Time for malaria control in school-age children

Lauren M. Cohee, Center for Vaccine Development and Global Health, University of Maryland School of Medicine, Baltimore, MD USA

Joaniter I. Nankabirwa, Makerere University College of Health Sciences and Infectious Diseases Research Collaboration, Kampala, Uganda

Brian Greenwood, Faculty of Infectious and Tropical Diseases, Department of Disease Control, London School of Hygiene and Tropical Medicine, London, UK

Abdoulaye Djimde, Malaria Research and Training Center, Department of Epidemiology of Parasitic Diseases, Faculty of Pharmacy, University of Sciences, Techniques and Technologies of Bamako, Bamako, Mali

Don P. Mathanga, Malaria Alert Center, University of Malawi College of Medicine, Blantyre, Malawi

School-age children bear an under-appreciated burden of malaria. Across sub-Saharan Africa, the prevalence of infection peaks in this age-group, and an estimated 200 million school-age children are at risk of malaria.[1–4] Infection in this age group not only threatens child health and education[5], but also serves as a source of onward parasite transmission, undermining elimination efforts.[6,7] It is assumed that universal malaria interventions, such as bed nets and access to prompt diagnosis and treatment, cover this age group. However, school-age children are the group least likely to benefit from these interventions.[8,9] Thus, interventions specifically targeting this age group are needed. Schools provide ready access to this population and are successfully employed to address other health concerns in schoolchildren, such as school-feeding for nutritional deficiencies and deworming campaigns for control of helminth infections.[10,11]

Why is there no policy to address the high prevalence of malaria infection in school-age children? The yardstick used to measure and prioritize malaria control interventions is a decrease in malaria-related mortality and/or morbidity. School-age children in endemic countries are at a lower risk of mortality and severe disease than young children. While it is undeniable that the highest priority must be preventing malaria and its adverse outcomes in the highest risk groups, which are children under five years of age and pregnant women, it is short-sighted not to specifically target interventions to school-age children. First, although infections in school-age children are often termed “asymptomatic”, these infections are associated with anemia, decreased school attendance, and decreased cognitive function.[1,5] Thus, by addressing the burden of malaria in school-age children, we can support Sustainable Development Goals 3 (promoting health at all ages) and 4 (ensuring quality education). Second, school-age children are an important reservoir of infections that fuel transmission to vector mosquitos and onward to higher risk groups.[6,7] Decreasing infections in school-age children could complement existing vector control interventions to decrease transmission.[12,13] Such complimentary interventions are needed in a range of epidemiologic settings, but may be especially critical in high burden areas where malaria is intransigent to current control measures. Third, as transmission decreases and development of immunity is delayed, overt disease and potentially mortality are likely to increase in older children.[14,15] Interventions targeting school-age children will prepare us to address this epidemiological shift.

Key barriers to development of a policy to address the burden of malaria in school-age children are determining appropriate interventions and funding. The pool of funding to support malaria control is relatively fixed and is insufficient to achieve the targets of global and national strategic plans to effectively control and eliminate malaria.[16] Thus, there is little appetite to develop a policy for interventions that may chip away at available funding. However, the importance of the health of the learner, meaning schoolchildren over the age of five years and through adolescence, is gaining attention in the development community. Indeed, the World Food Program and UNICEF have launched a joint initiative to improve the health of school-age children, recognizing the crucial role of good health at school-age for promoting educational outcomes and economic development.[17] While malaria is included as a health need to be addressed in an integrated school health package, the lack of policy limits the interventions that could be considered. Current proposals include enhancing malaria messaging in health

education activities and distributing insecticide treated bed nets to schoolchildren.[5] These approaches are likely to be useful, but they may be inadequate to substantially reduce the burden of malaria in school-age children. Specifically, there may be barriers to bed net use in school-age children that are not ameliorated by increasing net ownership, for example the sleeping spaces allocated to older children may not be amenable to net use and compliance with many interventions is more challenging in the adolescent years. Increasing access to testing and treatment in schools or providing chemoprevention to schoolchildren should also be considered as possible approaches. Recent meta-analyses suggest that preventive treatment in schools can reduce clinical malaria, infection, and anemia.[18] Indeed, chemoprevention strategies that have proved successful in clinical trials include treatment at the start of each term, monthly preventive treatment throughout the year in areas with perennial transmission, and preventive treatment limited to a few months of the year in areas where malaria transmission is seasonal. However, in the absence of a policy, these more aggressive approaches to burden reduction may not be considered for inclusion within school-health packages. Further data on their impact on transmission are required to define clearly the potential role and cost-effectiveness of preventive treatment and, in the future, to evaluate a potential role for malaria vaccines targeting this age group.

Interventions to address malaria in the context of school-health packages are likely to be more effective and cost-effective than developing stand-alone malaria interventions targeting this age group. Malaria, nutritional deficiencies, and helminth infections act together to cause anemia and decreased cognitive function that limit educational attainment and ultimately decrease human capital. Simultaneously, addressing each of these challenges in concert with hearing and vision screening, dental hygiene, adolescent vaccination, and menstrual hygiene among others will decrease costs and increase sustainability.[19] Furthermore, including malaria control interventions in this coordinated approach may allow access to funding outside of the current sources of support for malaria control.

For the fifth year in a row, the World Malaria Report shows slow but steady progress in reducing malaria mortality, but a plateau in malaria cases and even an increase in some areas.[16] New interventions are desperately needed to complement and enhance existing measures if we aim to achieve malaria elimination. Targeting school-age children can both improve their health and contribute to transmission reduction. With policy support, malaria should be included as a key component of school health programs to address the needs of this underserved population.

References:

1. Nankabirwa J, Brooker SJ, Clarke SE, et al. Malaria in school-age children in Africa: an increasingly important challenge. *Trop Med Int Health*. August 2014. doi:10.1111/tmi.12374
2. Pinchoff J, Chaponda M, Shields TM, et al. Individual and household level risk factors associated with malaria in Nchelenge District, a region with perennial transmission: A serial cross-sectional study from 2012 to 2015. *PLoS One*. 2016;11(6):e0156717.

doi:10.1371/journal.pone.0156717
3. Mwandagalirwa MK, Levitz L, Thwai KL, et al. Individual and household characteristics of persons with Plasmodium falciparum malaria in sites with varying endemicities in Kinshasa Province, Democratic Republic of the Congo. *Malar J*. 2017;16(1). doi:10.1186/s12936-017-2110-7
4. Touré M, Sanogo D, Dembele S, et al. Seasonality and shift in age-specific malaria prevalence and incidence in Binko and Carrière villages close to the lake in Selingué, Mali. *Malar J*. 2016;15(1):219. doi:10.1186/s12936-016-1251-4
5. Brooker S, Clarke S, Fernando D, et al. Malaria in Middle Childhood and Adolescence. In: Bundy D, de Silva N, Horton S, Jamison DT, Patton G, eds. *Disease Control Priorities (Third Edition): Volume 8, Child and Adolescent Health and Development*. Third edit. Washington, D.C.; 2017. https://www.ncbi.nlm.nih.gov/books/NBK525246.
6. Coalson JE, Cohee LM, Buchwald AG, et al. Simulation models predict that school-age children are responsible for most human-to-mosquito Plasmodium falciparum transmission in southern Malawi. *Malar J*. 2018;17(17). doi:10.1186/s12936-018-2295-4
7. Gonçalves BP, Kapulu MC, Sawa P, et al. Examining the human infectious reservoir for Plasmodium falciparum malaria in areas of differing transmission intensity. *Nat Commun*. 2017;8(1):1133. doi:10.1038/s41467-017-01270-4
8. Olapeju B, Choiriyyah I, Lynch M, et al. Age and gender trends in insecticide-treated net use in sub-Saharan Africa: a multi-country analysis. *Malar J*. 2018;17(1):423. doi:10.1186/s12936-018-2575-z
9. Coalson JE, Cohee LM, Walldorf JA, et al. Challenges in treatment for fever among school-age children and adults in Malawi. *Am J Trop Med Hyg*. 2019;100(2). doi:10.4269/ajtmh.18-0687
10. WFP. *World Food Programme: State of School Feeding Worldwide*.; 2013. https://documents.wfp.org/stellent/groups/public/documents/communications/wfp257481.pdf. Accessed June 24, 2020.
11. Uniting to Combat Neglected Tropical Diseases. Impact dashboard for preventive chemotherapy (PC) diseases. https://unitingtocombatntds.org/impact-dashboards/pc-diseases-dashboard/. Published 2019. Accessed June 24, 2020.
12. Staedke SG, Maiteki-Sebuguzi C, Rehman AM, et al. Assessment of community-level effects of intermittent preventive treatment for malaria in schoolchildren in Jinja, Uganda (START-IPT trial): a cluster-randomised trial. *Lancet Glob Heal*. 2018;6(6):e668-e679. doi:10.1016/S2214-109X(18)30126-8
13. Cohee LM, Valim C, Coalson JE, et al. School-based screening and treatment may reduce P. falciparum transmission. *Sci Rep*. 2021;11(1):6905. doi:10.1038/s41598-021-86450-5
14. O'Meara WP, Bejon P, Mwangi TW, et al. Effect of a fall in malaria transmission on morbidity and mortality in Kilifi, Kenya. *Lancet (London, England)*. 2008;372(9649):1555-1562. doi:10.1016/S0140-6736(08)61655-4
15. Kigozi SP, Kigozi RN, Epstein A, et al. Rapid shifts in the age-specific burden of malaria following successful control interventions in four regions of Uganda. *Malar J*. 2020;19(1). doi:10.1186/s12936-020-03196-7
16. World Health Organization. *World Malaria Report 2020: 20 Years of Global Progress and Challenges*.; 2020. https://www.wipo.int/amc/en/. Accessed December 30, 2020.

17. UN Live United Nations Web TV - Nurturing Human Capital: Achieving more for children in 2020 and beyond - UN SDG Media Zone, Davos, Switzerland (21-23 January 2020). http://webtv.un.org/watch/nurturing-human-capital-achieving-more-for-children-in-2020-and-beyond-un-sdg-media-zone-davos-switzerland-21-23-january-2020/6125778079001/. Accessed December 30, 2020.
18. Cohee LM, Opondo C, Clarke SE, et al. Preventive malaria treatment among school-aged children in sub-Saharan Africa: a systematic review and meta-analyses. *Lancet Glob Heal*. 2020;8(12):e1499-e1511. doi:10.1016/S2214-109X(20)30325-9
19. Bundy DAP, de Silva N, Horton S, Jamison DT, Patton GC. *Disease Control Priorities, Third Edition (Volume 8): Child and Adolescent Health and Development*. (Bundy DAP, de Silva N, Horton S, Jamison DT, Patton GC, eds.). Washington, DC: World Bank; 2017. doi:10.1596/978-1-4648-0423-6