

Title of the Study: The effect of various formulations of lipid-based nutrient supplements (LNS) on motor, cognitive, and socio-emotional development at age 18 months in Malawi, Ghana, and Burkina Faso.

Investigators

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Background and design

From conception to age two years is a crucial period for brain development and for the development of motor, cognitive, and socio-emotional skills. Many children in developing countries fail to reach their developmental potential in these areas, affecting later academic achievement and adult productivity (Grantham-McGregor et al., 2007). Lipid-based nutrient supplements (LNS) during pregnancy and infancy may improve these aspects of development, since brain development depends on adequate nutrition. For example, during gestation and infancy, lipids and micronutrients are necessary for neuron proliferation and myelination (McArdle & Ashworth, 1999; Uauy, Mena, DeSantiago, & Hernandez-Rodriguez, 2001).

Only two studies have investigated the developmental effects of LNS during infancy, while none have examined the effect of LNS during pregnancy on motor, cognitive, and socio-emotional development. One previous study in Ghana found that supplementation with LNS from age six to twelve months improved motor development compared to a non-supplemented group (Adu-Afarwuah et al., 2007). A second study in Malawi did not find differences in motor, cognitive, or socio-emotional development between children who received 71 g corn-soy flour per day, 25 g LNS per day, or 50 g LNS per day from age six to eighteen months (Phuka et al., 2011). Additional data are needed to clarify the effects of various formulations of LNS during pregnancy and infancy on motor, cognitive, and socio-emotional development.

In order to accurately evaluate the effect of various formulations of LNS on these abilities, child development must be assessed in a way that is reliable and valid in the iLiNS project areas in Malawi, Ghana, and Burkina Faso. The assessment of child development in low- and middle-income countries can be challenging since the most well-established and widely-used tests have been produced and standardized in high-income countries. Tests produced and standardized in one language, culture, and setting cannot be assumed to be valid in a setting that is different from that of the original target population. For example, children's test performance depends on their familiarity with the test format and materials (Greenfield, 1997). Such familiarity levels may be quite different for children who grow up in different cultures and contexts. Therefore, test items, materials, and procedures must be adapted to the local setting of the LNS intervention, and the adapted tests must be evaluated for reliability in the local population.

To assess child development in low- and middle-income countries, other issues must also be considered. For example, it can be difficult to find and hire personnel with expertise in child assessment. Therefore, it is necessary to select assessments that can be administered without prior experience or extensive training. In addition, assessment by direct observation of the child may be appropriate in certain contexts, while assessment by parent interview may be appropriate in others.

Specific objective: To evaluate the effect of various formulations of LNS on motor, cognitive, and socio-emotional development using tests that are appropriate and reliable in the iLiNS project areas.

Study procedures and research methods

Subjects: All children who participate in each iLiNS project will be monitored every four weeks to record the attainment of eleven developmental milestones (see below).

A comprehensive developmental assessment will be conducted at age 18 months. In Malawi, we aim to assess the full sample of 1,920 children enrolled in iLiNS-DOSE and the full sample of 864 children enrolled in iLiNS-DYAD-M. Likewise, in Ghana, we aim to assess the full sample of 1,320 children enrolled in iLiNS-DYAD-G. In Burkina Faso, we will compare four of the five trial arms: the delayed intervention group, and the groups receiving LNS containing 10 mg zinc per day plus a placebo tablet, LNS containing 0 mg zinc plus a placebo tablet, and LNS containing 0 mg zinc plus a tablet containing 5 mg zinc per day. To power the study to detect an effect size of 0.25 SD, accounting for cluster randomization and 15% attrition, we aim to assess 600 children from the delayed intervention group and 1,350 children from the intervention group (450 children for each of the treatment groups).

Developmental milestones. Children will be monitored every four weeks from 6 to 18 months in iLiNS-DOSE, from 9 to 18 months in iLiNS-ZINC, and from 4 to 18 months in iLiNS-DYAD-G and iLiNS-DYAD-M for the attainment of eleven developmental milestones. These milestones comprise the six WHO motor milestones (WHO, 2006) plus one additional motor milestone (running), two language milestones (waving good-bye and saying a meaningful word) and two personal/social milestones (drinking from a cup and eating without assistance).

Assessment of motor development at 18 months. In Malawi and Ghana, we are assessing motor development using the Kilifi Developmental Inventory, which is a tool developed in Kenya based on several standard tests originating in high-income countries, including the Griffiths Mental Development Scale (GMDS) and the Merrill-Palmer Scales (Abubakar, Holding, Van Baar, Newton, & Van de Vijver, 2008). In Burkina Faso, we are using an adapted version of the Developmental Milestones Checklist motor subscale, also developed in Kenya based in part on the GMDS and Vineland Adaptive Behavior Scales (Abubakar, Holding, van de Vijver, Bomu, & Van Baar, 2010).

Assessment of language development at 18 months. In Malawi and Ghana, we are using an adapted version of the MacArthur-Bates Communicative Development Inventory (Fenson et al., 2007), based in part on previous adaptations of this tool in Bangladesh (Hamadani et al., 2010) and Kenya (Alcock et al., 2010). In Burkina Faso, we are using an adapted version of the Developmental Milestones Checklist language subscale (Abubakar, et al., 2010). Both of these tools evaluate language development based on an interview with a parent or caregiver.

Assessment of working memory and executive function at 18 months. In Malawi and Ghana, we are assessing children on the A-not-B task (Epsy, Kaufmann, McDiarmid, & Glisky, 1999), which is a well-established and widely used test of working memory and executive function in very young children that has been previously used successfully in Kenya.

Assessment of socio-emotional development at 18 months. In Malawi and Ghana, we are using the Profile of Social and Emotional Development, a test developed in Kenya based in part on the Brief Infant/Toddler Social Emotional Assessment (Briggs-Gowan & Carter, 2002) to assess social cognition, independence, emotional lability, maladaptive behavior, and social competence (Holding et al., 2004). In Burkina Faso, we are using an adapted version of the Developmental Milestones Checklist personal/social subscale to assess the development of social interaction and personal skills, such as dressing, feeding, and toilet training (Abubakar, et al., 2010).

Test evaluation: In each study area, all tests will be evaluated for item appropriateness, inter-rater agreement, test-retest reliability, internal consistency, and developmental sensitivity. We will conduct an additional validation study of the language interviews by comparing the resulting scores to recordings of children's speech in their natural environment, in order to ensure that the parent's report is an accurate reflection of the child's expressive language ability.

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