A Stunting Prevention Cluster Randomized Controlled Trial

Leveraging the Social Protection System to Prevent Stunting in District Rahim Yar Khan, Punjab, Pakistan

احساس
BISP
Nurturing Women Empowerment
IRMNCH
آغا خان یونیورسٹی
THE AGA KHAN UNIVERSITY
Federal Ministry for Economic Cooperation and Development
WFP
World Food Programme

Suggested citation: Gul Nawaz Khan, Sumra Kureishy, Naveed Akbar, Muhammad Nasir, Masawar Hussain, Imran Ahmed, Rasool Bux, Arjumand Rizvi, Asmat Ullah, Amjad Hussain, Cecilia Garzon, Jessica Bourdaire, Mukhtar Hussain Syed, Sania Nishtar, Saskia de Pee, Simon Cousens and Sajid Soofi (2019). A Stunting Prevention Cluster Randomized Controlled Trial: Leveraging the Social Protection System to Prevent Stunting in District Rahim Yar Khan, Punjab, Pakistan. Islamabad/Bangkok; World Food Programme.

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Acronyms

AKU	Aga Khan University
BISP	Benazir Income Support Programme
BMI	Body Mass Index
CMAM	Community-based Management of Acute Malnutrition
DMU	Data Management Unit
ERC	Ethics Review Committee
HAZ	Height-for-age Z-score
IYCF	Infant and Young Child Feeding Practices
LHW	Lady Health Worker
LNS	Lipid-based Nutrient Supplement
MUAC	Mid-upper Arm Circumference
NBC	National Bioethics Committee
NNS	National Nutrition Survey
PDHS	Pakistan Demographic and Health Survey
PLW	Pregnant and Lactating Women
PW	Pregnant Women
RCT	Randomized Controlled Trial
RDA	Recommended Daily Allowance
SAM	Severe Acute Malnutrition
SD	Standard Deviation
SNF	Specialized Nutritious Food
SPSS	Statistical Package for Social Sciences
UC	Union Council
WAZ	Weight-for-age Z-score
WFP	World Food Programme
WHZ	Weight-for-height Z-score




Acknowledgments

"A Stunting Prevention Randomized Controlled Trial: Leveraging the Social Protection System to Prevent Stunting in district Rahim Yar Khan, Punjab" is a joint effort by the Government of Pakistan (GoP), the Aga Khan University (AKU), the United Nations World Food Programme (WFP) and in collaboration with related ministries, line departments, and technical institutions of Pakistan. This study focused on the in-kind provision of specialized nutritious foods (SNF), cash transfers and social and behavioural change communication (SBCC) to prevent stunting among children aged 6-23 months. The interventions were delivered through the existing health and social protection systems – the Benazir Income Support Programme (BISP), Poverty Alleviation and Social Safety Division and the Integrated Reproductive Maternal Newborn, Child Health & Nutrition Program (IRMNCH&NP), Government of Punjab. As a third party, AKU conducted the cluster randomized controlled trial (RCT), under the overall technical supervision of WFP, BISP and IRMNCH&NP.

With the rising interest and reach of social protection, there has been a rapid increase in countries with functional conditional cash transfer programmes – 64 countries in 2013 versus 2 in 1997. Similarly, an increase in interest to use cash-based programmes in vulnerable settings to prevent malnutrition has occurred, especially among the Government.

There is considerable evidence on nutrition-sensitive interventions delivered through social protection programmes addressing malnutrition in developing countries. These studies have mainly been conducted in Latin America and Africa, where institutional capacities within the health and food systems differ as compared to South Asia. In addition, local conditions and environmental differences make it difficult to generalize the results to South Asia, especially in Pakistan. The current limited evidence in the local context makes it difficult for decision-makers to identify and use the best strategies for high impact and sustainability. Hence, the findings from this study will expand the evidence available on social protection in Pakistan and improve understanding of decision-makers to identify and use the best strategies for high impact and sustainability.

The role and contribution of AKU, Professor Zulfiqar Bhutta (Senior Technical Advisor), Dr. Sajid Soofi (Principal Investigator), Mr. Gul Nawaz Khan (Research Manager), Mr. Masawar Hussain (Research Manager),

Mr. Imran Ahmed (DMU Senior Manager) and Ms. Arjumand Rizvi (Head Statistician), in conducting this randomized controlled trial is highly appreciated.

I would like to acknowledge the special contributions of the BISP and IRMNCH&NP team; Dr. Sania Nishtar (Special Assistant to the Prime Minister on Social Protection and Poverty Alleviation/BISP Chairperson), Dr. Ali Raza Bhutta (Secretary of Social Protection and Poverty Alleviation/BISP), Mr. Naveed Akbar (BISP Director General), Dr. Mukhtar Hussain (IRMNCH&NP Program Director), Dr. Muhammad Nasir (IRMNCH&NP Program Manager), Dr. Zubair Ahmed (IRMNCH&NP District Coordinator), Mr. Ishfaq Ahmad (BISP Divisional Director) and Mr. Rana Rehmat Ullah (District Assistant Director). I would also like to mention all the hard work put in by the WFP team; Ms. Cecilia Garzon, Mr. Shahzada Rashid Mehmood, Ms. Sumra Kureishy, Ms. Saskia de Pee, Ms. Jessica Bourdaire, Mr. Pablo Rodriguez and Ms. Salma Yaqub.

Finally, and most importantly, we would like to sincerely thank the Economic Cooperation and Development Section of the German Embassy in Pakistan (BMZ) for their generous funding support to WFP, through which AKU has been able to identify cash transfers with SNF and SBCC as a cost-effective method in the short term to protect children under two years of age from stunting in Pakistan.

Mr. Finbarr Curran,
Country Director,
World Food Programme Pakistan

I would like to thank the World Food Programme for their financial and technical support, without which this study would not have been possible. My special thanks to Ms. Cecilia Garzon (WFP Chief of Nutrition) and her team, Dr. Ali Ahmad Khan and Mr Pablo Rodriguez, Mr. Naveed Akbar (BISP Director General) and his team as well as Dr. Mukhtar Hussain (IRMNCH&NP Program Director) and his team for their continuous technical support and guidance.

I wish to express my gratitude for the authors of this report, Mr. Gul Nawaz and Dr. Shabina Ariff. Mr. Imran Ahmed, Ms. Arjumand Rizvi, and Mr. Rasool Bux. I would also like to thank Ms. Saskia de Pee, Ms. Jessica Bourdaire and Ms. Sumra Kureishy for their technical assistance and feedback on the report. Furthermore, I am thankful to all members, collaborators and agencies involved in this project, and to the field team, especially Mr. Masawar Hussain, Asmat Ullah & Amjad Hussain for making this study a timely success.

Last but not least, I express my gratitude to the families and infants who participated in this study for being cooperative, pleasant and always eager to be of any assistance.

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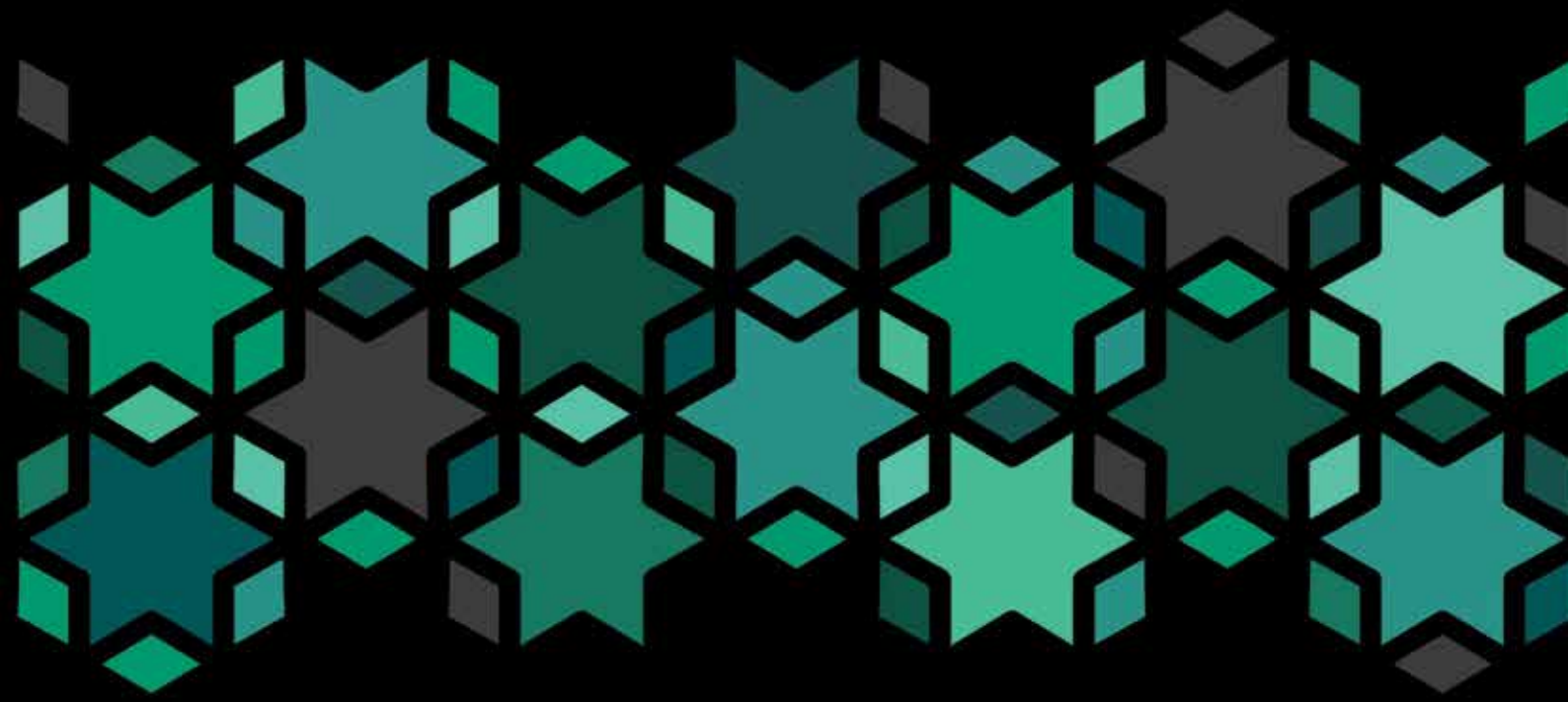
HAPPY TU



EXECUTIVE SUMMARY

Introduction

Adequate nutrition during pregnancy and in the first two years of a child's life has been shown to have a substantial influence on long-term health, growth and brain development. In Pakistan, the prevalence of stunting in children under five years has remained above global critical levels over the last two decades, with the current stunting rate being 40.2% in 2018[1]. Children living in rural areas and in the poorest households suffer the most from stunting across the country – 43.2% in rural areas and 51.4% in the lowest wealth quintile. As a continuing public health concern, it is essential that stunting prevention is a national priority in order to ensure human capital development, especially among the poorest households.

The World Food Programme (WFP), in collaboration with the Benazir Income Support Programme (BISP) and the Integrated Reproductive Maternal Newborn, Child Health & Nutrition Program (IRMNCH&NP) commissioned a stunting prevention operational research study from April 2017 to November 2019 in district Rahim Yar Khan, Punjab province, Pakistan. As a third party, Aga Khan University (AKU) conducted a five-arm cluster randomized trial to examine the effectiveness and cost-effectiveness of specialized nutritious foods (SNF), unconditional cash transfers delivered to the regular Benazir Income Support Programme (BISP) beneficiaries and social and behavioural change communication (SBCC) to prevent stunting among children 6-23 months. This study was funded by the Economic Cooperation and Development Section of the German Embassy in Islamabad, Pakistan.

Methods

The study was conducted in district Rahim Yar Khan in Punjab, Pakistan. The five study arms were (1) control group, which received routine government health services; (2) BISP cash transfers; (3) BISP cash transfers and SBCC; (4) BISP cash transfers and SNF; and (5) BISP cash transfers, SNF and SBCC. BISP beneficiary households with children 6-23 months were eligible to participate in the study (poverty score of <16.17). Households with a poverty score of 16.18 - 20.00 were eligible to participate in the study as part of the control arm. Children at six months of age were enrolled and followed on a monthly basis up to 24 months of age. The unit of randomization was the catchment area of the lady health workers (LHWs). A total of 250 clusters, 50 in each study arm, were randomized to the four interventions and one control arm. The total sample size was 2179 children, approximately 400 in each arm, to detect a 20% reduction in the prevalence of stunting at 24 months of age.

Interventions

1. **Cash Transfers:** A total of 5,000 Pakistani rupees (PKR) or 30 USD were transferred by BISP on a quarterly basis throughout the study period. Participants were able to collect their cash transfers from cashpoints in the form of direct cash after biometric verification.

2. **Specialized Nutritious Food (SNF):** A locally produced SNF (called Wawamum) was provided to children aged 6-23 months. Wawamum is made with heat treated (roasted) chickpeas, vegetable oils, dry skimmed milk, sugar, vitamins, minerals, emulsifier and antioxidants. A daily ration of 50 grams of Wawamum (one sachet) was provided to cover the recommended daily allowance (RDA) of most micronutrients and 260 kcal of energy (about 1/4 of daily energy requirements) for children aged 6-23 months. Each recruited child received SNF for a duration of 18 months – from 6 months to 24 months of age.

3. **Social and Behaviour Change Communication (SBCC):** Health, nutrition and hygiene messages were provided by LHWs during their routine monthly household visits. Additionally, on a quarterly basis, community sessions were conducted with the help of a specialized picture-booklet by LHWs.

The study participants received routine public and private health services available within the area. Often, these public services consisted of the Basic Health Unit (BHUs), Rural Health Centers (RHCs), Taluka Hospitals, District Headquarter Hospital (DHQ) and local healers available in the community.

1 Government of Pakistan, *National Nutrition Survey (NNS)*. 2018.

Results

The nutritional status (stunting, wasting and underweight) of children aged 6-23 months in the study arms was assessed through monthly anthropometric data and have been adjusted for cluster randomization, baseline nutritional status (z-score), gender and BISP poverty score.

Children who received cash with SNF (RR = 0.75, 95% CI 0.62-0.92, p=0.005) and cash with SBCC and SNF (RR = 0.70, 95% CI 0.59-0.84, p=0.001) at the age of 12 months had a significant reduction in the risk of being stunted as compared to the control arm. However, there was no significant reduction in the risk of being wasted in children who received cash only, cash with SBCC, cash with SNF and cash with SBCC and SNF at the age of 12 months as compared to the control arm.

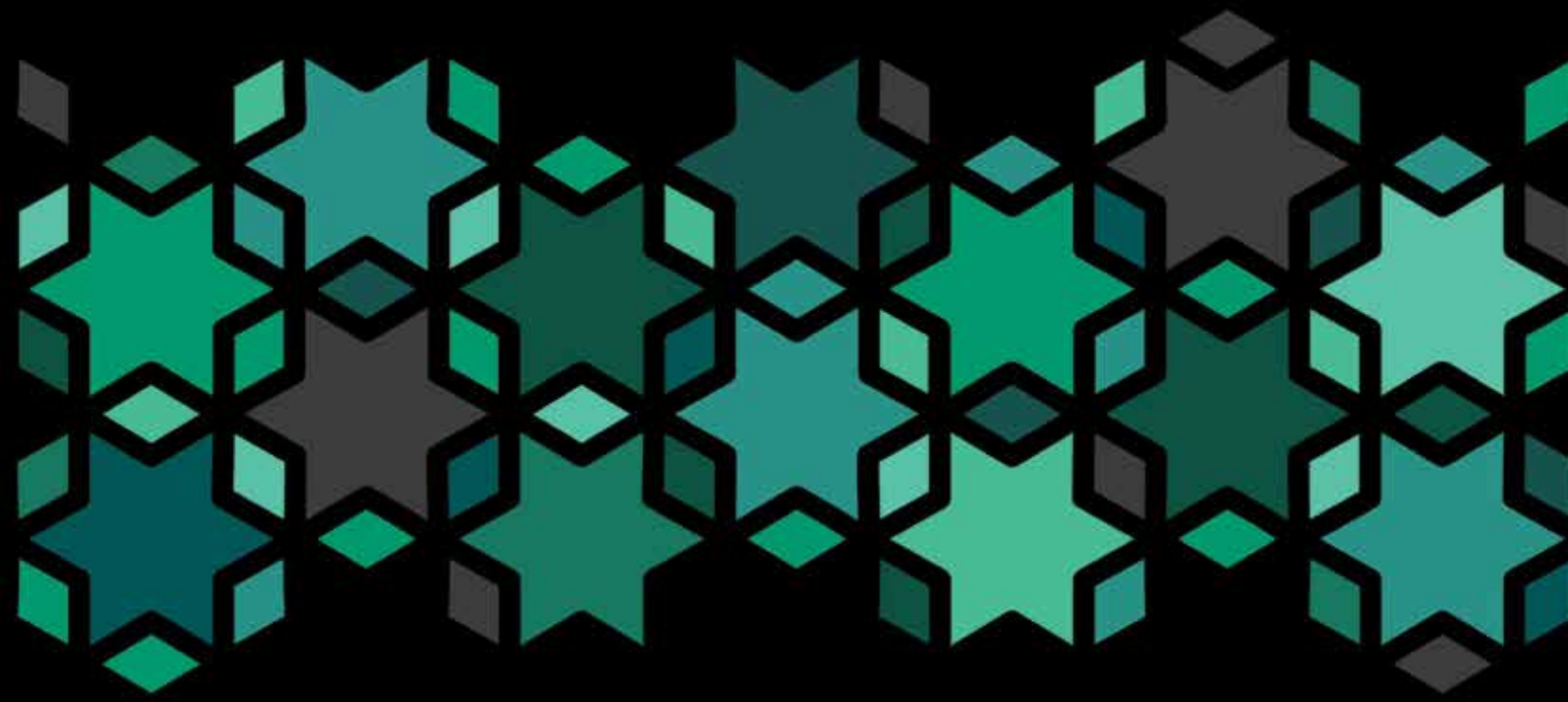
Once the children were 18 months of age, only those who received cash with SNF (RR = 0.83, 95%CI 0.71-0.98, p=0.027) had a significant reduction in the risk of being stunted as compared to the control arm. At 18 months of age, those children who received cash with SNF (RR = 0.58, 95% CI 0.34-0.99, p=0.046) and cash with SBCC and SNF (RR = 0.51, 95% CI 0.27-0.97, p=0.005) had a significant reduction in the risk of being wasted as compared to the control arm. Moreover, children who received cash with SBCC and SNF (RR=0.77, 95% CI 0.60-0.99, p=0.048) at the age of 18 months had a significant reduction in the risk of being underweight as compared to the control arm.

By 24 months of age, children who received cash with SNF (stunting RR=0.80, 95% CI 0.67-0.94, p=0.007; wasting RR = 0.53, 95% CI 0.34-0.83, p=0.04) and cash with SBCC and SNF (stunting RR=0.77, 95% CI 0.66-0.90, p=0.001; wasting RR = 0.57, 95% CI 0.34-0.98, p=0.04) had a significant reduction in the risk of being stunted and wasted as compared to the control arm. Similarly, by 24 months of age, children who received cash with SNF (RR = 0.70, 95% CI 0.51-0.95, p=0.022) and cash with SBCC and SNF (RR = 0.72, 95% CI 0.54-0.96, p=0.026) had a significant reduction in the risk of being underweight as compared to the control arm.

Furthermore, when compared with the control arm at 24 months of age, a 15% reduction in the prevalence of stunting was found in both the cash with SNF arm and the cash with SBCC and SNF arm. A substantially large reduction was also found in the prevalence of wasting in the cash with SNF arm (40%), and in the cash with SBCC and SNF arm (33%) at 24 months of age as compared to the control arm. The reduction in the prevalence of underweight at 24 months of age was 18% in the cash with SNF arm, and 13% in the cash with SBCC and SNF arm as compared to the control arm.

Conclusion

In conclusion, the study found a significant reduction in the prevalence of stunting, wasting, underweight and anemia in children who received cash transfers, SBCC and SNF between 6-23 months of age. The cost analysis revealed that cash with SNF and cash with SNF and SBCC are the most cost effective interventions in reducing malnutrition among children aged 24 months. The interventions were implemented through the existing health and social protection systems, which creates the potential for smooth scale up across the country. It is recommended that SNF in combination with cash transfers and SBCC be scaled up to improve the nutritional status of children in Pakistan and achieve the Sustainable Development Goals (SDGs).



BACKGROUND

Child stunting remains a major barrier to human capital development worldwide. In 2018, 150.8 million children under the age of five years worldwide were found to be stunted, with almost half of this burden being located in three countries: India (46.6 million stunted children<5), Nigeria (13.9 million) and Pakistan (10.7 million) [1]. South Asia has 58.7 million stunted children under the age of five, one of the highest burden of stunting across regions [2]. Furthermore, children living in rural areas and those living in the poorest households are more likely to be stunted than children living in urban and richer households.

In Pakistan, the prevalence of stunting in children under five years has remained above global critical levels over the last two decades, with the current stunting rate being 40.2% in 2018 [3]. Children living in rural areas and in the poorest households suffer the most from stunting across the country – 43.2% in rural areas and 51.4% in the lowest wealth quintile.

Punjab, where half of the population of Pakistan lives, has one of the highest burden of stunting (36.4%). Nearly 47.1% of the children from the poorest households in the province are stunted. Based on provincial statistics, the highest rate of stunting and poverty can be seen in Southern Punjab, especially in district Rahim Yar Khan, where more than 20% of the people live in extreme poverty and two out of five children under the age of five are stunted. Among the poorest 20% of households, one out of two children under the age of five are stunted in district Rahim Yar Khan, Punjab. As a continuing public health concern, it is essential that stunting prevention is a provincial and national priority in order to ensure human capital development, especially among the poorest households.

Stunting has underlying factors which expand beyond nutrition, health and agriculture to include poverty and social vulnerability. Social protection is increasingly recognized globally as a strategic tool to improve maternal and child nutrition outcomes due to its ability to alleviate poverty and social vulnerability. In particular, cash transfers have become increasingly popular as an effective, efficient and welcome means for welfare improvement of low-income households in many low- and middle-income countries. They help in off-setting out-of-pocket expenditure of households and encourage parents to invest in their children's health and education, breaking the cycle of transmitted poverty [4-6]. Cash transfers may be in the form of unconditional cash transfers (UCTs) or conditional cash transfers (CCTs), which are provided on the condition that recipient households must carry out certain actions (such as uptake of health, education, or nutrition services) [7] . Cash transfers make it possible for households to have more money with which they can buy more food, access health services, and potentially invest in productive activities such as small businesses and agriculture. Research has shown improvements in household food insecurity through cash transfers; however, evidence of their impact on child nutrition remains limited.

Cash transfers have shown to improve dietary intake and access to food, with some positive results showing improvements in care practices. There are also some positive indications of cash transfers complementing supplementary feeding programmes which aim to reduce the prevalence of stunting and wasting in children.

This is evident in the Mexican Progresa program, where 197 pesos (10 USD) were provided linked to school enrolment and attendance and uptake of health services per beneficiary household per month [8]. Additionally, in-kind nutritional supplementation and health benefits were provided to PLW and children under five. The nutritional supplements provided consisted of whole dry milk, sugar, maltodextrin, vitamins and minerals adapted to meet specific nutritional needs for PLW (52 grams, 250 calories of energy and 12-15 grams of protein) and children (40 grams, 194 calories of energy and 5.8 grams of protein). The program has shown a positive effect on children's health by lowering the incidence of illness by 12% in beneficiary children as compared to non-beneficiary children [9]. A significant positive impact on child growth has been shown, with an increase of 16% in the mean child growth per year (1 cm per year). The program has also shown a positive effect on consumption of vitamin and mineral among beneficiary households [10]. Over a period of 18 months, beneficiary households were seen to have increased their vitamin consumption by 15% and mineral consumption by 7%, especially for vitamin A, and iron.

Familias en Acción (FA), a CCT program modelled after the Progresa program, was implemented by the Colombian government [11]. The program provided 15 USD per month to mothers with children under five years of age to ensure uptake of preventive healthcare services, especially routine growth monitoring for children and targeted messages on hygiene, vaccination and family planning for mothers. Once received upon completion of the conditionality, the cash was found to increase overall household consumption by 9.3% in urban areas and 19.5% in rural areas, with considerable increases in the consumption of meat, chicken and milk. There was also an increase in the purchasing of clothes and footwear for children. The programme was found to have doubled the percentage of children under 24 months with up-to-date preventive healthcare visits from 17.2% to 40.0%, as well as reduce

diarrhoea episodes by 10% (32.6% to 22.0%) in children under 24 months living in rural areas. Linear growth was also found have improved by 0.44 centimetres in children at 12 months of age through the programme, highlighting that these programmes are more beneficial among younger children as they have the highest rates of growth.

Brazil's Bolsa Família CCT program was developed in 2003, where eligibility is similarly based on per capita household income, and the cash transfer amounts (11-98 USD) are based on household composition and income [12]. As direct beneficiaries, mothers are provided with monthly payments conditional on compliance with education and health services. In terms of the health conditionalities, children under seven years must receive all the Government's scheduled immunization and two growth monitoring visits annually. For the education conditionalities, children 6-17 years of age must be enrolled in school and have a daily school attendance of 85%. A recent impact evaluation found that the program increased the odds of health visits for growth monitoring (OR = 3.1; $p < 0.001$), checkups (OR = 1.6; $p = 0.061$) and vaccinations (OR = 2.8; $p = 0.002$) among children under seven years of age [13]. Another study reported that children under five years had 26% higher odds of having adequate height-for-age (OR = 1.26; $p<0.001$) and weight-for-age (OR = 1.26; $p<0.001$) [14]. Beneficiary households were also found to have spent 6 % more on food ($p = 0.015$) and have a 9.4 % higher availability of food items ($p = 0.010$), especially meat, tubers and vegetables. The program was also found to increase primary school enrolment in grades 1-4 by 2.8-5.5% and reduce drop outs by 0.3-0.55 percentage points.

As for UCTs, while there have been fewer studies done as compared to CCTs, evidence of their impact on nutrition comes mainly from South Africa and Malawi. In Malawi, through the Kufuna Kumvetsa Mchinji cash transfer program, beneficiaries received a monthly transfer of MK2,000 (USD 14) depending on the household size and the number of school aged children in the household (a MK200 (USD 1.4) top-up is paid for primary school aged children and MK400 (USD 2.8) for secondary aged youth [15]. The program showed an estimated reduction among children under five of 2.2 percentage points for wasting ($p>0.05$), 4.2 percentage points for stunting ($p>0.05$), and 10.5 percentage points for underweight ($p<0.08$). This indicates that the beneficiary children had a greater reduction in the percent that were wasted, stunted and underweight than non-beneficiary children. In 1997, The Government of South Africa initiated an UCT program, the Child

Support Grant, which provides ZAR280 (USD 34) per month as of 2012 to the poorest 30% of households with children under 18 years of age [16]. An impact evaluation conducted in 2006 on the South African UCT revealed that the program improved child height-for-age z -scores for recipient children (-0.84) as compared to non-recipient children (-1.08).

Improvements in nutrition are not possible without extensive, wide ranging changes in the everyday behaviours of people around the world. Evidence shows that people can change their behaviours to improve nutrition outcomes, when provided with financial support to afford nutritious foods [17]. Through the Maternal Cash Transfers on Child Malnutrition program in Myanmar, pregnant women in targeted villages were provided with monthly cash transfers of 15,000 MMK (USD 10.5) and social and behavioural change communication (SBCC), till their child was two years of age [18,19]. The cash transfer aimed to support women's ability to afford nutritious food for themselves and their children. A recent impact evaluation study of the program revealed that cash transfers combined with SBCC focused on maternal nutrition, infant and young child feeding practices and hygiene practices can reduce stunting by 4-percentage points and wasting by 3 percentage points, compared to only cash transfers. However, with the limited size of the cash transfers (USD 10-15 per month) and the large affordability gap experienced in the poorest 20-30% of households, in-kind nutritional supplementation is essential in order to prioritize improving nutrition for the most vulnerable – PLW and children under two years of age.

Given the alarming situation of child malnutrition in Rahim Yar Khan District, the Government of Pakistan, in collaboration with the World Food Programme (WFP) commissioned an operational research study, consisting of the in-kind provision of specialized nutritious foods (SNF), cash transfers and SBCC to prevent stunting in children. The interventions were delivered through the existing health system and the social protection programme, the Integrated Reproductive Maternal Newborn, Child Health & Nutrition Program (IRMNCH&NP) and the Benazir Income Support Programme (BISP), to the current BISP beneficiary households (poorest 20% of households) in Rahim Yar Khan. Through the IRMNCH&NP, the BISP beneficiary households were provided with SBCC and SNF by the lady health workers. To generate evidence that can guide policymakers, WFP partnered with the Aga Khan University (AKU) to conduct a cluster randomized controlled trial (RCT) and a cost analysis of the interventions on reducing stunting and other nutritional outcomes in children aged 6-23 months.

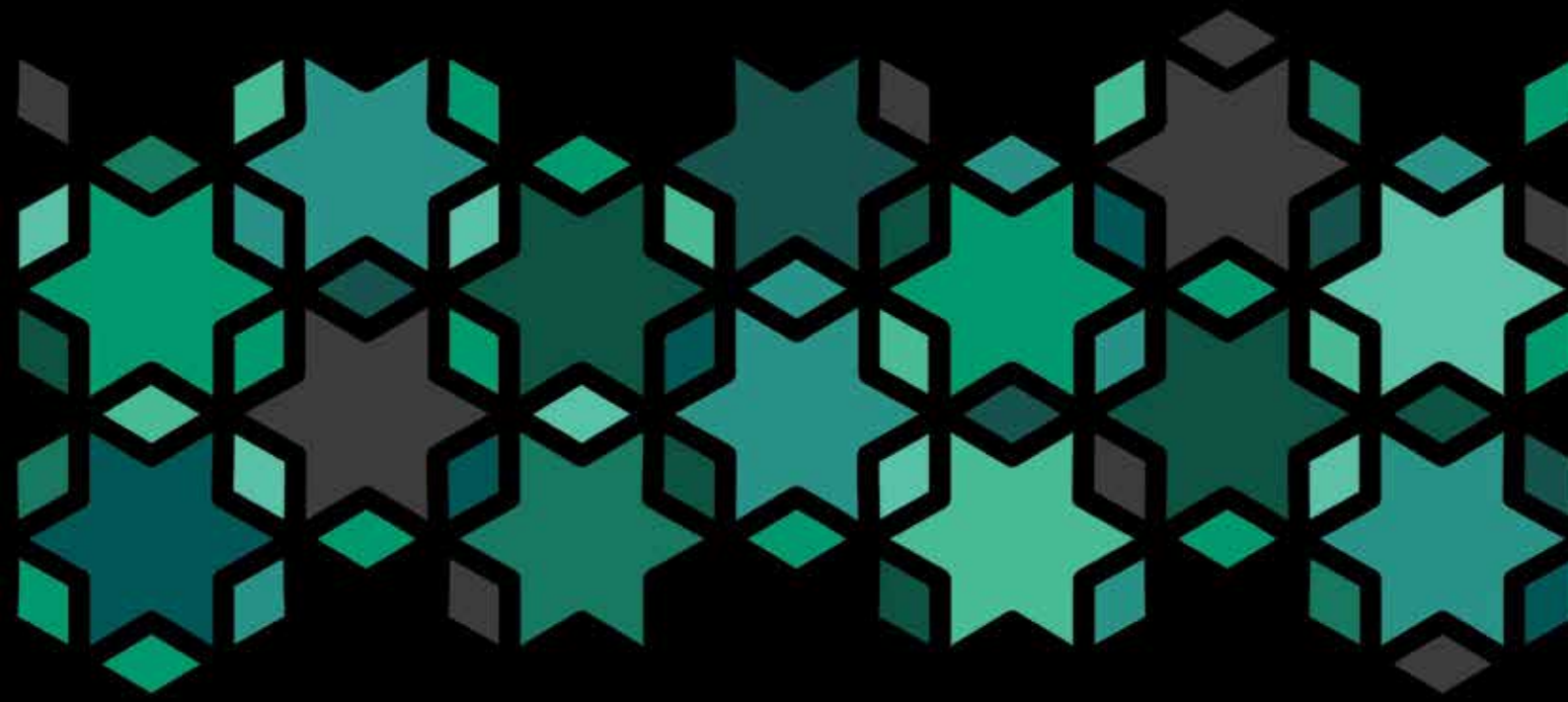
OBJECTIVES OF STUDY

Primary objectives

- To assess that unconditional cash transfers, specialized nutritious food and/or social and behavioural change communication will result in a 20% reduction in the prevalence of stunting among children at the age of 24 months

Secondary objectives

- To assess reduction in the prevalence of wasting and underweight among children at 24 months of age
- To assess improvement in the micronutrient status among children at 24 months of age
- To assess improvement in infant and young child feeding practices among children at 24 months of age
- To assess the cost-effectiveness of different intervention packages for the reduction in stunting among children at 24 months of age



METHODS

Study setting

The study was conducted in district Rahim Yar Khan in Punjab, Pakistan. The district is located in the southern part of Punjab province, with an area of 11,880 square kilometres. The district is administratively subdivided into four Tehsils and 122 Union Councils (UCs) with a population of 4.8 million (79% living in rural areas). According to the 2018 Multiple Indicators Cluster Survey (MICS) conducted in Punjab, the literacy rate is 43.1% among women and 58.1% among men aged 15-49 years in Rahim Yar Khan [20]. Within the district, 13.1% of the population has access to improved sources of drinking water (piped water), 75.6% have access to improved sanitation and 90.6% have access to electricity. As a predominately agrarian district, only 7.8% and 56.2% of households own agriculture land and livestock, respectively. Furthermore, infant mortality (56 infant deaths per 1000 live births) and under-five mortality (66 child deaths per 1000 live births) are similar to the provincial (60 infant deaths per 1000 live births, 69 child deaths per 1000 live births) and national averages (62 infant deaths per 1000 live births, 74 child deaths per 1000 live births).

Study design

A five-arm cluster randomized trial was conducted to examine the effectiveness and cost-effectiveness of cash transfers, SNF, SBCC and their combinations to prevent stunting in children 6-23 months living in BISP beneficiary households. Children at the age of six months were enrolled, randomized to one of the five study arms, and followed for 18 months during the study period. The five study arms were (1) control group, which received routine government health services; (2) BISP cash transfers; (3) BISP cash transfers and SBCC; (4) BISP cash transfers and SNF; and (5) BISP cash transfers, SNF and SBCC.

The study leveraged the existing Benazir Income Support Program (BISP), a national social protection program, and the provincial Integrated Reproductive Maternal Newborn & Child Health and Nutrition Program (IRMNCH & NP).

Study participants

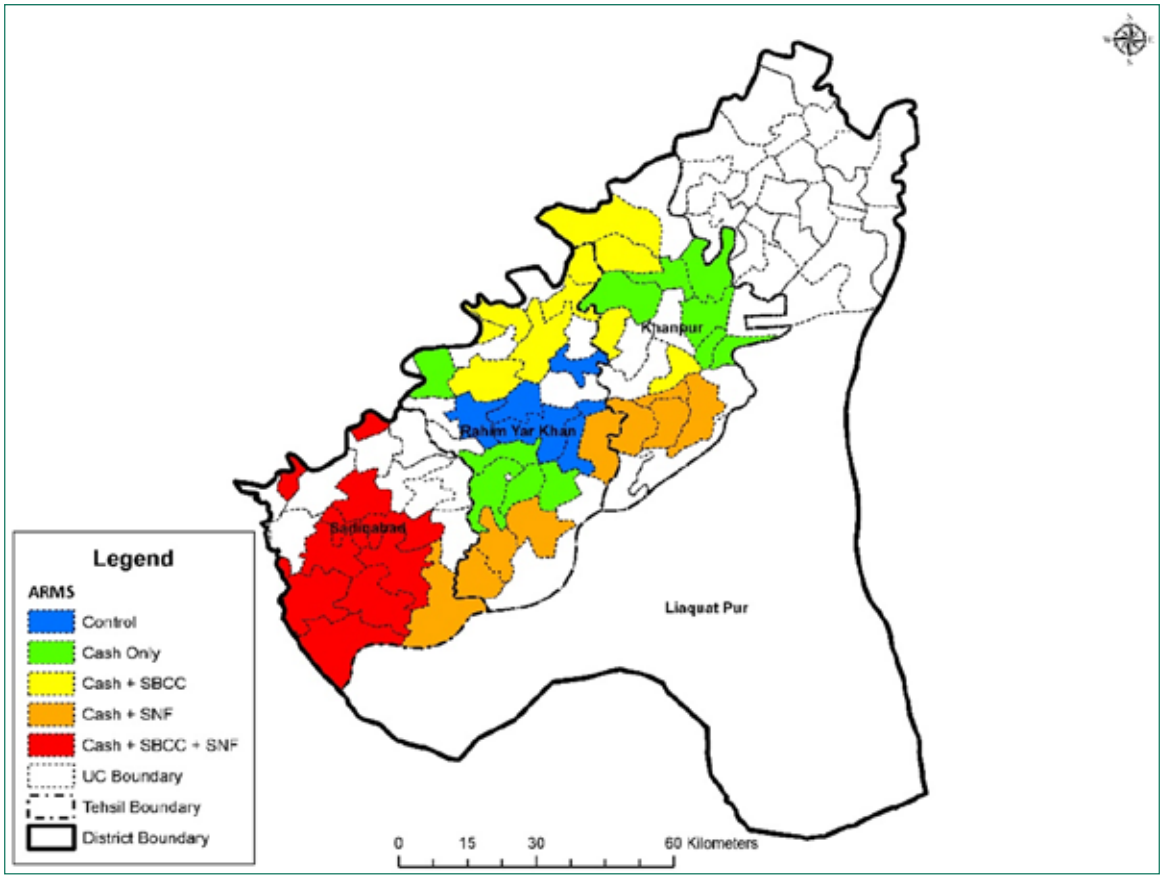
Children six months of age living in BISP beneficiary households identified through the LHW family register were eligible to participate in the intervention arms of the study. If the caregivers agreed to participate, they were enrolled in the study. Furthermore, children six months of age residing in communities served by LHWs, but from non-BISP beneficiary households with a poverty score of 16.18-20.00 were enrolled in the control arm. Children with acute malnutrition and/or chronic illnesses were not enrolled and were referred for treatment to health facilities. In households with more than one child aged 6 months, the child was randomly selected by a lottery draw. The study was conducted from April 2017 to November 2019.

Sample size & clusters

A sample size was calculated to detect a 20% reduction in the prevalence of stunting among children at the age of 24 months, with 45% as the baseline prevalence of stunting among children 6-23 months [20]. The unit of randomization was the LHW's catchment area; while the catchment area of two to three LHWs was considered one cluster. A sample size of eight children per cluster was estimated with a statistical significance of 0.05, power of 0.80, and an intra-cluster correlation of 0.0001. Each study arm had 50 clusters from which 400 children aged six months were enrolled in the study. A total of 2,179 children were enrolled in the study.

BISP beneficiary households are defined as households with a poverty score of less than 16.17, based on indicators such as household size, housing structure, type of toilet facilities, education, child status, household assets, agricultural landholding, and livestock ownership.

Figure 1: Study clusters



Interventions

The intervention package consisted of locally produced SNF, cash transfers and SBCC focused on health, nutrition and hygiene.

1. **Cash Transfers:** A total of 5,000 Pakistani rupees (PKR) or 30 USD were transferred by BISP on a quarterly basis throughout the study period. Participants were able to collect their cash transfers from cashpoints in the form of direct cash after biometric verification.

2. **Specialized Nutritious Food (SNF):** A locally produced SNF (called Wawamum) was provided to children aged 6-23 months (Table 1). Wawamum is made with heat treated (roasted) chickpeas, vegetable oils, dry skimmed milk, sugar, vitamins, minerals, emulsifier and antioxidants. A daily ration of 50 grams of Wawamum (one sachet) was provided to cover the recommended daily allowance (RDA) of most micronutrients and 260 kcal of energy (about 1/4 of daily energy requirements) for children aged 6-23 months. Each recruited child received SNF for a duration of 18 months – from 6 months to 24 months of age.

3. **Social and Behaviour Change Communication (SBCC):** Health, nutrition and hygiene messages were provided by LHWs during their routine monthly household visits. Additionally, on a quarterly basis, LHWs conducted community sessions using a specialized picture-booklet.

The study participants received routine public and private health services available within the area. Often, these public services consisted of the Basic Health Unit (BHUs), Rural Health Centers (RHCs), Taluka Hospitals, District Headquarter Hospital (DHQ) and local healers available in the community.

Figure 2: WFP's specialized nutritious foods

Table 1: Nutritional values of WFP's specialized nutritious foods

Nutritional values of SNF (per 50 g/one serving)	Unit	Minimum	Maximum
Energy	Kcal	255	280
Protein	g	5.5	8
Fat	g	13	18
ω-3 fatty acids	g	0.15	0.9
ω-6 fatty acid	g	1.3	3.1
Retinol (Vitamin A)	mcg	275	575
Thiamin (Vitamin B1)	mg	0.5	-
Riboflavin (Vitamin B2)	mg	1.05	-
Niacin (Vitamin B3)	mg	6.5	-
Pantothenic Acid (Vitamin B5)	mg	2	-
Pyridoxine (Vitamin B6)	mg	0.9	-
Biotin (Vitamin B7)	mcg	30	-
Folate (Vitamin B9) DFE	mcg	165	-
Cobalamine (Vitamin B12)	mcg	1	-
Ascorbate (Vitamin C)	mg	30	-
Cholecalciferiol (Vitamin D)	mcg	7.5	10
Tocopherol Acetate (Vitamin E)	mg aTE	8	-
Phytomenadione (Vitamin K)	mcg	13.5	-
Calcium (Ca)	mg	268	375
Copper (Cu)	mg	0.7	1.0
Iodine (I)	mcg	50	70
Iron (Fe)	mg	5	7
Magnesium (Mg)	mg	75	113
Manganese (Mn)	mg	0.6	1.2
Phosphorus (P)	mg	225	375
Potassium (K)	mg	450	700
Selenium (Se)	mcg	10	20
Sodium (Na)	mg	-	135
Zinc (Zn)	mg	5.5	7

Data collection

A total of six data collection teams were hired locally from district Rahim Yar Khan for the study. The minimum qualification for data collectors and team leaders to be a part of the team was 14th grade education and a Master's degree, respectively. Each team consisted of two female data collectors and one male team leader. The study questionnaires were developed in consultation with WFP, BISP, IRMNCH&NP Punjab and all other relevant stakeholders. Data was collected using tablets on pre-tested standard questionnaires.

The recruitment questionnaire was used to collect data on socio-demographic characteristics, parents' and children's anthropometric measurements, infant and young child feeding (IYCF) practices, immunization status, child morbidity, water, sanitation and hygiene (WASH), access and uptake of health services, exposure to other interventions, household food consumption, hunger scale and household coping strategies. Meanwhile, the follow-up questionnaire was used to collect data on anthropometry (length and weight), compliance to intervention, morbidity, care seeking practices, and IYCF practices. Blood samples were collected at 24 months of age for anemia and biochemical assessment.

The data collection teams received a five-day hands-on training on study objectives, methods, data collection tools, techniques, anthropometric measurements, haemoglobin testing and ethical issues. All questionnaires were pre-tested in the field and changes were incorporated accordingly before the actual data collection. The questionnaires used by data collectors were available in both English and Urdu. A one-day field test was carried out before initiating field work. As part of the training, all field staff was trained on anthropometric measurements with additional days for team measurers to continue to refine their skills. The training included both in class explanations and exercises with field practice. The training programme also included practice for weighing and measuring children. A study manual was provided to each team leader, which included instructions, methodology and sampling strategy.

Two trained staff measured anthropometric measurements. The first measurer measured and recorded each anthropometric measurement without revealing the values obtained to the second measurer. The second measurer then independently repeated the same measurements. Each measurer recorded their own values independently with no knowledge of the values recorded by the other measurer. After collecting the data, the two measurers compared their measurements to ensure that the differences between their measurements fell within the standard maximum allowed differences (7mm for length, and 50g for weight). Any pair of measurements fallen outside the maximum allowed differences were repeated by both measurers and entered on the recording sheet. If this second pair of measurements values again exceeded the standard limits for that measurement, the measurers repeated the measurement for a third and final time.

Compliance data was obtained by mother's recall and comparing the number of used and unused sachets during each follow-up visit. Children's weight was assessed using a calibrated balance allowing double weighing (mother–child) and an automatic deduction of the mother's weight to obtain the child's weight. The weight machine used was a SECA brand with an accuracy of 50 g. Children's length was measured using a SECA length board with an accuracy of 0·1cm. Haemoglobin levels were tested using HemoCue Hb 301 analyzers.

Data quality control & quality assurance

For the purpose of quality assurance, a verification team (independent of the data collection teams) randomly visited 5% of the households assessed by the data collection team to validate the study data, in particular the anthropometry and other vital indicators. The entire data collection process was supervised and closely monitored by a group of team leaders under the direct oversight of a field supervisor and supervision of the study manager. ENA-SMART software was used to track and conduct plausibility checks for anthropometric measurements by the field supervisor on a weekly basis and by the study manager on a monthly basis.

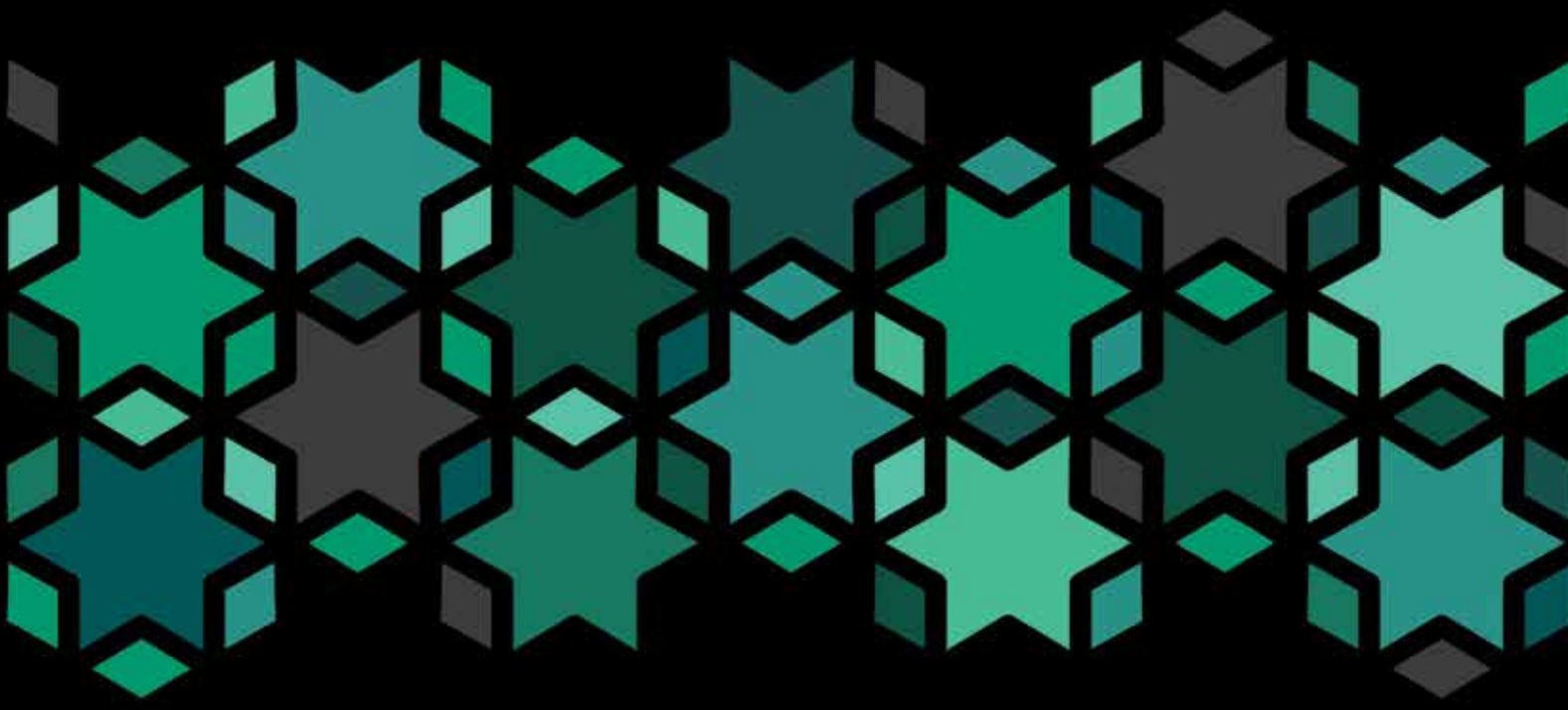
Data analysis

The primary outcome was the reduction in the prevalence of stunting at 24 months of age. Secondary outcomes were reduction in the prevalence of wasting, underweight and anaemia at 24 months of age. Prevalence of malnutrition in its different forms (underweight, wasting and stunting) was calculated using the z-score cut-off point of <–2 using the WHO child growth standards. Anaemia was defined as haemoglobin levels <11gm/dl.

Descriptive analysis was carried out on all independent variables at cluster and individual levels to assess differences between study arms. To assess the effectiveness of the interventions, an intention to treat analysis was used along with sensitivity analysis to account for loss to follow-up and noncompliance. Bivariate and multivariate analysis were conducted using logistic and Poisson regression for binary and count outcomes respectively to establish an association between growth factors (stunting, wasting, and underweight) and other variables. The analysis was adjusted for clustering, baseline measurements, gender and BISP poverty score. The results were presented as relative risk with 95% CI. For comparison, p-values <0.05 were considered significant. All analyses were performed with STATA statistical software (version 15). A cost-effectiveness analysis was also conducted to quantify the net costs of the interventions and assess the costs per disability-adjusted life year (DALYs) saved.

Ethical consideration

Written informed consent was obtained from all caregivers prior to enrolment in the study. Participation was voluntary in the study, and they were able to withdraw at any time. The Ethics Review Committee (ERC) of Aga Khan University granted approval for the proposed study. The National Bioethics Committee (NBC) of Pakistan granted approval for the study to be conducted on human subjects. The study was registered in ClinicalTrials.gov with registration number NCT03299218.



RESULTS

Sample characteristics

A total of 2,179 children were enrolled in the study, with little variation across each arm (Figure 1). Overall, there was more than 95% retention across the five study arms. A total of 61 (2.8%) children were lost to follow-up due to child death (1.7%), family migration (1.0%) and refusal (0.1%).

Household sociodemographic and anthropometric characteristics of parents and children are presented in Table 2. The average household size was between seven to eight people per household across all study arms. Nearly all households had access to an improved source of drinking water (97.6%) and an improved sanitation facility (73.6%).

The four intervention arms consisted of BISP beneficiary households with a poverty score of 0.00 - 16.17, with the average poverty score among the households being between 11.00-13.00 in the study. All households in the control arm had a poverty score of 16.18 - 20.00, with the average poverty score among the households being 17.92 in the study.

The mean age of mothers was 29 years across all study arms. The majority of mothers were housewives, ranging from 88.6% and 99.0% across all arm. The prevalence of underweight (BMI<18.5 kg/m2) was 19.3% among mothers in all study arms. Furthermore, fathers and mothers of children enrolled in study had 0-4 and 0-7 years of formal schooling across all study arms, respectively. Gender distribution and mean age at enrolment among children was similar in all study arms. Stunting (26.2%), wasting (12.4%) and underweight (25.3%) rates were comparable at the time of enrolment in all study arms. Over 85% of children were fully immunized across all arms at the time of enrolment in the study.

Figure 3: Consort flow diagram of the study

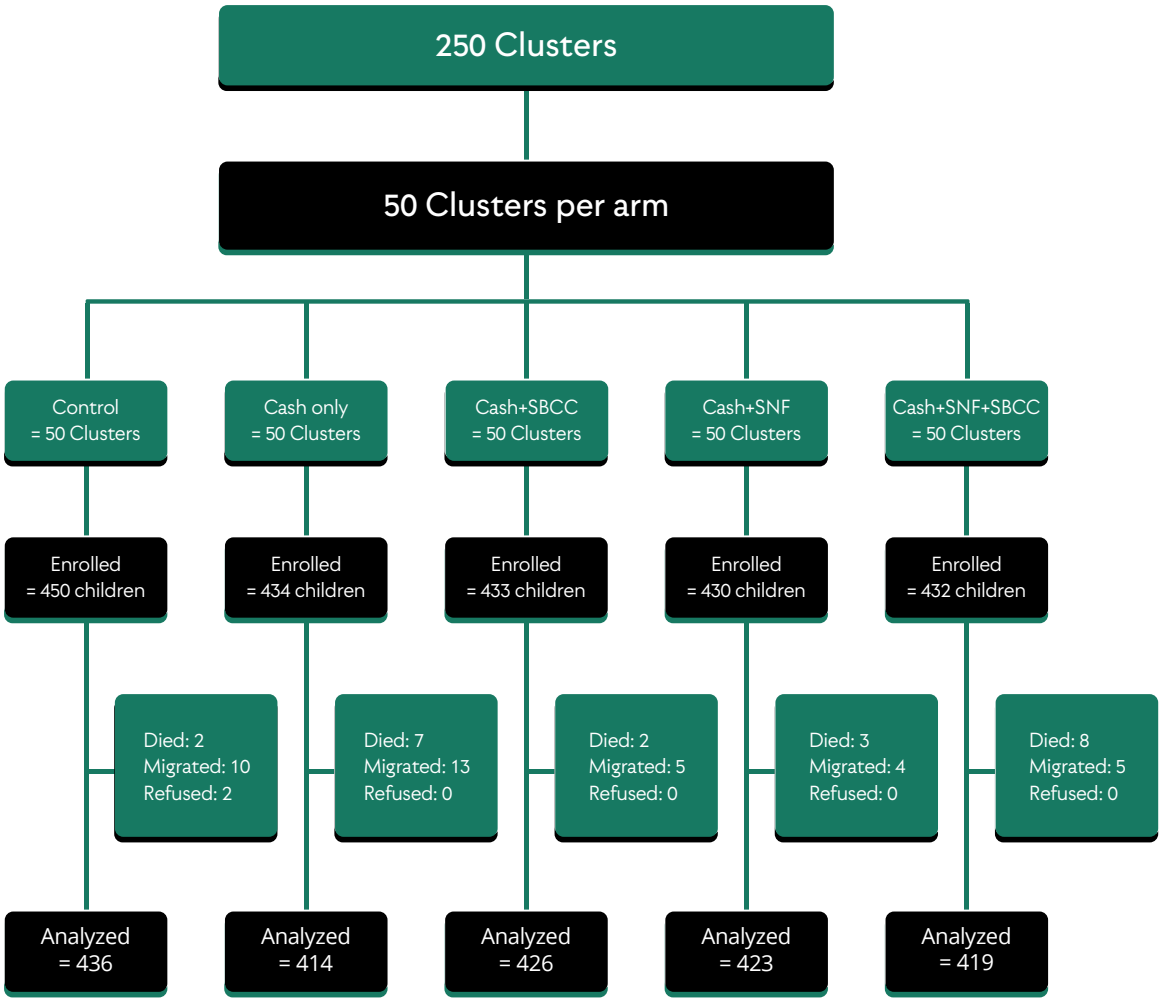


Table 2: Baseline characteristics of households, mothers and children by study arms

Variables	Control	Cash Only	Cash + SBCC	Cash + SNF	Cash + SBCC + SNF
N	**450**	**434**	**433**	**430**	**432**
Household size (mean ± SD)	7.77 ± 2.54	7.73 ± 2.50	7.48 ± 2.49	7.88 ± 2.48	7.73 ± 2.49
Improved water	449 (99.78%)	424 (97.70%)	418 (96.54%)	418 (97.21%)	418 (96.76%)
Improved sanitation facility	392 (87.11%)	313 (72.12%)	303 (69.98%)	324 (75.35%)	276 (63.89%)
BISP Poverty Score (mean ± SD)	17.92 ± 0.68	11.32 ± 0.67	12.47 ± 0.67	11.00 ± 0.66	11.55 ± 0.66
Mother age median (IQR)	30 (25-35)	30 (27-35)	28 (23-33)	30 (27-35)	27 (24-35)
Mother years of schooling median (IQR)	0 (0-0)	0 (0-4)	0 (0-2)	0 (0-0)	0 (0-0)
Mother's Occupation n (%)					
Housewife	442 (98.22%)	392 (90.32%)	429 (99.08%)	381 (88.60%)	421 (97.45%)
Working woman	8 (1.78%)	42 (9.68%)	4 (0.92%)	49 (11.40%)	11 (2.55%)
Total pregnancies median (IQR)	3 (2-6)	3 (2-5)	3 (2-6)	4 (2-6)	3 (2-6)
Mother's BMI (mean ± SD)	22.04 ± 3.82	22.38 ± 3.74	21.72 ± 3.83	22.05 ± 3.82	22.00 ± 3.798
BMI of mother (Kg/m²) n (%)					
Underweight (<18.5)	82 (19.43%)	74 (18.27%)	87 (20.52%)	83 (19.62%)	78 (18.71%)
Normal (18.5-24.9)	246 (58.29%)	232 (57.28%)	254 (59.91%)	242 (57.21%)	249 (59.71%)
Overweight (25-29.9)	72 (17.06%)	72 (17.78%)	66 (15.57%)	73 (17.26%)	70 (16.79%)
Obese(≥30)	22 (5.21%)	27 (6.67%)	17 (4.01%)	25 (5.91%)	20 (4.80%)
Mother's height (cm) (mean ± SD)	155.35 ± 6.40	154.18 ± 6.28	155.20 ± 6.42	154.07 ± 6.42	153.30 ± 6.37
Father years of schooling median (IQR)	0 (0-5)	0 (0-7)	0 (0-5)	0 (0-5)	0 (0-5)
Father's height (cm) (mean ± SD)	167.24 ± 6.58	164.59 ± 6.41	165.02 ± 6.55	167.01 ± 6.56	167.56 ± 6.55
Child Age (months) median (IQR)	6.1 (6.0-6.5)	6.2 (6.1-6.4)	6.0 (6.0-6.3)	6.2 (6.0-6.7)	6.1 (6.0-6.5)
Child's gender n (%)					
Male	224 (49.78%)	240 (55.30%)	224 (51.73%)	226 (52.56%)	225 (52.08%)
Female	226 (50.22%)	194 (44.70%)	209 (48.27%)	204 (47.44%)	207 (47.92%)
Length (cm) median (IQR)	64.3 (62.6-66)	64.2 (62.6-65.8)	64.3 (62.7-66.1)	64.7 (62.3-66.6)	64.2 (62.6-65.9)
Weight (Kg) median (IQR)	6.71 (6.04-7.37)	6.69 (5.97-7.41)	6.7 (6.09-7.37)	6.71 (6.04-7.43)	6.765 (6.11-7.37)
Stunted n (%)	112 (24.89%)	108 (24.94%)	115 (26.56%)	120 (27.91%)	115 (26.81%)
Underweight n (%)	115 (25.61%)	103 (23.79%)	113 (26.10%)	111 (25.93%)	108 (25.12%)
Wasted n (%)	57 (12.69%)	54 (12.47%)	53 (12.24%)	55 (12.82%)	52 (12.06%)
Ever breastfeed n (%)	450 (100.00%)	434 (100.00%)	433 (100.00%)	430 (100.00%)	432 (100.00%)
Fully immunized	387 (86.00%)	372 (85.71%)	361 (83.37%)	405 (94.19%)	377 (87.27%)

** Proportions and means are cluster adjusted*

Prevalence and rate ratio of stunting in children at 6, 12, 18 & 24 months of age

Prevalence and rate ratio of stunting in children at 6, 12, 18 and 24 months of age is presented across all study arms in Table 3. The prevalence and rate ratio have been adjusted for cluster randomization, baseline nutritional status (z-score), gender and BISP poverty score.

Children who received cash with SNF (RR = 0.75, 95% CI 0.62-0.92, p=0.005) and cash with SBCC and SNF (RR = 0.70, 95% CI 0.59-0.84, p=0.001) at the age of 12 months had a significant reduction in the risk of being stunted as compared to the control arm. However, by 24 months of age, children who received cash with SNF (RR=0.80, 95% CI 0.67-0.94, p=0.007) and cash with SBCC and SNF (RR=0.77, 95% CI 0.66-0.90, p=0.001) had a significant reduction in the risk of being stunted as compared to the control arm.

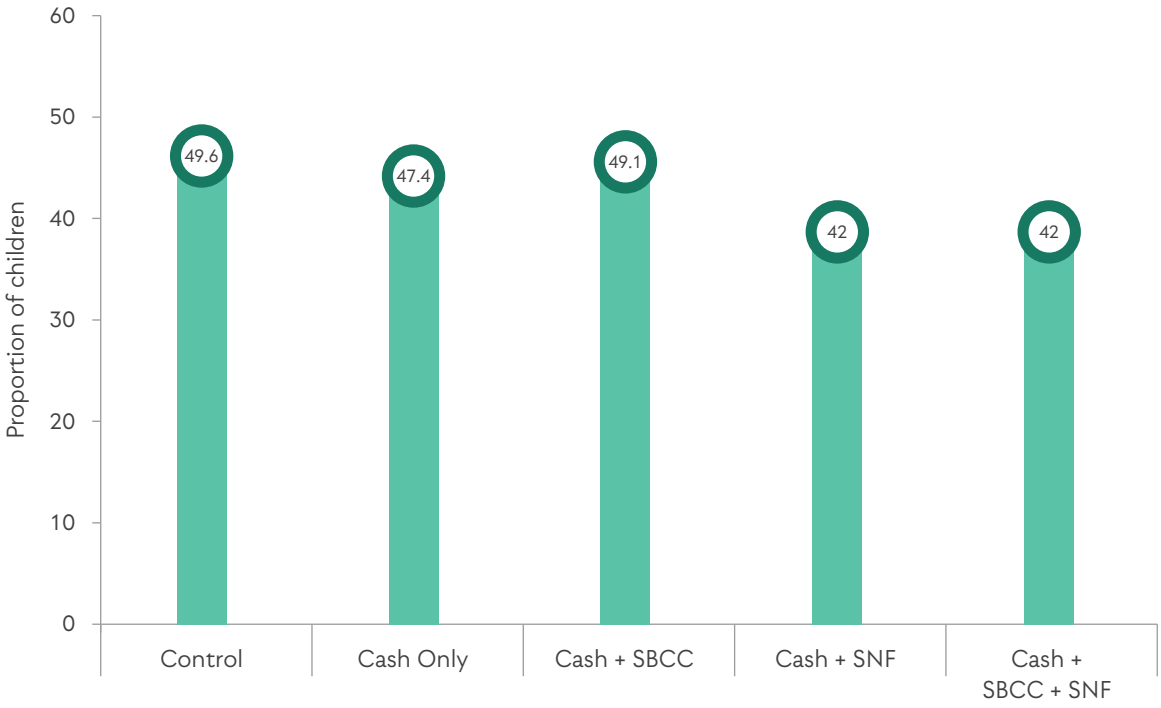
The prevalence of stunting at 24 months of age was 41.7% (95% CI: 37.22-46.74; p=0.007) in the cash with SNF arm, and 41.8% (95% CI: 37.21-46.93; p=0.001) in the cash with SBCC and SNF arm. When compared with the 49.3% (95% CI: 44.77 - 54.28) in the control arm at 24 months of age, a 15% reduction in the prevalence of stunting was found in both the cash with SNF arm and the cash with SBCC and SNF arm.

Table 3: Prevalence and rate ratio of stunting at 6, 12, 18 & 24 months of age

Variables	Number of children	N	Prevalence (95% CI)	Adjusted rate ratio (95% CI)*	P-value
6 Months					
Control	450	109	24.22 (20.57 - 28.52)		
Cash Only	430	105	24.42 (20.65 - 28.84)		
Cash + SBCC	429	110	25.64 (21.8 - 30.12)		
Cash with SNF	430	115	26.74 (22.84 - 31.27)		
Cash +SBCC + SNF	430	111	25.81 (21.96 - 30.3)		
12 Months					
Control	400	179	44.75 (40.13 - 49.9)		
Cash Only	382	146	38.22 (33.59 - 43.42)	0.90 (0.73 - 1.10)	0.299
Cash + SBCC	376	155	41.22 (36.44 - 46.51)	0.86 (0.70 - 1.05)	0.134
Cash with SNF	398	145	36.43 (31.99 - 41.48)	0.75 (0.62 - 0.92)	0.005
Cash +SBCC + SNF	412	143	34.71 (30.44 - 39.62)	0.70 (0.59 - 0.84)	0.001
18 Months					
Control	396	203	51.26 (46.57 - 56.43)		
Cash Only	385	190	49.35 (44.54 - 54.61)	1.05 (0.92 - 1.21)	0.483
Cash + SBCC	400	205	51.25 (46.6 - 56.39)	0.99 (0.86 - 1.14)	0.918
Cash with SNF	405	176	43.46 (38.93 - 48.56)	0.83 (0.71 - 0.98)	0.027
Cash +SBCC + SNF	408	191	46.81 (42.27 - 51.91)	0.87 (0.75 - 1.01)	0.063
24 Months					
Control	426	210	49.3 (44.77 - 54.28)		
Cash Only	395	187	47.34 (42.52 - 52.53)	0.99 (0.86 - 1.13)	0.876
Cash + SBCC	406	199	49.01 (44.29 - 54.13)	0.96 (0.83 - 1.12)	0.616
Cash with SNF	417	174	41.73 (37.22 - 46.74)	0.80 (0.67 - 0.94)	0.007
Cash +SBCC + SNF	404	169	41.83 (37.21 - 46.93)	0.77 (0.66 - 0.90)	0.001

* RR are adjusted by cluster, gender, BISP poverty score & baseline z-scores

Figure 4: Prevalence of stunting in children at 24 months across study arms



Prevalence and rate ratio of wasting in children at 6, 12, 18 & 24 months of age

Prevalence and rate ratio of wasting in children at 6, 12, 18 and 24 months of age is presented across all study arms in Table 4. The prevalence and rate ratio have been adjusted for cluster randomization, baseline nutritional status (z-score), gender and BISP poverty score.

There was no significant reduction in stunting across all study arms at 12 months of age. At 18 months of age, those children who received cash with SNF (RR = 0.58, 95% CI 0.34-0.99, p=0.046) and cash with SBCC and SNF (RR = 0.51, 95% CI 0.27-0.97, p=0.005) had a significant reduction in risk of being wasted as compared to the control arm. Similarly, by 24 months of age, children who received cash with SNF (RR = 0.53, 95% CI 0.34-0.83, p=0.04) and cash with SBCC and SNF (RR = 0.57, 95% CI 0.34-0.98, p=0.04) had a significant reduction in risk of being wasted as compared to the control arm.

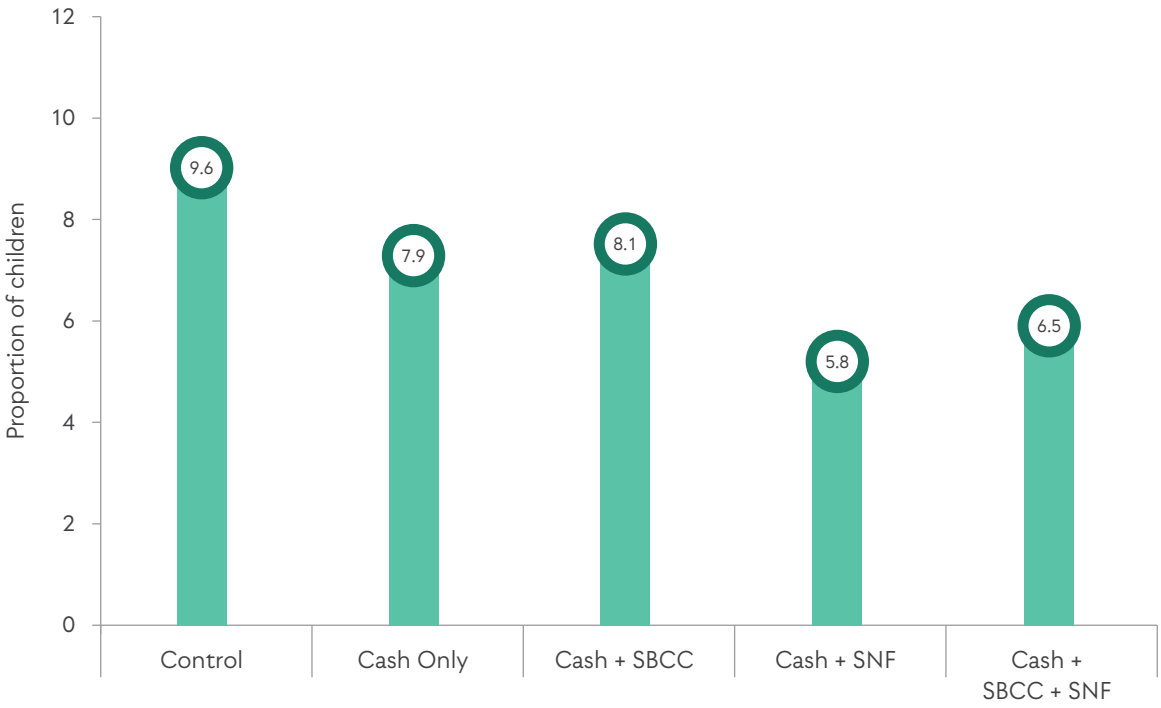
The prevalence of wasting at 24 months of age was 5.76% (95% CI: 3.90-8.49) in the cash with SNF arm, and 6.44% (95% CI: 4.43-9.33) in the cash with SBCC and SNF arm. When compared with the control arm at 24 months of age, a 40% reduction in the prevalence of wasting was found in the cash with SNF arm, while a 33% reduction was found in the cash with SBCC and SNF arm.

Table 4: Prevalence and rate ratio of Wasting at 6, 12, 18 & 24 months of age

Variables	Number of children	N	Prevalence (95% CI)	Adjusted rate ratio (95% CI)*	P-value
6 Months					
Control	450	58	12.89 (10.14 - 16.39)		
Cash Only	430	55	12.79 (9.99 - 16.37)		
Cash + SBCC	429	51	11.89 (9.18 - 15.38)		
Cash with SNF	430	55	12.79 (9.99 - 16.37)		
Cash +SBCC + SNF	430	52	12.09 (9.37 - 15.6)		
12 Months					
Control	400	41	10.25 (7.67 - 13.7)		
Cash Only	382	38	9.95 (7.35 - 13.45)	0.91 (0.53 - 1.55)	0.723
Cash + SBCC	376	38	10.11 (7.47 - 13.66)	0.94 (0.62 - 1.42)	0.755
Cash with SNF	398	36	9.05 (6.62 - 12.35)	0.87 (0.50 - 1.51)	0.618
Cash +SBCC + SNF	412	37	8.98 (6.61 - 12.21)	0.82 (0.50 - 1.35)	0.443
18 Months					
Control	396	46	11.62 (8.85 - 15.24)		
Cash Only	385	35	9.09 (6.63 - 12.47)	0.65 (0.39 - 1.07)	0.089
Cash + SBCC	400	36	9 (6.59 - 12.29)	0.65 (0.41 - 1.01)	0.057
Cash with SNF	405	32	7.9 (5.67 - 11.02)	0.58 (0.34 - 0.99)	0.046
Cash +SBCC + SNF	408	29	7.11 (5.01 - 10.09)	0.53 (0.34 - 0.83)	0.005
24 Months					
Control	426	41	9.62 (7.19 - 12.88)		
Cash Only	395	31	7.85 (5.59 - 11)	0.68 (0.40 - 1.15)	0.150
Cash + SBCC	406	33	8.13 (5.86 - 11.27)	0.70 (0.42 - 1.18)	0.181
Cash with SNF	417	24	5.76 (3.9 - 8.49)	0.51 (0.27 - 0.97)	0.04
Cash +SBCC + SNF	404	26	6.44 (4.43 - 9.33)	0.57 (0.34 - 0.98)	0.04

** RR are adjusted by cluster, gender, BISP poverty score, & baseline z-scores*

Figure 5: Prevalence of wasting in children at 24 months across study arms



Prevalence and rate ratio of underweight in children at 6, 12, 18 & 24 months of age

Prevalence and rate ratio of underweight in children at 6, 12, 18 and 24 months of age is presented across all study arms in Table 5. The prevalence and rate ratio have been adjusted for cluster randomization, baseline nutritional status (z-score), gender and BISP poverty score.

Children who received cash with SBCC and SNF (RR=0.77, 95% CI 0.60-0.99, p=0.048) at 18 months of age had a significant reduction in risk of being underweight as compared to the control arm. At 24 months of age, children who received cash with SNF (RR = 0.70, 95% CI 0.51-0.95, p=0.022) and cash with SBCC and SNF (RR = 0.72, 95% CI 0.54-0.96, p=0.026) had a significant reduction in risk of being underweight as compared to the control arm.

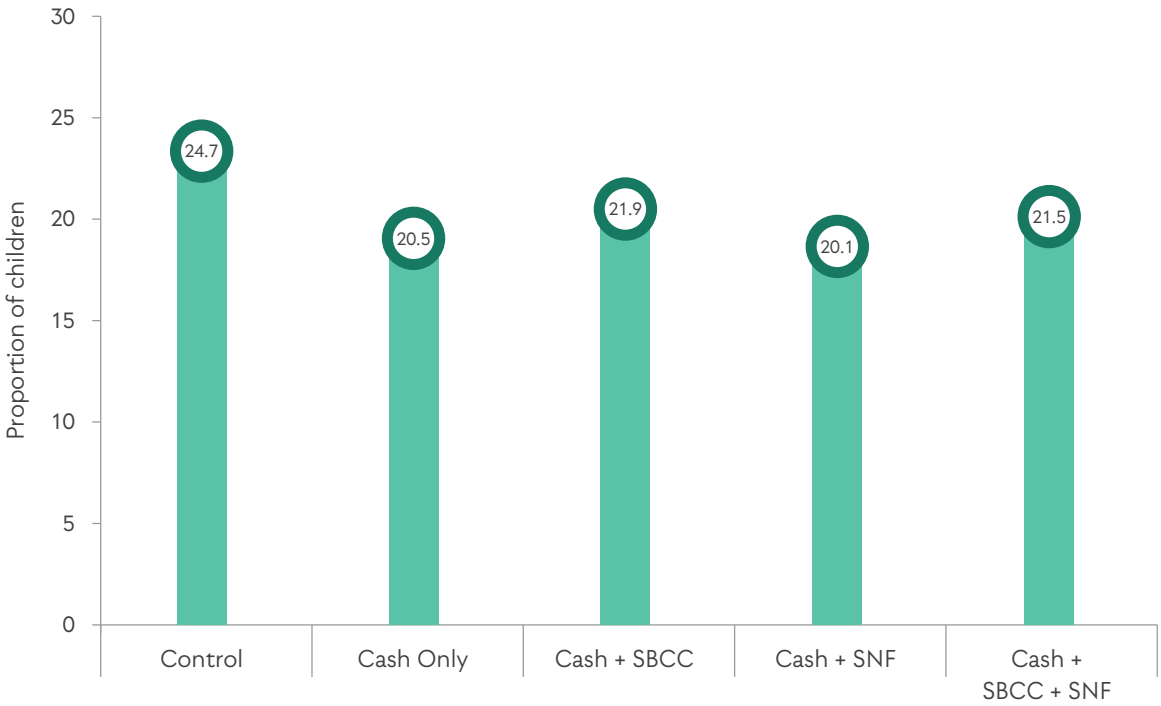
The prevalence of underweight at 24 months of age was 20.14% (95% CI: 16.63-24.39) in the cash with SNF arm, and 21.53% (95% CI: 17.85-25.94) in the cash with SBCC and SNF arm. When compared with the control arm at 24 months of age, a 18% reduction in the prevalence of wasting was found in the cash with SNF arm, while a 13% reduction was found in the cash with SBCC and SNF arm.

Table 5: Prevalence and rate ratio of underweight at 6, 12, 18 & 24 months of age

Variables	Number of children	N	Prevalence (95% CI)	Adjusted rate ratio (95% CI)*	P-value
6 Months					
Control	450	115	25.56 (21.83 - 29.92)		
Cash Only	430	102	23.72 (20 - 28.1)		
Cash + SBCC	429	111	25.87 (22.02 - 30.37)		
Cash with SNF	430	111	25.81 (21.96 - 30.3)		
Cash +SBCC + SNF	430	107	24.88 (21.09 - 29.32)		
12 Months					
Control	400	88	22 (18.29 - 26.46)		
Cash Only	382	73	19.11 (15.53 - 23.49)	0.87 (0.64 - 1.20)	0.404
Cash + SBCC	376	78	20.74 (17 - 25.28)	0.94 (0.70 - 1.28)	0.709
Cash with SNF	398	68	17.09 (13.76 - 21.21)	0.75 (0.51 - 1.10)	0.139
Cash +SBCC + SNF	412	83	20.15 (16.63 - 24.42)	0.82 (0.59 - 1.14)	0.246
18 Months					
Control	396	103	26.01 (22.03 - 30.71)		
Cash Only	385	88	22.86 (19.01 - 27.46)	0.94 (0.72 - 1.24)	0.687
Cash + SBCC	400	89	22.25 (18.53 - 26.72)	0.85 (0.65 - 1.12)	0.255
Cash with SNF	405	87	21.48 (17.84 - 25.88)	0.79 (0.57 - 1.09)	0.15
Cash +SBCC + SNF	408	87	21.32 (17.71 - 25.69)	0.77 (0.60 – 0.99)	0.048
24 Months					
Control	426	105	24.65 (20.88 - 29.1)		
Cash Only	395	81	20.51 (16.86 - 24.9)	0.79 (0.56 - 1.11)	0.167
Cash + SBCC	406	89	21.92 (18.22 - 26.34)	0.81 (0.61 - 1.07)	0.145
Cash with SNF	417	84	20.14 (16.63 - 24.39)	0.70 (0.51 - 0.95)	0.022
Cash +SBCC + SNF	404	87	21.53 (17.85 - 25.94)	0.72 (0.54 - 0.96)	0.026

** RR are adjusted by cluster, gender, BISP poverty score & baseline z-scores*

Figure 6: Prevalence of underweight in children at 24 months across study arms



Impact on child micronutrients at 24 months of age

Furthermore, the impact of intervention packages on micronutrient status was assessed among 500 children (100 per study arm) at 24 months of age (Table 6). The prevalence of anemia was found to be higher in children who received cash only (78.5%), cash with SBCC (77.7%) and among the children in the control arm (73.7%). However, children who received cash with SNF (54.0%) and cash with SBCC and SNF (57.5%) were found to have a lower prevalence of anemia at 24 months of age. Similarly, the prevalence of iron deficiency anemia was found to be higher in children who received cash only (71.4%) and children in the control arm (70.7%), as compared to children who received cash with SBCC (58.5%), cash and SNF (42.0%) and cash with SBCC and SNF (47.5%). The prevalence of vitamin A deficiency anemia was found to be much higher in the control arm (53.5%), cash only (74.5%), and cash with SBCC (74.8%), as compared to cash with SNF (39.0%) and cash with SBCC and SNF (55.4%) at 24 months of age.

Table 6: Impact on the micronutrients status of children at 24 months of age

Variables	Control	Cash Only	Cash+SBCC	Cash+SNF	Cash+SBCC + SNF
N	99	98	99	100	99
Child's Gender	n (%)	n (%)	n (%)	n (%)	n (%)
Male	46 (46.4)	60 (61.2)	47 (47.4)	51 (51.0)	48 (48.4)
Female	53 (53.5)	38 (38.7)	52 (52.5)	49 (49.0)	51 (51.5)
Haemoglobin (gm/dL)					
Normal (≥11 gm/dL)	26 (26.2)	21 (21.4)	22 (22.2)	46 (46.0)	42 (42.4)
Anemic (<11 gm/dL)	73 (73.7)	77 (78.5)	77 (77.7)	54 (54.0)	57 (57.5)
Haemoglobin (mean ± SD)	9.78 ± 1.81	9.58 ± 1.80	9.88 ± 1.81	10.61 ± 1.82	10.64 ± 1.81
Ferritin (ng/mL)					
Normal (≥12)	13 (13.1)	14 (14.2)	24 (24.2)	30 (30.0)	35 (35.3)
Low ferritin (<12)	86 (86.8)	84 (85.7)	75 (75.7)	70 (70.0)	64 (64.6)
Ferritin ng/mL mean ± SD	6.57 ± 8.69	6.65 ± 8.65	14.41 ± 8.69	11.34 ± 8.74	11.71 ± 8.69
Iron deficiency anemia					
Normal	29 (29.3)	28 (28.6)	41 (41.5)	58 (58.0)	52 (52.5)
Deficient	70 (70.7)	70 (71.4)	58 (58.5)	42 (42.0)	47 (47.5)
Vitamin A µmoll/L					
Non deficient (>0.70 µmoll/L)	46 (46.4)	25 (25.5)	25 (25.2)	60 (60.0)	44 (44.4)
Deficient (<0.70 µmoll/L)	53 (53.5)	73 (74.5	74 (74.8)	39 (39.0)	55 (55.4)
Vitamin A µmol/L mean ± SD	0.72 ± 0.28	0.60 ± 0.27	0.60 ± 0.27	0.97 ± 0.28	0.72 ± 0.27

SBCC messages provided to mothers of children aged 6 to 23 months

Based on the mothers' recall, 86.5%, 70.8% and 93.5% of mothers with children enrolled in the cash with SBCC arm, cash with SNF arm and cash with SBCC and SNF arm reported receiving messages or sessions on health and nutrition education over the past month, respectively (Table 7).

When probed on the topics covered during the sessions, 37.8% in the cash with SBCC arm and 52.0% in the cash with SBCC and SNF arm reported receiving messages on complementary feeding. Dietary diversity was low in the cash with SBCC and SNF arm (39.1%); whereas, in the cash with SBCC arm (94.7%), majority of the mothers were able to recall the messages. Similarly, a higher percentage of mothers in the arms with SBCC reported receiving messages on maternal nutrition, hygiene and sanitation, as well as the benefits of SNF.

Table 7: SBCC messages provided to mothers of children aged 6 to 23 months

Variables	Control	Cash Only	Cash+SBCC	Cash+SNF	Cash+SBCC + SNF
N	450	434	433	430	432
Received any health education session/ messages during last 1 month					
Yes	5.6	6.2	86.5	70.8	93.5
No	94.4	93.9	13.5	29.2	6.5
Received health session/messages on:					
Introduction of complementary feeding	31.1	11.3	37.8	6.0	52.0
Dietary diversity for the child	77.1	63.2	94.7	32.6	39.1
Continuation of BF for 2 years	21.9	29.5	74.1	20.2	54.2
Benefits of SNF	0.5	0.0	0.2	93.5	86.0
Not sharing of SNF with others	0.0	0.0	0.1	72.7	75.3
Maternal nutrition/balance diet	53.7	19.1	80.4	26.0	57.0
WASH	65.2	29.5	91.9	68.2	56.9
Other messages	0.0	17.2	0.6	0.5	0.1

**Estimates are cluster adjusted*

Impact on knowledge, attitudes and practices at 24 months of age

Midline and endline surveys were conducted with mothers in all study arms regarding their knowledge, attitude and practices about maternal and child health (MCH) and IYCF practices (Table 8). Knowledge about maternal nutrition during lactation improved in the cash with SBCC arm (from 38% at midline to 65% endline) and in the cash with SBCC and SNF arm (from 32% to 73%). Similarly, knowledge about undernutrition improved among the cash with SBCC arm (from 55% to 76%) and the cash with SBCC and SNF arm (57% to 86%). No improvements were observed in the attitudes of mothers regarding undernutrition across all study arms.

Minimum dietary diversity (MDD) among children 6-23 months was found to have improved in the cash with SBCC arm (from 2% to 27%) and in the cash with SBCC and SNF (from 5% to 14%). No improvements were observed in the minimum meal frequency (MMF) among children 6-23 months across all study arms. The minimum acceptable diet, which is a composite of MDD and MMF, was found to have improved in the cash with SBCC arm (from 1.39% to 13%) and in the cash with SBCC and SNF (from 4% to 7%) arm. An increase in the consumption of iron-rich or iron-fortified foods was also observed across all the study arms.

Table 8: Impact of maternal knowledge, attitude and practices

Variables	Midline					Endline				
	Control	Cash Only	Cash +SBCC	Cash + SNF	Cash + SBCC + SNF	Control	Cash Only	Cash +SBCC	Cash + SNF	Cash + SBCC + SNF
Knowledge about maternal nutrition during lactation	47.53	41.57	38.38	40.80	32.41	68.54	49.50	65.58	61.12	73.29
Knowledge about undernutrition	52.17	51.90	55.12	54.38	57.12	65.33	61.41	79.62	76.50	86.80
Attitudes about undernutrition	90.00	80.34	95.28	75.42	81.75	97.16	76.67	89.37	77.75	81.42
Knowledge about hand washing practices	67.11	36.80	64.89	58.10	46.11	85.45	59.95	93.29	91.44	95.11
Minimum dietary diversity	2.89	2.76	1.85	0.93	5.09	26.76	42.78	27.34	29.26	13.86
Minimum meal frequency	49.11	54.15	23.56	56.98	29.63	13.85	14.68	7.64	8.87	21.78
Minimum acceptable diet	2.22	2.76	1.39	0.70	4.40	12.91	24.30	13.55	12.95	7.43
Consumption of iron-rich or iron-fortified foods	0.89	12.44	12.24	10.47	8.56	49.30	55.19	40.15	53.24	49.75

Compliance of SNF among children 6-23 months of age

In the cash with SNF arm, the mean number of days' children were observed in the study was 533.49 ± 41.73 days (Table 9). On average, these children received SNF for 500.47 ± 60.88 days and consumed the SNF for 418.24 ± 83.12 days. The compliance rate of children consuming SNF was 80.03 ± 10.10% in the cash with SNF arm. Furthermore, only 50.34 ± 34.53 SNF sachets were shared with other family members.

Similarly, children receiving cash with SBCC and SNF were observed for 529.73 ± 41.87 days during the study. These children received SNF for 509.93 ± 61.10 days and consumed the SNF for 481.41 ± 83.41 days, with only 15.30 ± 34.65 SNF sachets being shared with other family members. The overall compliance rate of SNF was 84.02 ± 10.13% in cash with SBCC and SNF arm. As compared to the cash with SNF arm, there was an increase in the compliance rate of SNF among children receiving cash with SBCC and SNF, which can be attributed to SBCC component.

Table 9: Compliance of SNF among children 6-23 months of age

Variables	Cash + SNF	Cash + SBCC + SNF
N	428	431
Mean days observed	533.49 ± 41.73	529.73 ± 41.87
Mean days SNF received	500.47 ± 60.88	509.93 ± 61.10
Mean days SNF consumed	418.24 ± 83.12	481.41 ± 83.41
Mean compliance rate to SNF *(days consumed/days observed*100)*	80.03 ± 10.10	84.02 ± 10.13
Mean number of SNF sachets shared with others family members	50.34 ± 34.53	15.30 ± 34.65

Household utilization of BISP cash transfers

On average, 4,700 PKR was transferred to each household on a quarterly basis during the study period (Table 10). In December 2018, the cash transfer amount was increased to 5,000 PKR by BISP. In the cash with SBCC and SNF arm, the cash transfer was mostly used on household food items (3878 ± 1141 PKR), clothing (3208 ± 1338 PKR), health and medicine (2222 ± 1635 PKR), school fees (1091 ± 724 PKR), and on transportation (525 ± 560 PKR). Similar trends were also observed across all other study arms.

Table 10: Household utilization of BISP cash transfers

Variables	Cash Only	Cash + SBCC	Cash + SNF	Cash + SBCC + SNF
N	434	433	430	432
BISP cash received quarterly (PKR) (mean ± SD)	4726 ± 370	4757 ± 541	4708 ± 545	4649 ± 252
Spending on food (mean ± SD)	3475 ± 1376	3303 ± 1312	3826 ± 1212	3878 ± 1141
Spending on clothing (mean ± SD)	2930 ± 1328	2553 ± 1375	3339 ± 1407	3208 ± 1338
Spending on health/medicine (mean ± SD)	2549 ± 1602	2077 ± 1300	1909 ± 1395	2222 ± 1635
Spending on education/school fee (mean ± SD)	2164 ± 1576	2302 ± 1399	1974 ± 1618	1091 ± 724
Spending on transport (mean ± SD)	494 ± 690	892 ± 487	370 ± 458	525 ± 560
Spending on other items (mean ± SD)	2565 ± 1601	4196 ± 1082	3726 ± 1735	3832 ± 1561

Cost-effectiveness of interventions in preventing stunting, wasting and underweight cases at 24 months of age

For the cost-effectiveness analysis (CEA), cases prevented were defined as the difference in the prevalence of stunting, wasting and underweight between control and intervention arms. The CEA examined the number of cases and not the number of children, and only combined the number of cases of stunting and wasting prevented and not the number of children with both cases, since the focus in the CEA was on the cases prevented. The WHO threshold of three times the gross domestic product (GDP) per capita is defined as cost-effective. Interventions that cost less than the GDP per capita are considered very cost-effective, while interventions costing less than three times the GDP per capita are considered cost-effective.

Stunting – At 24 months of age, cash with SNF and cash with SNF and SBCC remained cost effective in reducing the prevalence of stunting. Cash with SNF reduced the prevalence of stunting by 15.3% and prevented 36 cases of stunting at a cost of $897.15 per case. Cash with SBCC reduced the prevalence of stunting by 0.6% and prevented 11 cases of stunting at a cost of $5925.18 per case. Cash with SNF and SBCC

reduced the prevalence of stunting by 15.2% and prevented 41 cases of stunting at $2,324.58 per case. Based on the WHO threshold, cash with SNF was very cost-effective in reducing stunting, cash with SNF and SBCC was cost-effective, and cash with SBCC was not cost-effective (Table 11). Cash with SNF and cash with SNF and SBCC remained cost-effective when intervention costs were adjusted for 10% miscellaneous costs.

Table 11: Cost-effectiveness of interventions in preventing stunting cases at 24 months of age

	Cost per cohort	Cost per cohort *adjusted*	Cases prevented	Cost per stunting case prevented	
				Unadjusted	Adjusted
BISP Cash + SNF	$ 32,297.30	$ 35,527.03	36	$ 897.15	$ 986.86
BISP Cash + SBCC	$ 65,473.93	$ 72,021.32	11	$ 5,925.18	$ 6,547.39
BISP Cash + SNF + SBCC	$ 95,307.84	$ 104,838.62	41	$ 2,324.58	$ 2,530.27

Wasting – At 24 months of age, cash with SNF reduced the prevalence of wasting by 40% and prevented 17 cases of wasting at a cost of $1,899.84 per case, making it the only cost-effective option based on the WHO threshold. Cash with SBCC reduced the prevalence of wasting by 15.5% and prevented 8 cases of wasting at a cost of $8184.24 per case. Cash with SNF and SBCC reduced the prevalence of wasting by 33% and prevented 15 cases at $6,353.86 per case. Cash with SBCC and cash with SNF and SBCC were not cost-effective in preventing cases of wasting in children 6-23 months of age (Table 12).

Table 12: Cost-effectiveness of interventions in preventing wasting cases at 24 months of age

	Cost per cohort	Cost per cohort *adjusted*	Cases prevented	Cost per wasting case prevented	
				Unadjusted	Adjusted
BISP Cash + SNF	$ 32,297.30	$ 35,527.03	17	$ 1,899.84	$ 2,089.83
BISP Cash + SBCC	$ 65,473.93	$ 72,021.32	8	$ 8,184.24	$ 9,002.67
BISP Cash + SNF + SBCC	$ 95,307.84	$ 104,838.62	15	$ 6,353.86	$ 6,989.24

Underweight – At 24 months of age, cash with SNF reduced the prevalence of underweight by 18.3% and prevented 21 cases at a cost of $1,537.96 per case, making it a cost-effective option. Cash with SBCC reduced underweight prevalence by 11.1% and prevented 16 cases at a cost of $4,092.12 per case, making it marginally cost-effective. Cash with SNF and SBCC reduced the prevalence of underweight by 12.6% and prevented 18 cases at $5,239.44 per case, thereby making it not cost-effective. When the costs are adjusted, cash with SNF remains cost-effective, cash with SBCC becomes not cost-effective, and cash with SNF and SBCC remains not cost-effective (Table 13).

Table 13: Cost-effectiveness of interventions in preventing underweight cases at 24 months of age

	Cost per cohort	Cost per cohort *adjusted*	Cases prevented	Cost per underweight case prevented	
				Unadjusted	Adjusted
BISP Cash + SNF	$ 32,297.30	$ 35,527.03	21	$ 1,537.96	$ 1,691.76
BISP Cash + SBCC	$ 65,473.93	$ 72,021.32	16	$ 4,092.12	$ 4,501.33
BISP Cash + SNF + SBCC	$ 95,307.84	$ 104,838.62	18	$5,239.44	$ 5,824.37

Sensitivity analyses of the number of cases with both stunting and wasting prevented

Since many nutrition interventions potentially impact both stunting and wasting, focusing the cost analysis on only stunting or only wasting can lead to an underestimation of the cost-effectiveness of the interventions. To overcome this underestimation, the cost-effectiveness of these interventions was estimated by combining the cases of stunting and wasting reduced at 24 months of age. This was based on existing evidence which suggests that stunting and wasting are closely related and often occur together in the same populations and often in the same children. Cash with SNF prevented 53 cases of stunting and wasting at a cost of $609.38 per case, making it a very cost-effective option for the prevention of stunting and wasting combined. Cash with SBCC prevented 19 cases of stunting and wasting at a cost of $3,445.99 per case, making it marginally cost-effective, and cash with SNF and SBCC prevented 56 cases of stunting and wasting at $1,701.92 per case, making it a cost-effective option (Table 14).

Table 14: Cost-effectiveness of interventions in preventing stunting and wasting cases at 24 months of age

	Cost per cohort	Cost per cohort *adjusted*	Cases prevented	Cost per stunting & wasting case prevented	
				Unadjusted	Adjusted
BISP Cash + SNF	$ 32,297.30	$ 35,527.03	53	$ 609.38	$ 670.32
BISP Cash + SBCC	$ 65,473.93	$ 72,021.32	19	$ 3,445.99	$ 3,790.59
BISP Cash + SNF + SBCC	$ 95,307.84	$ 104,838.62	56	$ 1,701.92	$ 1,872.12

CONCLUSION

In conclusion, the study found a significant reduction in the prevalence of stunting, wasting, underweight and anemia in children who received cash transfers, SBCC and SNF between 6-23 months of age. The cost analysis revealed that cash with SNF and cash with SNF and SBCC are the most cost effective interventions in reducing malnutrition among children aged 24 months. The interventions were implemented through the existing health and social protection systems, which creates the potential for smooth scale up across the country. It is recommended that SNF in combination with cash transfers and SBCC be scaled up to improve the nutritional status of children in Pakistan and achieve the Sustainable Development Goals (SDGs).

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