Optima Nutrition Analysis: Pakistan, February 2019[1]

Nick Scott (Burnet Institute), Jonathan Akuoku (World Bank), Yi-Kyoung Lee (World Bank), Davide De Beni (World Bank), on behalf of Optima Nutrition workshop participants (Islamabad, 13-15 Feb 2019)

Summary

- US$900 million may be available to invest in specialised nutritious foods (SNF) among the lowest wealth quintile in Pakistan, over the five-year period 2020-2024.
- The Optima Nutrition model was used to estimate the impact of this investment and determine whether greater impact may be possible with a combined intervention approach.
- In the model, investing in SNF for children (US$90 million per year) and SNF pregnant/lactating women (US$90 million per year) led to an additional 54,000 (+3%) alive and non-stunted children turning age five between 2020 and 2024.
- Using an optimised spending approach, the same investment was estimated to lead to **more than four times the impact** – an additional 230,000 (+11%) alive and non-stunted children turning age five between 2020 and 2024. This involved:
    - Financing a small proportion of the additional funds to vitamin A supplementation, kangaroo mother care and multiple micronutrient supplementation for pregnant women (which are effective and cheap compared to SNF, and therefore a small proportion of the additional funds could be sufficient to achieve high coverage, >90%).
    - Expanding infant and young child feeding education coverage from ~30% to >90%
    - Use the remaining additional funds for SNF for children

Background

Malnutrition contributes significantly to stunting and is a priority issue for Pakistan. It is estimated that 38% of Pakistani children stunted, with only 48% of children under six months exclusively breastfed and only 13% of children 6-23 months meeting the criteria of a minimum acceptable diet[1].

In early 2019, the Government of Pakistan considered a US$900 million investment to improve child nutrition by providing specialised nutritious food (SNF) supplements for pregnant/lactating women and children under five from the lowest quintile and requested the World Bank (WB) team to carry out the Optima Nutrition analysis

SNF supplementation may reduce stunting in children, as has been shown for other similar supplementation interventions[2,3]; however, with an estimated cost of US$70-120 per recipient per year, it is also one of the more expensive interventions for reducing stunting. There are a range of alternative interventions available[4], and while many are not expected to be as effective, their lower cost means that greater coverage can be achieved with the same amount of funding. The limited budget especially for health in Pakistan means that it is not possible to fund all available interventions, and to achieve the best health outcomes a balance is needed between low coverage of a more effective intervention and high coverage of one (or more) less effective interventions.

The Optima Nutrition model[5,6] provides advice on how to allocate a limited budget across a range of nutrition interventions to minimise stunting and mortality in children under five. We used the Optima Nutrition model to estimate the impact of a US$900 million planned investment in SNF, and to determine whether greater impact may be possible with a combined intervention approach. The

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analysis was conducted following an Optima Nutrition training workshop (13-15 February 2019), with consensus on parameters sought from participants from federal and provincial governments, development partners, and the World Bank and a unit cost study carried out in Sindh.

Overview of the Optima Nutrition model

Model populations, risk factors and outcomes

The Optima Nutrition model[5,6] tracks the number of women of reproductive age (15-49 years) in a population, who can become pregnant and give birth. After birth, children are tracked until five years of age and are categorised according to their mother's breastfeeding practices, family economic status, height-for-age (stunting) status, weight-for-height (wasting) status, and anaemia status. Children in the model can die from a range of causes, with the relative risks of dying from each cause related to the child's breastfeeding, stunting, wasting, and anaemia status.

Several risk factors for stunting in children are modelled, including birth outcomes (pre-term birth and/or a child being born small for gestational age), stunting in a previous age-band, suboptimal feeding practices (age-appropriate breastfeeding), and incidence of diarrhoea.

Interventions

For this analysis, a sub-set of 14 interventions were considered (Table 1). A cost-coverage relationship was modelled for each intervention, to define how many people could be reached for a given amount of funding. To approximate it becoming harder and more expensive to reach an additional person at high coverage, interventions were modelled to have increasing marginal costs. A logistic curve was used to link spending to coverage, and was assumed to pass through the origin with slope 1/unit cost and asymptote at a maximum coverage of 95% of the target population.

When the total amount of funding for an intervention is changed, the number of people in the model receiving it also changes according to this cost-coverage relationship. This leads to different projected outcomes based on the intervention's effectiveness. Further details can be found in the Optima Nutrition User Guide[6].

Optimisation

The model includes a mathematical optimisation algorithm, which can be used to incrementally shift a fixed amount of funding between interventions until it achieves a budget allocation that minimises (or maximises) a given objective[5,7,8]. For this analysis we aimed to maximise the number of alive and non-stunted children turning age five over the projection period (2020-2024 inclusive).

Data inputs

Population and epidemiological data

A national model was set up for the lowest wealth quintile of Pakistan. Data were obtained from the Pakistan Bureau of Statistics[9] (population sizes, and projections), Pakistan Demographic and Health Survey 2017/18[1] (weight-for-height, height-for-age, breastfeeding, and birth spacing distributions, diarrhoea incidence, child mortality rates, health facility attendance and school attendance), Pakistan Household Integrated Economic Survey (food consumption patterns), Pakistan National Nutrition Survey 2011[10] (anaemia status), the World Health Organization[11] (causes of deaths among children under 5), UNICEF[12] (maternal mortality rates), Social Policy and Development Centre[13] (poverty indicators), Say et al.[14] (maternal causes of death), Lee et al.[15] (birth outcome distribution), and Blencowe et al.[16] (stillbirth rates). In some cases, reanalysis of raw data was required to obtain inputs specific to the lowest wealth quintile, or for the age brackets required by Optima Nutrition.

Intervention costs and coverage data

Intervention costs were taken from a 2019 costing study conducted in Sindh, where the unit cost of each intervention was estimated using an ingredients-based approach (accounting for the commodity costs, staff/health worker time, training, transport and logistics required to deliver each intervention). For interventions not covered in this costing study (Table 1), unit costs were based on consensus estimates produced by participants of the Optima Nutrition training course, held at the World Bank office in Islamabad 13-15 February 2019. An ingredients-based approach was also used to estimate these unit costs. The 2018 coverages of interventions were estimated based on the 2017/18 Pakistan Demographic and Health Survey[1] data and the experience of paticipants. Estimated coverages and unit costs were discussed and consensus was reached among participants (Table 1).

Table 1: Interventions considered in analysis, their estimated 2018 coverage and unit cost.

Interventions included in analysis (population considered to be the lowest wealth quintile)	Estimated 2018 coverage	Unit cost (US$ per beneficiary per year)
Cash transfers (unconditional) targeted for poor households with young children	80%	30.07*
Iron folic acid fortification of wheat flour targeted to entire population	24%	0.17#
Iron folic acid supplementation (IFAS) for non-pregnant women (PW)	0%	1.21#
IFAS for PW (community)	18%	1.21#
IFAS for PW (health facility)	18%	0.71#
Infant and young child feeding education (IYCF) for children < 23 months	30%	5.23*
Kangaroo mother care (KMC) for children < 1 month	5%	8.84*
Long-lasting insecticide-treated nets (LLINs) targeted to entire population in endemic areas	1%	2.61*
Multiple micronutrient supplementation (MMS) for pregnant women	0%	1.80*
SNF for children 6-23 months	0%	68.50#
SNF for pregnant/lactating women (PLW)	0%	109.90#
Treatment of severe acute malnutrition (SAM) for children 1-59 months	60%	127.00#
Vitamin A supplementation for children 6-59 months	67%	0.14#
Oral rehydration salts (ORS) + Zinc for treatment for children 0-59 months	10%	1.01#

*Estimate based on Optima Nutrition training workshop consensus (February 2019).
#Estimate based on 2019 Sindh costing study.

Scenarios modelled

Three scenarios were projected for the five-year period 2020-2024 (inclusive):

- **Baseline**: if estimated 2018 spending were continued.
- **SNF scenario**: if estimated 2018 spending were continued, plus an additional US$90 million per year for SNF for pregnant/lactating women and US$90 million per year for SNF for children 6-23 months (i.e. US$900 million total investment over five years).
- **Optimised scenario**: if estimated 2018 spending were continued, plus an additional US$180 million per year invested optimally across the 14 selected interventions.

Sensitivity analysis

Unit costs for interventions can vary by location, facility, provider and a number of other factors. Therefore, a sensitivity analysis was conducted to determine the impact on results if the unit costs of non-SNF interventions were two or three times what was estimated, or if the unit costs of SNF were halved.

Results

The model projected that there would be approximately 2,140,000 alive and non-stunted children turning age five between 2020 and 2024 if 2018 spending allocations were continued (Figure 1, left). Investing the entire US$180 million per year in SNF (US$90 million for PLW and US$90 million for children 6-23mo) was estimated to lead to an additional 54,000 (+3%) alive and non-stunted children turning age five between 2020 and 2024 (Figure 1, middle).

If the US$180 million per year investment were optimised across interventions, then the model projected that this could lead to an additional 230,000 (+11%) alive and non-stunted children turning age five between 2020 and 2024—more than four times the impact of the SNF scenario (Figure 1, right). This involved financing a small proportion of the additional funds to vitamin A supplementation, kangaroo mother care and multiple micronutrient supplementation for pregnant women, expanding infant and young child feeding education to high (>90%) coverage, and then allocating the remaining additional funds to SNF for children.

Vitamin A supplementation, kangaroo mother care and multiple micronutrient supplementation for pregnant women are cheap compared to SNF, and therefore, a small proportion of the additional funds was sufficient to achieve high (>90%) coverage. Existing infant and young child feeding education coverage was estimated to be 30% or less, meaning that there was room for greater impact by scaling up this intervention.

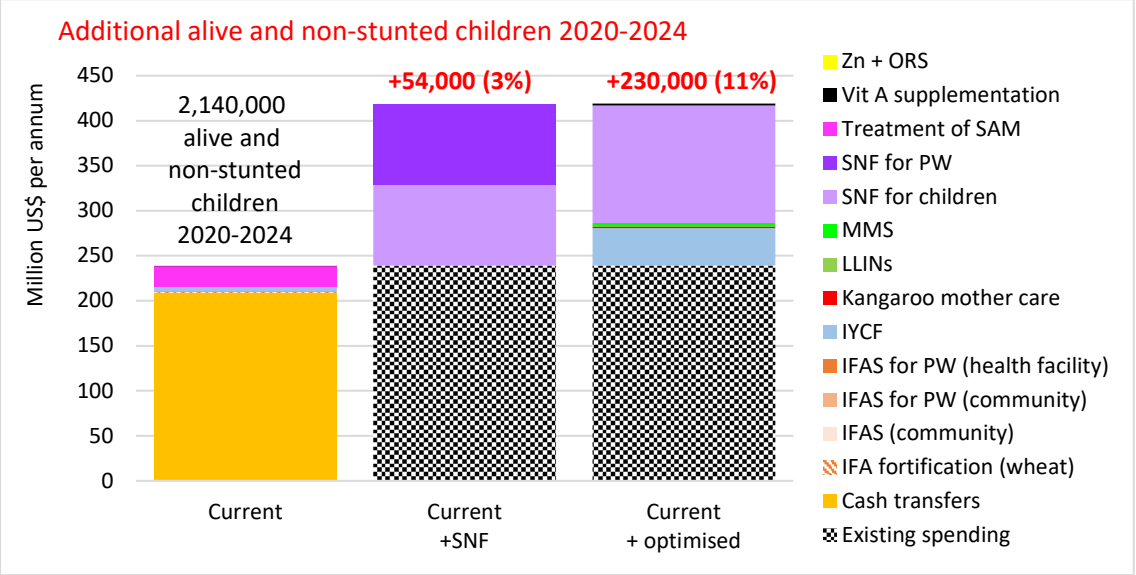

Figure 1: Annual budget allocations and impact of the scenarios modelled among the lowest wealth quintile in Pakistan, 2020-2024. Left: estimated 2018 spending on interventions. Centre: SNF only investment scenario. Right: Optimised investment scenario.

Sensitivity analysis

The results were robust to changes in the unit costs of interventions. If the unit costs of non-SNF interventions doubled or tripled, or if SNF could be provided at half the cost, then vitamin A

supplementation, kangaroo mother care, micronutrient supplementation for pregnant women and infant and young child feeding education were still prioritised over SNF (Figure 2).

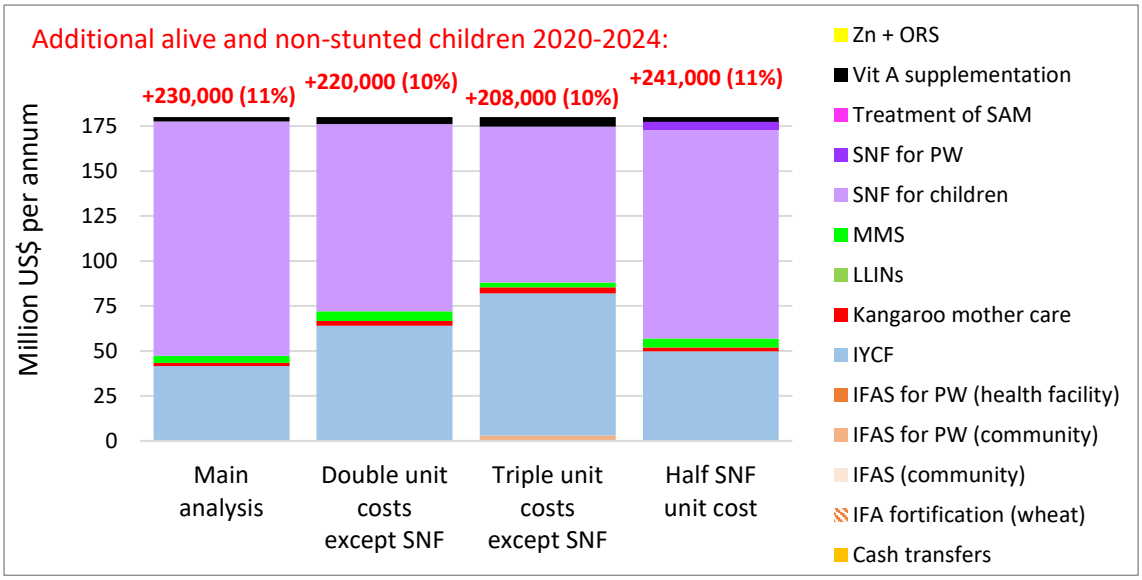

Figure 2: Sensitivity analysis for different intervention unit costs. The figure shows the optional allocation of the additional investment (US$180 million per annum) in the main analysis, compared to when alternate assumptions were used about intervention unit costs.

Limitations

The main limitations of this analysis are the data inputs. In particular:

- Unit costs were mainly taken from a costing study in Sindh or were derived based on the consensus of workshop participants. It will be important to validate these costs with program implementers and adjust when needed
- Unit costs were assumed to represent national averages, and variations according to geographic location, remoteness, service provider and facility type were not captured in this study. Therefore, some interventions may be more or less cost-effective in specific areas and circumstances.
- The estimated effect sizes of interventions are based on systematic reviews and global studies across a number of settings, and assume that the interventions are delivered effectively. Context specific factors in the way interventions are implemented may influence their impact.
- This analysis is based on national data and does not capture sub-national variations in health, intervention coverages and intervention delivery costs. This type of analysis could be repeated for specific provinces or districts of Pakistan where this data is available, to inform planning in these areas.

Conclusion

Quantitative efficiency tools can be useful to assist with budget allocation decisions. Compared to investing in a single intervention in Pakistan (i.e. SNF), a combined intervention approach could lead to more than four times the impact with the same US$900 million investment.

References

1. National Institute of Population Studies (NIPS) [Pakistan] and ICF. Pakistan Demographic and Health Survey 2017-18. Islamabad, Pakistan, and Rockville, Maryland, USA: NIPS and ICF. Accessed 10 November 2019 from: https://dhsprogram.com/pubs/pdf/FR354/FR354.pdf. 2019.
2. Bhutta ZA, Ahmed T, Black RE, et al. What works? Interventions for maternal and child undernutrition and survival. *The lancet* 2008; **371**(9610): 417-40.
3. Imdad A, Yakoob MY, Bhutta ZA. Impact of maternal education about complementary feeding and provision of complementary foods on child growth in developing countries. *BMC Public Health* 2011; **11**(3): 1.
4. Bhutta ZA, Das JK, Rizvi A, et al. Evidence-based interventions for improvement of maternal and child nutrition: what can be done and at what cost? *The Lancet* 2013; **382**(9890): 452-77.
5. Pearson R, Killedar M, Petravic J, et al. Optima Nutrition: an allocative efficiency tool to reduce childhood stunting by better targeting of nutrition-related interventions. *BMC public health* 2018; **18**(1): 384.
6. Optima Consortium for Decisions Science. Optima Nutrition User Guide. Available from: http://optimamodel.com/nutrition/documents.html. 2019.
7. Kerr CC, Stuart RM, Gray RT, et al. Optima: A Model for HIV Epidemic Analysis, Program Prioritization, and Resource Optimization. *J Acquir Immune Defic Syndr* 2015; **69**(3): 365-76.
8. Scott N, Hussain SA, Martin-Hughes R, et al. Maximizing the impact of malaria funding through allocative efficiency: using the right interventions in the right locations. *Malaria journal* 2017; **16**(1): 368.
9. Pakistan Bureau of Statistics. Access 25 Feb 2019 from: http://www.pbs.gov.pk/content/population-selective-age-groups. 2019.
10. Aga Khan University Pakistan, Pakistan Medical Research Council (PMRC), Nutrition Wing, Ministry of Health,, Pakistan Pakistan National Nutrition Survey 2011. Accessed 4 June 2019 from: https://www.mhinnovation.net/sites/default/files/downloads/innovation/research/Pakistan%20National%20Nutrition%20Survey%202011.pdf. 2012.
11. World Health Organization. WHO child cause of death estimates (2000-2015); http://www.who.int/healthinfo/global_burden_disease/estimates_child_cod_2015/en/. 2015.
12. UNICEF. Country profile: Pakistan. Accessed 4 June 2019 from: https://data.unicef.org/country/pak/. 2019.
13. Jamal H. Poverty and Vulnerability Estimates: Pakistan, 2016. *Social Policy and Development Centre* 2017.
14. Say L, Chou D, Gemmill A, et al. Global causes of maternal death: a WHO systematic analysis. *The Lancet Global Health* 2014; **2**(6): e323-e33.
15. Lee AC, Katz J, Blencowe H, et al. National and regional estimates of term and preterm babies born small for gestational age in 138 low-income and middle-income countries in 2010. *The Lancet Global Health* 2013; **1**(1): e26-e36.
16. Blencowe H, Cousens S, Jassir FB, et al. National, regional, and worldwide estimates of stillbirth rates in 2015, with trends from 2000: a systematic analysis. *The Lancet Global Health* 2016; **4**(2): e98-e108.

APPENDIX A: Intervention parameters

Table S1: Intervention target populations, effects and references

Intervention	Target population	Effects	Source / effect size
Specialized nutritious food (SNF)	Children 6-23 months below the poverty line	Reduces the odds of stunting Reduces the incidence of SAM Reduces the incidence of MAM *Indirectly reduces SAM mortality* *Indirectly reduces MAM mortality*	Stunting: OR = 0.89 [Bhutta et al. 2008, The Lancet [1]; Imdad et al. 2011, BMC Public Health [2]] SAM / MAM incidence RRR = 0.913 [LiST [3]] Based on public provision of complementary foods intervention
Specialized nutritious food (SNF) for pregnant women	Pregnant women below the poverty line	Reduces risk of SGA birth outcomes	RRR = 0.79 [Ota et al. 2015, The Cochrane Library [4]] Based on balanced energy-protein supplementation intervention
Cash transfers (unconditional)	All children below the poverty line	Reduces the incidence of SAM Reduces the incidence of MAM *Indirectly reduces SAM mortality* *Indirectly reduces MAM mortality*	SAM incidence: RRR = 0.766 for 6-23 months, RRR = 0.792 for 24-59 months [Langendorf et al. 2014, PLoS Med [5]] MAM incidence: RRR = 0.719 for 6-23 months, RRR = 0.792 for 24-59 months [Langendorf et al. 2014, PLoS Med [5]]
Vitamin A supplementation	Children 6-59 months	Reduces diarrhoea incidence mortality	Incidence RRR = 0.87 [Imdad et al. 2011, BMC Public Health [6]] Mortality RRR = 0.82 [Imdad et al. 2011, BMC Public Health [6]]
ORS + Zinc	Children 0-59 months (different quantity by age)	Reduces diarrhoea mortality	RRR = 0.14 [Munos, et al. 2010, I J Epi [7]; Walker & Black 2010, I J Epi [8]]
Kangaroo mother care	Children < 1 month	Increases exclusive breastfeeding Reduces deaths due to prematurity	Exclusive breastfeeding: OR = 1.5 < 1 month; OR = 1.39 1-6 months [Boundy et al. 2016, Pediatrics[9]] Mortality effectiveness = 0.51 [Lawn et al. 2010, I J Emi 2010[10]]
IFA supplementation for pregnant women	Pregnant women. Not given to women receiving MMS	Reduces anaemia Reduces SGA birth outcomes	Anaemia RRR = 0.33 [Pena-Rosas et al, Cochrane Database Reviews 2015 [11]] SGA RRR = 0.85 [Pena-Rosas et al, Cochrane Database Reviews 2015 [11]]
IFA supplementation for non-pregnant WRA	Non-pregnant WRA	Reduces anaemia	RRR = 0.73 [Fernandez-Gaxiola & De-Regil 2011, Cochrane Database Syst Rev [12]]
Multiple micronutrient supplementation in pregnancy	Pregnant women	Reduces risk of SGA birth outcomes	RRR = 0.77 [LiST [3]]
Food fortification	Everyone	Reduces anaemia Reduces neonatal mortality	Anaemia RRR = 0.61 for children; 0.73 for pregnant women; 0.66 for non-pregnant WRA [Keats et al. 2019, Am J Clinic. Nutrition [13]] Neonatal mortality OR = 0.59 [neural tube defects; Keats et al. 2019, Am J Clinic. Nutrition [13]]
Long-lasting insecticide-treated bed nets	Everyone in areas where there is malaria risk	Reduces anaemia Reduces SGA birth outcomes	Anaemia RRR = 0.83 [Eisele et al. 2010, Int J Epi [14]] SGA RRR = 0.65 [Eisele et al. 2010, Int J Epi [14]]

Exclusive breastfeeding	< 6 months	Reduces diarrhoea Reduces mortality Indirectly reduces stunting and wasting (through decreased diarrhoea)	Diarrhoea incidence: compared to exclusive breastfeeding, OR = 1.26, 1.68, 2.65 for experiencing diarrhoea with predominant, partial or no breastfeeding[15] Diarrhoea mortality: compared to exclusive breastfeeding, OR = 2.28, 4.62, 10.53 for diarrhoea mortality and 1.66, 2.50, 14.97 for other causes with predominant, partial or no breastfeeding[16] Diarrhoea→ stunting: OR for stunting = 1.04 for every additional diarrhoea episode compared to exclusively breastfed children[3]
Partial breastfeeding	6-23 months	Reduces diarrhoea Reduces mortality	OR = 2.07 for no breastfeeding compared to partial breastfeeding[15]
Appropriate complementary feeding		Reduces odds of stunting	OR = 0.67[2]

APPENDIX B: Intervention coverages

Table S1: Coverage of interventions under the different model scenarios. Denominators for coverage values are the targeted population (Table S1) in the lowest wealth quintile.

	Current	Current + SNF	Current + optimised			
			Main analysis	Double unit costs except SNF	Triple unit costs except SNF	Half SNF unit cost
Cash transfers	80%	80%	80%	80%	80%	80%
IFA fortification (wheat)	24%	24%	24%	24%	24%	24%
Iron folic acid supplementation (IFAS) for non-pregnant women (PW)	0%	0%	0%	0%	0%	0%
IFAS for PW (community)	18%	18%	11%	22%	65%	7%
IFAS for PW (health facility)	18%	18%	0%	0%	0%	0%
Infant and young child feeding education	30%	30%	94%	92%	90%	95%
Kangaroo mother care	5%	5%	93%	90%	86%	94%
Long-lasting insecticide-treated nets	1%	1%	1%	1%	1%	1%
Multiple micronutrient supplementation for pregnant women	0%	0%	89%	78%	35%	93%
SNF for children	0%	62%	77%	68%	60%	92%
SNF for PW	0%	55%	0%	0%	0%	6%
Treatment of SAM	60%	60%	60%	60%	60%	60%
Vitamin A supplementation	67%	67%	95%	95%	95%	95%
Oral rehydration salts (ORS) + Zinc for treatment of diarrhoea	10%	10%	10%	10%	10%	10%

APPENDIX C: Allocation of new investment across all wealth quintiles

A sensitivity analysis was conducted to assess the impact if the additional funding could be allocated across all wealth quintiles, rather than just the lowest. Figure S1 shows that additional impact may be possible by expanding the target population (839,000 additional alive and non-stunted children compared to 230,000 when funding allocation was restricted as in Figure 1).

When investment was restricted to the lowest wealth quintile, the model suggested that it should optimally be used to ensure that vitamin A supplementation, kangaroo mother care, micronutrient supplementation for pregnant women and then infant and young child feeding education were expanded to high coverage before the SNF program was scaled up. When the target population was expanded to all children a similar outcome was seen, with the exception that the greater target population meant only a partial expansion of infant and young child feeding education could be afforded. However, in the model this led to a greater overall impact because a greater number of children and pregnant women were able to receive the higher priority (more cost-effective) vitamin A supplementation, kangaroo mother care and micronutrient supplementation interventions.

As with the main analysis where investment was only among the lowest wealth quintile, these conclusions were robust to alternate assumptions about the unit costs of interventions (Figure S2).

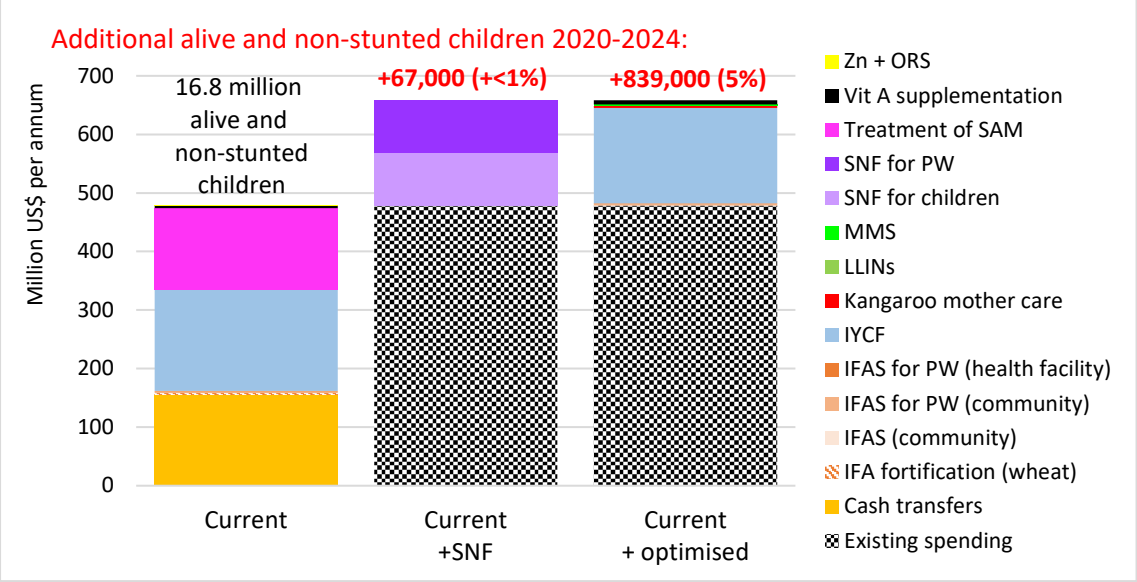

Figure S1: Annual budget allocations and impact of the scenarios modelled among <u>all wealth quintiles</u> in Pakistan, 2020-2024. Left: estimated 2018 spending on interventions. Centre: SNF only investment scenario. Right: Optimised investment scenario.

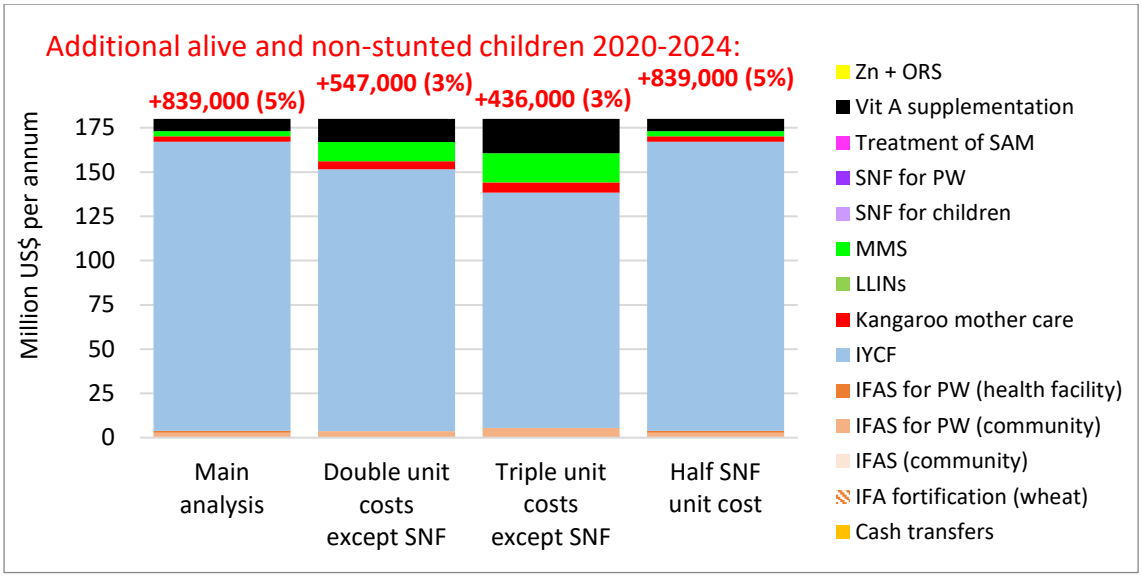

Figure S2: Sensitivity analysis for different intervention unit costs, in the scenario where investment can be allocated among all wealth quintiles in Pakistan. The figure shows the optional allocation of the additional investment (US$180 million per annum) using the best estimate unit costs, compared to when alternate assumptions were made.

Table S2: Coverage of interventions under the different model scenarios, when investment can be allocated among all wealth quintiles. Denominators for coverage values are the targeted population (Table S1) across the entire population.

	Current	Current + SNF	Current + optimised			
			Main analysis	Double unit costs except SNF	Triple unit costs except SNF	Half SNF unit cost
Cash transfers	42%	42%	42%	42%	42%	42%
IFA fortification (wheat)	24%	24%	24%	24%	24%	24%
Iron folic acid supplementation (IFAS) for non-pregnant women (PW)	0%	0%	0%	0%	0%	0%
IFAS for PW (community)	29%	29%	52%	45%	45%	52%
IFAS for PW (health facility)	29%	29%	61%	29%	29%	61%
Infant and young child feeding education	30%	30%	53%	41%	37%	53%
Kangaroo mother care	9%	9%	62%	50%	45%	62%
Long-lasting insecticide-treated nets	0%	0%	0%	0%	0%	0%
Multiple micronutrient supplementation for pregnant women	0%	0%	20%	36%	37%	20%
SNF for children	0%	35%	0%	0%	0%	0%
SNF for PW	0%	27%	0%	0%	0%	0%
Treatment of SAM	60%	60%	60%	60%	60%	60%
Vitamin A supplementation	75%	75%	94%	94%	94%	94%
Oral rehydration salts (ORS) + Zinc for treatment of diarrhoea	8%	8%	8%	8%	8%	8%

Appendix references

1. Bhutta ZA, Ahmed T, Black RE, et al. What works? Interventions for maternal and child undernutrition and survival. *The lancet* 2008; **371**(9610): 417-40.
2. Imdad A, Yakoob MY, Bhutta ZA. Impact of maternal education about complementary feeding and provision of complementary foods on child growth in developing countries. *BMC Public Health* 2011; **11**(3): 1.
3. LiST. Lives Saved Tool (LiST).
4. Ota E, Hori H, Mori R, Tobe-Gai R, Farrar D. Antenatal dietary education and supplementation to increase energy and protein intake. *The Cochrane Library* 2015.
5. Langendorf C, Roederer T, de Pee S, et al. Preventing acute malnutrition among young children in crises: a prospective intervention study in Niger. *PLoS medicine* 2014; **11**(9): e1001714.
6. Imdad A, Yakoob MY, Sudfeld C, Haider BA, Black RE, Bhutta ZA. Impact of vitamin A supplementation on infant and childhood mortality. *BMC Public Health* 2011; **11**(Suppl 3): S20.
7. Munos MK, Walker CLF, Black RE. The effect of oral rehydration solution and recommended home fluids on diarrhoea mortality. *International journal of epidemiology* 2010; **39**(suppl_1): i75-i87.
8. Walker CLF, Black RE. Zinc for the treatment of diarrhoea: effect on diarrhoea morbidity, mortality and incidence of future episodes. *International journal of epidemiology* 2010; **39**(suppl_1): i63-i9.
9. Boundy EO, Dastjerdi R, Spiegelman D, et al. Kangaroo mother care and neonatal outcomes: a meta-analysis. *Pediatrics* 2016; **137**(1): e20152238.
10. Lawn JE, Mwansa-Kambafwile J, Horta BL, Barros FC, Cousens S. 'Kangaroo mother care'to prevent neonatal deaths due to preterm birth complications. *International journal of epidemiology* 2010; **39**(suppl_1): i144-i54.
11. Peña-Rosas JP, De-Regil LM, Garcia-Casal MN, Dowswell T. Daily oral iron supplementation during pregnancy. *The Cochrane Library* 2015.
12. Fernández-Gaxiola AC, De-Regil LM. Intermittent iron supplementation for reducing anaemia and its associated impairments in menstruating women. *Cochrane Database Syst Rev* 2011; **12**.
13. Keats EC, Neufeld LM, Garrett GS, Mbuya MN, Bhutta ZA. Improved micronutrient status and health outcomes in low-and middle-income countries following large-scale fortification: evidence from a systematic review and meta-analysis. *The American journal of clinical nutrition* 2019.
14. Eisele TP, Larsen D, Steketee RW. Protective efficacy of interventions for preventing malaria mortality in children in Plasmodium falciparum endemic areas. *International journal of epidemiology* 2010; **39**(suppl_1): i88-i101.
15. Lamberti LM, Walker CLF, Noiman A, Victora C, Black RE. Breastfeeding and the risk for diarrhea morbidity and mortality. *BMC public health* 2011; **11**(3): 1.
16. Black RE, Allen LH, Bhutta ZA, et al. Maternal and child undernutrition: global and regional exposures and health consequences. *The lancet* 2008; **371**(9608): 243-60.