WASH BENEFITS

Introduction with focus on Height-for-Age Measurement Methods and Rationale (how + why)

The WASH Benefits Team
Topics

- Brief Overview of WASH Benefits
- Height-for-age (HAZ): How + Why
  1. What is the target population for intervention?
  2. How should we measure length?
  3. How should we measure age?
  4. How frequently should we measure height?
WASH Benefits: Goals

- Measure the impact of sanitation, water quality, and handwashing interventions on child growth and development
- Determine whether there is added benefit to providing combined interventions compared to single interventions
- **Primary outcomes**
  1. Child height-for-age (length-for-age)
  2. Child development at 21 – 30 months (motor, verbal, personal/social)
  3. Acute diarrhea
WASH Benefits: Team

Kenya

Innovations for Poverty Action
Emory University

Bangladesh

International Center for Diarrheal Disease Research, Bangladesh (ICDDRB)

Additional Experts:

LSTMH
Sanitation Water

SUNY Buffalo
Hand Washing

UC Davis
Nutrition

Johns Hopkins
Behavior Change
Study Design

- Villages will be randomized into 5 different arms
- We are actively considering the addition of 2 nutrition-related arms (*pending funding*)
- Plan to enroll 7,500 children < 6 months in ~750 villages in each country and measure them 3 times over 2 years
Rural Environments – but very different

Kenya
Distributed household compounds
Drier conditions, higher elevation

Bangladesh
Highly clustered baris
Water everywhere, low elevation
Sanitation
Household hardware + promotion

Example from Kenya:

Sani-scoop
(“kipupu”)

Child
Potties

Improved latrines
(slabs)
Water Quality: Hardware + promotion

Kenya

Community Source
Chlorine Dispensers

Bangladesh

Household candle or ceramic filters
Handwashing:
Hardware + community promotion

Kenya
Dual “Tippy Taps”
(water + soapy water)

Bangladesh
Soapy water bottles next to hand pumps
Why measure HAZ in WASH studies (1)

- It is an objective outcome
  - Avoids the problems of caregiver-reported illness

- Relatively stable – not temporally and spatially hyper-variable like diarrhea
  - Can characterize individual children well with a small number of measurements
Why measure HAZ in WASH studies (2)

- It captures impact from multiple types of infection that WASH interventions attempt to interrupt:
  - Acute diarrheal episodes (Checkley 2008)
  - Intestinal parasitic infections (numerous, e.g., Checkley 1998)
  - In theory: chronic nutrient malabsorption and immune system stimulation from repeated ingestion of fecal bacteria (Environmental Enteropathy) (Lunn 2000)

- Why HAZ vs. raw height measurements?
  - HAZ is a common metric to help standardize across populations and studies with different age distributions
  - “Stunting” is defined using HAZ (< −2 Z)
What is the target population for interventions that hope to improve HAZ?

- Enroll children < 6 months or in their 3rd trimester
- Why enroll children so young?

HAZ growth faltering occurs between 3 and 24 months
By 24 months the window for intervention has closed

N = 325,760
(Victora 2010)
HAZ Measurement Technique I: length
How to measure infant length?

- **Suggested methods:**
  - FANTA 2003 standards
    - (Cogill 2003)
    - (http://www.fantaproject.org/publications/anthropom.shtml)
  
  2 weeks of training and standardization for the field team
  - (de Onis 2004)
Why so much training and standardization?:

- At 24 months, 1 SD in HAZ ≈ 3 cm

- Mean HAZ increase from supplemental feeding interventions: 0.28 SDs or 0.84 cm (Dewey 2008)

- Our anticipated HAZ impacts from environmental interventions: ≤ 0.15 SDs or 0.45 cm

- Measurement error of the device = 0.10 cm

- Measurement error of the assessor = varies
HAZ Measurement Technique II: age
How to measure child age?

- **How:**
  - Measure age with birth dates.
  - Use vaccination cards to validate when possible.
  - In our Bangladesh EE pilot 58.8% of children ages 10 – 48 months had a vaccination card with a birth date.
  - In Kenya DHS 2008-9, 76.8% of children < 6 mo had a vaccination card in one of our target populations.

- **Why does age measurement need to be so accurate?**
  - Measurement error in age contributes to error in HAZ scores because the scores are standardized by sex and age (accurate to days)
  - If age measurement is really inaccurate, can resort to raw length measurements.
Impact of HAZ measurement error on sample size

Studies with poor measurement in length and/or age must be 2 – 3 times larger to compensate for measurement error:
When and how often should we measure height to estimate intervention impact?

- **Suggested minimum measurement:**
  - 2 measurements
    - 1 baseline at age < 6 months
    - 1 follow-up at age 24 months or later
Why a single measure on either end of the growth faltering window?

- The window between 3 and 24 months is when most of the faltering occurs.

- The within-child correlation of HAZ is high.
  - Example: Southern India measurements separated by 1 year: correlation of HAZ within child is 0.64 (Arnold 2010).

- There are two implications from the high correlation:
  - Repeated observations close in time provide relatively little new information for HAZ.
  - A treatment contrast within a child (i.e. both baseline + follow-up) adds a large amount of statistical power relative to follow-up only (Frison 1992).
Note: Two measures not needed for validity
A single post-treatment measure is unbiased

Post-treatment difference:
(-1.0) – (-2.0) = 1.0

Difference in change from baseline
(Difference in Differences):

\[ \left[ (-1.0) - (-0.5) \right] - \left[ (-2.0) - (-0.5) \right] = 1.0 \]
Ignoring Baseline HAZ Harms Power: Required Sample Size Increase $\sim 1.3 - 1.7x$

Sample Size Increase Required by Ignoring Baseline vs. HAZ Correlation Between Baseline + Follow-up

- Correlation = 0.64, 1 year between measures
  - Expect WASH Benefits to be in the middle with 2 years between measures
- Correlation = 0.49, 3 years between measures

SHEWA-B / EE pilot (3 Yr)
Tamil Nadu Cohort (1 Yr)
More frequent length measurement is required if estimating growth curves

- Two measurements for a child will allow us to estimate a difference in mean HAZ change between groups.

- This is a useful parameter of interest for average cumulative impacts of WASH interventions over the growth faltering window.

- 2 measurements will not provide a growth curve for individual children
More frequent length measurement is required if estimating growth curves

- If patterns of growth are important, then you must collect more frequent measurements (every 3 – 6 months) at uniform ages to estimate:
  - **Size**: absolute level of height at time $t$
  - **Velocity**: change in height from $t-1$ to $t$
  - **Tempo**: timing of growth (when does it start and end?)

(Cole 2010)


