Community-Based Approaches to Address Childhood Undernutrition and Obesity in Developing Countries

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Abstract

Community-based approaches have been the mainstay of interventions to address the problem of child malnutrition in developing societies. Many programs have been in operation in several countries for decades and originated largely as social welfare, food security and poverty eradication programs. Increasingly conceptual frameworks to guide this activity have been developed as our understanding of the complex nature of the determinants of undernutrition improves. Alongside this evolution, is the accumulation of evidence on the types of interventions in the community that are effective, practical and sustainable. The changing environment is probably determining the altering scenario of child nutrition in developing societies, with rapid developmental transition and urbanization being responsible for the emerging problems of obesity and other metabolic disorders that are largely the result of the now well-recognized linkages between child undernutrition and early onset adult chronic diseases. This dramatic change is contributing to the double burden of malnutrition in developing countries. Community interventions hence need to be integrated and joined up to reduce both aspects of malnutrition in societies. The evidence that community-based nutrition interventions can have a positive impact on pregnancy outcomes and child undernutrition needs to be evaluated to enable programs to prioritize and incorporate the interventions that work in the community. Programs that are operational and successful also need to be evaluated and disseminated in order to enable countries to generate their own programs tailored to tackling the changing nutritional problems of the children in their society.
Introduction

Three conceptual frameworks developed by international agencies have underpinned community-based approaches to improve child health and nutrition in developing countries. These include the ‘life cycle approach to undernutrition’ presented by a commission set up by the UN's Standing Committee on Nutrition [1] which underlines the importance of maternal and child nutrition as being essential for growth and healthy physical and mental development of children into adulthood and healthy old age, and to reduce the risk of premature morbidity and mortality due to adult-onset diseases. Secondly, the widely used ‘food-care-health conceptual framework’ developed by UNICEF [2] which explains the causes of malnutrition in society and their interactions at three levels: immediate (inadequate diet and infectious disease); underlying (household food insecurity, inadequate maternal and child care and poor health services in an unhealthy environment), and basic (i.e. structural factors including social, economic and political) – a framework that has considerable influence on approaches to remedial action and more recently has accorded recognition to the established links between child undernutrition and adult disease within this conceptual framework [3]. The ‘triple A process’, a framework again developed by UNICEF [2], is a cyclical and iterative participatory decision-making process wherein the problem of undernutrition is assessed, its causes analyzed, followed by a decision to implement an appropriate mix of actions.

Paradoxically community-based programs initiated by governments, aid agencies and NGOs have long preceded the evolution of these conceptual frameworks although they now influence and contribute significantly to the development and implementation of community-based interventions and programs in much of the developing world. Many of the earlier community intervention programs which preceded the evolution of those concepts were based on either the simple conviction that poor maternal and child nutrition is the result of inadequate intake of food thus resulting in programs that provide additional food supplements or are aimed more broadly at poverty reduction to alleviate food insecurity. The recognition of the high prevalence of nutritional deficiency diseases like anemia in pregnant women and children led to the development of community programs to supplement nutrients like iron and other micronutrients or reduce losses due to infections (malaria, worms, etc.) using treatment (e.g. deworming) or chemoprophylaxis. These interventions were expected to improve maternal nutrition during pregnancy and reduce maternal mortality, which in turn would have a beneficial impact on birth outcomes and child nutrition. Some of the community programs were national initiatives and were straightforward social welfare programs to improve overall nutrition or poverty reduction programs that were initiated for political reasons. In this chapter, the evidence from interventions through observational studies and well-designed trials will first be evaluated for their
Community Interventions for Child Undernutrition and Obesity

impact on reducing child undernutrition and obesity in developing country settings. A sample of the various national or regional level community-based programs aimed at reducing child undernutrition that have been operational for some time will be discussed and evaluated. This chapter will also make an effort to highlight those intervention strategies that work and are beneficial and hence need to be incorporated into national or regional level programs to address the problems of child nutrition in developing societies.

Do Community-Based Interventions Work? What Is the Evidence?

An attempt is made here to evaluate community-based intervention trials in pregnant women (antenatal, intrapartum and postnatal) and in infants and children, focusing mainly on developing countries. The objective is to identify key behaviors and interventions for which the weight of evidence is sufficient to recommend their inclusion in community- or population-based programs aimed at improving child nutrition and reducing the risk of later adult-onset diseases. With an understanding of the lifecycle approach, it is evident that poor maternal nutrition will result in poor birth outcomes such as low birth-weight (LBW), which increases the risk of obesity and chronic disease in later adult life. LBW infants are at increased risk of illness and mortality. Weight at birth is a good predictor of size in later adult life, and intrauterine growth-retarded (IUGR) infants demonstrate poor catch-up growth, thus the incidence of LBW is reflected in an increased prevalence of underweight children. IUGR infants are also at greater risk of stunting during childhood and adolescence and, like other stunted children due to poor nutrition, end up as shorter adults [4]. It is also well documented that undernourished individuals show indications of an increased risk of obesity and metabolic abnormalities in childhood.

Maternal undernutrition manifested as small maternal size (short stature and underweight) at conception and low gestational weight gain are the principal attributable risk factors for IUGR and LBW [5], hence community interventions to improve birth outcomes will have to target pregnant women. Evidence for successful interventions that promote infant and child nutrition will also need to be evaluated in order to develop holistic community-based approaches to tackle child undernutrition and at the same time ward off the potential risk of childhood obesity and metabolic disorders. The evidence from well-designed intervention studies covering multifarious aspects will then have to be reviewed, analyzed and prioritized in order to facilitate their successful incorporation into community approaches and programs to further good nutrition in children and to prevent early adult-onset diseases. There have been several previous attempts to address the issues related to maternal nutrition, pregnancy outcomes and child malnutrition in the past [6–8].
Maternal undernutrition and its consequent impact on fetal and infant nutrition are major problems in developing countries. A high proportion of births in developing countries fall into the category of LBW which is a major underlying risk factor for an increase in morbidity and mortality during infancy and the increased risk of childhood malnutrition. A recent review evaluated the impact of nutrition interventions on pregnancy outcomes while highlighting the fact that few studies have addressed this problem in community settings in developing countries [9]. The Cochrane Library’s pregnancy and childbirth database provides more evidence of the efficacy of interventions to improve maternal nutrition, health and pregnancy outcomes in addition to other summaries of reports in the literature [8, 10].

Prenatal Food Supplementation

In the Cochrane review [11], maternal food supplements that provided balanced protein and energy were the only interventions that improved pregnancy outcome measured as improved birthweight. Balanced protein-energy supplements provided <25% of the total energy content as protein. This review concluded that antenatal interventions with balanced protein-energy supplements significantly improved fetal growth, and reduced the risk of fetal and neonatal deaths. Fourteen trials were subjected to analysis and the intervention was associated with modest increases in maternal weight gain during pregnancy (+21 g), a small but significant increase in birthweight (+32 g), a smaller nonsignificant increase in birth length and head circumference as well as a tendency to a reduction in the prevalence of small-for-gestational age (SGA) babies (−32%) [12]. The interventions had a more substantial effect on reducing IUGR (OR 0.68; 95% CI 0.57–0.80) and a significant reduction in preterm births (OR 0.83; 95% CI = 0.65–1.06) [13]. Table 1 summarizes the significant features of many of these intervention trials, which were largely conducted in developing countries and in some cases in poor inner-city communities in industrialized countries.

It is important to note that the findings of the Cochrane review were largely biased by one recent large trial conducted in The Gambia [14]; excluding this study drastically alters the conclusions of this meta-analysis, leaving no demonstrable impact of antenatal interventions with food supplements. However, this trial provides a valuable example of an effective antenatal maternal intervention and has generated a resurgence of interest in this area of community interventions. This intervention trial showed remarkable increases in pregnancy outcomes: increase in birthweight (+136 g), decrease in LBW (−39%), increase in head circumference (+3.1 mm) with no changes in length or gestational age. Seasonal changes were also evident with even better outcomes when the intervention was in the hungry season. In addition
<table>
<thead>
<tr>
<th>Setting and sample</th>
<th>Intervention</th>
<th>Outcome</th>
<th>Other effects</th>
<th>Reference; type of trial</th>
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</thead>
<tbody>
<tr>
<td>The Gambia, rural; live births: 1,010 (I), 1,037 (C)</td>
<td>High protein energy biscuit supplement to pregnant women</td>
<td>Significant increase in birthweight (+136 g) and decrease (39%) in LBW</td>
<td>Decrease in incidence of stillbirths and reduced mortality first 7 days</td>
<td>14; RCT</td>
</tr>
<tr>
<td>Indonesia, rural; n = 542 pregnant women</td>
<td>Assigned to low and high energy supplementation groups</td>
<td>Significant difference in birthweight (+463 g) and at 12 months of age (+421 g)</td>
<td></td>
<td>64; QET</td>
</tr>
<tr>
<td>Indonesia, rural; n = 741 pregnant women</td>
<td>Assigned to high energy and low energy groups</td>
<td>No significant effect of either supplement on birthweight or LBW rates when compared to baseline, i.e. no supplementation</td>
<td>No difference in maternal weight gain compared to non-compliers</td>
<td>65; DB-RPCT</td>
</tr>
<tr>
<td>Guatemala, rural; n = 169 mothers followed through 2 consecutive pregnancies</td>
<td>Two supplements (high protein energy gruel vs. no protein low calorie drink) offered during pregnancy and lactation</td>
<td>Linear trend for increased birthweight from highest (gruel) to lowest (drink) supplements</td>
<td></td>
<td>66; QET</td>
</tr>
<tr>
<td>Thailand, rural; n = 43 women in 3rd trimester</td>
<td>3 groups; control plus 2 different levels of supplementation</td>
<td>Significant increase in birthweight of supplemented groups: 3,089 g and 3,104 g (I) compared to 2,853 g (C)</td>
<td>Placental weight significantly higher in supplemented groups</td>
<td>67; RCT</td>
</tr>
<tr>
<td>India, urban, hospital setting; n = 20 pregnant women</td>
<td>3rd trimester supplementation</td>
<td>No significant difference in birthweights and birth lengths</td>
<td>No difference in maternal weight gain; significantly improved Hb levels in supplemented group</td>
<td>68; RCT</td>
</tr>
<tr>
<td>Setting and sample</td>
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<td>Outcome</td>
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<tr>
<td>The Gambia, rural; n = 1,229 pregnant women</td>
<td>Supplementation with peanut-based biscuits and vitamin-fortified tea from 16th week</td>
<td>Increase in birthweight of supplemented group (+101 g); benefit only during wet season</td>
<td>Increased head circumference in infants of supplemented group</td>
<td>69; QET</td>
</tr>
<tr>
<td>Taiwan, rural; n = 212 women, supplemented from birth of first infant to birth of second infant</td>
<td>Supplements: high protein high calorie randomized with no protein low calories</td>
<td>Increase in birthweight of second infant (+161.4 g) in high protein-high calorie supplement</td>
<td>No effect of supplements on prematurity rates</td>
<td>70; DB-RCT</td>
</tr>
<tr>
<td>Colombia, urban; n = 456 pregnant women in 3rd trimester</td>
<td>Supplements of dry milk, bread, and vegetable oil to families of intervention group</td>
<td>Significant increase in birthweight (+95 g) of males in intervened group</td>
<td>Maternal weight gain significantly higher in supplemented group who had male infants</td>
<td>71; QET</td>
</tr>
<tr>
<td>Guatemala, rural; n = 405 chronically undernourished pregnant women</td>
<td>Two supplements (high calorie protein gruel and no protein low calorie drink) offered during pregnancy</td>
<td>No correlation between caloric supplementation and birthweights. Incidence of LBW halved in high calorie protein-supplemented group</td>
<td></td>
<td>72; QET</td>
</tr>
<tr>
<td>Location</td>
<td>Participants</td>
<td>Interventions</td>
<td>Increase in birthweight</td>
<td>Maternal weight gain</td>
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<tr>
<td>India, rural; n = 126 pregnant women from 20 weeks gestation</td>
<td>3 groups: group 1 iron-folate; group 2 high protein calories + iron-folate; group 3 control</td>
<td>Increase in birthweight: group 1 (= 270 g); group 2 (+810 g) compared to control group</td>
<td>Significant maternal weight gain (+1 kg) in group 2</td>
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</tbody>
</table>

**RCT** = Randomized control trial; **QET** = quasi experimental trial; **DB-RCT** = double-blind randomized control trial; **DB RPCT** = double-blind randomized placebo-controlled trial; **I** = intervention; **C** = control.
the antenatal food supplements were associated with a significant reduction in stillbirths and mortality of the newborn in the first 7 days.

As opposed to the interventions with balanced protein-energy supplementation, the benefits of protein supplements during pregnancy have been shown to be negligible following meta-analysis of the available evidence [11]. In studies conducted on Asian women in the UK [15] and Chilean women [16], where the habitual energy intake was iso-calorically replaced with protein, there was no effect on pregnancy outcome; if any a trend to a reduction in birthweights was observed. Even higher intakes of protein (>25% of energy) in relatively well-nourished women failed to show any benefit on pregnancy outcomes and birthweight [17].

One could safely conclude that supplementation during pregnancy with balanced protein and energy was the only intervention that improved birthweight, while high levels of protein alone cannot be recommended as an antenatal intervention. Most of the evidence comes from efficacy trials conducted under intense supervision with the weight of evidence in the meta-analysis being driven by the single large trial from The Gambia. Additional field evaluation is clearly required using available home diets or through dietary diversification strategies, and only by targeted supplementation in at-risk populations.

**Prenatal Micronutrient Supplementation**

Prenatal micronutrient supplementation was not considered an important intervention strategy for improving birth outcomes until the 1990s despite the concern with the high prevalence of iron deficiency among women of reproductive age in developing countries. Some of the earlier intervention studies aiming to increase energy and protein often provided some micronutrients with the food supplements. Since then evidence has been accumulating that the mineral and vitamin status of the mother can have a major impact on birth outcomes. Table 2 summarizes data from several intervention trials of micronutrient supplements either singly or as multiple micronutrients provided during pregnancy.

**Iron Supplementation.** There seems to be a U-shaped relationship between maternal anemia and birthweight because both low and high hemoglobin values are associated with increased risk of LBW [18, 19]. In developing countries, maternal iron deficiency is positively associated with LBW [20]. Meta-analysis of iron supplementation trials in the Cochrane collaboration [21] showed no detectable effect on birth outcome despite a significant reduction in maternal anemia. Community-based iron supplementation trials in developing countries have also failed to demonstrate any improvement in birthweights apart from a study in India [22], demonstrating a reduction in LBW rates with iron and folate supplementation from before 20 weeks of gestation, and another from rural Nepal where iron-folate supplementation slightly reduced the prevalence of LBW [23]. Oral iron supplementation may improve maternal anemia but has no clear impact on birth outcomes – a
### Table 2. Community intervention trials with micronutrients on low birthweights

<table>
<thead>
<tr>
<th>Setting and sample</th>
<th>Intervention</th>
<th>Outcome</th>
<th>Other effects</th>
<th>Reference; type of trial</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Antenatal iron supplementation</strong></td>
<td>100 mg/day elemental iron (I); placebo (C)</td>
<td>Supplemented group associated with increase in birth length but not birthweight</td>
<td>Significant effect on decreasing maternal anemia; drastic reduction in neonatal death</td>
<td>74; DB-RCT</td>
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<tr>
<td>Niger, peri-urban; n = 197 women</td>
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<tr>
<td>The Gambia, rural; n = 550 multigravida women</td>
<td>60 mg/day elemental iron (I); placebo(C); all women received 5 mg folic acid weekly</td>
<td>Supplement had no significant effect on birthweights or LBW rates. Those who took supplement for &gt;80 days delivered significantly heavier (+9.2 g) babies</td>
<td></td>
<td>75; DB-RCT</td>
</tr>
<tr>
<td>Sri Lanka, rural; n = 195 pregnant women</td>
<td>Fortified food supplement provided along with iron (60 mg)+ folate (0.25 mg) per day</td>
<td>No effect on birthweight</td>
<td>Iron supplements improved maternal Hb status</td>
<td>76; PCS</td>
</tr>
<tr>
<td>India, rural; n = 418 women 16–24 weeks gestation</td>
<td>Supplement of iron (60 mg) + folate (500 mg) daily for 100 days</td>
<td>Significantly heavier babies ~ 2.88 kg (I) vs. 2.59 kg (C); 46% decrease in LBW. Birthweight higher in those supplemented before 20 weeks gestation</td>
<td>Iron+folate-supplemented group had increased Hb and serum ferritin levels</td>
<td>22; RCT</td>
</tr>
<tr>
<td><strong>Antenatal folate supplementation</strong></td>
<td>3 groups: iron (200 mg/day); 5 mg folic acid+iron daily; 50 mg vitamin B₁₂+folate+iron</td>
<td>Folic acid+iron-supplement group had a much lower number of infants weighing &lt;2,270 g</td>
<td></td>
<td>24; RCT</td>
</tr>
<tr>
<td>Setting and sample</td>
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<td><strong>Antenatal zinc supplementation</strong></td>
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<tr>
<td>Chile, urban slum; n = 804 pregnant adolescents, &lt;20 weeks gestation</td>
<td>Zinc (20 mg/day) supplements until delivery (I) compared with placebo (C)</td>
<td>No effect on mean birthweights. Proportion of LBW significantly lower in supplemented group. Multiple regressions show significant effect of maternal nutritional status and supplements on birthweight</td>
<td>77; RCT</td>
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<tr>
<td>Indonesia, rural; n = 229 women between 10 and 20 weeks gestation</td>
<td>All 4 groups received iron + folate: group 1 + b-carotene; group 2 + zinc (30 mg/day); group 3 + b-carotene and zinc; group 4 only iron+folate (C)</td>
<td>Male infants born to mothers with all 4 nutrients were significantly heavier than the other 2 groups or controls</td>
<td>78; RCT</td>
<td></td>
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<tr>
<td>Peru, urban shanty town; n = 242 pregnant women 10–16 weeks gestation</td>
<td>Women receiving iron+folate were randomized to (25 mg zinc/day (I) or placebo (C)</td>
<td>No effect on birthweights</td>
<td>Positive effect of zinc on fetal femur diaphysis growth</td>
<td>79; RCT</td>
</tr>
<tr>
<td>Bangladesh, urban slum; n = 559 pregnant women; 12–16 weeks gestation</td>
<td>Randomized to 30 mg zinc/day (I) or placebo (C)</td>
<td>No significant effect on birthweight, length, head or chest circumference. No difference in LBW rates (RR1.12)</td>
<td>Supplement had no effect on maternal weight gain</td>
<td>80; RCT</td>
</tr>
<tr>
<td>Peru, urban, hospital setting; n = 1,295 women, 10–24 weeks gestation</td>
<td>Randomized to iron, 30 mg zinc/day (I) or placebo (C)</td>
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<td>81; RCT</td>
</tr>
<tr>
<td>Intervention</td>
<td>Setting</td>
<td>Participants</td>
<td>Details</td>
<td>Birthweight Impact</td>
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<td><strong>Community Interventions for Child Undernutrition and Obesity</strong></td>
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<tr>
<td>India, urban, hospital setting; n = 168 pregnant women</td>
<td>Intervention group (I) received zinc supplements (45 mg/day) compared to controls with no supplements (C)</td>
<td>Significant increase in birthweights of zinc supplemented group. Supplemented for 6–9 months (3.45 kg) compared to 1–3 months (2.98 kg) and controls (2.65 kg). Gestational age higher with increased duration of supplementation</td>
<td></td>
<td>82; RCT</td>
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| Antenatal iodine supplementation                  | Zaire, rural; n = 109 pregnant women | 28 weeks gestation at antenatal clinic either injection iodized oil (I) or iodine-free vitamins (C) | Birthweight increased (+109 g) in iodized oil group | Reduced infant mortality rate and improved maternal and infant thyroid hormone status in intervention group | 83; PCS                                                                   |               |

| Antenatal vitamin A supplementation               | Malawi, urban, hospital setting; n = 697 HIV-infected women; 18–28 weeks gestation until delivery | Randomized to receive daily iron+folate (C) or iron+folate+ vitamin A (3 mg retinol equivalent) (I) | Birthweights 2,895 g (I) vs. 2,805 g (C). Significantly lower proportion of LBW 14% (I) vs. 21.1% (C) | Significantly lower levels of anemic infants in vitamin A group (23.4%) compared to control group (40.6%) at 6 weeks postpartum | 84; RCT                                                                   |               |

| Antenatal multiple micronutrient supplementation   | Nepal, rural; n = 1,200 pregnant women | Individually randomized to either folate+iron (C) or MV supplements (I) during 2nd and 3rd trimesters | Birthweights 2,733 g (C) vs. 2,810 g (I). Difference 77 g (CI 24–130). 25% reduction in LBW in I group |  | 85; DB-RCT                                                               |               |

<p>|                                              | Nepal, rural; n = 4,926 pregnant women, 4,130 live births | Cluster/sectors randomized into 5 groups: folic acid; folic acid+iron; folic acid+iron+zinc; | Folic acid+iron increased birthweight (+37 g) and reduced LBW (–16%; RR = 0.84). MV supplements |  | 23; DB-CRT                                                               |               |</p>
<table>
<thead>
<tr>
<th>Setting and sample</th>
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<tbody>
<tr>
<td>Mexico, rural; n = 873 pregnant women before 13 weeks gestation</td>
<td>multivitamins; vitamins alone as control</td>
<td>increased birthweight (+64 g) and reduced LBW (−14%; RR = 0.86)</td>
<td>Mean birthweight and birth length did not differ significantly between the 2 groups</td>
<td>86; RCT</td>
</tr>
<tr>
<td>Tanzania, urban; n = 1,075 HIV-infected women</td>
<td>Randomized to receive supplements 6 days/week at home and antenatal care. Either iron (60 mg) alone or iron + 1–1.5 times RDA of several multivitamins</td>
<td>Vitamin A alone had no effect on LBW (OR = 1.14), or SGA (OR = 0.83). Risk of LBW and SGA significantly reduced in both MV groups 2 and 3. LBW decreased by 44% (OR = 0.56); SGA risk reduced by 43% (OR = 0.57)</td>
<td>Risk of preterm birth was significantly reduced in both MV groups 2 and 3. 40% decrease in fetal deaths in MV-supplemented groups</td>
<td>87; DB-RCT</td>
</tr>
<tr>
<td>Chile, urban; n = 709 pregnant women attending 9 prenatal clinics</td>
<td>Given either powdered milk with high milk fat or multiple micronutrient-fortified powdered milk. Non-consumers of any supplement were controls</td>
<td>Mean birthweights higher (+73 g) in the fortified powdered milk group than in other powdered milk supplement groups and even higher compared to controls (+335 g)</td>
<td>Significantly better maternal weight gain and iron status in the fortified milk group</td>
<td>16; PCS</td>
</tr>
</tbody>
</table>
South Africa, rural; n = 171 nutritionally deficient pregnant women >20 weeks gestation randomized to 4 groups:

<table>
<thead>
<tr>
<th>Group</th>
<th>Description</th>
<th>Mean birthweight higher in group compared to group 1 and higher by placebo group</th>
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<tbody>
<tr>
<td>Group 1</td>
<td>Micronutrient fortified high bulk supplement (high niacin + iron)</td>
<td>9.5% compared to group 1 and by 6.5% compared to placebo group</td>
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<tr>
<td>Group 2</td>
<td>Micronutrient-fortified low bulk supplement (high in vitamin A, calcium, thiamine, riboflavin)</td>
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<tr>
<td>Group 3</td>
<td>Zinc supplement</td>
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<td>Group 4</td>
<td>Placebo controls</td>
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</table>

Mean birthweight higher in group 2 (low bulk) compared to group 1 (high bulk) by 9.5% and higher by 6.5% compared to placebo group.

RCT = Randomized control trial; QET = quasi-experimental trial; DB-RCT = double-blind randomized control trial; DB-RPCT = double-blind randomized placebo-controlled trial; C = control; RR = relative risk; OR = odds ratio; MV = multivitamins/multiple micronutrients; LBW = low birthweight; SGA = small-for-gestational age.
conclusion that is drawn largely on a paucity of robust trials of iron supple-
mentation in community settings in developing countries.

**Folate Supplementation.** A study in South Africa in a tertiary hospital
setting is the only one to show a significant decrease in the incidence of
LBW births [24]. Along with iron supplements, folic acid has a demonstrable
impact on improving maternal hemoglobin levels. The evidence is very strong
that peri-conceptual folate supplementation reduces neural tube defects.
However the impact on other beneficial birth outcomes resulting from folate
supplementation during pregnancy is doubtful.

**Zinc Supplementation.** The potential for zinc supplementation to
improve birthweight is largely based on a review of 17 studies which indicated
an association between maternal indicators of zinc status and birthweight of
the offspring [25]. An in-depth review of zinc supplementation trials showed
that birthweight increased in 4 of 10 trials [26], although the Cochrane review
on maternal zinc supplementation revealed no differences in birth outcome
[27]. Evidence from other community-based studies summarized in table 2
suggest that overall zinc supplementation failed to show any impact on birth-
weight. Interestingly, two of the studies did show a reduction in the incidence
of infectious disease morbidity among LBW infants [28] and mortality among
SGA infants [29] born to zinc-supplemented mothers. This obviously has
enormous implications in reducing childhood malnutrition, particularly given
that LBW infants are at increased risk.

Neither iodine nor vitamin A supplementation trials have demonstrated
any benefit on birth outcomes, although there is little doubt that iodine sup-
plementation, even in mid-pregnancy, reduces deaths in infancy and early
childhood while vitamin A supplementation reduces maternal mortality [8].

**Multiple Micronutrient Supplementation.** The benefits of multiple
micronutrient supplements during pregnancy may be potentially high given
the increased demand on nutrients for fetal growth. However, community-
based intervention trials have not provided clear-cut evidence from stud-
ies in developing countries as either data are limited or the programs under
evaluation are so varied. In addition many of the trials are complicated by
the provision of additional energy or protein or food supplements alongside
the micronutrient supplements. A recent Cochrane review [30] has shown
that multiple micronutrient supplementation during pregnancy resulted in a
decrease in LBW (RR 0.83; 95% CI 0.76–0.91) and SGA infants (RR 0.92; 95%
CI 0.86–0.99). There is also evidence emerging that multiple supplements are
not that superior to iron-folate supplements alone [23] and a meta-analysis
comparing multiple micronutrients with folic acid and iron alone reports a
small increase in birthweight (pooled effect of 21.2 g) [30]. Iron-folate supple-
mentation alone also reduced LBW (RR 0.94; 95% CI 0.8–1.06) and SGA (RR
1.04; 95% CI 0.93–1.17). A recent report highlights the fact that the effects of
antenatal multiple micronutrient supplementations on the fetus persist into
childhood with increases in both bodyweight and body size [31].
Prevention of Maternal Infections

Maternal infections have an adverse impact on birth outcomes. The infections include malaria which greatly increases the risks of maternal anemia, preterm birth, LBW and neonatal mortality. The estimated population-attributable risk of LBW among primigravidae with malaria is 10–40% [32]. Hookworm infections and the associated maternal anemia are another problem and so is maternal sexually transmitted diseases like HIV, syphilis and gonorrhea.

Malaria chemoprophylaxis of mothers has been the main option in malaria endemic areas, although its efficacy is uncertain compared to intermittent presumptive treatment. A review of 15 trials by the Cochrane collaboration has shown that infants born to mothers on malaria chemoprophylaxis were heavier, especially so if they were born to primigravida [33]. In rural Uganda primigravidae on chloroquine had a significantly lower LBW rate (2% in treated vs. 9% in placebo group; p = 0.009) [34]. Other studies in Africa also support the findings of a benefit related to improved birthweights associated with malaria chemoprophylaxis during pregnancy. The increase in birthweight observed in almost all studies provides strong evidence for the beneficial effect of malaria chemoprophylaxis on birthweight in endemic areas. Compared to chemoprophylaxis, the use of insecticide-treated bed nets as a preventive measure had little impact on birthweights although they were effective in reducing mortality and morbidity from malaria [8].

Deworming is an accepted strategy to tackle helminthic infections like hookworm, which affect maternal health. The summary of evidence based on several small trials does favor deworming as being effective in reducing maternal anemia, improving maternal hemoglobin status and having some benefit in improving birthweights [8]. Maternal treatment of urinary tract infections and sexually transmitted diseases with antibiotics has also been shown to have benefits with regard to improving birth outcomes [8].

Other Interventions to Promote Maternal Health

Maternal Cessation of Smoking. Data on the effect of the cessation of smoking during pregnancy on birth outcomes are largely from industrialized countries and they seem to present mixed results on birth outcomes such as preterm birth or LBW rates. The important issue from a developing country perspective, i.e. the impact of the maternal environmental exposure to smoke and the beneficial effects of its reduction, has not been systematically examined in developing countries.

Interventions to Improve Diets and Weight Gain among Adolescent Mothers. Pregnant adolescents are at increased risk of inadequate gestational weight gain and micronutrient malnutrition due to inadequate intakes in their diets to support healthy fetal growth and promote good birth outcomes. Reviews of community interventions in developed societies show a predominance of medical models providing prenatal care with little emphasis on
nutrition education to alter the prenatal dietary behaviors of adolescents [35]. Positive effects on birth outcomes were evident when the approaches were driven by multidisciplinary teams supporting the nutritional and psychosocial needs of pregnant teenagers while individualized education and counseling encouraged optimal dietary intakes and appropriate gestational weight gain.

**Interventions to Promote Initiation and Sustenance of Breastfeeding**

Early initiation of breastfeeding is not a serious problem in developing countries as the initiation of breastfeeding is almost universal in the countries studied. However initiation rates remain low in many high income countries, particularly among the low income groups in their populations. A Cochrane collaboration report showed that the evaluation of all forms of breastfeeding education were effective in increasing breastfeeding initiation rates among low income groups in the USA [36].

Community-based intervention strategies to promote exclusive breastfeeding of infants up to 6 months of age and to sustain continued breastfeeding up to 12 months of age have also been evaluated. A Cochrane review that analyzed 34 trials of 29,385 mother–infant pairs in 14 countries provided evidence that any form of extra support increased the duration of both partial and exclusive breastfeeding up to 6 months [37]. All forms of extra support affected the duration of exclusive breastfeeding significantly. A review of specific breastfeeding promotion showed that both individual counseling (OR 1.93, 95% CI 1.18–3.15, p < 0.0001) and group counseling (OR 5.19, 95% CI 1.90–14.15, p < 0.00001) substantially increased exclusive breastfeeding at 6 months of age [13].

A Cochrane review of the potential benefits and drawbacks of exclusive breastfeeding for up to 6 months of age, based on trails and observational studies in both developed and developing country settings, showed no growth deficits in infant weight gain or increase in length [38]. The infants experienced less morbidity due to gastrointestinal infection compared to partially breastfed infants. The review in addition provided evidence of lactational amenorrhea and postpartum weight loss in the mothers.

**Nutrition Interventions to Promote Child Growth and Development and to Prevent Undernutrition**

**Behavior and Practices of Caregivers**

Caregivers provide food, healthcare, psychosocial stimulation and the emotional support necessary for the healthy growth and development of children [39]. The practices and the ways in which they are performed are critical for survival, optimum growth and proper development of children and in
the prevention of under- or malnutrition. Caregivers require time, energy and money to provide this important contributor of child health. A WHO review [40] concluded that interventions that incorporate care components are effective and identified the following conditions to maximize impact: interventions targeted to early life – both prenatally and in infancy; targeting children in poor households, and employing several types of interventions with more than one delivery channel and a high level of parental involvement. The significance of care practices on the nutrition status of children was demonstrated by a study in Ghana showing a close association of better scores for care practices with lower levels of stunting and underweight in children [41].

Complementary Feeding

Complementary feeding is the provision of foods and liquids along with continued breastfeeding of infants. Since the nutrient intake of an infant deteriorates when complementary foods start to be substituted for breast milk, many of the interventions that are central to complementary feeding include interventions with micronutrients and nutrition education [13].

Interventions that improve the intake of complementary foods by infants 6–12 months of age in developing countries have been shown to have a positive impact on their growth and nutrition [42]. A review of all the studies conducted on complementary feeds in developing countries is summarized in a recent report [12] and is based on two other compilations of trials published since 1988 in infants between 6 and 12 months of age [43, 44]. The trials varied in terms of the age of infant at intervention, the composition of the complementary food, and the extent of breastfeeding. Of the 14 trials reviewed, 3 demonstrated an increase in weight and length, and 2 showed only an increase in weight [12]. Nutrition education to improve complementary feeding in food-secure populations produced an increase in height for age Z scores compared to control groups [13], whereas in food-insecure populations educational interventions were of benefit only when combined with food supplements.

Community-Based Supplementary Feeding

Supplementary feeding implies the provision of extra food to children over and above the normal ration of their home diets. This intervention merits careful evaluation since several community-based programs have a component of supplementary feeding to improve child health and nutrition and to promote optimum growth. A Cochrane review has addressed the evaluation of the effectiveness of supplementary feeding at the community level for promoting the physical growth of preschool children [45]. Four randomized control trials were reviewed but no firm conclusions could be drawn on the effectiveness of supplementary feeding in improving child nutrition. Universal and untargeted supplementary feeding programs seem to have contributed to the rise in overweight and obesity among children in Chile [46].
Micronutrient Supplementation on Growth and Risk of Infections

Micronutrient supplementation either singly or as micronutrient mixes have been used as intervention strategies to improve child nutrition as well as to reduce the infectious disease burden which in turn has an impact on child undernutrition. Micronutrients have also been added to interventions with complementary foods or during supplementary feeding interventions in the community. Iron supplementation resulted in weight gain in anemic children but had a variable impact on improving heights [47] while the risk of diarrheal disease increased, demonstrating that iron supplementation in children has adverse effects on infectious diseases and no major gains with regard to growth [48]. Zinc supplementation or fortification of foods, on the other hand, reduces morbidity and mortality due to diarrheal disease and respiratory illness [49]. A meta-analysis of 25 studies provided evidence of an overall small but significant impact on the height of children with zinc supplementation, but only in children who had evidence of stunting [50]. The impact of vitamin A supplementation of infants is expected to reduce morbidity (and mortality) but the overall findings are largely variable with several randomized control trials failing to show any benefit on the risk of infections and growth [12]. Multiple micronutrient supplements also provide variable impact – improvements have been noted in stunted children in Vietnam and Mexico with no impact on growth in Peru and Guatemala [12].

Prevention and Treatment of Infections

Many of the interventions with micronutrient supplements have relevance on the prevention of infections in childhood and hence reduce the risk of child undernutrition. Treatment of infections and infestations also has a positive impact on child growth and nutrition. Deworming and use of anti-helminthics is particularly effective in children. A systematic review of 25 studies has documented the impact of single and multiple doses of anti-helmintics on growth [51]. While a single dose was associated with an average 0.24 kg increase in weight and 0.14 cm increase in height, several doses over a year resulted in 0.10 kg increase in weight and 0.07 cm in height over that time. A recent Cochrane review provided data only on weight gain and showed a 0.34 kg gain (95% CI 0.05–0.64) from 9 trials with a single dose while several doses over a year had no impact [52].

Other Interventions to Promote Infant and Child Nutrition

Interventions that promote hand washing, water quality treatment, sanitation and health education also reduce the risk of diarrheal disease and thus have impacts on promoting child nutrition [13].
Interventions to Prevent Childhood Obesity

The Cochrane database provides one review on the impact of interventions for preventing obesity in children [53]. All the studies were conducted in industrialized societies and there are no studies reported in the literature on interventions to reduce childhood obesity in developing countries. The only studies from developing countries were two conducted in Cuba where the intervention was dietary restriction [54] and hence cannot be considered as a community-based intervention. The Cochrane collaboration reviewed 22 studies: 10 considered long-term, i.e. at least 12 months duration, and 12 short-term, i.e. 12 weeks up to 12 months. Nineteen of the intervention trials were school-based, one was a community-based intervention targeting low income families, and 2 were family-based interventions targeting non-obese children of obese/overweight parents. The interventions either focused on dietary change or were targeted to increase physical activity, and in some instances was a combination of both. As the interventions were heterogeneous in design and quality, target population and outcome measures, the review was unable to provide statistical analysis of the impact. The review concluded that the interventions employed to date have largely not had an impact on the weight status of children. A recent comprehensive multicenter, multifactorial behavioral change intervention carried out over 3 years has been unable to demonstrate any change in the weight status among American Indian children [55]. Despite the global epidemic of obesity, the prevalence of obesity in most developing countries is small and there is no evidence that well-designed intervention trials to deal with childhood obesity have been carried out or reported.

Summary of Community-Based Intervention Trials: What Works?

Strategies that aim to improve maternal nutrition and health are the most significant interventions that have the best possible pregnancy outcome. An adequate and diversified diet promotes weight gain in pregnancy and hence food supplements or balanced energy-protein supplementation may be used to target vulnerable groups such as undernourished low BMI pregnant women and adolescent mothers. Multi-vitamin supplements have been shown to be effective not only in improving maternal health and birth outcomes but also on subsequent infant growth and health. Promotion of exclusive breastfeeding in early infancy followed by optimum complementary feeding in the presence of good hygienic practices diminishes risk of infections, promotes infant growth and prevents child undernutrition. Table 3 summarizes the most important interventions for good pregnancy outcomes and infant and child nutrition that are supported by evidence from community-based intervention studies and trials.
Table 3. Summary of interventions that have a positive impact on pregnancy outcomes and infant and child nutrition

<table>
<thead>
<tr>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Interventions with evidence of positive impact on good birth outcomes, e.g. LBW</strong></td>
</tr>
<tr>
<td>Maternal supplementation of balanced energy and protein supplements/food supplements</td>
</tr>
<tr>
<td>Supplementation with iron-folate or multiple micronutrients</td>
</tr>
<tr>
<td>Micronutrient fortification of food</td>
</tr>
<tr>
<td>Dietary diversification strategies</td>
</tr>
<tr>
<td>Non-nutritional interventions: increase age of marriage/conception; reduce physical activity during pregnancy; malaria prophylaxis and deworming; cessation of smoking/reduce smoke exposure</td>
</tr>
</tbody>
</table>

**Interventions for better infant and child nutrition and growth**

<table>
<thead>
<tr>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Promotional strategies and support for breastfeeding</td>
</tr>
<tr>
<td>Educational strategies and support for better and safe complementary feeding</td>
</tr>
<tr>
<td>Ensure adequate micronutrient intakes during complementary feeding</td>
</tr>
<tr>
<td>Prevent infections: hygienic interventions, deworming</td>
</tr>
</tbody>
</table>

Community-Based Intervention Programs: Country Experiences

Some of the important community programs [56] with nutritional objectives and goals are summarized here. These are large district-wide or national programs that cover large sections of the population in developing countries – many of them ongoing even now. Many were initiated either by national governments or by aid agencies and bilaterals with the collaboration and support of the state. Some of them have been evaluated and others have adopted and evolved as the evidence for what works emerges.
Kenya – Applied Nutrition Project (ANP)

Started in 1983, the ANP covers 3 food-insecure divisions in Kenya. Although the main goals of this community-based project are related to food production, it also has nutrition and health objectives since nutrition education, promotion of breastfeeding and better weaning foods as well as improving water and sanitation are also objectives. Initially largely external aid driven, its long existence has institutionalized several components of the program with incorporation into existing community structures.

Madagascar – Expanded School and Community Food and Nutrition Surveillance and Education Program (SEECALINE)

Started in 1993 and funded by the World Bank, SEECALINE has been expanded nationally since 1998 and has received support from the state. The program has a supplementary feeding component with specific nutrition objectives. Data on growth monitoring indicate considerable improvement in child nutrition with between 8 and 15% reductions in underweight in 5 provinces. It is, however, a top-down program with weak community participation.

Zimbabwe – Community Food and Nutrition Program (CFNP)

In existence since 1987, this national program evolved from an earlier supplementary feeding program. State funded, it has both food security and nutritional objectives and integrates both agricultural and nutritional activities in the community. Until the recent troubles in Zimbabwe, CFNP demonstrated a reduction in both underweight and stunting in children.

Brazil – Child Pastorate Program

This large program in all 27 states of the country has been in existence since 1982 and is run by the Catholic Church with funding from the Ministry of Health. In addition to poverty reduction, the program has specific objectives related to health and nutrition. The program has been very successful with significant impact on maternal and child health. The achievements include: a reduction in underweight pregnant mothers; reduction in LBW (from 14% in 1988 to 5% in 2001); reduction in child malnutrition (18% in 1988 to 4% in 2001), and a considerable reduction in maternal and child morbidity and mortality. It is a politically popular and visible community program with strong support nationally and an interesting mixture of partners – the church, state, and NGOs.

Mexico – Education, Health and Nutrition Program (PROGRESA)

Started in 1997, PROGRESA is a large nationally funded initiative with broad objectives aimed at poverty reduction. This complex multi-sectoral program provides educational grants and food and income supplements. The food supplements provided were fortified with micronutrients and given to both to children and pregnant women and showed that supplemented
children had gains in stature and lower levels of undernutrition and better hemoglobin and vitamin A status. An evaluation report showed that children receiving PROGRESA supplements had improved growth and a reduced probability of stunting [57].

_Chile – Supplementary Feeding Program (Programa Nacional Alimentacion Complementaria; PNAC)_

This national program with universal coverage is financed by public and private sectors. PNAC targets all children below 6 years of age and pregnant women in Chile. Since 1983, it operates at two levels – one basic for all and the other enhanced targeting specific vulnerable groups. The program has demonstrated good nutritional outcomes and benefits, although more recently concern has been raised about the program contributing to the rise in overweight and obesity in Chilean children [46].

_The Philippines – Program on Good Nutrition for Health (LAKASS)_

LAKASS is a nationally funded program with aid from Japan, and has been operational since 1989. It has a high level and consistent support and claims significant improvements in the nutritional status of young children. The program includes growth monitoring, micronutrient supplementation and supplementary feeding and weaning food components as well as other broader community development projects. With the built-in community participation, this is a sustainable community program.

_India – The Integrated Child Development Services Scheme (ICDS)_

ICDS is the largest program for the promotion of maternal and child health and nutrition in India, and was launched in 1975 in pursuance of the National Policy for Children. It is a multi-sectoral program run by the national government with the cooperation of the provincial governments. The beneficiaries are preschool children and women of reproductive age including those pregnant and lactating. ICDS provides an integrated approach to converge all the basic services for improved childcare, early stimulation and learning, health and nutrition, and water and environmental sanitation. Independent evaluation has demonstrated an improvement in the nutrition of children under the scheme as compared to those with no access to the program [58, 59], while other evaluations of ICDS have found its impact on nutrition to be limited [12].

_Tamil Nadu, India – Tamil Nadu Integrated Nutrition Project (TINP)_

Initiated in 1980, TINP goes beyond supplementary feeding to focus on improving caring practices and has achieved significant success in reducing severe malnutrition among children in participating districts as compared to non-participating ones [60]. In 1991 the second TINP (TINP-II) was launched and aimed to move beyond the reduction of severe malnutrition and was
aimed at reducing the high prevalence of moderate undernutrition in children. The completion report of TINP-II found that the project had been successful in reducing severe undernutrition and infant mortality rates, but was less successful in reducing moderate undernutrition or LBW prevalence [61].

**Bangladesh – Bangladesh Integrated Nutrition Project (BINP)**

BINP is a large national program which evolved from its forerunner – the TINP in India and is an example of the pursuance of the food-care-health conceptual framework. It has been operational since 1995 funded largely by the World Bank with the overall aim to reduce malnutrition until it ceases to be a public health problem. This is an example of collaboration between an aid agency and national government. Among the various components of this program, the community-based elements, which consume most of the budget, are largely nutritional interventions including growth monitoring and supplementary feeding. BINP claims to have made a significant positive impact on the nutritional status of children and on the incidence of LBW, although doubts have been raised about the impact of this huge intervention program [62, 63].

The community-based programs summarized above are not exhaustive, and several programs with some degree of success have not been covered and include countries like Sri Lanka, Pakistan, Indonesia, Thailand, Cambodia and Vietnam in Asia. The success, effectiveness and impact of large scale nutrition intervention programs depend on both contextual success factors, i.e. the macro-environment in which the program operates, and the program success factors, i.e. the components, features and structure of the program itself [12, 56]. In addition the sustainability of the program depends on political will, the availability of resources (both monetary and human), community participation and involvement, and the level of institutionalization of the program that takes place over time. Table 4 provides a summary analysis of some of these features carried out by the Food and Agriculture Organization on some of the community-based intervention programs summarized above.

Community-based approaches can work if established as broad-ranging, multi-sectoral and integrated food and nutrition programs, often as part of poverty reduction and social welfare initiatives in developing countries. Because maternal and child undernutrition is the result of many factors, multiple sectors and strategies will have to bear on the objective of eradicating this problem. With child undernutrition and obesity and adult disease linked, as evident in the life cycle approach, and the consequent double burden of malnutrition manifesting in developing societies, tackling this emerging problem of malnutrition is a priority. Hence community-based approaches have to ensure a minimum package which addresses the ‘food-health-care’ triad recognizing the documented synergies in these approaches [12]. Thailand is often cited as an sterling example to demonstrate the success of community-based approaches in dramatically reducing child undernutrition [1].
Table 4. Summary of Community based Intervention Programs with food and nutrition objectives

<table>
<thead>
<tr>
<th>Countries</th>
<th>Kenya</th>
<th>Madagascar</th>
<th>Zimbabwe</th>
<th>Brazil</th>
<th>Mexico</th>
<th>Philippines</th>
<th>Bangladesh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration of program, years(^1)</td>
<td>18</td>
<td>8</td>
<td>14</td>
<td>19</td>
<td>4</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>Coverage(^2)</td>
<td>S</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>Impact on nutritional status</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Inter-sectoral collaboration(^3)</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Program approach(^4)</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Level of institutionalization(^5)</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

Adapted from FAO [56].

\(^1\) Duration at the time of the analysis of the country programs in 2002/2003.

\(^2\) S = Limited coverage (e.g. one district); L = wide or national coverage.

\(^3\) Inter-sectoral collaboration: 1 = weak; 2 = good at central level; 3 = good at local level; 4 = good at all levels.

\(^4\) Program approach: 1 = top-down; 2 = both; 3 = largely community driven.

\(^5\) Level of institutionalization: 1 = total reliance on external funding and technical input; 2 = mostly reliant from outside; 3 = mostly reliant from outside but some state contributions and local technical inputs; 4 = good government contribution with or without external resources and technical inputs; 5 = fully institutionalized and totally funded by state – no external inputs.
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Community Interventions for Child Undernutrition and Obesity


Discussion

Dr. Mathur: In the theme of this conference, you showed the obesity interventions in one slide but the focus has been on changing undernutrition. The successes and failures of the programs which you mentioned were mainly on undernutrition. In these societies where undernutrition and overnutrition coexist, can we give this country or any country a single package of nutrition as a policy? While we are tackling undernutrition we are looking at overnutrition also. The policymakers are confused on what would be an appropriate nutritional package. Undernutrition strategies aim at providing something extra, whereas overnutrition policies are restrictive. As a human behavior it is easier to take than to give up, and that is the challenge for all nutrition intervention trials. I suggest we look at some of the behavioral aspects and the new social determinants of health in tackling nutrition problems in coexisting societies.
Dr. Shetty: I think that is a very apt comment. I must apologize because I knew I was the last speaker and the main focus of the symposium was childhood obesity and undernutrition. I have about 5 or 6 slides which deal with the whole issue of population-based approaches and I wanted to highlight how, if you take this population-based approach, you can actually use the success stories of Finland and Norway to show that if you make the sort of changes that are required you can address the problem of chronic diseases in the population. I don't think I have the time to do that here. There are several lessons to be learned. Dr. Popkin spoke first at this meeting and I last, but we both believe that there are major macroeconomic and structural drivers of the changes happening in developing societies, which are contributing to the problem of obesity in these countries. Norway and Finland are two good examples of how they actually went about implementing policies that reduce coronary heart disease in a reasonably short period of time [1].

Non-communicable diseases are preventable. There is good evidence that population-based prevention is cost-effective, and is an affordable option for major public health improvement with regard to both obesity and non-communicable diseases and can bring about major changes in disease burden in a relatively short time. We have to learn lessons from countries which have addressed this issue very seriously. Not all countries have done that. We have to have population-based approaches, we have to use the experience that they have used in changing their food and agricultural policies which have had an impact on the prevention of non-communicable diseases. Norway and Finland are very good examples. In the recent literature there are examples of economic and food policy analysis that implicate the US agricultural policies and farm subsidies from the 1950s in the epidemic of obesity [2, 3]. The European Union promotes the increased consumption of fruits and vegetables; on the other hand it actually subsidizes farmers who are unable to sell their fruits and vegetables by providing what is called ‘withdrawal compensation’ for the destruction rather than promotion of the consumption of fruits and vegetables by making them available cheaply, particularly to low income households [4]. That is a paradoxical policy and I highlight this only to emphasize that the health sector cannot achieve much unless it understands the whole situation at the national level and acts to influence and change opposing policies and deals with other economic interests to achieve its goals. There are several such examples from which we can learn, and we can learn from positive experiences, and also from negative experiences. The last point that I would like to address is that the health sector, i.e. the people concerned with obesity and non-communicable diseases or undernutrition, has very little power within the system of governments. If you look at the health minister’s budget in most countries, it is a very small fraction compared to what is spent on everything else. And yet the health sector makes several demands and recommendations for a healthy diet and lifestyles which end up having little impact. We in the health sector have to realize that we have to work with other people in other sectors while understanding their points of view and help influence policies that will be beneficial from a health perspective. We need to temper our demands or do it in such a way that it does not antagonize the interests of other sectors and ensures that all sectors recognize that the health of the population is important because of the economic burden on the nation. The examples of Finland and Norway I provided earlier show how the involvement and close cooperation of other sectors are crucial to success. We also need to emphasize that when we make recommendations for dietary intakes or healthy body weights or BMIs, for example, with population-based approaches we are actually referring to the population mean or median, and our attempt is to shift the distribution so that the median shifts below the recommended level. If we progress towards shifting the distribution we will achieve a lot more in terms of public health benefit. If you shift the median of the distribution of
the risk factor, the incidence or burden of the disease is lowered [5]. In summary, we need the sort of approaches which take into consideration the macro changes within the food system that occur with economic development and the political will to implement the necessary policies to favor healthy diets and lifestyles.

Dr. Popkin: I just want to add a couple of things to Dr. Mathur's comments because they are relevant. First, in many countries around the world, particularly in Latin America today, there are still pockets of undernutrition as you mentioned. In contrast, Mexico has effectively eliminated acute malnutrition except for tiny pockets. In Asia and Sub-Saharan Africa we have larger numbers of acutely malnourished children. India is not at the point of Mexico. In South Asia the difficulty is we know what we need to do for children to deal with underweight and so much of it relates to birthweight and weaning foods in that critical period from prenatal to infants. But the difficulty we are facing in many countries is how to shift the lower end of the BMI distribution without much more rapidly shifting the upper end rightwards. This is where the complexity lies at the national level. We haven't figured out how to do that and it is particularly worrisome for India because we are beginning to see IGT forming in rural areas, with low BMIs for women and men and so forth. So the question of what BMI we need to shift to, and given this very unique etiology, is a complex one. Then we come to all the classic strategies. We clearly know breastfeeding can work for everyone. Once we move beyond that we usually deal with energy density issues for infant feeding, and we typically even think about protein density for pregnancy. But the complexity here is that very quickly, depending where you are in the spectrum, it creates negative things. Now Dr. Shetty mentioned a very small, not so well-done study in Chile showing that in programs dealing with undernutrition, when undernutrition improved and the −1 z score was changed for targeting children and preschoolers for food programs, and the children became overweight from those programs. PROGRESA is a huge study affecting 20 million people in Mexico, which is a much bigger country than Chile with over 100 million people, and the same thing has happened. In fact we just changed the whole PROGRESA program to move from whole milk to skim milk and a number of other things to try to deal with some of the programs in that country. In India where there is still so much undernutrition in rural areas; could you imagine for example moving to skim milk, it would be wonderful if you could even get some milk into children and infants in the rural areas. This is really a unique circumstance in South Asia, but in general it is not so different from what we faced in China. I could show the same kind of evidence for China as for Mexico and Chile. So we really have an issue in Asia. Africa is very different because there you have got either HIV in South Africa, or CHD. We have got two worlds presenting some extremely complex public health challenges related to body image. How do we reduce adult obesity while not making people think that adult has HIV/AIDS.

Dr. Ganapathy: Our patients visit a doctor when their child is thin and frail, undernourished as they call it. There is no awareness of obesity. Obesity is still a cosmetic problem and a storage issue. I think there is a need for the awareness that adipose tissue is an important endocrine system, a source of inflammatory cytokines that can give rise to chronic disease. Health education definitely plays a role. In rapid urbanization, children skip breakfast and get packed lunches. With working parents, not even a single meal is shared by the family. Their sleep patterns are also messy; no proper sleep hygiene.

Dr. Sesikaran: When we were students in school in India, we used to have the National Cadet Corps which ensured regular physical activity of at least 1 h almost every alternate day. That has been stopped, and now in schools we are unable to bring in physical activity.

Dr. Sawaya: For the last 2 years at our centers, we have been treating both obese and malnourished children. Although the social problems might be slightly different
talking about slum children, it is true that at least 40% of the families have 1 malnourished child and 1 obese adult in the same family. If you a good adequate diet is given, body mass, especially fat mass, decreases and lean mass increases, and there is also recovery from malnutrition. In our experience it is much more a social question, for example the way the mother cares for her child, if lunch and dinner are provided and the type of food eaten, thinking more of the environment in the context of the family. But in terms of nutrients and food, in our experience the treatment for obesity in children and the treatment for malnutrition are practically the same.

Dr. Subramanian: In one of your slides you showed that there seems to be no evidence about the role of iodine in birth outcome, but the later slide includes salt iodization as part of the package for improving maternal and child nutrition. Why is iodine not considered important for birth outcome?

Dr. Shetty: I just looked at the evidence in the Cochrane review showing that iodine supplementation alone has no impact on birthweight, on pregnancy outcome. Iodine cannot be ignored because we know that there are periods with iodine deficiency, and also that there are other ill effects of not having enough iodine. Therefore we want to ensure that there is enough iodine. But giving iodine alone has no impact, that is the paradox.

Dr. Subramanian: You mentioned the LAKASS program and made a good summary of all the strengths as well as some weaknesses of what make community-based programs successful. We want to call them area-based, starting from a good analysis of the situation in an area. The combination and presentation of the package of services need not be the same for different communities, even in the same country because of cultural and regional differences. What is really very important here is political commitment, good leadership. Especially in a country like ours where political exercise happens more often than we desire. When there is a change in local leadership, we have to make sure that the program is sustained. Political participation is very important; how the program is run. When there is a change in local leadership and the people who run the government, surveillance is necessary. Local government needs feedback on what is happening, so that they continue to support the local programs.

References
