VIEWPOINT

Improving Child Survival in Sub-Saharan Africa: Key Environmental and Nutritional Interventions

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Many countries in Sub-Saharan Africa (SSA), did not achieve the Millennium Development Goal 4 target of reducing under-five mortality by two-thirds between 1990 and 2015. A large proportion of under-five deaths in SSA and other developing regions have been attributed to undernutrition and poor household environmental conditions. Failure to address nutritional deficit and household environmental pollution in SSA will therefore likely result in many countries not meeting the Sustainable Development Goal (SDG) 3.2 target which aims to reduce under-five mortality to less than 25 deaths per 1000 livebirths by 2030. This paper pinpoints the nutritional and environmental threats to child health in SSA, and identify interventions that will work best to improve child survival in countries. It is important to broaden the spectrum of interventions for improving child survival beyond health systems strengthening to enable countries meet the SDG 3.2 target. The following interventions are thus proposed: strengthening child welfare clinics through digital technologies; investment in school feeding programmes; addressing household air pollution; and improving water, sanitation and hygiene (WASH) services in basic schools. There are certainly barriers to effective implementation of the proposed interventions in countries but are surmountable with strong political will and involvement of the private sector.
rate [8]. The findings were independent of immunization and socioeconomic status.

Breastfeeding confers survival throughout the entire continuum of childhood. Optimal breastfeeding prevents around 12% under-five deaths annually in low- and middle-income countries [9]. All-cause and infection-related mortality in infants and children have been reported to be higher in partially- and non-breastfed infants compared to exclusively breastfed infants [10]. Early initiation of breastfeeding is associated with reduced risk of neonatal mortality [11]. Exclusive breastfeeding also confers a lower risk of mortality including infection-related deaths in the neonatal period [11].

Complementary feeding is important for child growth and development. Provision of complementary foods with and without nutrition education and counselling has been associated with weight and height gain, increased linear growth, and decreased incidence of respiratory infections especially in food insecure populations [12–14].

Household air pollution from solid fuel use has been associated with risk of childhood pneumonia, acute lower respiratory infections, stunting, underweight, childhood anemia, and neonatal and child mortality [15–17]. In SSA and other developing regions where solid fuels are predominantly used, women are customarily responsible for cooking and very often, are accompanied by their young children whilst cooking. Both are exposed to the resulting air pollution as a result with the scenario depicted in Figure 1.

Poor water, sanitation and hygiene (WASH) conditions have detrimental effect on child growth and development owing to continual exposure to enteric pathogens, and associated wider social and economic complexities [18]. There is an increased risk of diarrheal diseases among children who do not wash their hands [19]. Access to improved water and sanitation is associated with reduced risk of diarrheal illnesses, stunting, and child mortality [20]. Repeated bouts of diarrhea cumulatively increases

**Figure 1:** A woman cooking with wood and surrounded by her children.
the risk of childhood stunting [21]. A multi-country ecological study also found improvement in population water and sanitation access to significantly decrease infant and under-five mortality [22].

**Way Forward**

**Strengthening Child Welfare Clinics through Digital Technologies**

In many developing countries, community health workers (CHW) are responsible for provision of health services in rural and remote communities. This is because primary healthcare centers are usually several kilometers away from these communities thereby making access a challenge for residents of these communities. CHWs, however, have limited training in nutrition which hampers the nutrition advice they are expected to provide to enhance child growth and development.

Smartphone technology should be leverage to improve child welfare services through the development of mobile applications for effective triage of nutrition care and provision of accurate, reliable, consistent, timely and up to date nutrition advice tailored toward the needs of children. The mobile applications can also be used to advise mothers and caregivers during the triage about environmental conditions that adversely impacts child health and survival. The mobile applications can also be used to send short SMS messages on nutrition and environmental health tips in the dominant language of the child welfare service coverage area to mothers and caregivers on regular basis. A study assessing the feasibility of mobile health technology (mHealth) for the provision of maternal and child health services in a deprived region of Ghana found the intervention to have the potential of eliminating barriers to equitable access to maternal and child healthcare services in rural areas [23]. A study evaluating the effectiveness of Rwanda’s nationwide mHealth programme reported that, with adequate resources, the programme can increase use of maternal and child health services [24]. Barriers to digital technology for improving child health and survival include low mobile network penetration, limited or erratic power supply, and poor mobile network connectivity in many countries. However, in many SSA countries mobile network penetration stands at more 90%.

**Investment in School Feeding Programmes (SFP)**

There is compelling evidence on the benefits of SFPs for child health and nutrition [25–27]. Well-designed and properly implemented SFPs assures nutrient adequacy of children leading to improved nutritional status, decreased morbidity, and increased cognitive abilities. SFPs also drives children into school and keep them there, guarding against their stay at home and subsequent use by parents and relatives for water and fuel fetching, agriculture activities, and vending and other economic activities that threatens their health and survival. However, countries need to guard against politicization of the programme, the main challenge impeding effectiveness and threatening sustainability of SFPs in the limited SSA countries where they have been implemented. In these countries, programme managers at the various levels of operation and caterers assigned to schools earn their positions because of their political leanings and as a result, are replaced whenever the government changes. Ghana is a typical example. Programme managers and school caterers should earn their positions on merit and be given performance contracts. That way, nutritional quality of the meals served which has always been questioned in the countries where the programme is politicized will improve tremendously as managers and caterers will be accountable.

**Addressing Household Air Pollution (HAP)**

There is limited evidence from randomized cookstove intervention trials conducted in Ghana, Nigeria, Malawi, and Nepal on the benefits for child health and survival of the use of liquefied petroleum gas (LPG), ethanol and improved cookstove for cooking [28–31]. Major barriers to the adoption of LPG and other clean cooking solutions in developing countries are poverty and supply chain issues. To overcome the poverty barrier, governments should heavily subsidize LPG and other clean cooking solutions, and also consider their provision as part of social protection programmes. To overcome the supply chain issues, governments should create an enabling environment for private sector involvement in LPG production and distribution, and innovations in clean cooking technologies.

Another source of HAP in SSA countries is the open burning of solid waste in households owing to limited and irregular waste collection services in many neighbourhoods.

Guarding against open burning of waste in households also demands private sector involvement to ease the burden on municipal authorities, as well as ensuring universal waste collection and curtailing the proliferation of informal dumpsites.

Creating awareness on the dangers of solid fuel use and open burning of waste through community durbars and religious fellowships could also help to address HAP. Governments and their development partners should support local non-governmental organizations and community-based organizations to take up the task.

**Improving Water, Sanitation and Hygiene (WASH) Services in Basic Schools**

WASH remains an essential intervention for improved child health and development, and is very fundamental to sustainable development [32]. Improved WASH services prevents the two syndromes that are the common causes of child deaths globally; diarrhoea and acute lower respiratory infection [33]. Several WASH interventions have been associated with lower risk of diarrhoeal morbidity and will enable meeting the SDG targets [34, 35]. Handwashing interventions have also been found reduce school absenteeism, respiratory tract infections, and laboratory confirmed influenza-like illness [36].

WASH content should be incorporated into the curriculum of basic schools at all levels to assure increased WASH knowledge of pupils for enhancing proper attitudes and practices. Ministries of Education should encourage the
formation of health clubs in basic schools to provide a platform for promoting proper WASH attitudes and practices in schools and communities. Through meetings of the health club, the capacity of pupils in WASH promotion can be developed to enable them become effective change agents.

Sustained use of veronica buckets (Figure 2A), a key infrastructure for promoting handwashing in schools in SSA countries, is threatened by the inability of many schools to maintain and/or replace them when they become damaged owing to financial constraints. Many schools are also unable to provide soap for handwashing for the same reason. Local governments should supply schools in their localities with veronica buckets and soap regularly to promote and sustain handwashing practices in schools. Tippy tap (Figure 2B), an improvisation of veronica buckets, and made from local raw materials is recommended in places where sustained use of veronica buckets is a challenge.

Local governments should also invest in the construction of toilets facilities in schools and provide access to improve water sources through the construction of mechanized boreholes and payment of water utility bills of schools.

Conclusion
In conclusion, improving child health and survival in Sub-Saharan Africa and achieving the SDG targets will require a package of interventions beyond health system strengthening. There is ample empirical evidence on the effectiveness of the proposed interventions. Governments should therefore invest in these interventions by resourcing and strengthening the appropriate ministries, departments and agencies to act. There are barriers to effective implementation of the proposed interventions in countries but are surmountable with strong political will and involvement of the private sector.

Competing Interests
The author has no competing interests to declare.

References
1. Reidpath DD, Allotey P. Infant mortality rate as an indicator of population health. J Epidemiol Community Health. 2003; 57: 344–346. DOI: https://doi.org/10.1136/jech.57.5.344
2. You D, Hug L, Ejdemyr S, et al. Global, regional, and national levels and trends in under-5 mortality between 1990 and 2015, with scenario-based projections to 2030: A systematic analysis by the UN Inter-agency Group for Child Mortality Estimation. Lancet. 2015; 386(10010): 2275–86. DOI: https://doi.org/10.1016/S0140-6736(15)00120-8
3. Wang H, Naghavi M, Allen C, et al. Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980–2015: A systematic analysis for the Global Burden of Disease Study 2015. Lancet. 2016; 388(10053): 1459–544. DOI: https://doi.org/10.1016/S0140-6736(16)31012-1
4. Burstein R, Henry NJ, et al. Mapping 123 million neonatal, infant and child deaths between 2000 and 2017. Nature. 2019; 574: 353–358. DOI: https://doi.org/10.1038/s41586-019-1545-0

Figure 2: A: Veronica bucket; B: Pupil using tippy tap for handwashing.
5. Golding N, Burstine R, et al. Mapping under-5 and neonatal mortality in Africa, 2000–15: A baseline analysis for the Sustainable Development Goals. *Lancet*. 2017; 390: 2171–2182. DOI: https://doi.org/10.1016/S0140-6736(17)31758-0

6. Rutstein SO. Factors associated with trends in infant and child mortality in developing countries during the 1990s. *Bull World Health Organ*. 2000; 78: 1256–70.

7. Acharya A, Paunio M, Ahmed K. Environmental Health and Child Survival; Epidemiology, Economics, Experiences. Washington, DC: The World Bank (Environment Department); 2008.

8. Ashworth A, Shrimpton R, Jamil K. Growth monitoring and promotion: review of evidence of impact. *Maternal Child Nutr*. 2008; 4: 86–117. DOI: https://doi.org/10.1111/j.1740-8709.2007.0125.x

9. Black RE, Victora CG, Walker SP, et al. Maternal and child undernutrition and overweight in low-income and middle-income countries. *Lancet*. 2013; 382: 427–51. DOI: https://doi.org/10.1016/S0140-6736(13)60937-X

10. Sankar MJ, Sinha B, Chowdhury R, et al. Optimal breastfeeding practices and infant and child mortality: A systematic review and meta-analysis. *Acta paediatrica*. 2015; 104: 3–13. DOI: https://doi.org/10.1111/apa.13147

11. Khan J, Vesel L, Bahl R, Martines JC. Timing of breastfeeding initiation and exclusivity of breastfeeding during the first month of life: Effects on neonatal mortality and morbidity—a systematic review and meta-analysis. *Maternal Child Health J*. 2015; 19: 468–79. DOI: https://doi.org/10.1007/s10995-014-1526-8

12. Imdad A, Yakoob MY, Bhutta ZA. Impact of maternal education about complementary feeding and provision of complementary foods on child growth in developing countries. *BMJ Public Health*. 2011; 11(3): S25. DOI: https://doi.org/10.1136/1471-2458-11-S-9-S25

13. Lassi ZS, Das JK, Zahid G, Imdad A, Bhutta ZA. Impact of education and provision of complementary feeding on growth and morbidity in children less than 2 years of age in developing countries: a systematic review. *BMJ Public Health*. 2013; 13(3): S13. DOI: https://doi.org/10.1136/1471-2458-13-S-3-S13

14. Bhutta ZA, Ahmed T, Black RE, et al. What works? Interventions for maternal and child undernutrition and survival. *Lancet*. 2008; 371(9610): 417–440. DOI: https://doi.org/10.1016/S0140-6736(07)61693-6

15. Bruce NG, Dherani MK, Das JK, et al. Control of household air pollution for child survival: estimates for intervention impacts. *BMJ Public Health*. 2013; 13(3): S8. DOI: https://doi.org/10.1136/1471-2458-13-S-3-S8

16. Kleimola LB, Patel AB, Borkar JA, Hibberd PL. Consequences of household air pollution on child survival: Evidence from demographic and health surveys in 47 countries. *Int J Occup Environ Health*. 2015; 21(4): 294–302. DOI: https://doi.org/10.1179/1493967151000000007

17. Dherani M, Pope D, Mascalenas M, Smith KR, Weber M, Bruce N. Indoor air pollution from unprocessed solid fuel use and pneumonia risk in children aged under five years: A systematic review and meta-analysis. *Bull World Health Organ*. 2008; 86: 390–8C. DOI: https://doi.org/10.2471/BLT.07.044529

18. Cumming O, Cairncross S. Can water, sanitation and hygiene help eliminate stunting? Current evidence and policy implications. *Maternal Child Nutr*. 2016; 12: 91–105. DOI: https://doi.org/10.1111/mcn.12258

19. Curtis V, Cairncross S. Effect of washing hands with soap on diarrhoea risk in the community: a systematic review. *Lancet Infect Dis*. 2003; 3(5): 275–81. DOI: https://doi.org/10.1016/S1473-3099(03)00606-6

20. Fink G, Günther I, Hill K. The effect of water and sanitation on child health: Evidence from the demographic and health surveys 1986–2007. *Int J Epidemiol*. 2011; 40(5): 1196–204. DOI: https://doi.org/10.1093/ije/dyr102

21. Checkley W, Buckley G, Gilman RH, et al. Multi-country analysis of the effects of diarrhoea on childhood stunting. *Int J Epidemiol*. 2008; 37: 816–830. DOI: https://doi.org/10.1093/ije/dyn099

22. Cheng JJ, Schuster-Wallace CJ, Watt S, Newbold BK, Mente A. An ecological quantification of the relationships between water, sanitation and infant, child, and maternal mortality. *Environ Health*. 2012; 11(1): 4. DOI: https://doi.org/10.1186/1476-069X-11-4

23. Laar AS, Bekyieriya E, Isang S, Baguune B. Assessment of mobile health technology for maternal and child health services in rural Upper West Region of Ghana. *Public Health*. 2019; 168: 1–8. DOI: https://doi.org/10.1016/j.puhe.2018.11.014

24. Ruton H, Musabiyamana A, Gaju E, et al. The impact of an mHealth monitoring system on health care utilization by mothers and children: An evaluation using routine health information in Rwanda. *Health Policy Plan*. 2018; 33(8): 920–7. DOI: https://doi.org/10.1093/heapol/czy066

25. Simeon DT. School feeding in Jamaica: a review of its evaluation. *Am J Clin Nutr*. 1998; 67(4): 790S–4S. DOI: https://doi.org/10.1093/ajcn/67.4.790S

26. Kristjansson B, Petticrew M, MacDonald B, et al. School feeding for improving the physical and psychosocial health of disadvantaged students. *Cochrane Database Sys Rev*. 2007; 1. DOI: https://doi.org/10.1002/14651858.CD004676.pub2

27. Awojobi ON. A systematic review of the impact of Ghana’s school feeding programme on educational and nutritional outcomes. *Agro-Sci*. 2019; 18(2): 42–50. DOI: https://doi.org/10.4334/as.v18i2.8

28. Asante K, Wylie B, Chilrud S, et al. The Ghana Randomized Air Pollution and Health Study
(GRAPHS): A cluster randomized trial of liquefied petroleum gas (LPG) and efficient biomass cookstoves delivered during pregnancy. *Environ Epidemiol.* 2019; 3: 296. DOI: https://doi.org/10.1097/01.EE9.0000609200.07410.e1

29. **Alexander DA, Northcross A, Karrison T,** et al. Pregnancy outcomes and ethanol cook stove intervention: A randomized-controlled trial in Ibadan, Nigeria. *Environment international.* 2018; 111: 152–63. DOI: https://doi.org/10.1016/j.envint.2017.11.021

30. **Mortimer K, Ndamala CB, Naunje AW,** et al. A cleaner burning biomass-fuelled cookstove intervention to prevent pneumonia in children under 5 years old in rural Malawi (the Cooking and Pneumonia Study): a cluster randomised controlled trial. *Lancet.* 2017; 389(10065): 167–75. DOI: https://doi.org/10.1016/S0140-6736(16)32507-7

31. **Tielsch JM, Katz J, Khatry SK,** et al. Effect of an improved biomass stove on acute lower respiratory infections in young children in rural Nepal: A cluster-randomised, step-wedge trial. *Lancet Glob Health.* 2016; 4: S19. DOI: https://doi.org/10.1016/S2214-109X(16)30024-9

32. **Russell F, Azzopardi P.** WASH: A basic human right and essential intervention for child health and development. *Lancet Glob Health.* 2019; 7(4): e417. DOI: https://doi.org/10.1016/S2214-109X(19)30078-6

33. **World Health Organization (WHO), The United Nations Children’s Fund (UNICEF).** Ending preventable child deaths from pneumonia and diarrhoea by 2025: The integrated global action plan for pneumonia and diarrhoea. Geneva: World Health Organization; 2013.

34. **Wolf J, Hunter PR, Freeman MC,** et al. Impact of drinking water, sanitation and handwashing with soap on childhood diarrhoeal disease: Updated meta-analysis and meta-regression. *Trop Med Int Health.* 2018; 23(5): 508–25. DOI: https://doi.org/10.1111/tmi.13051

35. **Darvesh N, Das JK, Vaivada T,** et al. Water, sanitation and hygiene interventions for acute childhood diarrhea: A systematic review to provide estimates for the Lives Saved Tool. *BMC public health.* 2017; 17(4): 776. DOI: https://doi.org/10.1186/s12889-017-4746-1

36. **Willmott M, Nicholson A, Busse H, MacArthur GJ, Brookes S, Campbell R.** Effectiveness of hand hygiene interventions in reducing illness absence among children in educational settings: A systematic review and meta-analysis. *Arch Dis Child.* 2016; 101(1): 42–50. DOI: https://doi.org/10.1136/archdischild-2015-308875

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