Cost Effectiveness of Childhood Nutritional Interventions in Developing Countries: A Systematic Review

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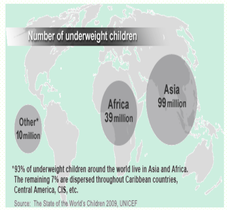
Background

- Nearly half of all deaths in children under five years old are attributed to malnutrition.[1]
- Nutritional deficiencies in children are costly for the economy of a country causing potential loss of income or impaired socioeconomic advancement.[2]
- A systematic review of studies evaluating the cost benefit of interventions to prevent malnutrition in developing countries may help to identify effective interventions and whether differences exist between countries.



Objective

Among children 0-5 years of age in underdeveloped and underprivileged countries, do nutritional interventions lead to improved measures of cost compared to usual care?

Methods

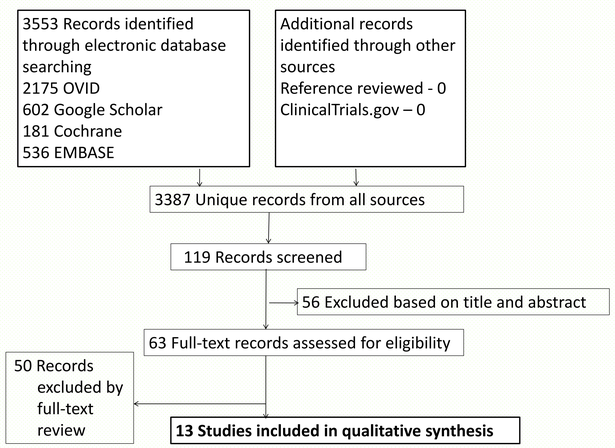
Study Eligibility

Clinical trials, cohort, and cost-effective analysis study designs were included that compared placebo or usual care with intervention (education, dietary, community based, cash based transfers, and integrated health facility care).

Search Methods

We searched Medline, the Cochrane Library, Web of Science, Google scholar, EMBASE & clinical trial registries thru November 2016 using keywords & MeSH terms to generate the following themes of childhood nutrition, developing countries, & cost.

Study identification and selection:



Data collection:

- 2 independent reviewers extracted and confirmed the data
- Standardized, piloted data collection form was used and assessment of risk bias for the included studies was done.

Analysis:

- Qualitative analysis of primary and secondary outcomes.
- Subgroup analyses based on country and type of intervention.

Results

Table 1: Characteristics of studies comparing effects childhood nutritional interventions effect on cost in underdeveloped countries.

Author, Year	Design	Country	Age Range (mos)	Total Subjects (N)	Description of intervention
Ackatia-Armah, et al., 2015	RCT	Mali	6-35	2224	Ready-to-use supplementary food
Fenn, B., et al., 2014	Cohort	Niger	6-36	824	Cash based transfer program
Bahwere, P., et al ., 2014	RCT	Malawi	6-59	600	Whey protein concentrate-read to use therapeutic food in which whey protein concentrates 34% replaces skimmed milk
Gowani, S., et al., 2014	RCT	Pakistan	0-24	172	Responsive stimulation, Enhanced nutrition
Chhagan, M., et al., 2013	Non-RCT	S. Africa	6-24	10,000	Zinc + Vitamin A supplements
Wilford, R., et al., 2010	CEA	Malawi	< 60	2780	Community based management of acute malnutrition
Bachmann, M., 2009	CEA	Zambia	<60	2523	Community based therapeutic care
Waters, H.R. et al., 2006	RCT	Peru	<18	338	Nutritional education program
Hossain, et al., 2005	RCT	Bangladesh	6-24	166	Amylase-rich flour supplementary food, Water supplementary food
Sharieff W., et al., 2005	RCT	Pakistan	6-24	75792	Sprinkles
Schellenberg, J., et al., 2004	Non-RCT	Tanzania	< 60	3934	Facility based integrated management of childhood illness
Awasthi, S., et al., 2000	RCT	India	18 to 42	1061	Albendazole
Ashworth et al, 1997	RCT	Bangladesh	12-60	446	Domicillary care; Inpatient care

*RCT= Randomized controlled trial; CEA= cost effective analysis; mos= Months

Table 2 Cost effectiveness ratios

Author, year	N	Outcome Measure	CEA Ratio	Author's overall conclusion
Waters, 2006	2,333 (6 centers)	Marginal cost of intervention per case of stunting prevented	$55.16	Within acceptable range and favor intervention
		Marginal cost of intervention per death averted	$1,952	Within acceptable range and favor intervention
Wilford, 2010	2,780	ICER ($) per DALY averted	$42	Highly cost-effective as defined by WHO criteria ($250) and remained cost effective under a sensitivity analysis, assuming a worst case scenario for each studied variable ($493)
Sharieff, 2005	37,896	Cost per death averted	$406	Cost effective; A sensitivity analysis suggested a range of $273-$3,248
		Cost per DALY averted	$12.2	Cost effective; A sensitivity analysis suggested a range of $8 - $97
		Gain in earnings due to higher cognitive functioning per $ spent	$37	Cost effective; A sensitivity analysis suggested a range of $18 - $51
Awasthi, 2000	1,061	ICER (Rs) per case of stunting prevented	543 Rs	Ratio was sensitive to the clinical efficacy of albendazole & placebo; Range Rs 498- 629

DALY = Disability Adjusted Life Years; ICER = Incremental Cost Effectiveness Ratio; Rs = Indian Rupees; $ = U.S. Dollars

Table 3 Costs of the intervention

Author, year	N	Outcome Measure	Intervention	Control	Difference between groups
Ashworth, 1997	130	Institutional cost	$29.4	Inpatient: $155.9 Day care: $59.3	$126.5; $29.9
Fenn, 2014	412	Median money spent in last 1 month (child food + child medical)	1700 WAF	600 WAF	1100 WAF

NR = Not reported; Rs = Indian Rupees; $ = U.S. Dollars; DALY = disability-adjusted life year; WAF=West African Franc

Table 4 Secondary Outcomes

Type of Intervention	Author/Country	Intervention	Control	Conclusion/Significance
Community based	Wilford et al/ Malawi	91.3% cured in OTP 85.1% ITP cured/stabilized and returned to OTP, base case 1.0% of OTP exits died	18.1% of non-CMAM patients died	Community based management of acute malnutrition (CMAM) in addition to standard health services in Dowa, Malawi was cost-effective.
Dietary Interventions	Awasthi et al/India	Albendazole: 2.06% increase in proportion of stunted children	Placebo: 11.44% increase in proportion of stunted children	P<0.0001
	Sharieff et al/ Pakistan	6% reduction in longitudinal prevalence of diarrhea would reduce risk of mortality by 18%, 112 deaths averted	N/A	Sprinkles supplementation leads to reduction in mortality rate.
Cash based transfers	Fenn et al/Niger	-0.60 WAH z score (0.25 difference from control)	0.85 WAH z score	P<0.001 Cash transfers can be effective.
Integrated health facility care	Ashworth et al/Bangladesh	All achieve 80% WAH range	N/A	P<0.001 Domiciliary care is most cost-effective.
Nutritional education	Waters et al/Peru	Prevent 11.1 cases of stunting per 100 children; 0.33 times as likely to be stunted as control	N/A	P<0.01

Methodological Quality of Included Studies:

Evers checklist (Evers 2005)

Item	Number of Studies: Yes	No
Is the study population clearly described?	13	0
Are competing alternatives clearly described?	13	0
Is a well-defined research question posed in answerable form?	13	0
Is the economic study design appropriate to the stated objective?	12	1
Is the chosen time horizon appropriate to include relevant costs and consequences?	10	3
Is the actual perspective chosen appropriate?	11	2
Are all important and relevant costs for each alternative identified?	9	4
Are all costs measured appropriately in physical units?	13	0
Are costs valued appropriately?	12	1
Are all important and relevant outcomes for each alternative identified?	13	0
Are all outcomes measured appropriately?	12	1
Are outcomes valued appropriately?	12	1
Is an incremental analysis of costs and outcomes of alternatives performed?	5	8
Are all future costs and outcomes discounted appropriately?	8	5
Are all important variables, whose values are uncertain, appropriately subjected to sensitivity analysis?	5	8
Do the conclusions follow from the data reported?	13	0
Does the study discuss the generalizability of the results to other settings and patient/ client groups?	10	3
Does the article indicate that there is no potential conflict of interest of study researcher(s) and funder(s)?	6	7
Are ethical and distributional issues discussed appropriately?	5	8

Limitations

Of our Review

- Included studies varied in methods and design, limiting our ability to do a quantitative analysis.
- Unable to formally assess for publication bias.

Of the Included studies

- Most studies did not include an incremental cost effectiveness analysis.
- Some studies did not mention blinding which raised concerns that co-interventions may have occurred.

Conclusions

- Many studies suggest nutritional interventions are cost effective.
- Further research using standardized outcome measures is needed to determine cost effectiveness of different nutritional interventions based on country.