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DYAD-G2 Statistical Analysis Plan: Parental Investments in the Index Child and Close Sibling

Background and Objectives

A growing body of literature studies the relationship between a child's endowment (or early life stock of capabilities that are indicators of a child's health and/or cognitive ability and are observable to parents) and subsequent parental investments in the child's health and human capital (Almond and Mazumder, 2013; Alderman et al., 2015). The literature also explores whether shocks to a child's endowment result in changes in parental investments in the child's siblings.

Small-quantity lipid-based nutrient supplements (SQ-LNS) were designed to prevent undernutrition during the critical "first 1,000 days". In the iLiNS DYAD-G randomized controlled trial in Ghana, the provision of SQ-LNS to mothers during pregnancy increased mean birth size, particularly among first-time mothers (Adu-Afarwuah et al., 2015) and maternal plus child supplementation with SQ-LNS increased mean attained size at 18 months of age (Adu-Afarwuah et al., 2016). In a follow-up study, we collected data on parental investments in the health and human capital of the index children who participated in the DYAD-G trial. We also collected data on parental investments in the index child's siblings. The randomized provision of SQ-LNS paired with the follow-up parental investments data provide an opportunity to study whether receiving SQ-LNS throughout most of the "first 1,000 days" influenced parental investments in the health and human capital of their children.

The primary objectives of this analysis are as follows:

1. Evaluate the effects of maternal and child supplementation with SQ-LNS on parental investments in the health and human capital of the index child.
2. Evaluate the effects of maternal and child supplementation with SQ-LNS on parental investments in the health and human capital of the index child's siblings.

Description of the Intervention

The iLiNS DYAD-G randomized controlled trial and the effects of the provisions of SQ-LNS on birth outcomes, growth and development have been described elsewhere in detail (Adu-Afarwuah et al., 2015; Adu-Afarwuah et al., 2016; Prado et al., 2016). In short, maternal and child supplementation with LNS increased birth size (weight, weight-for-age z-score (WAZ), and BMI-for-age z-score (BMIZ)) (Adu-Afarwuah et al., 2015) and maternal plus child supplementation increased mean attained size (length, length-for-age z-score (LAZ), weight, and WAZ) at 18 months of age (Adu-Afarwuah et al., 2016), though child development at 18 months was not affected (Prado et al., 2016).

The main DYAD-G trial was conducted between December, 2009 and March, 2014. The 'DYAD-G2' follow-up study collected data from the mother, her child (the index child), and other members of the index child's family between January, 2016 and December, 2016 when the index children were between 4 and 6 years of age. As a component of the follow-up data collection activities, we collected data on

parental investments in the index child and the index child's close siblings (defined as biological siblings under age 10 on January 1, 2016).

Description of Variables

Outcomes

Investments in the index children and their siblings will be analyzed by cohorts of children: (1) index children, (2) the next closest younger siblings and (3) older siblings under age 10. There are 5 domains of parental investments: family planning, breastfeeding, health, schooling, and financial support. Tables 1-5 below define the parental investment outcome variables by domain. The nature of each outcome is specified, and the cohorts of children for whom each outcome will be analyzed are identified.

Table 1. Outcomes in the Family Planning Domain

Outcome variable	**Definition**	**Nature of outcome**	**Cohorts**
Birth interval	0 = mother did not deliver another child within 48 months of the index child 1 = mother delivered next child between 24 and 48 months after the index child 2 = mother delivered next child within 24 months after the birth of the index child	Ordinal	Index children

[1]Limited to siblings born within 4 years of the index child to account for variation in age of the index child at the time of investments interview.

Table 2. Outcomes in the Breastfeeding Domain

Outcome variable	**Definition**	**Nature of outcome**	**Cohorts**
First complementary food at 6 months	Mother followed the World Health Organization recommendation on timing of introduction of complementary foods (food/drink other than breastmilk introduced at age 6 months)	Dichotomous	Index children Younger siblings age 6 months and older at time of investments interview
Duration of breastfeeding	Age in months when child was completely weaned	Count	Index children

Table 3. Outcomes in the Health Domain

Outcome variable	**Definition**	**Nature of outcome**	**Cohorts**
Delivered in health facility	Child was delivered in a health facility	Dichotomous	Younger siblings
Health insurance coverage	Child is currently registered with the National Health Insurance Scheme (NHIS)	Dichotomous	Index children Younger siblings Older siblings
Health card	Mother has child's health record	Dichotomous	Index children Younger siblings Older siblings
Bednet	0 = child did not sleep under bednet the night prior to the investments interview	Ordinal	Index children Younger siblings Older siblings

	1=child slept under a bednet the night prior to the Investments interview but it was not insecticide treated or was treated > 2 yrs ago 2=child slept under an insecticide treated bednet the night prior to the investments interview		

Table 4. Outcomes in the Schooling Domain

Outcome variable	**Definition**	**Nature of outcome**	**Cohorts**
Months of education	Z-score of proportion of months of completed formal education to maximum number of months of formal education based on age and date of investments interview	Continuous	Index children Older siblings
Private school	Child is attending private school	Dichotomous	Index children Older siblings

Table 5. Outcomes in the Financial Support Domain

Outcome variable	**Definition**	**Nature of outcome**	**Cohorts**
Financial support	Father/husband of iLiNS woman provides financial support for child	Ordinal	Index children[1]

[1]Relevant only for index children whose mothers are married or in an informal/loose union

Baseline Covariates and Effect Modifiers

The following variables will be considered as baseline covariates:

- Child gender
- Child birth order
- Maternal height
- Maternal age
- Maternal education
- Female-headed household
- Household electrification

The following variables will be considered as effect modifiers:

- Child gender
- Gender of index child (relevant only for sibling analyses)
- Child birth order
- Maternal height
- Maternal age
- Maternal education
- Female-headed household
- Household electrification

Primary Null Hypotheses

Index Children

For each investment, we will test the following null hypothesis:

There is no difference in the parental investment in the index child between households in which the mother-child dyad received LNS compared to households in which the mother-child dyad did not receive LNS. That is, the IFA and MMN groups will be combined and compared to the LNS group.

As a sensitivity analysis, we will also test the null hypothesis of no difference in the parental investment in the index child between the three groups (LNS, MMN, and IFA).

Younger Siblings

For each investment relevant the index child's younger sibling, we will test the following null hypothesis:

There is no difference in parental investments in the index child's younger sibling between households in which the mother-child dyad received LNS compared to households in which the mother-child dyad did not receive LNS. That is, the IFA and MMN groups will be combined and compared to the LNS group.

As a sensitivity analysis, we will also test the null hypothesis of no difference in parental investments in the index child's younger sibling between the three groups (LNS, MMN, and IFA).

Older Siblings

For each investment domain relevant to the index child's older siblings, we will test the following null hypothesis:

There is no difference in parental investments in the index child's older siblings between households in which the mother-child dyad received LNS compared to households in which the mother-child dyad did not receive LNS. That is, the IFA and MMN groups will be combined and compared to the LNS group.

As a sensitivity analysis, we will also test the null hypothesis of no difference in parental investments in the index child's older siblings between the three groups (LNS, MMN, and IFA).

Analysis Principles

Data Cleaning

To the extent possible, data cleaning happened concurrently with follow-up data collection. Queries were identified using Stata syntax and were relayed to the local home visit team manager. Queries were then resolved by seeking clarification from the field worker who completed the form and/or by re-contacting the respondent.

Outliers

Outliers in the investments data will be identified by visually inspecting histograms and/or densities of continuous variables and scatterplots of related variables. Outliers that are clearly impossible or implausible values will be corrected if possible and otherwise recoded as missing. Outliers which are plausible or possible will be retained. In cases where extreme outliers are retained, sensitivity analysis omitting the top and bottom 2.5% of the distribution will be performed to determine whether the extreme outliers have undue influence on the results.

Software

All analyses will be performed using Stata 14 statistical package.

Basis for the Analysis

The analysis will be by intent-to-treat. That is, by-group analysis will be according to group assignment regardless of any protocol violations. Missing data will not be imputed. All tests will be two-sided at the 10% level of significance.

In cases where the index child has a twin, the twin will be dropped from all analyses. In cases where the index child's closest siblings (younger or older) are twins, one twin will be chosen at random and included in the sibling analysis while the other twin will be dropped.

The primary analyses will be performed with the sample limited to households in which the index child still resides with his/her biological mother (92.85% of total sample size). As a sensitivity analysis, we will perform the analyses on the full sample of children. Note that this sensitivity analysis is relevant only for the schooling domain and only for index children, as only investment data on index child schooling were collected in cases where the index child no longer resided with his/her biological mother.

Attrition and Balance

Baseline covariates, birth weight, and child length-for-age z-scores at 18 months will be summarized by sample (follow-up analytic sample and lost-to-follow-up sample) using mean ± SD or median (Q1, Q3) for continuous and count variables and percentages for dichotomous variables. P-values for tests of differences in sample means between the follow-up and lost-to-follow-up groups will be reported.

Baseline covariates plus index child age on the date of the Investments interview will also be summarized by group (LNS and combined IFA and MMN groups) for the follow-up analytic sample only. To assess balance, p-values for tests of difference in group means will be reported.

Analysis of the Effect of the Intervention

The effect of intervention group on each parental investment for each child cohort will be assessed as follows according to the nature of the outcome variable:

- Dichotomous outcome variables will be analyzed using logit or probit regression models.
- Continuous outcome variables will be analyzed using ordinary least squares regression models.
- Count outcome variables will be analyzed using poisson or negative binomial regression models.
- Ordinal outcome variables will be analyzed using ordered logit or ordered probit regression models.

All regression models will control for index child age at the time of the Investments interview. Analyses of younger and older sibling investments will also control for the age of the sibling at the time of the investments interview, and cluster-robust standard errors will be used for analyses of investments in older siblings. For adjusted analyses, we will additionally control for baseline covariates that are significantly associated with a particular outcome at the 10% level of significance in a bivariate analysis.

When the null hypothesis of no difference between groups is rejected, post-hoc pairwise comparisons of group means will then be performed. For sensitivity analysis comparing the three groups, where we reject the null of no difference between the three groups, post-hoc pairwise comparisons of group means will be adjusted for multiple comparisons.

Effect modification will be assessed using interaction terms, and statistically significant interactions ($p<.10$) will be further examined using Stata's 'margins' command. For dichotomous effect modifiers, the treatment effect by effect modifier will be estimated. For continuous effect modifiers, the treatment effect at values along the range of the effect modifier will be estimated.

References

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