Optima Nutrition

Overview and example applications

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Optima Nutrition is a mathematical model designed to answer

“What combinations of investments in nutrition interventions can lead to optimal outcomes?”

Overall public health budget available for nutrition

Intervention 1
Intervention 2
Intervention 3
Intervention 4
Intervention 5
Intervention 6
Intervention 7
Overview of the Optima Nutrition model

• The underlying model tracks the under-5 population over a given period (e.g. 2018-2030)
• The model includes risk factors that contribute to mortality, stunting, wasting and anaemia
• The model includes a range of interventions
  • For children, pregnant women, non-pregnant women of reproductive age, or the general population.
• Key outcomes are the number of deaths (child and maternal), stunting, wasting and anaemia (number of cases as well as prevalence)
• An optimisation algorithm is used to allocate a given budget across the nutrition interventions to minimise a chosen objective
  • For example, maximise the number of alive and non-stunted children
Definition of stunting in the model

• Risk factors for stunting are:
  • Birth outcomes
  • Breastfeeding practices
  • Diarrhoea incidence
  • Past stunting

• Stunting increases the risk of mortality for children who have diarrhoea, pneumonia, measles and other illnesses
Model populations and the ageing process

Births

- Pre-term SGA
- Term SGA
- AGA

<1 month

Risks of stunting include:
- Breastfeeding practices
- Past stunting
- Diarrhoea incidence

Height-for-age: Four categories tracked relative to global mean

1-6 months
6-12 months
1-2 years
2-5 years

Stunted

Neonatal death

Post-neonatal death

Deaths

Stunting

Others not stunted by age 5 years

SGA: Small for gestational age
AGA: Appropriate for gestational age

Key endpoints

- Stunting
- Deaths

Risks of stunting include:
- Breastfeeding practices
- Past stunting
- Diarrhoea incidence

Relative to global mean
Stunting interventions

For pregnant women:

- Balanced energy protein supplementation
- Multiple micronutrient supplementation

For children:

- Lipid-based nutrition supplements
- Public provision of complementary foods
- Prophylactic zinc supplementation
- Vitamin A supplementation

For pregnant women/parents:

- Infant and young child feeding education

- Improves birth outcomes \(\rightarrow\) reduces stunting
- Reduces stunting
- Reduces diarrhoea \(\rightarrow\) reduces stunting
- Increases breastfeeding and complementary feeding \(\rightarrow\) reduces diarrhoea \(\rightarrow\) reduces stunting
Breastfeeding promotion and complementary feeding education interventions are modelled as user-defined (IYCF) packages.
Wasting implementation

- The weight-for-height distribution is tracked for children in each age band
- Split according to weight-for-height Z-scores (WHZ) as four categories (similar to stunting)
  - Wasting considered to be SAM + MAM categories
- Wasting is modelled as an incident (short-duration) condition
Wasting interventions

- Treatment of SAM
  - Improves recovery → reduces prevalence (and mortality)

- Cash transfers

- Lipid-based nutrition supplements
  - Prevents wasting

- Public provision of complementary foods

- Prophylactic zinc supplementation

- Vitamin A supplementation
  - Reduces diarrhoea → reduces wasting

For children

For pregnant women / parents

- Infant and young child feeding education
  - Increases breastfeeding and complementary feeding
    → reduces diarrhoea → reduces wasting
Interventions: treatment of SAM

• Treatment of severe acute malnutrition (SAM)
  • Target population is all children experiencing SAM
  • Treated children are moved to the MAM category
Extending treatment of SAM to include MAM

• Treatment of severe acute malnutrition (SAM)
  • Target population is all children experiencing SAM
  • Treated children are moved to the MAM category

• The treatment of SAM intervention has an option to include management of MAM.
Anaemia interventions

For women of reproductive age
- IFA supplementation
- Multiple micronutrient supplementation
- IPTp
Reduces anaemia

For pregnant women
- IFA supplementation
- Multiple micronutrient supplementation
- IPTp
Reduces anaemia \(\rightarrow\) reduces maternal mortality, improves birth outcomes

For children
- Micronutrient powders
- Delayed cord clamping
- Lipid-based nutrition supplements
Reduces anaemia

For everyone
- LLINs
- Food fortification
Reduces anaemia (all populations) \(\rightarrow\) reduces maternal mortality, improves birth outcomes
Interventions: fortification of foods

• All population groups

• Fortification with iron and folic acid:
  • Fortification of wheat, rice and maize flour
  • Coverage restricted to fraction who eat each food as their staple
  • Does not reach the fraction on subsistence farming

• Double fortification of salt (iron + iodine)
  • Targets entire population

*Coloured areas represent 100% coverage of a particular food fortification.
**Depending on the country, the target population of a particular food vehicle may be zero
Mortality interventions

For pregnant women
- Calcium supplementation
- Mg for eclampsia/pre-eclampsia
- IPTp

Reduces maternal mortality

For children
- Kangaroo mother care
- ORS +/- Zinc for treatment of diarrhoea
- Treatment of SAM

Reduces pre-term mortality, improves breastfeeding
Treats diarrhoea → reduces mortality
Improves recovery → reduces mortality

For everyone
- Food fortification

Reduces child mortality (birth defects)
Other nutrition-sensitive interventions

• Family planning:
  • When family planning services are scaled up this decreases the number of projected births (restricted by unmet need)
  • Family planning also decreases the odds of suboptimal birth spacing

• Five WASH interventions*:
  • Improved water source
  • Piped water
  • Improved sanitation
    Hygienic disposal of stools
  • Handwashing with soap

*Evidence on the effectiveness of these interventions is mixed and unclear, in particular given some recent large studies
Linking investment in interventions to impact

- The spending on interventions is linked to their coverage
- For each intervention, increasing investment:
  - Increases the number of people receiving the intervention
  - Leads to reductions in stunting and deaths according to estimated effectiveness / odds ratios from the literature

- The model is given inputs on how much to spend on each intervention, and produces estimates for stunting and mortality (among other things).
Example: Pakistan
How is Optima Nutrition applied?

1. Burden of malnutrition
   • Data on undernutrition
   • Data on breastfeeding behaviours

2. Programmatic responses
   • Data on intervention costs and coverage
   • Identify constraints on interventions

3. Objectives and constraints
   • Strategic goals
   • Ethical, logistic & economic constraints

4. Optimization algorithm
Pakistan: potential impact of additional US$180m p.a.

Additional alive and non-stunted children 2020-2024:

More than 4.5 times the impact with the same amount of money
Example: Tanzania
Estimated 2017 spending

Projections:
2017 spending across the 22 regions was estimated at US$31 million per annum, based on intervention coverages and unit costs.

If continued between 2019-2025, this was estimated to lead to:
• 5,092,000 alive and healthy* children
• 1,064,000 child deaths
• 3,765,000 stunted children (29.6% under-5 prevalence)
• 51% under-5 anaemia prevalence
• 4.68% under-5 wasting prevalence

*Alive and non-stunted, non-wasted and non-anaemic children leaving the model 2019-2025
An additional US$33M per annum, distributed optimally across regions and interventions

**Impact** (compared to continued 2017 spending, 2019-2025):
- 484,000 (10%) additional alive and healthy children
- 67,900 (6.4%) fewer child deaths
- 311,000 (8.3%) additional non-stunted children
- 14.6% relative reduction in under-5 stunting prevalence (from 29.6% to 25.3%)
- 15% relative reduction in under-5 anaemia prevalence (from 51% to 43%)
- 1.1% relative reduction in under-5 wasting prevalence (from 4.68% to 4.63%)
Example: Bangladesh
Example: Geospatial optimization of additional US$10 million per annum in Bangladesh

- Breastfeeding promotion
- Public provision of complementary foods
- Balanced energy-protein supplementation
- Vitamin A supplementation
- IYCF education (6-23 months)
- Antenatal micronutrient supplementation
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