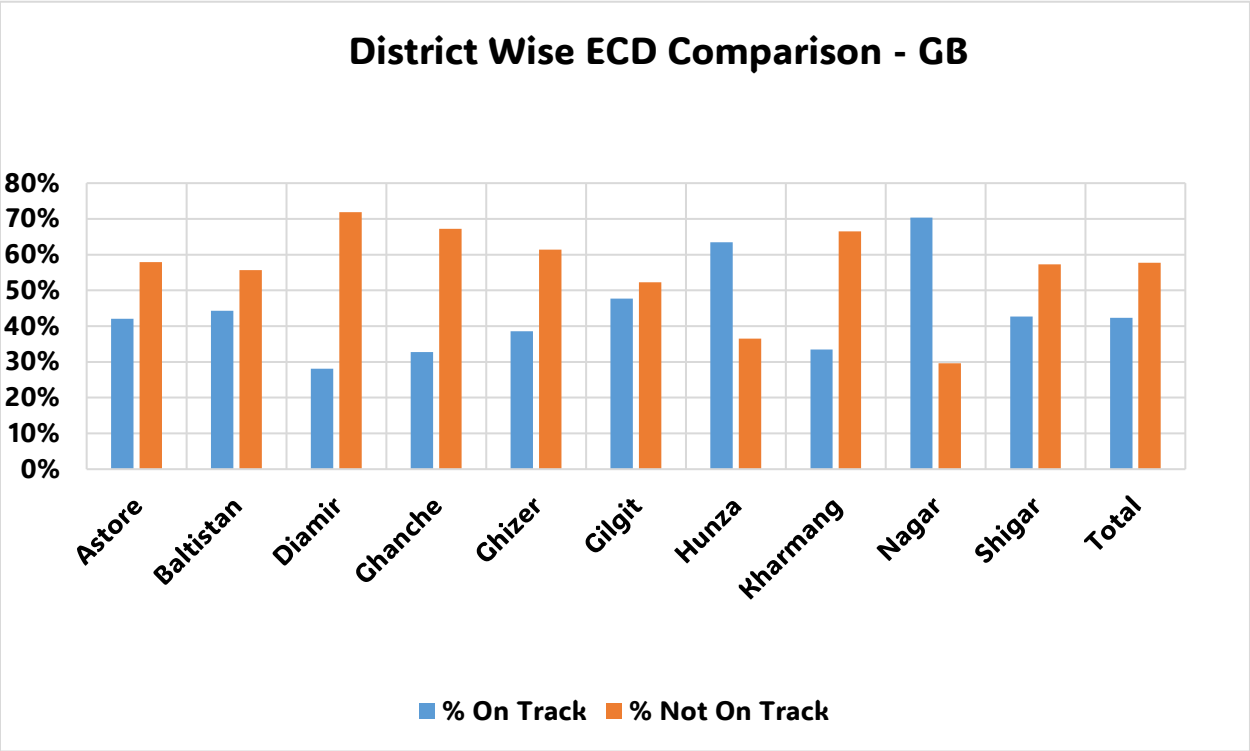
Higher household literacy environment & Increased access to resources and services:

Interventions that support early learning at home should specifically target families where mothers have lower levels of education. Parental education programmes, home-based early learning, and maternal literacy initiatives can help bridge the developmental gap.

Children not developmentally on track have a slightly higher average BMI (18.17) compared to those on track (18.01).

The difference is very small (0.16 points) and is not statistically significant. Both groups fall within the typical healthy range for BMI in early childhood. So, BMI alone may not be a strong predictor of overall developmental status in this data set. Slightly Higher BMI in "Not On Track" Group: May suggest links between poor development and: Over nutrition (less physical activity, screen time), Underlying health or socio-environmental factors, but again, the difference is marginal and should be interpreted cautiously.

5.1.5. District Wise Early Childhood Development Comparison



Top Performing Districts (Highest % On Track) are as under:

Nagar is the best-performing district where 70.4% of children are developmentally on track. – Hunza falls among significantly above average districts where 63.5% children are on track. –Gilgit is near the top and close to parity where 47.7% are on track. –.

Districts Below Average are as follows:

Diamir district has lowest ECD outcomes where only 28.1% are on track. Ghanche also falls among significantly below average districts where 32.8% are on track. Kharmang needs targeted support where 33.5% children are on track.

ECD outcomes vary widely by district from 70.4% (Nagar) to 28.1% (Diamir). Districts like Diamir, Ghanche, and Kharmang show critical gaps and may benefit most from targeted ECD interventions (e.g. preschool access, parenting support, health services). Hunza and Nagar are leading districts and may serve as models of best practices.

5.1.6. Evidence from Gilgit-Baltistan

[Impact of Climate Change on Early Childhood Development in Gilgit-Baltistan]

Mr Sana Ullah is a poor farmer, who lives with his wife and six children in Gilgit-Baltistan. His story reflects the harsh realities of climate change and its devastating impact on vulnerable people, especially the young ones.

In recent years, the extreme climatic events, such as floods, have destroyed his means of livelihood. During the most recent disaster, Sana Ullah's family faced severe food shortages. His children were left without enough to eat, and some fell sick due to malnutrition and the absence of proper healthcare facility in the vicinity.

These circumstances have directly affected their physical growth, weakened mental well-being, and disrupted access to education, all of which are key pillars of ECD. The floods not only destroyed his crops but also perished his animals and birds like cows, goats, and hens – his primary sources of milk, meat, and income.

Loss of these resources has intensified the family's poverty and left the children even more vulnerable to hunger and illness. Sana Ullah's experience is a testament to how these severe natural disasters steal the childhood of children.

5.2. Results of Balochistan (MICS4) Survey 2010

Table 5.2. Age of Child (Years)

2010			2020		
Age (Years)	**Frequency**	**Percentage**	**Age (Years)**	**Frequency**	**Percentage**
3	2515	50.6	3	5947	49.1
4	2458	49.4	4	6153	50.9
Total	4973	100	**Total**	12100	100

In 2020, the overall sample size was 10,432. However, the sample size after implying ECD criteria, i.e. age group between 36-59 months, was 4,973. The data shows an almost equal split between 3 and 4 years old, with a very slight majority being 3-year old. This balance is important when evaluating access to ECD programmes, curriculum design, and readiness for transition to pre-primary or formal schooling.

Overall, sample size (including all groups) was 25,638. However, sample size after focusing on the ECD target group, i.e. 36- 59 months was reduced to 12,100.

The sample consists of 12,100 children, evenly split between 3 years old and 4 years old. There's a slightly higher proportion of 4 years old (50.9%) compared to 3 year old (49.1%). The distribution is relatively balanced, which is good for comparing developmental indicators between the two age groups.

5.2.1. Descriptive Analysis

Table 5.2.1. Overall Early Childhood Development (ECD) in Balochistan

	2010		2020			
Indicator	**% Achieved**	**% Not Achieved**	**% Achieved**	**% Not Achieved**	**ECD Domain**	**Interpretation**
Identifies at least 10 letters	19	81	16.50	83.50	Literacy	Very low early literacy levels; majority of children are not prepared for reading readiness.
Reads at least 4 simple words	25.20	74.80	19.40	80.60	Literacy	Most children lack basic reading skills, indicating poor foundational

						literacy development.
Recognizes numbers 1–10	18.80	81.20	21.10	78.90	Numeracy	Early numeracy skills are underdeveloped; only 1 in 5 children meet this milestone.
Picks up small object with two fingers	81.50	18.50	54.00	46.00	Physical	Just over half meet fine motor development milestones; supports classroom readiness.
Sometimes too sick to play	43.50	56.50	62.1 (Not Sick)	37.9 (Sick)	Health/ Physical	Nearly 4 in 10 children are frequently ill, which may hinder physical and cognitive development.
Follows simple directions	72	28	48.90	51.10	Cognitive	Half the children are unable to follow simple instructions; potential concern for school adjustment.
Able to do something independently	62.20	37.80	52.20	47.80	Cognitive/Self-help	Just over half show emerging independence; others may need more developmental support.
Gets along with other children	83.10	16.90	64.40	35.60	Social-Emotional	Most children demonstrate positive peer relationships; social

						development is relatively stronger.
Kicks, bites, or hits others	39 (Yes)	61 (No)	45.10	54.90	Social-Emotional	Nearly half show aggressive behaviors; suggests need for social-emotional intervention.
Gets distracted easily	27.2 (Yes)	72.8 (No)	52.20	47.80	Cognitive/Attention	Attention regulation is a concern for over half of the children; may affect learning outcomes.

Overall Early Childhood Development (ECD) in Balochistan

	2010		**2020**			
Indicator	**% Achieved**	**% Not Achieved**	**% Achieved**	**% Not Achieved**	**ECD Domain**	**Interpretation**
Identifies at least 10 letters	19	81	16.50	83.50	Literacy	Very low early literacy levels; majority of children are not prepared for reading readiness.
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Able to do something independently	62.20	37.80	52.20	47.80	Cognitive/Self-help	Just over half show emerging independence; others may need more developmental support.
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Gets distracted easily	27.2 (Yes)	72.8 (No)	52.20	47.80	Cognitive/Attention	Attention regulation is a concern for over half of the children; may affect learning outcomes.

Index Category	2010				2020			
	Response	Frequency	Percent	On track (%)	Response	Frequency	Percent	On track (%)
Numeracy Literacy	Yes	943	19	19	Yes	1974	16.3	16
	No	4030	81		No	10126	83.7	
Physical	Yes	1856	37.3	37	Yes	3585	29.6	30
	No	3117	62.7		No	8515	70.4	
Learning	Yes	2796	56.2	56	Yes	6715	55.5	56
	No	2177	43.8		No	5385	44.5	
Social Emotional	Yes	2208	44.4	44	Yes	4953	40.9	41
	No	2765	55.6		No	7147	59.1	
Overall Early Childhood Development Index	Yes	1024	20.6	21	Yes	2621	21.7	22
	No	3949	79.4		No	9479	78.3	

The 2010 data paints a clear picture: while many children are physically healthy and socially engaged, early learning outcomes: especially literacy and numeracy - are lagging significantly. There's also a concerning overlap between behavioural challenges and developmental readiness gaps. Targeted interventions, particularly in early learning quality, health support, and responsive care giving, are needed to ensure children are school-ready, socially competent, and developmentally on track.

The 2020 data from Balochistan presents a clearcut call to action: Early literacy and numeracy are critically underdeveloped and require urgent intervention through teacher training, community-based early learning programmes, and home learning support. Cognitive and social-emotional skills are at fragile development stages, necessitating holistic support strategies that include play-based learning, behaviour modelling, and responsive care giving. Health and nutrition must be integrated into early childhood programmes, as poor health can undermine progress across all domains.

Improving outcomes across these areas will demand a multi-sectoral response involving education, health, nutrition, and social protection systems-working together to ensure that children in Balochistan not only survive but thrive in their early years.

5.2.2. Early Childhood Development Indices in 2010 and 2020

Table 5.2.2. Early Childhood Development Indices

In 2010,

Numeracy & Literacy (19% On Track)

Only 1 in 5 children meets foundational numeracy and literacy benchmarks. This aligns with earlier data showing low letter and number recognition. Indicates a significant learning gap needing urgent attention.

Physical (37% On Track)

About 1 in 3 children is on track with physical milestones. This suggests physical development challenges for a large portion of children. May reflect nutrition, health status, or environmental stimulation issues.

Learning (56%)

Over half of the children are meeting learning-related milestones. This domain covers cognitive skills like following directions and problem-solving. It is relatively better compared to literacy and numeracy but still leaves a large group behind.

Social and Emotional Development (44%)

Less than half are on track in social-emotional skills such as peer interaction and emotional regulation. This indicates a need for enhanced support in behavioural and emotional learning.

Overall ECD Index (21%)

Only about 1 in 5 children is on track across all key developmental domains. The low numeracy and literacy scores highlight a priority area for early learning interventions. Physical development is lagging but somewhat better than literacy/numeracy. Learning and social-emotional development show moderate performance but still reveal significant gaps. Overall, the data suggests major systemic challenges in providing holistic ECD support.

5.2.3. Recommendations

- Prioritize integrated ECD programmes focusing on literacy, numeracy, and social-emotional learning,
- Strengthen nutrition and health programmes to improve physical development,
- Provide caregiver training to promote responsive care giving and early stimulation,
- Invest in early detection and intervention services for children not on track,
- Monitor progress regularly with standardized ECD assessment tools.

5.2.4. ECD Analysis

Table 5.2.4. ECD Analysis (Gender, Mother's Education)

	Sex	
	On Track	**Not on Track**
Male	557	2167
Female	466	1782

	On Track (1.00)	Not On Track (0.00)
Preschool	0	4
Primary	54	131
Middle	34	59
Matric (Secondary)	45	135
Higher (College+)	27	91
Madrassa	1	2

The proportion of children on track in ECD is roughly equal between boys and girls (~20%). Similarly, the proportion not on track is also similar (~79-80%) across sexes. This suggests no major gender disparities in overall ECD outcomes within this data set. Both boys and girls show low rates of being on track, reinforcing the earlier finding of widespread developmental delays or challenges. The data indicates that both male and female children face similar developmental challenges with about 4 out of 5 children not on track in their early childhood development milestones.

Children with mothers, who have completed middle school education, have the highest proportion on track (36.6%). Those whose mothers only reached preschool or no formal education are least likely to be on track (0%). Surprisingly, higher education (college and above) does not correspond to the highest on-track rate, possibly due to small sample size or other socio-contextual factors.

There is a clear positive correlation between maternal education and child development - particularly basic literacy levels (primary and middle education) seem to benefit children most. This supports global evidence that maternal education is one of the strongest predictors of child developmental outcomes.

Some categories (e.g. preschool, madrassa) have very small sample sizes and may not be statistically reliable.

5.2.5. Body Mass Index and Early Childhood Development

Low BMI range (<12.5): High number of children are not on track. Very few are on track, especially when BMI is extremely low (e.g. <10). Example: BMI 10.2 → 4 not on track, 0 on track.

Moderate BMI range (13–17): Higher proportion of children on track appears. Example: BMI 14.4 → 43 not on track, 21 on track (≈33%).

High BMI range (>18): Fewer total children. Some increase in the percentage on track, but lower counts make it hard to generalize.

Malnutrition (underweight) is strongly associated with developmental delays.

Table 5.2.6. BMI Categories

BMI	Category
<13	Severely underweight
13–14.9	Underweight
15–16.9	Normal (low)
17–18.9	Normal (moderate)
19–25	Healthy
>25	Overweight

There is a visible association between higher BMI (within healthy range) and better developmental outcomes. Very low BMI values correlate with poor ECD status. The pattern suggests that under nutrition is a key barrier to early childhood development

5.2.6. District-wise Early Childhood Development comparison

Table 5.2.7. District-wise Complete Early Childhood Index with Percentages

District	Not On Track (0.00)	% Not On Track	On Track (1.00)	% On Track	Total
Quetta. Zarghoon Town	60	69.0	27	31.0	87
Quetta, Chilton Town	95	63.3	55	36.7	150
Pishin	181	79.4	47	20.6	228
Qilla Abdullah	268	91.5	25	8.5	293
Ziarat	97	71.3	39	28.7	136
Harnai	94	64.8	51	35.2	145
Mastung	106	71.1	43	28.9	149
Kalat	172	91.0	17	9.0	189
Khuzdar	154	79.4	40	20.6	194
Awaran	91	86.7	14	13.3	105
Lasbela	74	51.0	71	49.0	145
Jaffarabad	158	82.3	34	17.7	192
Naseerabad	135	79.4	35	20.6	170
Jhal Magsi	88	89.8	10	10.2	98

Bolan	155	83.8	30	16.2	185
Sibi	114	72.6	43	27.4	157
Dera Bugti	135	85.9	22	14.1	157
Noshki	50	74.6	17	25.4	67
Chagai	86	70.5	36	29.5	122
Kharan	113	86.9	17	13.1	130
Washuk	80	67.2	39	32.8	119
Panjgoor	58	53.2	51	46.8	109
Kech	185	88.1	25	11.9	210
Gwader	73	62.4	44	37.6	117
Killa Saifullah	177	76.6	54	23.4	231
Zhob	229	81.8	51	18.2	280
Sherani	115	86.5	18	13.5	133
Musakhail	177	100.0	0	0.0	177
Loralai	157	90.8	16	9.2	173
Barkhan	119	74.4	41	25.6	160
Kohlu	153	92.7	12	7.3	165
Total	**3,949**	**79.4**	**1,024**	**20.6**	**4,973**

Overall, only about 21% (1,024) of children are on track across districts.

Districts with the highest % on track:

Lasbela: 71 on track out of 145 → ~49%

Panjgoor: 51 out of 109 → ~47%

Quetta Chilton Town: 55 out of 150 → ~37%

Harnai: 51 out of 145 → ~35%

Killa Saifullah: 54 out of 231 → ~23%

Districts with the lowest % on track:

Musakhail: 0 out of 177 → 0%

Kohlu: 12 out of 165 → ~7%

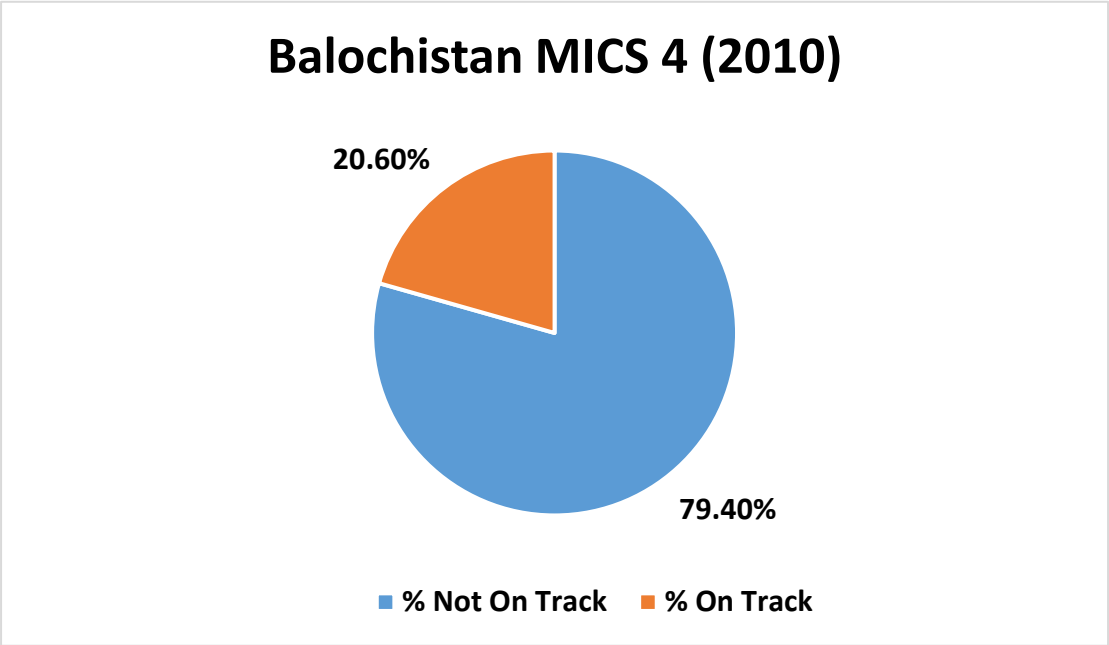
Jhal Magsi: 10 out of 98 → ~10%

Awaran: 14 out of 105 → ~13%

Kalat: 17 out of 189 → ~9%

Some districts show relatively better development outcomes, while others lag seriously.

Wide disparities exist across districts, indicating uneven access to quality ECD services, health care, nutrition, and stimulation. Districts like Lasbela and Panjgoor may have better ECD programme implementation, caregiver education, or resource availability. Districts with very low "on track" rates may face challenges like: Poor infrastructure, Higher poverty or food insecurity. Limited ECD centers or trained providers. Less caregiver knowledge/support



This pie chart indicates that only **20.60%** of children in Balochistan were on track with their early childhood development, while a large majority of **79.40%** were not.

5.2.7. Recommendations

Following are the targeted interventions in low-performing districts, especially Musakhail, Kohlu, Kalat, and Jhal Magsi.

- Allocate resources to improve nutrition and health services,
- Provide ECD center access and quality,
- Launch parental and community awareness programmes,
- Use district-level data for planning and monitoring progress,
- Consider peer learning from higher-performing districts to replicate best practices.

5.3. Balochistan MICS 6 Analysis

5.3.1. Gender Wise Analysis

Table 5.3.4. Complete Early Childhood Development Index by Sex and Mother's Education Level

Sex				
	Not on Track	**On Track**	**% On Track**	**Total**
Male	4887	1365	21.8	
Female	4592	1256	21.5	
Mother's Education Level				
Preschool	8194	2222	21.3	10416
Primary	384	137	26.3	521
Middle	203	47	18.8	250
Matric (Secondary)	453	128	22	581
Higher (College+)	243	87	26.4	330
Madrassa	2	0	-	2
Total	9479	2621	21.7	12100

The Overall Development Index achievement rate is low for both sexes, with only about 1 in 5 children meeting the composite benchmark. Males: 21.8% achieved (1,365 out of 6,252). Females: 21.5% achieved (1,256 out of 5,848). The difference between male and female achievement is minimal (0.3%), which suggests no significant gender disparity in overall developmental outcomes. This indicates that the barriers to early childhood development in Balochistan are systemic and widespread, that affect boys and girls almost equally.

Mothers with higher or primary education show the highest achievement rates on the overall development index: Higher education: 26.4% achieved. Primary education: 26.3% achieved. Mothers with no or pre-primary education still form the majority of sample (86%), with only 21.3% achieving the development benchmark. Interestingly, mothers with middle-level education have a lower-than-average achievement rate (18.8%), which may be due to sample size or contextual factors (e.g. socio-economic conditions not aligned with education level). The data confirms a positive correlation between maternal education and child development outcomes, particularly at the higher and primary levels.

Mothers (even with an education up to primary or secondary level) can significantly improve ECD outcomes. Investments in adult female literacy and education programmes can have a multi generational impact. Interventions should prioritize low-literacy households, where many developmental delays are concentrated.

5.3.2. Body Mass Index and Early Childhood Development

Children who did not achieve the overall development benchmark had a higher average BMI (17.64) than those who did achieve it (16.47).

This inverse relationship is somewhat unexpected, as one might assume that better physical health (reflected by BMI) would correlate with stronger development outcomes. However, several interpretations are possible: Overweight or unhealthy weight (e.g. high BMI not due to lean mass) may be associated with reduced physical activity, lower motor skill development, or poorer overall health, impacting development. Children with lower BMIs (within a healthy range) may be more physically active or nutritionally balanced, supporting stronger development. Alternatively, this could point to underlying socio-economic or health disparities, such as poor diet quality in both undernourished and over nourished households. BMI alone is not a sufficient indicator of developmental health; a high BMI could reflect nutritional imbalance, not necessarily better health. Nutritional quality and early childhood care practices matter more than weight alone in influencing development. Health and education programmes should focus on balanced nutrition, physical activity, and holistic child well-being, not just weight gain.

5.3.3. District-wise Early Childhood Development comparison

Table 5.3.7. District-wise Complete Early Childhood Index with Percentages

District	Not Achieved (Count)	Achieved (Count)	Total	% Achieved	% Not Achieved
Awaran	388	27	415	6.5	93.5
Barkhan	396	28	424	6.6	93.4
Chaghi	144	25	169	14.8	85.2
Dera Bugti	315	151	466	32.4	67.6
Gwadar	225	36	261	13.8	86.2
Harnai	174	114	288	39.6	60.4
Jaffarabad	369	21	390	5.4	94.6
Jhal Magsi	200	180	380	47.4	52.6
Kachhi (Bolan)	211	43	254	16.9	83.1
Kalat	314	31	345	9.0	91.0
Kech (Turbat)	305	47	352	13.4	86.6
Kharan	397	65	462	14.1	85.9
Khuzdar	192	53	245	21.6	78.4
Killa Abdullah	337	6	343	1.7	98.3
Killa Saifullah	199	196	395	49.6	50.4

Kohlu	164	26	190	13.7	86.3
Lasbela	419	39	458	8.5	91.5
Lehri	200	83	283	29.3	70.7
Loralai	541	71	612	11.6	88.4
Mastung	97	18	115	15.7	84.3
Musakhel	415	24	439	5.5	94.5
Nasirabad	705	44	749	5.9	94.1
Nushki	160	20	180	11.1	88.9
Panjgur	157	76	233	32.6	67.4
Pishin	288	61	349	17.5	82.5
Quetta	616	159	775	20.5	79.5
Sheerani	336	280	616	45.5	54.5
Sibbi	175	28	203	13.8	86.2
SohbatPur	305	105	410	25.6	74.4
Washuk	163	125	288	43.4	56.6
Zhob	285	319	604	52.8	47.2
Ziarat	287	120	407	29.5	70.5

Out of 12,100 children assessed across Balochistan, only 21.7% (2,621 children) met the overall early childhood development benchmarks, while the majority 78.3% (9,479 children) did not. District-level achievement varies widely, highlighting significant disparities in child development outcomes across the province.

Top-performing districts include:

Zhob (52.8%), Killa Saifullah (49.6%), Sheerani (45.5%), Jhal Magsi (47.4%), and Washuk (43.4%).

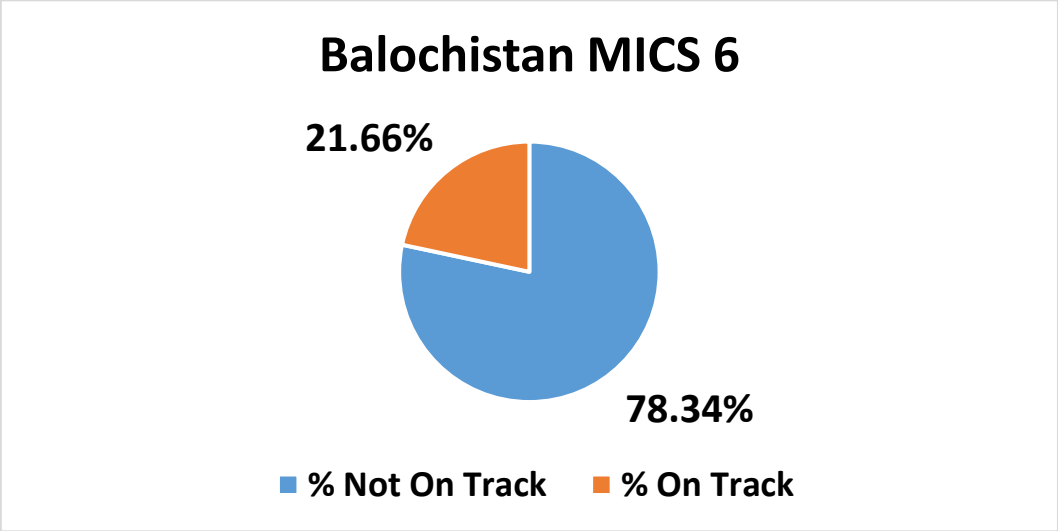
These districts have almost half or more children achieving developmental milestones, well above the provincial average.

Lowest-performing districts include:

Killa Abdullah (1.7%), Jaffarabad (5.4%), Musakhel (5.5%), Nasirabad (5.9%), and Awaran (6.5%).

These areas have alarmingly low percentages of children meeting developmental benchmarks, indicating urgent need for intervention.

Some populous districts like Quetta (20.5%) and Loralai (11.6%) fall below the provincial average, reflecting urban-rural and intra-provincial disparities.



This graph shows a slight improvement from MICS 4, with **21.66%** of children on track. However, a significant majority of **78.34%** of children still remain not on track with their early development.

5.3.4. Comparison of two data sets in Balochistan

Index Category	On Track (%): Earlier	On Track (%): Recent	Change (Percentage)	Interpretation
Numeracy & Literacy	19	16	**−3**	**Decline** in foundational literacy & numeracy
Physical Development	37	30	**−7**	**Significant decline**, possible health/nutrition concerns
Learning	56	56	**0**	**No change**, stable performance
Social-Emotional	44	41	**−3**	**Slight decline**, potential emotional support gap
Overall ECD Index	21	22	**+1**	**Marginal improvement**, but still very low overall

Despite some improvement in the overall ECD index (from 21% to 22%), the gains are minimal, and development remains low overall. Learning remains stable at 56%, showing consistent performance in cognitive or direction-following tasks. Declines in physical (−7%) and literacy-numeracy (−3%) domains are concerning, possibly reflecting worsening health,

nutrition, or lack of foundational learning support. A drop in social-emotional development (−3%) could indicate rising behavioral, environmental, or mental health challenges.

The data suggests stagnation or regression in most developmental areas, even as the overall ECD score inches up slightly. Renewed focus is needed in: Early literacy and numeracy programmes, Physical development and child nutrition, Parental and teacher training for emotional development. The fact that only 1 in 5 children are developmentally “on track” calls for urgent, multi-sectoral interventions.

[Education Washed Away by Floods]

Recently, cotton farming gained traction in District Kech due to the promising market rates. In hopes of a stable and promising income, Dil murad, a small farmer, decided by to switch to cotton farming. He was convinced that it will be enough to provide for his household expenses and allow his eldest son, Shokat, to remain enrolled in an FSc academy in Quetta.

However, the buzz word of climate change manifested its reality. The monsoon of 2022 brought unusually heavy rains, flash floods ravaged entire villages and damaged the mud-brick houses. The cotton fields were submerged by the floodwater just before harvest. In a single season, Dil Murad lost both his crop and his income. His family was forced to move into temporary shelter, struggling to rebuild their home.

With no earnings left, Dil murad could not continue paying Shokat’s hostel and tuition fees. For a short time, friends supported him through contributions and partial fee waivers from the academy, but the arrangement could not last. Eventually, Shokat had to return home, his education cut short in efforts to help his family.

The sudden end to his studies was a setback for him and for the family’s hope of a better future. The sudden end to Shokat’s studies illustrates a painful truth: climate change is no longer an abstract idea. In Balochistan, unpredictable floods and weather extremes directly affect the livelihoods, and children are often the first to bear the brunt, losing access to education and opportunities for a bright future.

5.4. KP MICS 5 Analysis

5.4.1. Age of Child

Table 5.4.1. Age of Child

2016			2019		
Age (Years)	**Frequency**	**Per cent**	**Age (Years)**	**Frequency**	**Per cent**
3	4523	53.9	3	5365	53.1
4	3863	46.1	4	4737	46.9
Total	8386	100	**Total**	10102	100

This table presents the age distribution of children enrolled in an ECD programme in Khyber Pakhtunkhwa (KP), in 2019 and 2010. The 2020 data includes a total of 8,386 children, categorized by their ages: 3 and 4 years old. Among the children surveyed, 4,523 (53.9%) are 3 years old. About 3,863 children (46.1%) are 4 years old. The majority of children enrolled in ECD programmes are 3 years old (53.9%), with the remaining 46.1% aged 4 years. This distribution reflects a relatively balanced age representation, with slightly more younger children participating. The presence of a significant number of 3-year-old implies that a large proportion of the cohort is in the early stages of skill acquisition, which may affect performance on subsequent learning indicators.

The total number of children in the data set is 10,102, in 2019. The children fall only in two age groups – 3 and 4 years old. About 53.1 children are 3 years old, while 46.9 are 4 years old. The cumulative percentage helps see that after including all 4-year-old, we reach 100% of the sample. In the ECD context, this kind of age distribution is useful to: i) understand which age group is more represented in the data set. ii) analyze developmental milestones or outcomes based on age. and Iii) plan age-appropriate interventions or educational content.

5.4.2. Overall Description of Early Childhood Indicators

Table 5.4.2. Overall Description of Early Childhood Indicators in 2016 and 2019

	2016			2019			
Indicator	**Positive Outcome**	**Yes (%)**	**No (%)**	**Positive Outcome**	**% Yes**	**% No**	**Description**
Child identifies at least 10 letters	Can identify ≥10 letters	38.60	61.40	Yes	22.70	77.30	Low early literacy
Child reads at least 4 simple words	Can read ≥4 words	48.70	51.30	Yes	35.10	64.90	Moderate reading ability
Child knows numbers/symbols 1–10	Can recognize numbers 1–10	29.40	70.60	Yes	21.10	78.90	Very low numeracy

Child picks up small object with two fingers	Demonstrates fine motor skills	89.90	10.10	Yes	79.40	20.60	Strong fine motor skills
Child is sometimes too sick to play	**Not** frequently sick	37.80	62.20	**No**	55.20	44.80	Health concern (high illness rate)
Child follows simple directions	Can follow instructions	82.90	17.10	Yes	71.20	28.80	Good functional skill
Child does things independently	Demonstrates autonomy	75.70	24.30	Yes	67.00	33.00	Fair independence level
Child gets along with other children	Displays positive social behavior	92.80	7.20	Yes	81.80	18.20	Strong social skills
Child kicks, bites, or hits others	**Does not** show aggression	46.00	54.00	**No**	42.10	57.90	High aggression (negative behavior)
Child gets distracted easily	Maintains attention	35.00	65.00	**No**	40.70	59.30	High distractibility (negative behavior)

Strong Domains:

Social skills (92.8% get along with others)

Fine motor skills (89.9%)

Following directions (82.9%)

Independence (75.7%)

Weak Domains:

Numeracy (only 29.4% know 1–10)

Attention (65% are easily distracted.)

Literacy (only 38.6% know letters.)

Aggression (54% show physical aggression.)

Health (62.2% too sick to play.)

Children in KP's ECD programmes show strong physical, social, and personal development, but there are critical gaps in literacy, numeracy, attention, and health. These weaknesses can significantly affect school readiness and should be addressed through a) early literacy and numeracy intervention, b) health and nutrition programmes, c) social-emotional learning, d) teacher training on behaviour, and f) classroom management.

Cognitive gaps: Most children in this sample lack the foundational academic skills required for a smooth transition into school.

Health & behaviour issues: Health vulnerabilities and behavioural challenges (aggression and distraction) are widespread and could impact learning outcomes and classroom dynamics.

Strengths to build on: Fine motor skills are well developed. Most children get along with others and can follow instructions which are essential foundations for early childhood education (ECE) programmes.

5.4.3. Early Childhood Development Indices

Table 5.4.3. Early Childhood Development Indices

		2016				2019		
Index	Label / Meaning	Positive Outcome (1)	Yes (%)	No (%)	Description / Implications	% Yes (1.00)	% No (0.00)	Interpretation
Numeracy & Literacy (Num_Lit_Index)	Numeracy & Literacy Readiness	Achieved literacy & numeracy skills	37.60	62.40	Only about 1 in 3 children show adequate early literacy and numeracy - a major area of concern.	23.00	77.00	Only 23% of children meet the minimum criteria for early literacy and numeracy. This reinforces the low performance shown in letters, reading, and number recognition.

Physical Development (Physical_Index)	Physical (motor & health) readiness	Demonstrates physical readiness	55.70	44.30	Over half of children show age-appropriate motor development. Still room for improvement.	38.60	61.40	Less than 4 in 10 children meet physical development standards (fine motor skills + health). This includes those too sick to play.
Learning/Cognitive (Learning_Index)	Cognitive & learning-related behaviours	Exhibits learning-related behaviorus	70.30	29.70	Most children are ready to learn cognitively (focus, following instructions, etc.).	59.10	40.90	Majority show readiness in areas like following instructions and working independently - indicating potential to benefit from structured learning.
Social & Emotional (Social_Emo_Index)	Social & Emotional development	Positive peer interaction & behavior	83.30	16.70	Very strong domain; children are generally sociable and emotionally balanced.	74.70	25.30	A strong result: nearly 75% exhibit good social-emotional skills (getting along, regulating aggression, attention span). However, recall individual aggression/distractibility scores were high - this suggests possible index inflation.

Overall ECD Readiness (Complete_Index)	Fully developmentally “on track” across all domains	Meets full school readiness criteria	52.40	47.60	Just over half of the children are fully ready for school across all domains.	32.00	68.00	Only 1 in 3 children are developmentally on track across all domains - a critical figure that reflects limited school readiness at population level.

		2016				
Index	**Label / Meaning**	**Positive Outcome (1)**	**Yes (%)**	**No (%)**	**Description / Implications**	**% Yes (1.00)**
Numeracy & Literacy (Num_Lit_Index)	Numeracy & Literacy Readiness	Achieved literacy & numeracy skills	37.60	62.40	Only about 1 in 3 children show adequate early literacy and numeracy - a major area of concern.	23.00
Physical Development (Physical_Index)	Physical (motor & health) readiness	Demonstrates physical readiness	55.70	44.30	Over half of children show age-appropriate motor development. Still room for improvement.	38.60

Learning/Cognitive (Learning_Index)	Cognitive & learning-related behaviours	Exhibits learning-related behaviors	70.30	29.70	Most children are ready to learn cognitively (focus, following instructions, etc.).	59.10
Social & Emotional (Social_Emo_Index)	Social & Emotional development	Positive peer interaction & behavior	83.30	16.70	Very strong domain; children are generally sociable and emotionally balanced.	74.70
Overall ECD Readiness (Complete_Index)	Fully developmentally “on track” across all domains	Meets full school readiness criteria	52.40	47.60	Just over half of the children are fully ready for school across all domains.	32.00

The most urgent policy need is to strengthen foundational literacy and numeracy skills. Introduce play-based literacy/numeracy curricula in ECD centres. Train teachers in early reading and math instruction using age-appropriate techniques. Supply learning materials (books, blocks, number charts) to households and preschools. The 44.3% gap in physical development and the high rate of children “too sick to play” reflect underlying health vulnerabilities. Integrate nutrition, immunization, and deworming into ECD programmes. Improve access to child health services through school-based health checks. Provide parent education on hygiene, nutrition, and early health care. While social-emotional and learning domains are strong, overall readiness is limited by lack of access and quality in services. Scale up public ECD centers, especially in rural and under served areas. Ensure adequate staffing, infrastructure, and child-to-teacher ratios. Monitor ECD outcomes using standardized tools across the province. Children’s home environment plays a crucial role in early development. Launch parenting programmes that promote learning at home. Distribute home-learning kits and run campaigns on the importance of ECD. Nearly half (47.6%) are not fully ready for school. Develop remedial or bridging programmes before children enter primary school. Use community health workers to identify and support lagging children early.

The ECD indices show that while many children in KP have strong social and learning potential, there are critical deficiencies in early literacy, numeracy, and health. A multi sectoral response that integrates education, health, nutrition, and family support is necessary to ensure that all children are ready for school and lifelong learning.

Critical Learning Gaps: Numeracy and literacy outcomes are very poor, and must be addressed through early childhood care and education (ECCE) access, literacy-focused parenting interventions, and language-rich environments.

Physical vulnerabilities: Poor health and fine motor skill challenges affect over 60% of children.

Social-emotional readiness is strong, which is a good foundation - but high aggression and distractibility rates (seen in individual indicators) may complicate classroom behaviour.

Only 32% of children are developmentally ready across all key domains, meaning 2 out of 3 children may struggle in formal school environments.

5.4.4. ECD Analysis by gender and mother's education level

KP MICS 5

Gender				
	Not On Track (0.00)	**On Track (1.00)**	**ECD**	**Total**
Male	3,602	1,700	52.5	5,302
Female	3,270	1,530	52.3	4,800
Mother's Education Level				
	Not Fully Ready (Index = 0)	**Fully Ready(Index = 1)**	**Fully Ready (Percentage)**	**Total**
None / Pre-school	2,883	2,745	48.8	5,628
Primary	387	500	56.4	887
Middle	192	307	61.5	499
Secondary	249	381	60.5	630
Higher	281	461	62.1	742
Total	3,992	4,394		8,386
District				
	Not Ready (Index = 0)	**Fully Ready** (Index = 1)	**% Fully Ready**	**Total**

Abbottabad	156	106	40.50	262
Bannu	191	215	52.90	406
Batagram	212	113	34.80	325
Buner	114	148	56.50	262
Charsadda	158	156	49.70	314
Chitral	94	97	50.80	191
D.I. Khan	194	219	53.00	413
Hangu	228	152	40.00	380
Haripur	126	125	49.80	251
Karak	129	143	52.60	272
Kohat	136	172	55.80	308
Kohistan	308	214	41.00	522
Lakki Marwat	136	159	53.90	295
Lower Dir	81	243	**75.00**	324
Malakand Protected Area	147	173	54.10	320
Mansehra	154	131	46.00	285
Mardan	141	278	**66.30**	419
Nowshera	80	236	**74.70**	316
Peshawar	267	412	**60.70**	679
Shangla	186	51	**21.50**	237
Swabi	127	159	55.60	286
Swat	153	242	**61.30**	395
Tank	173	163	48.50	336
Tor Ghar	173	46	**21.00**	219
Upper Dir	128	241	**65.30**	369

There is no significant gender gap in overall ECD readiness.

Both boys and girls show similar performance: About 52% of both genders meet the full ECD development criteria. Around 48% of both genders are not fully school-ready. This suggests that barriers to ECD readiness are systemic, and not gender specific. Since both boys and girls perform similarly, programmes should maintain gender parity in resource allocation, enrolment drives, and outreach. Focus should remain on universal access to early learning and health services, and not gender-specific interventions. While gender is not a determining factor here, location, poverty, or maternal education might be more significant. Future policies should include dis-aggregated data by socioeconomic and geographic factors to better target vulnerable groups. Continuous monitoring of gender-dis-aggregated data is a must to ensure no emerging disparities in access, outcomes, or quality of ECD services over time.

Both boys and girls in Khyber Pakhtunkhwa have nearly equal chances of being fully ready for school, with around 52% achieving full ECD readiness. The findings reinforce the importance of inclusive, system-wide investments in early childhood development, without a need for gender-differentiated interventions at this stage.

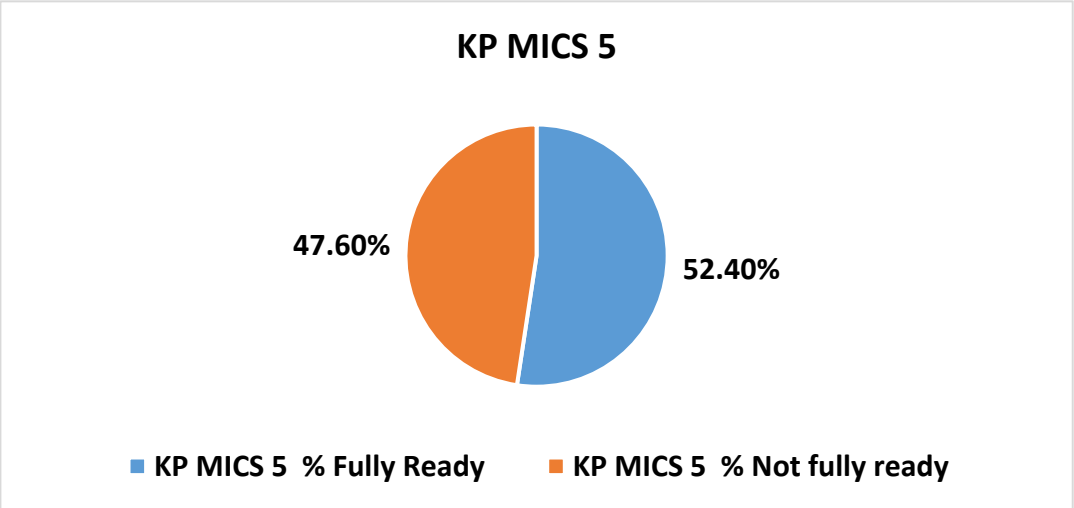
A clear upward trend exists, i.e. the higher the mother's education, the more likely the child is to be fully school-ready. Mothers with no education have the lowest ECD readiness (48.8%). Readiness peaks at 62.1% among children whose mothers have higher education. This confirms that mother's education is strongly correlated with better early childhood development outcomes. Improving girls' and women's education has a direct impact on inter generational outcomes. Mothers with no or low education are disproportionately at risk of poor development. ECD centers should be combined with community-based parenting classes to boost mothers' involvement and knowledge regardless of their formal education level.

Mother's education is a key determinant of a child's early development. Children whose mothers have secondary or higher education are significantly more likely to be school-ready. Strengthening female education and providing targeted support to low-literacy families can break the cycle of poor developmental outcomes and improve overall education equity in KP.

These districts have a higher-than-average proportion of children, who are fully ready for school; Lower Dir: 75.0%, Nowshera: 74.7%, Mardan: 66.3%, Upper Dir: 65.3%, Swat: 61.3%, and Peshawar: 60.7%. These districts have better access to early learning services, igher maternal education, and stronger infrastructure, health, and nutrition programmes.

These districts also have a substantial proportion of children not developmentally ready such as: Tor Ghar: 21.0%, Shangla: 21.5%, Batagram: 34.8%, Hangu: 40.0%, Abbottabad: 40.5%, and Kohistan: 41.0%. These areas may suffer from limited access to ECD centers, low maternal literacy, geographical remoteness and infrastructure constraints, and inadequate health/nutrition services.

The variation between districts is significant, ranging from just 21% to 75% in terms of children being fully ready. This variation is not necessarily aligned with population size but appears to reflect disparities in service delivery, geographical access, parental education, and public investment in ECD.



This chart shows that in Khyber Pakhtunkhwa, 52.40% of children were considered "fully ready" for early development, while 47.60% were "not fully ready."

5.4.5. BMI and ECD

ECD	Mean BMI
ECD =1	19.35
ECD=0	20.19

Children, who are not fully developmentally ready for school have a higher average BMI (20.19) than those who are fully ready (19.35). This is counter intuitive, as we typically expect better-nourished children (i.e. normal BMI) to perform better developmentally. However, this may indicate a few possible patterns: Overweight/Obesity could be associated with lower physical activity, poor motor development, or health-related absenteeism-factors that affect ECD readiness. Some well-nourished children may still lack cognitive, emotional, or social stimulation, highlighting that nutrition alone is not enough. Alternatively, underweight children (below normal BMI) may be more likely to be in early learning programmes that offer additional support, which can improve their readiness scores. BMI alone doesn't indicate nutritional quality or micro nutrient deficiencies, which are crucial for brain development. This is a correlation, not causation - further analysis (e.g. regression) would be needed to control for other variables like income, parental education, or environment.

There is a need to focus not only on underweight children, but also on those who may be overweight or obese. The government must implement balanced school feeding programmes that promote healthy weight and cognitive development.

Nutritional interventions must be paired with stimulation, play, and learning opportunities. Parent's education is needed on both nutrition and early child development.

Regular BMI checks can help identify children at risk in early development. Children with unusually high or low BMI can be referred for health assessments, and additional learning support.

Children with lower school readiness tend to have a higher average BMI. This suggests that nutritional imbalances, especially overnutrition, may be associated with poorer ECD outcomes. Nutrition programmes should focus on balanced growth, not just weight gain, and be integrated with learning, health, and family support services for holistic early childhood development.

There is a need to focus on resources and programming in Tor Ghar, Shangla, Kohistan, Batagram, and Hangu. Actions may include establishing new ECD centers, recruiting and training ECD facilitators, expanding mobile services for remote areas, leveraging High-Performing Districts as Models, studying successful strategies in Lower Dir, Nowshera, Mardan, and Peshawar. Furthermore, the government must identify and replicate best practices in curriculum, community engagement, or health-nutrition integration.

There is also a need to use ECD readiness as a key performance indicator (KPI) in education and health planning at district level. Align with local government decentralization efforts to

tailor interventions based on local needs. The large variation underscores the need to monitor equity in early childhood development, not just access to education.

This district-wise analysis reveals significant disparities in children's developmental readiness for school across KP. While some districts are showing promising results, nearly half the province's children are not fully ready for school, especially in remote and under served areas. A geographically targeted approach, combining education, health, and parenting support, is essential for building an equitable and effective ECD system in Khyber Pakhtunkhwa.

5.5. KP MICS 6 Analysis

5.5.1. ECD Analysis by Gender, Mother's Education Level;

Table 5.5.1. Role of Mother Education in ECD

No gender gap is there as both boys and girls have very similar ECD outcomes when looking at the overall developmental readiness: 32.1% of boys and 31.9% of girls are on track. This shows no meaningful gender disparity in complete developmental readiness in this data set. However, both genders face significant developmental gaps, as only about 1 in 3 children is fully developmentally ready.

Gender					
	Not On Track (0.00)	**On Track (1.00)**	**% On Track**	**% Not On Track**	**Total**
Male	3,602	1,700	32.10	67.90	5,302
Female	3,270	1,530	31.90	68.10	4,800
Total	6,872	3,230	32.00	68.00	10,102
Mother's Education Level					
	Not On Track (0.00)	**On Track (1.00)**	**% On Track**	**% Not On Track**	**Total**
Pre-primary or none	5,333	2,173	28.90	71.1	7,506
Primary	556	324	36.80	63.2	880
Middle	295	185	38.50	61.5	480

Secondary	351	240	40.60	59.4	591
Higher	337	308	47.80	52.2	645
Total	6,872	3,230	32.00	68	10,102
District					
	Not On Track (0.00)	**On Track (1.00)**	**% On Track**		**Total**
Abbottabad	184	59	24.30	75.5	243
Bannu	191	103	35.00	65	294
Batagram	191	16	7.70	92.3	207
Buner	223	61	21.50	78.5	284
Charsadda	158	118	42.80	57.2	276
Chitral	184	93	33.60	66.4	277
D.I. Khan	232	32	12.10	87.9	264
Hangu	242	33	12.00	88	275
Haripur	101	87	46.30	**53.7**	188
Karak	160	165	**50.80**	49.2	325
Kohat	296	32	9.80	90.2	328
Kohistan	499	198	28.40	77.6	697
Laki Marwat	191	124	39.40	60.6	315
Lower Dir	230	98	29.90	70.1	328
Malakand	124	171	**58.00**	42	295
Mansehra	175	54	23.60	76.4	229
Mardan	224	133	37.30	62.7	357
Nowshehra	144	146	**50.30**	49.7	290
Peshawar	267	230	46.30	53.7	497
Shangla	255	118	31.60	68.4	373

Swabi	139	131	48.50	51.5	270
Swat	279	99	26.20	75.8	378
Tank	166	32	16.20	83.8	198
Torghar	292	81	21.70	78.3	373
Upper Dir	329	72	18.00	82	401
Bajaur	198	97	32.90	67.1	295
Khyber	245	72	22.70	**77.3**	317
Kurram	151	161	**51.60**	48.4	312
Mohmand	322	161	33.30	66.7	483
North Waziristan	127	90	41.50	58.5	217
Orakzai	146	48	24.70	75.3	194
South Waziristan	207	115	35.70	**64.3**	322
Total	**6,872**	**3,230**	**32.00**	68	**10,102**

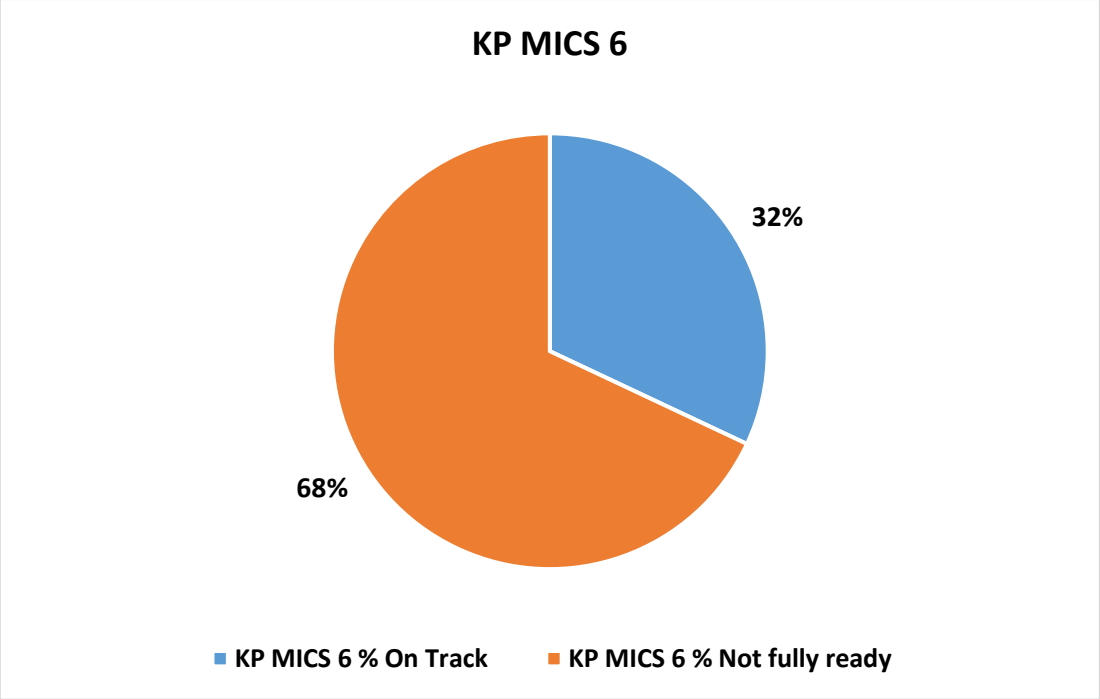
Clear-cut Positive Correlation: There is a strong and consistent link between higher levels of mother's education and better developmental outcomes in children. Mothers with higher education are 65% more likely to be developmentally on track (47.8%) than those whose mothers had no formal education (28.9%).

Impact as Progressive: The increase in ECD readiness is gradual with each level of education, which shows that even basic education (primary or middle) contributes meaningfully.

Highest Benefit: The biggest jump appears between secondary (40.6%) and higher education (47.8%), which suggests that tertiary-educated mothers may provide more stimulating environments, improved health practices, and learning support.

Educated mothers are more likely to value early learning, better equipped to provide home-based cognitive stimulation (e.g., reading, storytelling), more aware of health and nutrition practices,and better able to interact with formal education systems.

The provincial average for children developmentally on track is 32.0% - meaning that 2 out of 3 children in KP are not ready across all ECD domains. Strong performing districts (e.g. Malakand, Kurram, Karak) may have better health, education access, parental education, or ECCE programmes. Weaker districts (e.g. Batagram, Kohat, Hangu) may need urgent, targeted interventions, especially in early learning, parenting support, and child health.



This pie-chart indicates a positive shift, with **68%** of children being on track in their early development, and only **32%** being not fully ready.

5.5.2. Relationship between BMI and ECD

ECD Status	Mean BMI (WHO Standard)
Not on track	16.60
On track	16.32
Average	16.46

Although the difference is small, it suggests a slight inverse association. Children with slightly lower BMI scores were more likely to be developmentally on track. This does not necessarily mean lower BMI improves development. Instead, it could reflect more physically active or engaged children, lower rates of over nutrition or overweight (common in some urban areas).

Possible Alternative Explanation: Children not developmentally on track may include those with less physical activity, leading to slightly higher BMI, poor nutrition leading to higher or imbalanced BMI despite poor cognitive/social development.

Underlying health issues affecting both BMI and development the difference (16.60 vs 16.32) is only 0.28 units, which is very small. BMI alone is not a precise indicator of health or nutrition in early childhood: It doesn't distinguish between fat mass and lean mass. It can be influenced by growth spurts, hydration, illness, etc. Developmental delays are usually more strongly linked to under nutrition (low weight-for-age) or stunting (low height-for-age), and not just BMI.

5.6. Punjab MICS 5

5.6.1. Age of Child

Table 5.6.1. Age of Child

2014			2018		
Age of the child	**Frequency**	**Percent**	**Age of the Child**	**Frequency**	**Percent**
3 Years	5957	51.9	3	8310	52
4 Years	5517	48.1	4	7686	48
Total	11474	100	**Total**	15996	100

The data shows an even distribution of children between the two age groups. Slightly more children are aged 3 years (51.9%) than 4 years (48.1%). The nearly equal representation of both age groups suggests the sample was either randomly selected or intentionally balanced, providing a solid basis for comparative analysis between the two age cohorts.

[How Flash Floods Shape Childhood in Swat Valley]

A sudden flash flood, triggered by a glacial burst ended in just two days, claimed at least 13 lives. A perfect summer evening in Swat Valley turned into a crisis for five young friends, namly Amina (5), Bilal (6), Sana (4), Hamid (5), and Zoya (3).

The children's families moved to temporary shelters. With schools damaged and classrooms submerged, thousands of children were again out of school. The trauma was immediate and profound. At night, Hamid cried at the sound of thunder, and Sana had nightmares of rushing waters swallowing her home, which are the typical signs of PTSD, anxiety, causing learning difficulties later.

Thousands of children were out of school for weeks - echoing an earlier situation when more than 40 schools in Swat were destroyed by flooding, and local educators opened makeshift schools to keep education alive. Loss of crops and livelihoods deepened poverty and increased food insecurity causing the families to retort to desperate measures - such as forced child marriages - as reported in other flood affected areas.

Yet, even amid the loss, resilience emerged. The community, with support from local NGOs, launched clean-up and reforestation initiatives to restore the environment. The children, with the help of education volunteers, began to process their trauma through art. Their mothers joined meetings to learn about early warning systems and other protective measures.

The experience of these children shows that while extreme weather events can be devastating, they can also spark collective action.

About 52.0% of the children are 3 years old (8,310 children), making them the slightly dominant group in the sample. About 48.0% are 4 years old (7,686 children), showing a near-balanced distribution.

The small difference (4%) suggests that the sampling approach aimed for age parity, likely to facilitate comparison across developmental milestones at different early ages. Ages 3 and 4 are crucial for brain development, language acquisition, and social-emotional growth. The data from this age range can inform policy decisions, curriculum design, parenting interventions, and pre-school readiness programmes. A balanced age distribution is essential for tracking developmental progress, comparing year-on-year growth, and evaluating the effectiveness of ECD interventions.

This table reflects a well-structured, representative dateset of children aged 3–4 in Punjab . The near-equal distribution between the two age groups enhances the reliability of any comparative analyses made in the study. Insights derived from this data can support evidence-based planning for early childhood education, health, and development services across the province.

5.6.2. Early Childhood Development Overall Description in Punjab

Table 5.6.2. ECD Overall Description

	2014				2018		
ECD Index	**% Meeting (1.00)**	**% Not Meeting (0.00)**	**Description**	**Implications**	**% Meeting Benchmark (1.00)**	**% Not Meeting Benchmark (0.00)**	**Description / Implications**
Literacy-Numeracy Index	26.40	73.60	Measures ability to identify letters, read simple words, and recognize numbers (basic academic readiness).	Low performance shows major gaps in cognitive readiness. Urgent need for early learning programmes and home-based literacy promotion.	17.80	82.20	Very low foundational literacy and numeracy skills. Indicates major learning gaps and weak school readiness.
Physical Development Index	30.30	69.70	Assesses physical health (not too sick to play) and fine motor skills (e.g., picking up small objects).	Indicates health and wellness concerns. Highlights need for child healthcare access, nutrition, and motor development activities.	43.60	56.40	Only 44% of children meet physical development standards. Highlights health concerns and need for motor-skill stimulation.

Learning/Cognitive Index	78.70	21.30	Evaluates the ability to follow directions and complete tasks independently - core learning behaviors.	Strong foundational behaviors for structured learning. Suggests children are ready to engage in classroom activities if content is developmentally appropriate.	62.30	37.70	Cognitive learning skills are relatively stronger. Suggests potential to benefit from structured early education.
Social-Emotional Index	85.00	15.00	Measures ability to get along with others, manage aggression, and maintain attention.	Indicates emotional resilience and strong interpersonal skills. Can be leveraged to support peer-based and collaborative learning approaches.	68.10	31.90	Majority of children show healthy social-emotional development, a key strength for early learning and peer interaction.
Overall ECD Index	37.60	62.40	Composite of all four domains. A child meets the standard only if all domain-level criteria are satisfied.	Only about 1 in 3 children are developmentally on track. Urgent need for multi-sectoral early childhood interventions to improve holistic readiness.	29.70	70.30	Only 3 in 10 children are developmentally on track across all domains. Reflects a critical need for comprehensive ECD interventions.

These results suggest a critical gap in early literacy development and poor school readiness, which could stem from limited access to quality pre-primary education, inadequate learning materials, and insufficient parental support for early learning at home. The table reveals a mixed developmental profile for young children in Punjab: This pattern indicates that while biological development and basic cognitive processing are

strong, early learning environments are not adequately supporting academic skill acquisition or emotional regulation. Health and nutrition challenges further compound these issues. Urgent improvements are needed in early childhood education quality, focusing on literacy, numeracy, and social-emotional learning.

Parent and teacher training should emphasize early stimulation, emotional support, and positive behavior management. Health and nutrition programmes must be strengthened to reduce illness-related setbacks. Interventions should be holistic, combining education, health, and family support to foster well-rounded child development.

Expand access to early learning programmes with a strong focus on pre-literacy and numeracy. Strengthen caregiver education on managing aggression and improving attention through structured play and routines. Promote child health through better nutrition, immunization, and hygiene services. Leverage children's strong social and physical skills as entry points to build academic readiness.

5.6.3. Early Childhood Development Indices

Table 5.6.3. Early Childhood Development Indices

		2014		2018		
ECD Domain	**Indicator**	**% Achieving**	**Interpretation**	**% Yes (Skill Present)**	**% No (Skill Not Present)**	**Developmental Implications**
Language & Literacy	Identifies ≥10 letters	27.30	Very low	27.10	72.90	Indicates poor early literacy; most children lack basic letter recognition, affecting future reading skills
	Reads ≥4 simple words	23.20	Very low	26.00	74.00	Major gap in emergent reading; highlights low school readiness and possible weak ECE exposure
Numeracy	Recognizes numbers 1–10	26.80	Very low	28.20	71.80	Signals a lack of foundational math skills; early numeracy intervention needed
Comprehension & Cognitive	Follows simple directions	90.00	High	88.40	11.60	Strong auditory comprehension and readiness for classroom routines
Social-Emotional	Can do something independently	83.50	High	83.50	16.50	High self-help and autonomy; important for adaptive development and school readiness
	Gets along with other children	92.10	Very high	94.10	5.90	Strong peer interaction; positive social development

	Kicks, bites, or hits others	48.7 (Yes)	Concerning	63.6 (affected)	36.4 (not affected)	Nearly half of children show aggressive behavior; reflects emotional regulation challenges
	Gets distracted easily	70.4 (Yes)	Concerning	69.0 (affected)	31.0 (focused)	Very high distractibility; impedes focus, learning, and classroom participation
Motor Development	Picks up small object with two fingers	95.40	Very high	89.70	10.30	Indicates well-developed fine motor skills; strong physical readiness for writing, self-care
Health & Well-being	Sometimes too sick to play	28.2 (Yes)	High concern	33.1 (affected)	66.9 (healthy)	Suggests frequent illness or malnutrition in nearly 1 in 3 children: impacts learning and physical activity
Social Skills	Does not get along with others	7.9 (Yes)	Low but notable			Minority struggle socially; may need behavior support or social skill training
Independence	Cannot do anything independently	16.5 (Yes)	Moderate concern			Some children still highly dependent; may affect transition into structured learning

Numeracy & Literacy**:** The low percentage (25.1%) reflects critical deficits in early academic skills. Children are struggling with basic number recognition, letter knowledge, and early reading, which can affect their progress throughout schooling.

Physical Development**:** Just 26.6% meeting physical benchmarks could relate to health, nutrition, or motor skill challenges. This contrasts somewhat with earlier fine motor findings, so this index may reflect a broader set of physical or health measures.

Learning Skills: The high rate (79.6%) of children meeting learning criteria indicates that most children have the cognitive engagement and attention skills necessary for classroom learning, despite low academic readiness.

Social-Emotional Development: Similarly, a strong 81.9% meet social-emotional criteria, showing positive behaviors like cooperation and emotional control are prevalent.

Complete Development: Only 33.4% meet combined criteria across all indices, illustrating that while many children do well in some domains (learning, social-emotional), they often struggle in literacy/numeracy and physical development. This reflects uneven developmental progress and identifies the need for multi-dimensional support programmes.

Children in Punjab exhibit strong learning and social-emotional skills, which provide a solid foundation for early education.

However, low performance in literacy, numeracy, and physical development suggests gaps in both cognitive and physical readiness.

The fact that only a third of children meet comprehensive development criteria underscores the importance of integrated early childhood programmes that address cognitive, physical, social, and emotional needs together.

Interventions should focus on improving early literacy and numeracy exposure, enhancing health and nutrition, and leveraging the existing strengths in social and learning skills for more balanced child development.

5.6.4. Comparison of Early Childhood development in Punjab

Table 5.6.4. Comparison of Early Childhood Development by Gender, Mother's Education Level and Rural Urban Area

Sex				
	Not Meeting Complete Index (0)	**Meeting Complete Index (1)**	**Total Children**	**% Meeting Index**
Male	3,912	1,938	5,850	33.10
Female	3,729	1,895	5,624	33.70
Total	7,641	3,833	11,474	33.40

Rural Urban Comparison				
Area	**Not Meeting Complete Index (0)**	**Meeting Complete Index (1)**	**Total Children**	**% Meeting Index**
Urban	2,374	1,519	3,893	39.00
Rural	5,267	2,314	7,581	30.50
Total	7,641	3,833	11,474	33.40

Mother's Education

	Not Meeting Complete Index (0)	**Meeting Complete Index (1)**	**Total Children**	**% Meeting Index**
None / Pre-school	4,281	1,576	5,857	26.90
Primary	1,379	704	2,083	33.80
Middle	605	437	1,042	41.90
Secondary	798	541	1,339	40.40
Higher	578	575	1,153	49.90

This near parity suggests that, in Punjab, there is no significant gender disparity in the overall early childhood development status when considering the comprehensive index that includes physical, cognitive, social-emotional, literacy, and numeracy components.

Both boys and girls face similar challenges and opportunities in early childhood development.

Intervention programmes and policies can be designed in a gender-neutral way, ensuring that both sexes benefit equally from early childhood education, health, and development initiatives.However, further dis-aggregated analysis of specific domains (literacy, numeracy, social skills, etc.) could reveal nuanced gender differences worth addressing.

The data shows gender equity in overall early childhood developmental outcomes in Punjab, with approximately one-third of both boys and girls meeting the comprehensive developmental milestones. This parity offers an encouraging baseline for policymakers aiming to promote inclusive early childhood programmes.

Urban children have a higher rate of meeting the Complete ECD Index criteria (39.0%) compared to rural children (30.5%).This indicates that children in urban areas of Punjab tend to have better overall early childhood development outcomes than those in rural areas

The urban-rural gap highlights disparities in access to resources that support early childhood development, such as quality preschool education, healthcare, nutrition, and stimulating home environments.

Rural children may face more challenges such as limited access to trained teachers, fewer learning materials, poorer health and nutrition services, and less parental awareness or involvement.

Policymakers and programme designers need to focus targeted interventions in rural areas to close this developmental gap, such as improving infrastructure, increasing access to early childhood education centers, and enhancing parental education and community support.

Children in urban Punjab show better overall early childhood development, with nearly 4 in 10 meeting comprehensive developmental milestones compared to just about 3 in 10 in rural areas. This urban advantage points to significant inequities in early childhood conditions and emphasizes the need for focused rural development programmes.

Children whose mothers have no formal education or only pre-school education show the lowest rate (26.9%) of meeting the Complete ECD Index. As mother's education level increases, the percentage of children meeting the complete ECD criteria increases steadily, indicating a clear positive correlation: The highest developmental outcomes are seen in Mothers with higher education, where nearly half (49.9%) of children meet the full ECD benchmarks. Mother's education strongly influences ECD outcomes in the Punjab.

The increase from 26.9% (no education) to almost 50% (higher education) in children meeting the ECD index demonstrates the critical role of maternal education in enhancing child development. This gradient highlights the importance of maternal literacy, health knowledge, and parenting skills in supporting cognitive, social-emotional, and physical development. Mothers with lower education levels are at higher risk of developmental delays and poor school readiness.

Promote female education at all levels, ensuring girls complete secondary and higher education. Develop parenting and early learning programmes targeted at mothers with low education, to compensate for limited home learning environments. Integrate community outreach and adult education programmes to improve maternal literacy and health awareness. Support early childhood interventions that provide learning materials and stimulation, especially for mothers with no or low education.

Mother's education is a key determinant of comprehensive early childhood development in Punjab. Children whose mothers have higher education are nearly twice as likely to meet complete ECD criteria compared to those whose mothers have no education. Addressing educational disparities among women is essential to improve child development outcomes and long-term societal progress.

5.6.5. ECD and BMI

Table 5.6.7. ECD and BMI in Punjab

ECD Status	Average BMI (WHO)
Did not meet Complete Index (0)	17.61
Met Complete Index (1)	18.01

Children who meet the Complete ECD Index (i.e., demonstrate appropriate development in literacy/numeracy, physical, learning, and social-emotional domains) have a higher average BMI (18.01) compared to those who do not (17.61).

The difference, while numerically small (0.4 points), is developmentally meaningful in a population-level context - especially in early childhood, where small changes in BMI can reflect significant differences in nutrition, health status, and physical growth.

There is a positive linkage between physical health (BMI) and overall child development.

Undernourished children are less likely to meet complete ECD milestones, underlining the importance of integrating nutrition support into early childhood programmes.

Interventions in the Punjab should ensure: Regular growth monitoring, Access to nutritious meals (especially in ECE centres and low-income areas), Parental education on child feeding practices, and Linkages between health and education services.

Children in the Punjab who meet the Complete Early Childhood Development Index tend to have a higher average BMI (18.01), which means better health and nutrition status. This reinforces that adequate nutrition is foundational for achieving full developmental potential and should be a core component of early childhood development strategies.

5.6.6. District-wise comparison

Table 5.6.8. Percentage of the Children Meeting ECD index by District

District	Total Children	ECD Not Met (Count)	ECD Met (Count)	% ECD Met
Rawalpindi	336	155	181	53.9
Attock	237	118	119	50.2
Gujranwala	441	210	231	52.4
Jhang	312	194	118	37.8
Toba Tek Singh	264	162	102	38.6
Dera Ghazi Khan	434	258	176	40.6
Rajanpur	375	231	144	38.4
Faisalabad	486	325	161	33.1
Muzaffarargarh	503	343	160	31.8
Sialkot	348	219	129	37.1
Okara	379	241	138	36.4
Gujrat	317	192	125	39.4
Sheikhupura	327	201	126	38.5
Multan	348	225	123	35.3
Bahawalpur	373	250	123	33.0
Kasur	368	272	96	26.1
Rahim Yar Khan	516	370	146	28.3
Vehari	321	233	88	27.4

Pakpattan	279	207	72	25.8
Sahiwal	282	211	71	25.2
Khanewal	306	209	97	31.7
Lodhran	248	195	53	21.4
Mianwali	245	207	38	15.5
Bhakkar	265	220	45	17.0
Khushab	204	154	50	24.5
Sargodha	294	183	111	37.8
Narowal	310	244	66	21.3
Hafizabad	188	141	47	25.0
Mandi Bahauddin	242	165	77	31.8
Jhelum	166	102	64	38.6
Chakwal	197	105	92	46.7
Nankana Sahib	223	155	68	30.5
Chiniot	213	168	45	21.1
Bahawalnagar	332	228	104	31.3
Layyah	306	204	102	33.3
Lahore	489	344	145	29.7

Top Performing Districts

(Highest % of Children Meeting ECD Index):

Rawalpindi – 53.9%,

Attock – 50.2%,

Gujranwala – 52.4%,

Chakwal – 46.7%,

Dera Ghazi Khan – 40.6%

Lowest Performing Districts:

Mianwali – 15.5%,

Bhakkar – 17.0%,

Khushab – 24.5%,

Narowal – 21.3%,

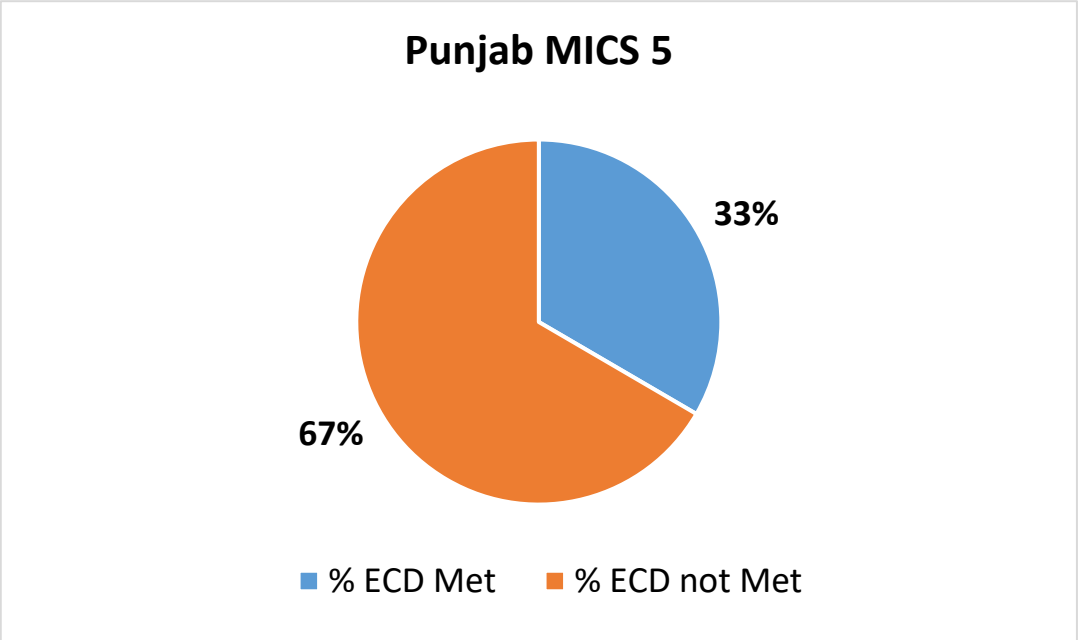
Chiniot – 21.1%

Key Observations:

Urbanized districts like Rawalpindi, Gujranwala, and Attock have significantly higher percentages of children meeting complete ECD benchmarks.

Southern and Western Punjab districts like Mianwali, Bhakkar, and Khushab show lower performance, which potentially reflects disparities in infrastructure, access to early learning, health services, and maternal education.

Surprisingly, despite being an urban center, Lahore shows relatively low performance (29.7%), which may reflect pockets of disadvantage or slum populations affecting averages.



The above pie-chart indicates that only **33%** of children met their early childhood development milestones, while **67%** did not.

5.6.7. Implications for Policy and Planning:

District-level targeting is essential: Interventions must be tailored for lagging districts with focused investment in early childhood education, nutrition, and health.

Rural and underserved areas require urgent support to bridge the development gap.

Cross-sector collaboration is needed: education, health, nutrition, and social protection sectors must coordinate to improve ECD outcomes.

5.7. Punjab MICS 6 Analysis

5.7.1. ECD comparison

Table 5.7.4. ECD comparison based on Gender, Mother's Education and Wealth

Gender				
	Not Developmentally on Track	**Developmentally on Track**	**Total**	**Percentage on Track**
Male	5132	3094	8226	37.6
Female	4853	2917	7770	37.5
Total	9985	6011	15996	37.6
Mother's Education Level				
None / Preschool	5,028	2,387	7,415	32.20
Primary	2,022	1,191	3,213	37.10
Middle	942	653	1,595	40.90
Secondary	1,058	885	1,943	45.50
Higher Education	918	889	1,807	49.20
Missing / Don't Know	0	0	0	-
Household Wealth Status and ECD development				
Wealth Quintile				
Poorest	2,754	1,298	4,052	32.00
Second	2,238	1,190	3,428	34.70
Middle	2,014	1,186	3,200	37.10
Fourth	1,757	1,217	2,974	40.90
Richest	1,205	1,114	2,319	48.00
Missing (Wealth Index = 0)	17	6	23	-

There is no significant gender gap in overall ECD. This suggests equitable access and outcomes across genders in early years. Since both boys and girls show low overall readiness (only ~38%), interventions need to target all children, not just specific gender groups. Policies and programmes should prioritize universal ECD access, especially in literacy, numeracy, and health - rather than gender-differentiated approaches at this stage.

As mother's education level increases, so does the likelihood of the child being developmentally on track. Mothers with no formal education: Only 32.2% are developmentally on track. Primary education: 37.1% are on track. Higher education: Nearly half (49.2%) are on track. There is a strong positive association between a mothers education and a child's

likelihood of being developmentally on track. ECD policies should not only focus on direct child services, but also include strategies to empower and educate mothers, which can have a multiplier effect on child well-being and future learning outcomes.

There is a strong, positive correlation between household wealth and the likelihood of a child being developmentally on track. The proportion of children developmentally on track rises consistently across quintile (i.e. from 32.0% in the poorest group to 48.0% in the richest. Children from the richest households are nearly 1.5x more likely to be developmentally ready than those from the poorest households.

Wealthier families often have better access to education, nutrition and healthcare, more stimulating home environments (books, toys, conversation), time and resources for parental engagement. Children from the lowest wealth quintile face multiple, interconnected deprivations—including food insecurity, poor health, and limited access to early stimulation—that collectively hinder their early development. Without timely interventions, these children are at a heightened risk of falling further behind as they enter school, reinforcing inter-generational cycles of poverty and limiting opportunities for cognitive, social, and emotional growth.

Wealth status is a strong predictor of early childhood development. Children from wealthier families have better developmental outcomes, largely due to enhanced access to resources and stimulation. To ensure equitable developmental opportunities, policies must prioritize children from the poorest households, focusing on early learning, nutrition, and caregiver support.

5.7.2. ECD and BMI

ECD Status	**Mean BMI (WHO Standards)**
Developmentally on track (1.00)	18.77
Not Developmentally on track (0.00)	18.48

Children who are developmentally on track have a slightly higher average BMI (18.77) compared to those not on track (18.48). While the difference (+0.29) is modest, it reflects a positive association between better nutritional status and developmental outcomes.

Adequate nutrition (reflected in healthier BMI levels) is crucial for brain development, physical growth, and cognitive functioning. Poor nutrition or under nutrition may delay motor skill and cognitive development, lower energy levels, reduce learning engagement, and compromise immune function, leading to more illness (which affects play, learning, and socialization). Children with better development may also have better feeding practices (due to more engaged caregivers) and improved access to health services (due to higher-functioning households).

Although the BMI difference between groups is relatively small, it supports global evidence that nutrition and development are closely linked. Investing in early nutrition, particularly in the first five years, is essential for improving developmental outcomes and school readiness among children in the Punjab.

5.7.3. District-wise Comparison

District	Not On Track (0.00)	On Track (1.00)	Total	% On Track
Lahore	375	429	804	**53.4**
Rawalpindi	304	397	701	**56.6**
Dera Ghazi Khan	259	227	486	46.7
Muzaffargarh	315	262	577	45.4
Bhakkar	224	227	451	50.3
Chakwal	192	158	350	45.1
Layyah	181	158	339	46.6
Rajanpur	224	168	392	42.9
Multan	448	292	740	39.5
Mandi Bahauddin	329	203	532	38.2
Jhang	301	160	461	34.7
Faisalabad	564	296	860	34.4
Vehari	253	165	418	39.5
Gujrat	302	138	440	31.4
Gujranwala	455	215	670	32.1
Okara	274	123	397	31.0
Toba Tek Singh	230	128	358	35.8
Khanewal	235	145	380	38.2
Bahawalpur	325	87	412	21.1
Bahawalnagar	292	125	417	30.0
Rahim Yar Khan	398	223	621	35.9
Sialkot	329	145	474	30.6
Sargodha	265	147	412	35.7
Hafizabad	230	63	293	21.5
Chiniot	182	87	269	32.3
Narowal	261	57	318	17.9

The percentage of children who are developmentally on track varies widely across districts from as low as 17.9% (Narowal) to as high as 56.6% (Rawalpindi).

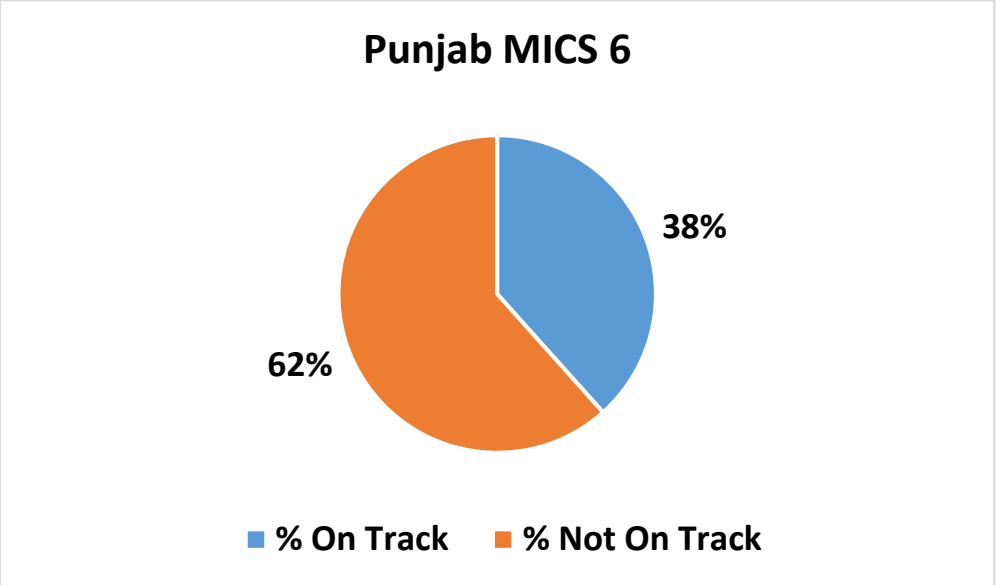
This shows a clear inequality in ECD outcomes within the province.

Urbanized districts like Rawalpindi and Lahore perform best, with more than half of children developmentally on track. In contrast, poorer and rural districts such as Narowal, Bahawalpur, Hafizabad, Bahawalnagar show significantly lower ECD readiness, with fewer than 1 in 3 children on track. South Punjab (e.g. Bahawalpur, Bahawalnagar, Rahim Yar Khan) and some west-central districts tend to underperform.

North-central and Potohar region generally perform better. Districts in the region that had the highest number of children surveyed like Faisalabad (860), Lahore (804), and Rawalpindi (701) strengthen the reliability of their results.

Smaller districts like Jhelum, Chiniot, and Narowal had fewer observations, but still reveal important trends.

This table provides crucial insight into geographic disparities in ECD across the Punjab. It highlights the need for equitable resource allocation, tailored interventions, and district-specific planning to ensure that all children, regardless of where they live, have a fair start in life.



This above pie-chart shows a notable improvement from MICS 5, with 62% of children being on track in their development, a significant increase from the previous survey. Conversely, 38% were not on track.

5.7.4. Evidence from the Punjab

[Childhood development at Risk in Mullapur]

In Mullapur village of Faisalabad district, Shabana Kausar's family is a living example as to how climate change impacts a child's well-being.

it was the time when heavy monsoon rains left fields waterlogged, homes damp and there was nothing to do. Staying inside a modest mud-brick house, Shabana was worried about her three young children. Her husband, a farm labourer, had gone for daily wage work. The family's food supply shrank to a little flour and lentils, since the nutritious items like milk, meat, and eggs were unaffordable.

The consequences were immediate and visible in her children. Her five-year old son's heart raced from dangerously low iron levels, and her younger daughter, once lively, winced in pain from a calcium deficiency.

Shabana watched as malnutrition left its mark, her children’s energy fading, school days being missed. She was witnessing what a health worker had once told her that poor diets in early childhood could limit growth, learning, and future opportunities.

For families like hers, every extreme event of climate change is a direct threat to the health and development of their children.

5.8. Sindh MICS 5 Analysis

5.8.1. Age of child

Table 5.8.1. Age of child

2014			2018		
Age	**Frequency**	**Per cent**	**Age**	**Frequency**	**Per cent**
3	3563	51.8	3	3839	48.6
4	3316	48.2	4	4060	51.4
Total	6879	100	**Total**	7899	100

The sample is almost evenly split between 3- and 4-year old children in 2014 with a slightly higher proportion of 3 years old. This distribution is important for planning age-appropriate ECD programmes, as both age groups represent a critical window for foundational learning and school readiness. The Sindh government introduced its Early Childhood Education (ECE) policy in 2015, aiming to reach children aged 3 to 8. Currently, about 6,000 ECE classes are active, serving over 800,000 children in that age range.

However, Sindh has one of the lowest ECE enrolment rates in Pakistan, i.e. around 27% compared to the national average of 43%.

This nearly even distribution between ages 3 and 4 during 2018 indicates that the ECD initiative is reaching both early preschool (age 3) and later preschool/pre-kindergarten (age 4) cohorts almost equally. This is common in many ECD programmes aiming to balance early readiness and foundational learning. According to the World Bank's Pakistan Human Capital Review (2020) in Sindh, 19.7% of urban children aged 3–5 were enrolled in ECE, compared to just 4.1% of rural children. This highlights a significant urban–rural enrolment gap. UNICEF reports that Sindh has the lowest ECE enrolment in Pakistan, at around 27% compared to a national average of 43%.

Demographically, 40% of Sindh's population is under 15 years with a large share under 5 - emphasizing the critical need for effective ECD programmes. The age breakdown you provided (48.6% age 3; 51.4% age 4) consists of a sampled group of ECD attendees, showing relatively balanced coverage across those early years. However, broader enrolment remains low, especially in rural areas. Efforts like those by UNICEF (establishing ECD centers, training providers, and supporting parents) are essential to expand reach and improve outcomes.

5.8.2. ECD Overall Analysis

	2014		2018			
Indicator	**% Yes (Skill Present)**	**% No (Skill Not Present)**	**% Yes (Skill Present)**	**% No (Skill Not Present)**	**Description**	**Implications**
Can identify at least 10 letters of the alphabet	19.30	80.70	22	78	Can recognize at least 10 alphabet letters.	Very low literacy readiness; urgent need for foundational reading skill development in ECD programmes.
Can read four simple words	21.00	79.00	26.40	73.60	Can read common words like "milk", "book", etc.	Reading skills underdeveloped; reflects weak literacy instruction and exposure.
Can recognize numbers from 1 to 10	18.90	81.10	21.30	78.70	Can name and recognize all numbers from 1 to 10.	Very low numeracy readiness; number exposure and concept-building activities are lacking.

Can pick up small objects with two fingers	82.20	17.80	70.50	29.50	Demonstrates fine motor control using thumb and index finger.	Strong motor development; children are physically capable of engaging in writing and manipulative tasks.
Is sometimes too sick to play *(negative health indicator)*	51.00	49.00	59.60	40.40	Child is generally healthy enough to participate in play.	40% being too sick to play is concerning; suggests need for health and nutrition interventions.
Follows simple directions	76.80	23.20	69.40	30.60	Understands and responds to basic instructions.	Good indicator of school readiness; 30% may have cognitive or communication delays.
Can do something independently	69.40	30.60	63.70	36.30	Demonstrates independence in simple tasks (e.g., dressing, eating).	Encouraging for self-help skills, but over one-third still need assistance - needs caregiver guidance.
Gets along well with other children	81.20	18.80	84.10	15.90	Can cooperate, play, and interact positively with peers.	Strong social-emotional foundation for group learning; a key strength to leverage in classrooms.
Kicks, bites, or hits others *(negative behavior indicator)*	44.50	55.50	41.80	58.20	Does not show aggressive or disruptive physical behaviours.	High levels of aggression (58%) suggest emotional/behavioural regulation issues; need for SEL programmes.
Gets distracted easily *(negative attention indicator)*	44.70	55.30	33.70	66.30	Able to sustain attention during activities.	High distractibility is a major barrier to learning; calls for structured routines and focus-building activities.

Cognitive & Academic Readiness is very low (i.e. less than 1 in 5 children meet basic benchmarks in literacy and numeracy). Motor and Social-Emotional Skills are relatively strong, especially in fine motor control and peer relationships. Health and behavioural challenges (e.g. illness, aggression, distractibility) affect a large portion of children and can obstruct learning. There is a clear disconnect between physical readiness and academic preparedness, which points to a lack of structured early learning environments rather than developmental limitations.

Policy Actions

- Prioritize literacy and numeracy instruction through play-based child-centered learning,
- Introduce structured behavioural routines to manage aggression and improve focus.
- Leverage children's social strengths to support peer learning and cooperation,
- Integrate health, hygiene, and nutrition interventions to reduce illness-related absences,
- Provide teacher training in classroom management and emotional development.

5.8.3. Early Childhood Development Indices

Table 5.8.3. Early Childhood Development Indices

	Sindh MICS 5		Sindh MICS 6			
Index	**% Meeting Benchmark (1.00)**	**% Not Meeting Benchmark (0.00)**	**% Meeting Standard (1.00)**	**% Not Meeting (0.00)**	**Description**	**Implications**
Num_Lit_Index *(Numeracy & Literacy)*	17.80	82.20	22.20	77.80	Measures ability to recognize letters, numbers, or simple words.	Very low performance shows urgent need for foundational learning in early years.
Physical_Index *(Fine Motor & Health)*	43.60	56.40	31.20	68.80	Assesses motor skills and health-related development.	Indicates possible malnutrition or lack of physical activity; requires health-nutrition-ECD integration.
Lear_Index *(Cognitive Learning)*	62.30	37.70	55.80	44.20	Evaluates if the child can follow instructions and complete tasks independently.	Moderate performance; structured early learning programmes can improve readiness.
Social_emo_Index *(Social & Emotional)*	68.10	31.90	77.70	22.30	Reflects emotional maturity and social	Strong domain; can be leveraged to support group-based learning and inclusion.

					interaction with others.	
Overall_Index *(All Domains Combined)*	29.70	70.30	30.10	69.90	Composite of the above; on track in at least 3 of 4 domains.	Majority of children not developmentally on track; systemic reforms urgently needed.
	2014		**2018**			
Index	**% Meeting Benchmark (1.00)**	**% Not Meeting Benchmark (0.00)**	**% Meeting Standard (1.00)**	**% Not Meeting (0.00)**	**Description**	**Implications**
Num_Lit_Index *(Numeracy & Literacy)*	17.80	82.20	22.20	77.80	Measures ability to recognize letters, numbers, or simple words.	Very low performance shows urgent need for foundational learning in early years.
Physical_Index *(Fine Motor & Health)*	43.60	56.40	31.20	68.80	Assesses motor skills and health-related development.	Indicates possible malnutrition or lack of physical activity; requires health-nutrition-ECD integration.
Lear_Index *(Cognitive Learning)*	62.30	37.70	55.80	44.20	Evaluates if the child can follow instructions and complete tasks independently.	Moderate performance; structured early learning programmes can improve readiness.
Social_emo_Index *(Social & Emotional)*	68.10	31.90	77.70	22.30	Reflects emotional maturity and social interaction with others.	Strong domain; can be leveraged to support group-based learning and inclusion.

The Numeracy & Literacy Index is the weakest area with only 17.8% of children developing on track. Social-emotional and cognitive learning are comparative strengths, suggesting children have the capacity to learn but lack the support to acquire academic skills. Only 29.7% of children meet the overall ECD benchmark, confirming a systemic challenge in early childhood development in Sindh.

Policy Actions:

- Strengthen foundational literacy and numeracy through play-based, language-rich ECE programmes,
- Invest in child health and nutrition, especially to improve physical readiness,
- Build on existing social-emotional strengths through group activities and behavioural guidance, and

- Carry out targeted interventions for the 70% of children, who are developmentally off-track overall.

Only 30.1% of children in 2018 are developmentally on track in at least three of the four domains while 69.9% are not. This composite index provides a holistic view of child development across all critical areas. The overall low score is alarming. It reflects a systemic failure to meet the developmental needs of young children in Sindh. It points to urgent cross-sectoral interventions, including early education, caregiver training, nutrition, child protection, and policy reform to improve early childhood outcomes.

Foundational skills (literacy, numeracy, and physical development) are underdeveloped in most children, severely impacting school readiness. Social-emotional development is a relative strength, providing a base to build holistic interventions. The overall ECD Index (30.1% on track) shows that over two-thirds of children are not meeting minimum development milestones.

Policy Actions:

- Prioritize early learning programmes focused on literacy, numeracy, and play-based learning,
- Integrate health and nutrition services with ECD to improve physical development outcomes,
- Leverage strengths in social-emotional development to support inclusive classroom practices,
- Invest in caregiver education and home-based stimulation to promote early cognitive skills,
- Expand access to quality Early Childhood Education (ECE), especially in rural and underserved areas.

5.8.4. ECD Analysis

Table5.8.4. ECD Analysis based on Gender, Mother's Education and Wealth

Gender				
	Not Developmentally on Track	**Developmentally on Track**	**Total**	**Percentage on Track**
Male	2452	1056	3508	30.10
Female	2386	985	3371	29.20
Total	4838	2041	6879	29.70
Mother's Education Level				
None / Preschool	3,534	1,140	4,674	24.40
Primary	626	307	933	32.90
Middle	184	129	313	41.20

Secondary	273	203	476	42.60
Higher Education	135	157	292	53.80
Higher Education (College)	86	104	190	54.70
Household Wealth Status and ECD development				
Wealth Quintile				
Poorest	1,679	457	2,136	**21.40**
Second	1,474	463	1,937	**23.90**
Middle	993	496	1,489	**33.30**
Fourth	437	332	769	**43.20**
Richest	255	293	548	**53.50**

Males (30.1%) are slightly more likely to be developmentally on track than females (29.2%), though the gap is marginal (~0.9%). Both genders have low overall ECD performance, with about 70% of children not meeting developmental benchmarks. The results are consistent with national trends showing slightly higher ECD outcomes among boys, possibly due to gendered differences in access to nutrition, stimulation, or education.

The small gender gap should not distract from the broader issue: ECD performance is low for both boys and girls. Interventions should be universal but with targeted support for girls, who may face additional barriers due to cultural norms, lower investment in female education, higher rates of malnutrition and household neglect in some areas.

There's a clear positive correlation between a mother's education and her child being developmentally on track. Mothers with no education are the least likely to be developmentally on track (only 24.4%). Mothers with college or higher education are more than twice as likely to be developmentally on track (54.7%) compared to those whose mothers have no formal education. Mother's education is one of the strongest predictors of positive child development outcomes.

Policy Actions:

- Engage educated mothers in stimulating activities (such as reading, talking, counting),
- Provide better nutrition and health care,
- Enroll children in ECE programmes,
- Prioritize female literacy and education in policy, especially in rural and under served areas,
- Target less-educated mothers for parenting programmto provide skills and knowledge about child development,
- Employ cross-sectoral approaches linking maternal education, health, and ECD interventions.

There is a strong positive correlation between household wealth and ECD outcomes. Children from the richest quintile are more than twice as likely to be developmentally on track

(53.5%) compared to those from the poorest quintile (21.4%). The developmental gap narrows steadily with each increase in wealth quintile. Poverty is a major barrier to ECD. Poor households may struggle to provide nutritious food, learning materials, stimulating environment, access to ECE and healthcare. Programmes must prioritize low-income families for ECD interventions, include cash transfers, nutrition support, and free or subsidized early learning opportunities. There is a need to integrate ECD with social protection systems.

5.8.5. ECD and BMI

ECD Status	Mean BMI (WHO Standards)
Developmentally on track (1.00)	19.5
Not Developmentally on track (0.00)	18.96

Children, who are developmentally on track, have a higher average BMI (19.50) compared to those who are not on track (18.96). The difference suggests that better nutritional status (as reflected by BMI) is positively associated with ECD. A BMI closer to the healthy range (depending on age and sex) often reflects adequate nutrition, better overall health, and higher energy and participation levels in developmental activities. Nutrition and physical health are foundational to early development. Children with poor nutritional status (under weight or stunted) may struggle with concentration, physical activity, cognitive and emotional regulation. Integrating nutrition services (like supplementation, growth monitoring, and parental education) into ECD programmes can significantly improve development outcomes.

5.8.6. District-wise Comparison

District	Not On Track (0.00)	On Track (1.00)	Total	% On Track
Kashmore	257	40	297	13.5
Jacobabad	201	17	218	**7.8**
Shahdad Kot	216	112	328	34.1
Larkana	189	76	265	28.7
Shikarpur	267	42	309	13.6
Ghotki	270	73	343	21.3
Sukkur	206	82	288	28.5
Khairpur	181	142	323	**44.0**
Naushahro Feroze	193	75	268	28.0
Shaheed Benazirabad	201	160	361	**44.3**

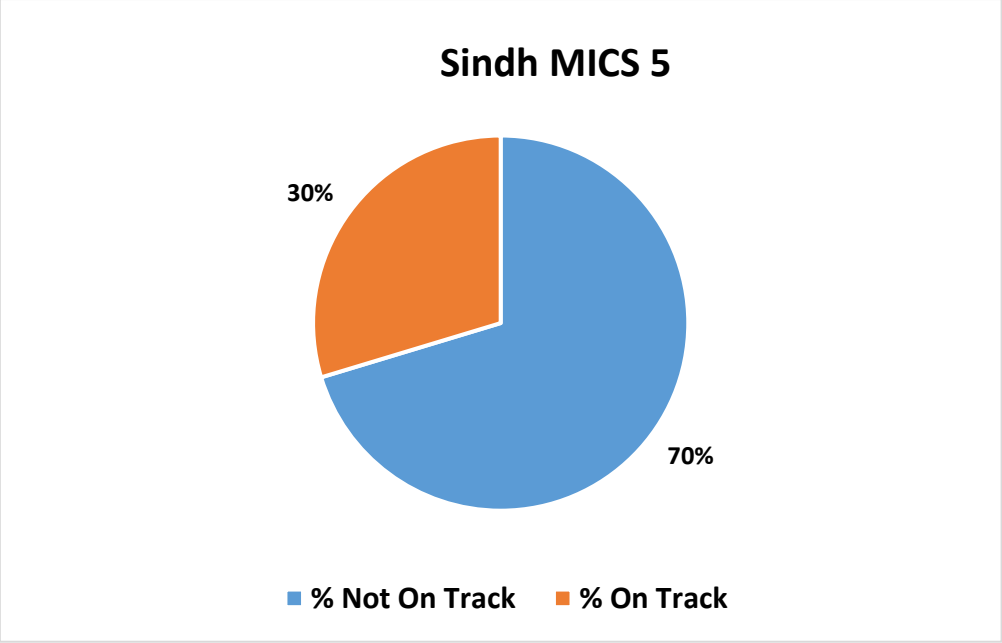
Dadu	248	69	317	21.8
Jamshoro	111	30	141	21.3
Hyderabad	83	125	208	**60.1**
Matiari	192	59	251	23.5
Tando Allahyar	140	80	220	36.4
Tando Muhammad Khan	162	22	184	12.0
Badin	210	39	249	15.7
Sujawal	138	128	266	**48.1**
Thatta	161	50	211	23.7
Sanghar	209	39	248	15.7
Mirpur Khas	147	39	186	21.0
Umer Kot	228	54	282	19.1
Tharparkar	184	50	234	21.4
Karachi Malir	99	75	174	43.1
Karachi East	93	98	191	**51.3**
Karachi Central	68	86	154	**55.8**
Karachi West	120	106	226	**46.9**
Karachi South	64	73	137	**53.3**

Urban Advantage: All Karachi districts and Hyderabad show above-average ECD performance, likely due to higher household wealth, education, and service availability.

Rural Deprivation: Most districts in Northern and Interior Sindh (Jacobabad, Kashmore, Shikarpur) are well below the provincial average.

Unexpected High Performers: Some semi-urban or rural districts like Sujawal (48.1%) and Khairpur (44.0%) show promising results, possibly due to targeted programmes or NGO support.

ECD Inequality: The range from 7.8% to 60.1% shows stark regional disparities, requiring district-specific planning. Target low-performing districts with integrated ECD services (health, nutrition, education). Scale successful interventions from high-performing areas to under served regions. Implement district-specific action plans, focusing on maternal education, child health, and early learning.



The **Sindh MICS 5** graph shows a positive trend where **70%** of children were considered "not on track," while only 30% were on track.

5.9. Sindh MICS 6 Analysis

5.9.1. ECD Analysis

Table 5.9.4. ECD Analysis based on Gender, and Mother's Education, Wealth and BMI

Gender				
	Not Developmentally on Track	**Developmentally on Track**	**Total**	**Percentage on Track**
Male	2844	1296	4140	31.3
Female	2677	1082	3759	28.8
Mother's Education Level				
None / Preschool	4,103	1,386	5,489	25.20
Primary	579	297	876	33.90
Middle	210	138	348	39.70
Secondary	285	241	526	45.80
Higher Education	339	313	652	48.00
Household Wealth Status and ECD development				
Wealth Quintile				

Poorest	1,760	495	2,255	21.90
Second	1,419	493	1,912	25.80
Middle	1,186	472	1,658	28.50
Fourth	735	456	1,191	38.30
Richest	417	459	876	52.40
ECD and BMI				
Mean BMI (WHO Standards)	16.36		16.54	

About 31.3% of boys are developmentally on track overall compared to 28.8% of girls. Although both genders are far below acceptable development thresholds, boys have a small advantage in this dateset. Over two-thirds of both boys and girls are not meeting expected developmental milestones in at least 3 of the 4 ECD domains. This shows a system-wide issue, that is not limited to one gender.

The gender gap of about 2.5 percentage points in favour of boys is modest, but still important. It may reflect: Gendered differences in caregiver expectations or attention. Access to early learning (e.g. boys may be slightly more likely to attend ECE programmes). Cultural norms influencing how boys vs girls are engaged in early development activities. Female disadvantage, although modest, is concerning because girls in some communities may have less access to early stimulation, outdoor play, or learning opportunities. Both boys and girls show alarmingly low ECD outcomes, indicating that gender-specific interventions should be part of a broader, system-wide strategy.

Policy Actions:

- Promote gender-equitable caregiving and learning,
- Encourage parents and caregivers to engage equally with girls and boys in literacy, play, and learning.
- Ensure girls' equal access to ECE programmes, learning materials, and health services,
- Train teachers and caregivers to be aware of unconscious gender bias and ensure inclusive environments for both genders, and
- Dis aggregate all ECD monitoring data by gender for targeted planning and programme adjustments.

There is a clear cut upward trend. As mother's education level increases, so does the percentage of children, who are developmentally on track. Only 25.2% children, whose mothers have no or pre-primary education, are on track. Children of highly educated mothers, i.e. nearly 48.0%, are developmentally on track.

In this scenario, mothers with higher education are almost twice as likely to be on track as those whose mothers have no education (48% vs 25.2%). Maternal education is one of the strongest predictors of child development in this data set. Educated mothers may be more aware of child development needs.

Policy Actions:

- Provide them better learning environments at home,
- Be more likely to enroll children in ECE programme,
- Have better health-seeking behavior,
- Promote girls' education (as investing in girls' and women's education today leads to better ECD outcomes tomorrow.),
- Target ECD interventions to low-education households to provide them additional support, outreach, and home-based learning materials to mothers with little or no formal education,
- Include parenting education in ECD policy and teach them early stimulation and care giving practices regardless of the mother's education level,
- Leverage educated mothers as community champions to influence peer networks and promote ECD best practices.

Only 21.9% of children from poorest households are on track. Over half (52.4%) of children from richest households are developmentally on track. Children in the poorest quintile are more than twice as likely to be developmentally off track compared to children in the richest quintile. The ECD disadvantage among the poor is both wide and deep, with nearly 4 in 5 children in the poorest group falling behind. Wealthier households can provide better nutrition and healthcare, early learning materials (such as books, toys, digital media, etc.), environment that stimulate play and socialization, access to quality early childhood education (ECE) programmes. Poorer households may face food insecurity, limited caregiver time, etc.

This data clearly shows that wealth-based inequality is a major driver of poor ECD outcomes in Sindh. Intervening early in low-income households offers the highest return - helping children catch up and reducing inter-generational poverty.

Children, who are developmentally on track have a higher average BMI (16.54) than those who are not on track (16.36). The difference is modest (0.18 points) but consistent with research showing that nutritional status affects physical and cognitive development. For children aged 3–5 (typical ECD range), a BMI between 15.0–17.0 is considered normal. This means that most children in the sample are not severely underweight, but those who are doing better developmentally have marginally better nutrition.

Nutrition plays a critical role in early childhood development. Even small differences in BMI can reflect better dietary diversity, more consistent feeding practices, improved immunity and energy levels, which support learning and physical play. This aligns with existing evidence that malnutrition in early childhood impairs brain development, learning, and school readiness.

Policy Actions:

- Integrate nutrition interventions into ECD programmes,
- Ensure that children have access to adequate and diverse diets, especially in low-income areas,
- Screen for under-nutrition in early childhood centers to identify children at risk of developmental delays,

- Educate caregivers about child nutrition, feeding practices, and growth monitoring as part of parenting sessions,
- Coordinate with health departments to offer deworming, vitamin supplementation, and regular growth tracking in ECD programmes.

Even though the difference in BMI is small, it's meaningful, pointing to the important role of child nutrition in early cognitive and physical development. Investing in early nutrition is equal to investing in early learning.

5.9.2. District-wise Comparison

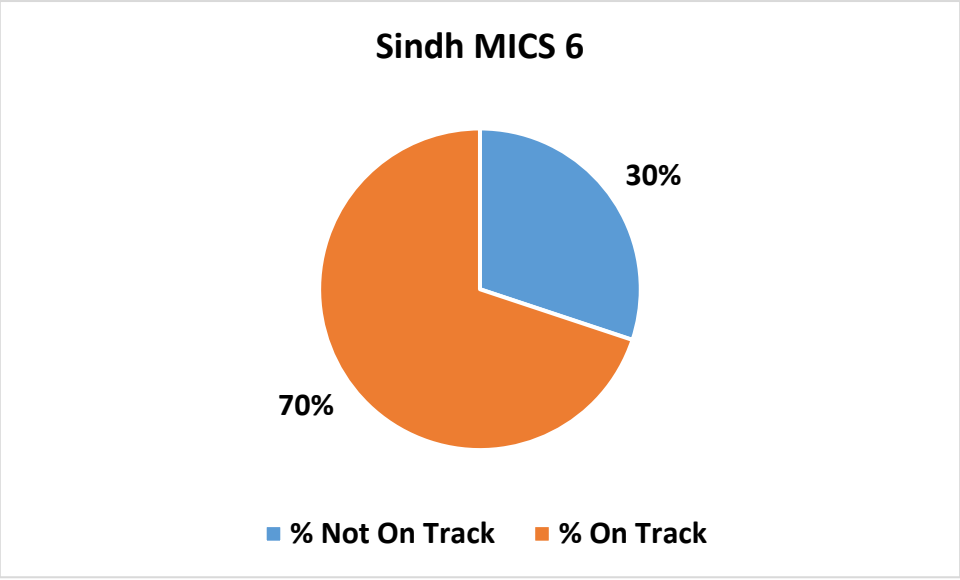
District	**Not On Track (0.00)**	**On Track (1.00)**	**Total**	**% On Track**
District	On Track	Not On Track	Total	% On Track
Karachi East	219	131	350	62.6
Karachi South	104	75	179	58.1
Karachi Central	106	112	218	48.6
Khairpur	157	138	295	53.2
Kashmore	174	226	400	43.5
Sanghar	84	142	226	37.2
Matiari	126	161	287	43.9
Thatta	124	200	324	38.3
Kambar Shahdadkot	94	223	317	29.7
Karachi West	108	206	314	34.4
Larkana	74	179	253	29.2
Korangi	52	177	229	22.7
Jamshoro	10	219	229	4.4
Tharparkar	12	248	260	4.6
Naushahro Feroze	32	190	222	14.4
Mirpur Khas	59	227	286	20.6
Shikarpur	61	238	299	20.4
Ghotki	65	226	291	22.3
Umerkot	100	228	328	30.5
Jacobabad	42	249	291	14.4
Sukkur	63	248	311	20.3
Tando Muhammad Khan	59	223	282	20.9

Tando Allahyar	56	194	250	22.4
Dadu	26	158	184	14.1
Badin	117	211	328	35.7
Hyderabad	91	132	223	40.8
Malir	66	158	224	29.5
Shaheed Benazirabad	54	191	245	22.0
Sujawal	43	211	254	16.9

There is a clear-cut urban-rural divide in ECD outcomes. Urban centers like Karachi East and South outperform interior districts by a wide margin. Many districts in rural Sindh have alarming levels of developmental delay with less than 1 in 5 children developmentally on track. Even within urban areas, disparities Korangi and Malir lag behind Karachi East or South, reflecting internal inequality.

Policy Actions:

- Prioritize low-performing districts for ECD investments, with multi-sectoral approaches.
- Improve access to ECE programmes, especially in Jamshoro, Tharparkar, and Jacobabad.
- Deploy mobile ECD units or community-based preschools in hard-to-reach areas.
- Use high-performing districts as models for scalable, localized ECD interventions.



This pie chart shows a positive trend, with **70%** of children in Sindh being on track in their development. This means only **30%** of children were not on track.

6. Empirical Analysis

6.1. Descriptive Analysis

In Pakistan, the extreme climatic events is a frequent phenomenon. The details of events occurred during the last one and a half decades are presented in the below table.

Table 6.1. Occurrence of extreme events during last one and a half decades in Pakistan

Year(s)	Event Type	Regions Affected	Impact Overview
2010	Mega Floods	Nationwide	~2,000 deaths; massive land and village flooding
2013–2014	Flash & Monsoon Floods	Multiple provinces	Hundreds of deaths; millions affected
2015	Heatwave	Sindh, Karachi	~2,000 deaths
2020	Urban Flood (Karachi)	Karachi	Major disruption; 41 deaths
2022	Monsoon Floods	Sindh, Balochistan, etc.	33 million affected; 1,300+ deaths
2022	Snowstorm (Murree)	Murree, Punjab	23 tourist deaths
2022	Early Heatwave	Sindh, interior	Extreme highs around 49 °C
2023	Prolonged Heatwave	Nationwide	22 deaths; health strain
2024	Heatwave + Floods	Sindh, Punjab, Khyber Pakhtunkhwa, Balochistan	Hundreds of deaths; widespread losses
2025	Flash Floods	Punjab, Khyber Pakhtunkhwa	300+ deaths; massive displacement

Over the past one and a half decades, Pakistan has faced increasingly frequent and severe heatwaves, urban and monsoon flooding, snow-related disasters, and flash floods, often with overlapping impacts. Climate change, land-use shifts, inadequate infrastructure, and rapid urban expansion intensify the country's vulnerability. Moving forward, adaptive planning, stronger early warning systems, improved water management, and climate-resilient infrastructure are essential to mitigate these escalating threats.

6.2. Selection of Extreme Events

The primary focus was on two climate change variables, i.e. rainfall and temperature. From these continuous variables, the extreme variables were extracted by calculating the deviation from the mean. In case of rainfall, 10 per cent deviation from mean was considered as extreme event. Similarly in case of temperature, 3 per cent and 2 per cent deviation from mean was considered as extreme event. The details are presented in the tables below.

Table 6.2.1 Description of Average and Extreme Events (Rainfall and Temperature)

Climate Indicator	Average	Extreme Events Occurrence (Frequency)	Extreme Events (Percentage)
Rainfall (mm/annum)	350.68	0.33	33 per cent
Temperature (degrees)	21.37		
Temperature (3 per cent deviation)		0.22	22 per cent
Temperature (2 per cent deviation)		0.44	44 per cent

Source: NASA data set.

Table 6.2.2. Descriptive Statistics of Rainfall and Temperature

Indicator	Minimum	Maximum	Mean	Std. Dev.
Rainfall	251	461	350	72.94
Temperature	21	22	21.37	0.566
ECD	5	37	21.56	10.56

Source: Author' calculations

6.3. Correlation Analysis

To document the impact of extreme events on ECD, two climate change indicator/variables have been selected, i.e. rainfall and temperature. Their impact on ECD has also been documented by using detailed correlation analysis as well as regression analysis.

Correlation analysis is important in impact evaluation because it helps identify and understand relationships between variables, which is critical when assessing whether and how an intervention or policy has had an effect.

Pearson Correlation (r): Measures the strength and direction of the linear relationship between two variables. It ranges between -1 to +1, positive 1 indicates perfect correlation, 0 = no correlation, -1 = perfect negative correlation. The correlation between rainfall and early childhood development is -0.69 indicating strong negative correlation. As rainfall increases, early childhood development outcomes tend to decline. Significant at the 0.05 level: This relationship is statistically reliable.

Similarly, relationship between extreme rainfall and early childhood development is strong negative, i.e. -0.821. More extreme rainfall events are strongly associated with poorer early childhood development. Highly significant ($p < 0.01$): Very reliable evidence of a negative impact.

Similarly, correlation between temperature and ECD is strong negative, i.e. -0.673. The results are also significant. Similarly extreme temperature events have strong negative correlation with ECD.

All climate indicators are negatively correlated with ECD, suggesting that as climate stress increases, child development worsens. The most impact full indicators appear to be: Extreme rainfall events (strongest negative effect). Rainfall and average temperature (also strong effects). Even moderate or weak indicators, like temperature extremes, show statistically significant negative associations. Climate change isn't just an environmental issue, it has serious implications for child well-being and development. Policymakers and stakeholders in child health and education need to consider climate resilience strategies.

Since rainfall variability, extreme rainfall, and temperature increases are strongly negatively correlated with ECD, policies must embed climate adaptation strategies into all early childhood services, climate-resilient infrastructure for early childhood centers, emergency preparedness plans to cope up with floods, storms, and heatwaves, continuity of care and education during climate shocks.

There is a need to prioritize vulnerable regions and populations. Areas more exposed to extreme weather events or high climate variability should be prioritized for targeted investments in child services. This includes strengthening social safety nets in climate-affected communities, deploying mobile or flexible early childhood care solutions during displacement or disaster events, monitoring and early warning systems tailored for child-related risks.

High temperatures and extreme events can worsen child health outcomes (e.g. malnutrition, waterborne diseases). Health policies should ensure access to clean water, sanitation, and nutrition during and after climate events. The government should train health workers to identify and respond to climate-related child health risks. Rigorous monitoring of child growth and cognitive development is need in climate-stressed areas. Climate-Sensitive Urban and Rural Planning is needed. Urban flooding and heat islands affect child safety, especially in low-income areas.

Policy Actions:

- Invest in green infrastructure (trees, cool spaces) near early childhood facilities.
- Improve drainage and housing standards to protect young children from floods and temperature extremes.
- Incorporate child impact assessments in climate-related urban planning.

Cross-Sectoral Coordination, Climate change impacts on ECD are multi-sectoral-spanning health, education, infrastructure, and environment.

Governments must promote integrated policy frameworks across ministries, Data-sharing between climate agencies and child welfare departments, Joint funding mechanisms for climate-resilient child development programmes. There is a need to

invest in Climate-Resilient Education, as early education is disrupted by extreme weather events.

Policy Actions:

- Promote remote learning platforms that can be activated during disasters,
- Build disaster-resilient schools and childcare centers,
- Train early educators to provide trauma-informed care after extreme climate events

Monitoring, Data & Research, the correlations point to significant relationships but not causation. More localized, longitudinal data is needed to track how specific climate events affect ECD outcomes (e.g. cognitive development, health). Design evidence-based interventions. Evaluate effectiveness of climate-sensitive child development programmes

Children, especially in low-income or rural communities, are disproportionately impacted. Policies should ensure equitable access to early childhood services in climate-affected zones. Community voices should be prioritized in climate and child policy design, recognize inter generational impacts of climate change and protect child rights.

This table below is a clear call to action. Climate change is already undermining ECD. Policy must evolve to be proactive rather than reactive, focus on resilience-building, and target the unique vulnerabilities of children.

Table 6.3. Relationship between climate change and early childhood development

Indicator	**Pearson Correlation (Early Childhood Development)**	**Significance Level**
Rainfall	-0.690	*
Extreme Rainfall Event	-0.821	**
Temperature	-0.673	*
Temperature Extreme	-0.194	*
Temperature Extreme	-0.341	**

Note: Results are significant at ***, **, * 1, 5 and 10 percent level of significance.

6.3.1. Province-wise Comparative Analysis

The province-wise comparative analysis is presented in the table below .

Table: Province-wise Comparative Analysis (Rainfall)

Province	**Pearson Correlation (Early Childhood Development)**	**Significance Level**
Azad Jammu & Kashmir	-0.60	**
Gilgit-Baltistan	-0.14	*
Khybe Pakhtunkhwa	-0.183	***
Punjab	-0.240	*
Sindh	-0.407	**
Balochistan	-0.5	-

Note: Results are significant at ***, **, * 1, 5 and 10 percent level of significance.

Balochistan province shows strong negative correlation (-0.50) that is linked to droughts, extreme heat, and poor infrastructure. Sindh shows moderate to strong correlation (-0.407).

Climate impacts on ECD are statistically significant. Reflects high exposure to urban flooding, extreme heat, and possibly malnutrition due to poor water/food access.

Punjab shows moderate negative correlation(-0.240,). Despite economic advantages, the Punjab still sees ECD challenges that are linked to climate stress, especially in urban and peri-urban areas.

Khyber Pakhtunkhwa (-0.183, *) shows weak correlation (-0.183, *) but statistically significant which indicates that even small changes in climate can measurably affect ECD here. It highlights the sensitivity of vulnerable populations in mountainous areas.

Gilgit-Baltistan shows weakest correlation (-0.14,), which Is still statistically significant. It suggests that climate impacts on ECD are currently less severe or buffered by traditional practices or smaller population size. Note: GB is glacier-dominated, so climate change risks here may be future-facing rather than current.

Table: Policy implications by province

Province	**Policy Focus Areas**
Azad Jammu & Kashmir	Flood-resilient infrastructure, landslide preparedness, mobile ECD units in remote areas
Balochistan	Drought-resilient nutrition and water systems, targeted early child health programmes
Sindh	Urban heat/flood mitigation, public health integration into ECD programmes
Punjab	Improve heat stress adaptation in urban ECD centers, monitor peri-urban vulnerabilities
Khyber Pakhtunkhwa	Child health resilience in disaster-prone and mountainous communities
Gilgit-Baltistan	Long-term planning for glacier melt and water stress impacts on children

Every province shows a negative correlation between climate indicators and ECD, though strength and significance vary. Azad Jammu and Kashmir (AJK), Balochistan, and Sindh are the most climate-sensitive in terms of child development. Even weak correlations in KP and GB are statistically significant, highlighting the subtle but real impacts of climate change on young children.

6.3.2. Province-wise Temperature Correlation Analysis

Province	**Pearson Correlation (Early Childhood Development)**	**Significance Level**
Gilgit-Baltistan	-0.11	-
Khyber Pakhyunkhwa	-0.260	**
Punjab	-0.154	*

Sindh	-0.372	***
Balochistan	-0.223	**

Rising temperatures in Sindh are strongly and reliably associated with declining ECD outcomes. This is because of urban heat islands, inadequate cooling infrastructure, malnutrition and dehydration, poor air quality in high-heat areas. Rising temperatures, particularly in mountainous and climate-sensitive regions, are likely to disrupt multiple pathways essential for early childhood development, including access to health services, nutritional security due to crop stress, and maternal and child health outcomes in already vulnerable communities. In Balochistan, a moderate but statistically significant negative correlation (–0.223, **p < 0.01**) highlights the persistent developmental risks associated with chronic exposure to extreme heat, prolonged water scarcity, and weak rural health infrastructure. These structural and environmental challenges amplify children's vulnerability to climate stressors, resulting in sustained developmental disadvantages.

In Punjab, the observed correlation between rising temperatures and early childhood development outcomes is weaker to moderate (–0.154), yet remains important in interpretation. Despite the province's relatively stronger economic position, recurring urban heatwaves pose significant risks by restricting outdoor physical activity for young children, impairing nutritional absorption, and disrupting school attendance as well as children's attention spans. These findings suggest that urban resilience does not fully shield children from the developmental consequences of extreme heat.

Gilgit-Baltistan appears to be the least affected region statistically, with a weak and non-significant correlation (–0.11). This relative insulation may be attributed to cooler baseline temperatures driven by high altitude and glacial landscapes, which currently limit the intensity and frequency of heatwaves impacting children's health. However, this apparent resilience should be interpreted with caution, as accelerating glacier melt, increasing water stress, and long-term climatic shifts pose emerging threats that could substantially alter developmental risks for children in the region in the future..

6.3.3. Policy Implications by Province (Temperature Focus)

Province	**Policy Recommendations**
Sindh	Prioritize urban cooling, heatwave early warnings, child-safe shelters, and nutritional interventions.
Khyber Pakhtunkhwa	Focus on heat-resilient rural health systems, maternal care, and mobile child services in highland areas.
Balochistan	Expand climate-smart nutrition, ensure water security, and integrate cooling in child care centers.

Punjab	Develop urban heat adaptation in schools and ECD centers, and integrate heat exposure education in curricula.
Gilgit-Baltistan	Begin long-term planning for glacier melt impacts, water shortages, and adaptive infrastructure for ECD.

Rising temperatures are clearly impacting ECD in most provinces, especially Sindh, Khyber Pakhtunkhwa, and Balochistan. Province of Sindh shows the most severe and statistically significant correlation, making it a critical area for intervention. Even provinces with lower correlations (e.g., GB) should begin preparing for future risks, as temperature rise accelerates.

6.4. Regression Analysis

6.4.1. Impact of Rainfall on Early Childhood Development

Regression analysis is used to examine the relationship between variables. The OLS regression model has been used to estimate the impact of rainfall and temperature on early childhood development (ECD). The coefficient is negative and significant at 5 percent level of significance indicating that more the occurrence of the extreme events less the early childhood development and vice versa.

Table: OLS estimates (Rainfall)

Variable	**Coefficient**	**t-values**
Early Childhood Development Index	-0.690	-2.25**
Constant	0.052	9.658***

Note: Results are significant at ***, ** and * 1, 5 and 10 percent levels respectively.

More the occurrence and intensity of the extreme events less the early childhood development. In other words, the occurrence of extreme events has negative impact on ECD.

Policy Actions:

Based on these empirical findings, it is suggested that resilience needs to be focused in early childhood programmes. Since rainfall negatively affects ECD programmes, support to young children must be adapted to function effectively during and after such events. There is a need to establish weather-resilient ECD centers (e.g. flood-resistant infrastructure). Caregivers and educators must be trained in disaster preparedness and trauma-informed care. Infrastructure needs to be improved in the vulnerable communities. Poor infrastructure exacerbates the impact of extreme weather on families, especially children. Invest in drainage systems, safe roads, and emergency shelters. Ensure continuity of nutrition and health services during extreme events.

In addition, climate risk needs to be integrated into national ECD policies. Current ECD policies may not account for increasing climate risks. Thus,

- Include climate adaptation strategies in ECD frameworks.
- Develop early warning systems tailored to caregivers and communities.

- Provide target Support to High-Risk Areas.

Some regions face more frequent or intense rainfall events. Thus,

- Prioritize funding and resources to regions most vulnerable to climate shocks.
- Use geospatial data to monitor risk exposure and ECD performance.
- Promote Parental and Community Awareness as informed communities can better protect their children during climate shocks.
- Launch public campaigns on the impact of extreme weather on child development.
- Fund longitudinal studies on climate impacts on child development.
- Disaggregate data by region, gender, and socioeconomic status.

This regression analysis provides evidence that extreme weather events, especially rainfall, harm early childhood development. Policymakers should treat this as a call to action to integrate climate resilience into child development policies and invest in adaptive infrastructure, services, and education to safeguard children's futures.

6.4.2. Impact of Extreme Rainfall on Early Childhood Development

In continuation from the previous rainfall data set, the impact of extreme events on ECD has been estimated by using the probit model. The probit model has been employed because the dependent variable is dummy 1 if the extreme rainfall event has occurred and 0 otherwise. The independent variables included in the model are the early childhood development index. The results are presented in the table below:

Table: Impact of extreme rainfall on early childhood development (Probit estimates)

Variable	**Coefficient**	**t-values**
Early childhood Development Index (ECD)	-0.84***	-3.49
Constant	0.33**	2.07

Note: Results are significant at ***, ** and * 1, 5 and 10 percent levels respectively.

Areas experiencing extreme rainfall events tend to have lower early childhood development scores. This inverse relationship suggests that regions hit hardest by climate extremes may lack the infrastructure, resources, or support systems that foster child development. The Probit regression analysis reveals a statistically significant inverse relationship between early childhood development and the occurrence of extreme rainfall events. Regions with lower ECD scores are more likely to experience extreme climate shocks, indicating a vulnerability-development gap. These findings highlight the need for integrated policy approaches that combine child development programmes with climate adaptation strategies to protect and promote early development in the face of growing climate risks.

6.4.3. Impact of Temperature on Early Childhood Development

The OLS model has been employed to estimate the impact of temperature on early childhood development. The dependent variable is the temperature and independent variables included in the model are the early childhood development index . The results are presented in the below table

Table: OLS estimates (Temperature)

Variable	**Coefficient**	**t-values**
Early childhood Development Index	-0.225	-1.71*
Constant	0.412	2.58***

Note: Results are significant at ***, ** and * 1, 5 and 10 percent levels respectively.

This suggests that better early childhood development is associated with slightly lower temperatures. Since temperature isn't influenced by human development, this likely implies: Geographical or socioeconomic disparities: Regions with lower ECD may correspond to hotter environments-possibly due to factors like poverty, inadequate infrastructure, or environmental exposure. The ECD coefficient is marginally significant at the 10% level, meaning there's weak but notable evidence of this relationship.

The connection between temperature and ECD isn't limited to statistical associations. Recent studies highlight several mechanisms and real-world impacts:

In Bangladesh, even a 1% increase in extreme heat days raised the risk of stunting by 56%.

Although modestly significant, your regression suggests that regions with lower early childhood development tend to be hotter-likely to highlight underlying vulnerabilities rather than a direct causal link.

External evidence strengthens this observation with robust findings: Elevated temperatures contribute to growth faltering (wasting, under nutrition). They impair neuro development, including language and cognitive skills.

They reduce physical activity and undermine learning environments like schools.

6.4.4. Impact of Extreme Temperature on Early Childhood Development (Probit Estimates)

Table: Impact of Extreme Temperature on Early Childhood Development (ECD) (PRobit estimates)

Variable	**Coefficient**	**t-values**
Early childhood Development Index (ECD)	-0.038	-1.71*
Constant	0.300	2.58***

Note: Results are significant at ***, ** and * 1, 5 and 10 percent levels respectively.

The Probit regression results highlight a critical insight: children's developmental well-being and extreme heat exposure are closely interlinked. Areas with weaker early childhood

development face more frequent or severe temperature risks, stunting the growth and potential of their youngest citizens. Tackling this requires a multi-layered response: heat-resilient infrastructure, equity-focused interventions, and integrated planning across health, education, and climate adaptation sectors.

Climate extremes such as intense heat and erratic rainfall are both a symptom and a driver of underdevelopment in early childhood. Addressing this requires climate-smart development policies that protect the youngest and most vulnerable.

The possible policies implications can be; Prioritize High-Risk, Low-ECD Regions: Direct resilience-building efforts-like flood-proof infrastructure and heat-adapted learning spaces-to areas with developmental deficits and climate vulnerability.

Enhance ECD Facilities for Climate Resilience: Integrate climate adaptation (e.g., shaded schools, cool safe zones) into early childhood and school infrastructure planning.

Expand Public Health Interventions: Target maternal and child health programmes to mitigate climate impact nutrition, water, sanitation, and psycho social support must be climate informed.

Incorporate Climate Risk in ECD Strategy: Build climate foresight into child development and education policies for proactive adaptation.

Invest in Monitoring and Adaptive Responses: Use geospatial targeting and trend analysis to identify evolving hot spots and adapt programmes accordingly.

7. Policy Recommendations

Based on the empirical evidence, the following policy actions are recommended to safeguard early childhood development in the face of growing climate risks.

1. Integrate Climate Resilience into National ECD Frameworks

There is a need to embed climate adaptation into early childhood education and health policies. Climate-contingency protocols must be developed for ECD centers, which will ensure service continuity during floods, heatwaves, or displacements.

2. Prioritize High-Risk, Low-ECD Regions

Geospatial and developmental indicators should be used to target Balochistan, Sindh, and AJK for priority interventions. Besides, additional resources should be allocated for infrastructure, health, and education in these areas.

3. Climate-Resilient Infrastructure for Children

Flood and heat-resistant ECD centers need to be built or properly equipped. Similarly, water drainage systems, shade structures, and safe cooling zones should be created in schools and childcare facilities.

4. Strengthen Public Health Systems

Maternal and child health services may be expanded with a focus on climate-sensitive issues such as malnutrition, dehydration, and heat stress. Frontline health workers should be trained to recognize and respond to climate-related child health risks.

5. Emergency Preparedness and Early Warning Systems

Early warning systems should include caregivers, teachers, and health workers. Mobile child services and temporary learning spaces should be earmarked in disaster-prone areas.

6. Cross-Sectoral Coordination

There is a need to strengthen collaboration between ministries of climate change, health, education, and planning. Similarly, joint climate-ECD task forces should be created at national and provincial levels.

7. Community Engagement and Public Awareness

To educate families about climate risks and child safety during extreme events, orchestrated awareness campaigns should be launched by involving local communities in designing and monitoring resilience-building programmes.

8. Long-Term Planning and Data Investment

Longitudinal studies should be carried out to monitor how climate change is affecting ECD over time. These studies should dis-aggregate data by region, gender, and socioeconomic status, which will ensure inclusive and targeted policies.

9. Urban and Rural Planning for Child Safety

There is a need to address urban heat islands through green infrastructure near child-focused facilities. Similarly, housing and sanitation should be improved in peri-urban areas vulnerable to flooding and heat stress.

Climate change is already compromising the development potential of Pakistan's youngest citizens. Without swift and coordinated policy action, these impacts are likely to worsen, deepening inequality and undermining human capital for generations to come. Thus, a proactive, climate-informed, and child-centered policy response is not optional, it is essential.

8. Conclusion

Over the past fifteen years, Pakistan has experienced a marked increase in extreme climatic events, including floods, heatwaves, and snowfall anomalies, with substantial implications for early childhood development (ECD). This study provides empirical evidence of a statistically significant negative relationship between climate variability—particularly fluctuations in rainfall and temperature—and key ECD outcomes. The findings demonstrate that both average climatic changes and extreme deviations adversely affect young children's health, learning, and developmental trajectories.

Correlation and regression analyses consistently indicate that extreme rainfall events exert the strongest negative influence on ECD (correlation coefficient: –0.821), followed by average rainfall (–0.690) and temperature variations (–0.673). Although extreme temperature events show relatively weaker associations, their statistical significance underscores the pervasive nature of climate-related risks to early childhood development. These results highlight that climate stressors operate through multiple pathways, including health shocks, nutritional insecurity, caregiver stress, and disruption of early learning environments.

Provincial-level analysis reveals pronounced regional disparities in climate vulnerability. Balochistan, Sindh, and Azad Jammu and Kashmir exhibit the strongest negative associations between climatic shocks and ECD, reflecting chronic exposure to drought, heat stress, flooding, and infrastructural deficits. While regions such as Gilgit-Baltistan display comparatively weaker statistical relationships, emerging risks linked to glacier melt, water scarcity, and changing seasonal patterns suggest that these areas may face heightened vulnerability in the future. This underscores the need for region-specific adaptation and resilience strategies.

Regression and Probit model results further confirm that climatic extremes significantly depress ECD outcomes and that regions with already weaker childhood development indicators are disproportionately affected by climate shocks. This finding points to a critical vulnerability–development feedback loop, wherein socioeconomically disadvantaged children face compounded risks from both environmental hazards and developmental deprivation. The study therefore reinforces the argument that climate change is not only an environmental challenge but also a profound developmental and equity issue.

The significance of this research lies in its contribution to the limited empirical literature linking climate variability to early childhood development in low- and middle-income countries, particularly in the Pakistani context. By integrating climate indicators with ECD outcomes, the study provides evidence to inform climate-sensitive social protection, health, nutrition, and early education policies. The findings underscore the urgency of incorporating child-centered and development-focused approaches into climate adaptation and disaster risk reduction strategies.

Future research should build on this work by employing longitudinal and micro-level data to better capture causal mechanisms and long-term developmental impacts of climate shocks on children. Further studies could explore mediating pathways such as nutrition, care giving practices, health service access, and early learning disruptions. Additionally, qualitative and mixed-methods research would provide valuable insights into household coping strategies and community resilience. Expanding the analysis to assess the effectiveness of climate-adaptive ECD interventions would also support evidence-based policy making aimed at safeguarding children’s development in an increasingly climate-vulnerable Pakistan.

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