

# Associations of Childhood Exposure to Malaria with Cognition and Behavior Outcomes in Low- and Middle- Income Countries: A Systematic Review

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**Background:** Malaria impacts >24 million children globally, resulting in >300,000 child deaths annually in low- and middle-income countries (LMICs). Little is known about the association between malarial infection and its impact on cognition and behavior. Our objective was to determine the association between different types of malaria infection with cognitive and behavioral outcomes among children living in LMICs.

**Methods:** We systematically searched and reviewed the literature using six online bibliographic databases on 2/10/2022. Studies included involved children <18 years living in LMICs with active or past malaria infection and measured cognitive and/or behavior outcomes. A meta-analysis is underway for asymptomatic and severe categories of malaria. Due to heterogeneity of data, a qualitative summary was performed for uncomplicated malaria studies.

**Results:** Out of 1994 initial titles reviewed, 40 articles met the inclusion criteria. 30 studies contributed data to the meta-analysis. Initial analyses suggest children with asymptomatic malaria tend to have lower mean scores than children without malaria in attention (SMD (standardized mean difference) -0.14, 95% CI -0.35 to 0.07) and general cognitive function (SMD -0.15, 95% CI -0.38 to 0.07). No differences were found in language and numeracy scores. Children with severe malaria had significant reductions in their mean scores compared to children without malaria in language (SMD -0.35, 95% CI -0.53 to -0.17), general cognition (SMD -0.26, 95% CI -0.48 to -0.04), and memory (SMD -0.25, 95% CI -0.41 to -0.09). Most studies on uncomplicated malaria (7/8) found declines across multiple domains of cognitive testing compared to children without malaria.

**Conclusion:** While analyses are not yet finalized, our initial findings suggest severe malaria is associated with worse neurodevelopment outcomes for children living in LMICs. Asymptomatic and uncomplicated malarial infection tend to have lower scores, though more research is needed. Support for children with malaria should consider strategies to optimize neurodevelopment.