Impoverished Rural Districts of Pakistan: An Independent Evaluation of Impact on Educational and Cognitive Outcomes in Sindh Province, Pakistan

Sajid Bashir Soofi, Imtiaz Hussain, Nelofer Mehboob, Masawar Hussain, Zaid Bhatti, Saiqa Khan, Seema Hasan and Zulfiqar A. Bhutta

Abstract This article presents findings of cognitive and performance assessment among recipient and non-recipient school girls in the catchment schools of the Tawana Pakistan Project using standardised matrices. This is the first such evaluation of the relationship of a school feeding programme with developmental outcomes in rural Pakistan. There was evidence of benefits of the school feeding programme on a range of outcomes with significant improvement in the literacy and numeracy scores. The paired analysis showed a significant improvement ($p<0.001$) in Raven's Coloured Progressive Matrices and Draw-a-Person test while no association was established in grade performance assessment (GPA). The correlation analyses in terms of the effects of intervention on child cognitive development confirmed the positive correlation in all aspects. DID estimates also revealed an improvement in cognitive outcomes due to the programme. Findings support such potential programmes for improving educational and cognitive outcomes of primary school girls in impoverished districts of Pakistan.

1 Introduction and background

The role of nutrition in the mental development of young people is indisputable, with undernourished children tending to do less well on tests of cognition and educational achievement (Chandler 1993; Grantham-McGregor 1995; Glewwe *et al.* 1999; Fernald *et al.* 1997). Poverty is a major impediment to accessing a nutritionally richer or a 'stimulus enriched' environment (Isaacs *et al.* 2008), both of which are required for promoting intellectual capacity, especially during the early phases of life.

Poverty limits the choices available to the economically disadvantaged who tend to opt for cheaper, energy-dense foods rather than nutritious ones (Drewnowski and Darmon 2005); while those in low and middle-income countries tend to commit their children into the labour force rather than sending them to school (Kudat *et al.* 2000), generating the cyclical triad of undernutrition, lack of education and poverty. Even in countries with free public schooling, the indirect costs of books, transport and clothing can be formidable and prevent parents from sending their children to school (Massow 2001). Sadly, due to poverty and gender discrimination, 30 per cent of Pakistani adolescents are deprived of any schooling (Durrant 2000) with one third of the 60 million girls not going to school worldwide residing in India and Pakistan (Mathieu 2006).

Birth weight and post-natal height independent of the social background (Richards *et al.* 2002), as well nutritional deficiencies such as those of iron, iodine, zinc and vitamin B (Black 2003) affect the cognitive powers of children. Nutritional supplementation between birth and the first two years of life is critical to later performance in school and wage-earning capacity in adulthood (Hoddinott and Maluccio 2008). School-based food programmes offer an incentive to the poor to ensure a free meal for their child (Massow 2001) thereby increasing enrolment (Barrett and

IDS Bulletin Volume 44 Number 3 May 2013
Published by Blackwell Publishing Ltd, 9600 Garsington Road, Oxford OX4 2DQ, UK and 350 Main Street, Malden, MA 02148, USA

Maxwell 2005), academic performance, cognitive functioning and higher retention in schools in severely undernourished populations (Taras 2005; UNICEF 2007).

The Tawana Pakistan Project (TPP) was launched by the government of Pakistan between 2003–05 in 4,035 girls' primary schools in the rural areas of the poorest districts of Pakistan identified from the list provided by the government, to improve the nutritional status and school attendance of primary school girls. The intervention included the provision of freshly prepared balanced midday meals from locally available foods to over 418,000 girls at about US$0.12/child/day (Badruddin *et al.* 2008). This article describes the effects of balanced midday meals on the cognitive abilities of the girls enrolled in the feeding programme.

2 Methods

Academic performance, child maturity and cognitive assessment were measured as part of the impact assessment and evaluation conducted by the Department of Paediatrics and Child Health, Aga Khan University. The impact assessment evaluation consisted of a cross-sectional survey at baseline and endline and a nested longitudinal follow-up of a subset, one year after the implementation of the feeding programme.

Three impact assessment approaches, (1) Grade Performance Assessment (GPA), (2) the Draw-a-Person (DAP) test, and (3) Raven's Coloured Progressive Matrices (RCPM) measurement, were chosen to quantify the measurable end points concerned with the relationship between nutrition, diet and development behaviours before and after the implementation of school feeding in selected schools of Sindh, Pakistan.

Grade Performance Assessment (GPA) of the children in grades 1–5 was carried out using relevant portions from the Monitoring Learning Achievement for literacy and numeracy of the 1999 Joint UNESCO and UNICEF project (Goodenough 1926 and Harris 1963) and the Modified Scholastic Assessment for arithmetic and vocabulary assessment questionnaires.

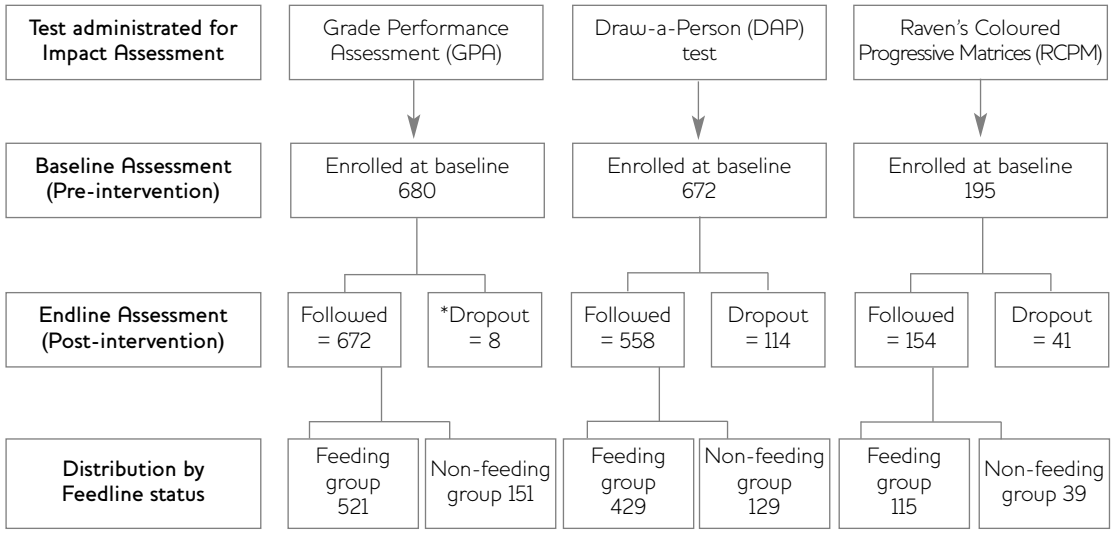
The Draw-a-Person (DAP) test was implemented to assess abstract reasoning and non-verbal intelligence and it has been the subject of a substantial literature over a very long period since 1926 (*ibid.*). There have been many strategies advocated for objective scoring, as well as approaches to psychological interpretation (Koppitz 1982; Dennis 1966). The features and characteristics of the human figure drawing provide a measure of general maturity, according to several theorists. When asked to draw a person, children draw a significant figure in their life, and, depending on the child's feelings towards that person, their drawings often reveal something of these feelings, not only in what they draw but how they go about the activity. Children often draw themselves. They may even focus on one body part, draw an unusually small, hidden, large or otherwise 'odd' person, and reflect some transient or deep-seated emotional feelings (Koppitz 1982).

The Raven's Coloured Progressive Matrices (RCPM) (Raven 1965) were used for girls in grades 3–5 aged 5–12 years, who were residents of the villages where the Tawana Pakistan Project was carried out. The RCPM is a non-verbal visual test, assessing the ability of non-verbal and abstract reasoning. It is often used as one of the indicators of verbal or fluid intelligence in studies on cognitive ageing (Aartsen *et al.* 2002, 2004; Zimprich *et al.* 2004) or as a predictor of change in other domains of functioning (Zimprich *et al.* 2004).

Every third child from each of grades 1–5 who was present at the time of baseline assessment and participated in the Health and Nutrition assessment, was randomly selected for the GPA and DAP tests; the maximum limit was ten children from each grade. However, all children from the class were tested if the class size comprised of less than or equal to ten children. The RCPM test was performed for grades 3–5 on a subset and a similar process was employed for randomly selecting a maximum of six girls from each.

Grade-specific tools (grades 1–5) were used for education performance assessment during the baseline and endline survey. Tools were developed and administrated considering the current level of education at the time of assessment. For example, for a girl who was in grade 3 at the time of baseline, grade 3 education and cognitive assessment tools were administrated and if at the time of endline the same girl was promoted to the next grade (grade 4), grade 4 tools were administrated as per defined guidelines. This article describes the findings of matched group

Figure 1 Education performance and cognitive assessment – TPP pre- and post-intervention impact evaluation



Note Dropouts reported for all three assessments due to refusals and girls did not attempt test fully at baseline.
Source Authors' own.

data (a cohort of girls 6–12 years in the school population who were assessed at the baseline survey before the implementation of intervention and subsequently re-assessed at the endline survey, irrespective of the feeding initiation/ implementation). No specific tolls were used for the DAP test. Randomly selected students of GPA were asked to test the draw-a-person activity to check the learning ability and maturity level of the children.

For educational performance assessment, we calculated the total scores obtained by each student and divided it by the total marks allocated to each of the respective instruments to calculate the individual percentage and then calculate mean score (in per cent) for comparison purposes. DAP scoring was done by having assistance from two scorers. The scoring pattern was followed by given scores, that is, 1 and 0; therefore, score=1 was given to the present projection and 0 for not present. A total of 45 marks were allocated for the DAP test with no negative scoring. We calculated mean scores to compare the pre- and post-performance of the girl. For RCPM every part of each question carried one mark with a total of 35 marks. The educational assessment tools were developed in English and translated into Sindhi. All involved field staff were trained through workshops and data collecting and educational assessment instruments were validated by pre-testing in rural and slum areas.

Female students were assessed from 69 targeted schools at baseline (before initiation of intervention) and after intervention during the Tawana impact assessment. Though the Tawana project was intended to cover all girls' primary schools from the targeted districts, it could not include some for a variety of reasons. At the time of the endline survey, students from 25 out of 69 selected schools who had undergone a baseline assessment were found not to have participated in the feeding programme. The female students from 46 participating schools were classified as the Feeding Group and from the 25 non-participating schools as controls (Non-Feeding group).

Different data analytical methods were applied to assess the impact of the programme on education performance, child maturity and cognitive outcomes. At first, a one way ANOVA test was performed to compare the mean score among feeding and non-feeding groups by age band and further analysed using paired t-tests to compare the mean score over the period (pre- and post-intervention) by grade and age groups.

DID regressions estimates were used to validate the impact of the programme and attribution of causality (McEwan 2010). The DID or 'double

Table 1 Mean score and standard deviation of cognitive assessments by pre- and post-intervention

	Feeding status	N	Mean score (Standard deviation)			p-value
			Pre-intervention	Post-intervention	Diff	
Grade Performance Assessment (GPA)	Feeding	521	29.5 (12.3)	34.4 (11.4)	4.9	< 0.0001
	Non-feeding	151	29.1 (13.8)	28.9 (13.3)	-0.2	0.869
Raven's Coloured Progressive Matrices (RCPM)	Feeding	115	11.4 (3.9)	14.9 (4.4)	3.5	< 0.0001
	Non-feeding	39	10.4 (2.9)	12.4 (3.5)	2	0.007
Draw-a-Person (DAP) test	Feeding	429	15.5 (7.3)	20.8 (8.4)	5.3	< 0.0001
	Non-feeding	129	13.1 (6.1)	17.7 (7.7)	4.6	< 0.0001

Source Authors' own.

difference' estimator is defined as the difference in average outcome in the treatment group before and after treatment minus the difference in average outcome in the control group before and after treatment/intervention (Lechner 2011). Since the work by Ashenfelter and Card (1985), the use of difference-in-differences methods has become very widespread (Whaley 2003). The DID estimates remove biases in second period comparisons between the treatment and control group that could be the result from permanent differences between those groups, as well as biases from comparisons over time in the treatment group that could be the result of trends (McEwan 2010; Lechner 2011; Whaley 2003). Formally, the difference-in-differences model can be specified as a two-way fixed effect linear regression model. We estimated DID for three dependent variables: Grade performance (GP) test score, RCPM test score and DAP test score. Paired data of feeding and non-feeding schools were used in order to evaluate the impact of school meals programmes on grade performance, child maturity and cognitive outcomes.

3 Results

A cohort of 672 girls (divided into 521 feeding and 151 non-feeding group) were included for the final analysis of education performance and 558 (429 feeding and 129 non-feeding group) for the DAP test. The RCPM test was performed for 154 (115 feeding and 39 non-feeding group) paired girls. Findings of cognitive assessment and educational performance are summarised in Figure 1 and Table 1.

Table 1: The overall findings of pre- and post-intervention compression by feeding status showed a significant improvement for all three education and cognitive outcomes among the feeding group. However for DAP it was significant in both the non-feeding and feeding groups, but the difference of percentile was more in the feeding group.

Table 2 Pre- and post-impact assessment of cognitive outcomes using difference-in-differences estimate

	Feeding status	Mean scores		Difference
		Pre-intervention	Post-intervention	between periods
Grade Performance Assessment (GPA)	Feeding	29.5	34.4	4.9
	Non-feeding	29.1	28.9	-0.2
	Difference between groups	**0.4**	**5.5**	**5.1 (DID estimates)**
Raven's Coloured Progressive Matrices (RCPM)	Feeding	11.4	14.9	3.5
	Non-feeding	10.4	12.4	2.0
	Difference between groups	**1.0**	**2.5**	**1.5 (DID estimates)**
Draw-a-Person (DAP) test	Feeding	15.5	20.8	5.3
	Non-feeding	13.1	17.7	4.6
	Difference between groups	**2.4**	**3.1**	**0.7 (DID estimates)**

Source Authors' own.

Table 3 **Assessment of main outcomes among feeding and non-feeding groups by age categories (paired)**

Age bands	Feeding status		Baseline (pre-intervention)			Endline (post-intervention)		
			Grade Performance Assessment (GPA)	Draw-a-Person (DAP) test	Raven's Coloured Progressive Matrices (RCPM)	Grade Performance Assessment (GPA)	Draw-a-Person (DAP) test	Raven's Coloured Progressive Matrices (RCPM)
< 7 years	Non-feeding	Mean ± SD N	31.8 ± 13.2 52	11.8 ± 5.2 31	9.1 ± 3.7 9	33.9 ± 13.8 52	15.5 ± 7.0 31	11.4 ± 1.7 9
	Feeding	Mean ± SD N	31 ± 12.5 212	13.8 ± 6.9 129	8.8 ± 2.9 16	37.3 ± 11.3 212	18.8 ± 7.9 129	13.4 ± 3.4 16
	Total	Mean ± SD N	31.1 ± 12.6 264	13.4 ± 6.7 160	8.9 ± 3.1 25	36.6 ± 11.8 264	18.1 ± 7.8 160	12.7 ± 3 25
	p-value		**0.659**	**0.130**	**0.787**	**0.068**	**0.039**	**0.130**
7–10 years	Non-feeding	Mean ± SD N	27.6 ± 14.1 73	13.8 ± 5.7 72	10.5 ± 2.6 25	27.9 ± 12.9 73	18.3 ± 7.4 72	13 ± 4.1 25
	Feeding	Mean ± SD N	29.2 ± 12.1 224	15.7 ± 7 218	11.5 ± 3.8 74	33.1 ± 11.2 224	21.2 ± 8.1 218	14.7 ± 4.3 74
	Total	Mean ± SD N	28.8 ± 12.6 297	15.2 ± 6.7 290	11.2 ± 3.5 99	31.9 ± 11.8 297	20.5 ± 8 290	14.2 ± 4.3 99
	p-value		**0.347**	**0.035**	**0.222**	**0.001**	**0.008**	**0.091**
10+years	Non-feeding	Mean ± SD N	27.9 ± 14.2 26	12.7 ± 7.7 26	12.2 ± 1.5 5	21.5 ± 9.4 26	18.3 ± 9.3 26	11 ± 1.7 5
	Feeding	Mean ± SD N	26.5 ± 12 85	17.5 ± 8.3 82	12.7 ± 4.3 25	30.8 ± 10.6 85	23.1 ± 9.5 82	16.4 ± 4.9 25
	Total	Mean ± SD N	26.8 ± 12.5 111	16.3 ± 8.4 108	12.6 ± 3.9 30	28.6 ± 11 111	21.9 ± 9.6 108	15.5 ± 4.9 30
	p-value		**0.613**	**0.010**	**0.809**	**0.0001**	**0.027**	**0.023**
Overall	Non-feeding	Mean ± SD N	29.1 ± 13.8 151	13.1 ± 6.1 129	10.4 ± 2.9 39	28.9 ± 13.3 151	17.7 ± 7.7 129	12.4 ± 3.5 39
	Feeding	Mean ± SD N	29.5 ± 12.3 521	15.5 ± 7.3 429	11.4 ± 3.9 115	34.4 ± 11.4 521	20.8 ± 8.4 429	14.9 ± 4.4 115
	Total	Mean ± SD N	29.4 ± 12.7 672	14.9 ± 7.1 558	11.1 ± 3.7 154	33.2 ± 12.1 672	20.1 ± 8.4 558	14.2 ± 4.3 154
	p-value		**0.755**	**0.001**	**0.155**	**< 0.0001**	**< 0.0001**	**0.002**

Note 114 children did not attempt the DAP test at baseline. SD = standard deviation.
Source Authors' own.

Table 2: The importance of double differencing is usually understood by reading row-wise data which focuses on differences between groups and periods of intervention. In the first row, the baseline mean score (29.5) of grade performance was increased to mean score (34.4) after implementation of the Tawana programme with 4.9 points of difference between the two periods of feeding group. However, the non-feeding group showed a negative impact (-0.2 point decrease) in the rate of mean score. The DID estimate was also improved (5.1 points) between groups and periods. Thus, this indicates the positive impact of the intervention on the grade performance of girls aged 6–12 years in rural areas of Sindh. Similarly for RCPM, the pre-intervention mean score of 11.4 increased to 34.4 after intervention with 3.5 points of difference between the two periods of the feeding group, and the non-feeding group progressed by a 2 point increase in the rate of the mean score. The DID estimate of RCPM showed less impact (1.5 points) between groups and periods compared to grade performance. This also shows the positive impact of intervention. DID estimates of DAP describes the least impact (0.7 points) between groups and periods compared to the other two cognitive outcomes (performance and Raven's assessment). It was revealed that the intervention impact was also positive between the two groups, that is, 2.4 at baseline and 3.2 at post-intervention. DID estimates revealed an improvement in outcomes of the RCPM and DAP test due to the programme but not in grade performance.

Table 3: Grade performance and cognitive assessment were analysed to assess the impact of intervention by feeding status across age groups, and intervention over the pre- and post-intervention periods, and the findings are presented in Table 3. The analysis of educational performance (which included literacy and numeracy tests) revealed a significant improvement (p<0001) in all three age groups separately and collectively. The DAP test also revealed similar findings at post-intervention between feeding groups (overall: p<0001, < 7 years: 0.039, 7–10 years: p<0.008 and 10+ years 0.027). The results of the RCPM showed an overall improvement for the collective age groups from 12.4 ± (SD 3.5) at non-feeding to 14.9 ± (SD 4.4) feeding group (p<0.002), and breakdown by age groups revealed a significant improvement only for the 10 + years from (mean

Table 4 Unpaired analysis of education and cognitive assessment

						Draw-a-Person			Raven's Coloured Progressive Matrices		
	Grade	Mean	(SD)	N	p-value	Mean (SD)	N	p-value	Mean (SD)	N	p-value
	Post	43.6	12.4	65		19.6 (10.1)	65		13.9 (4.8)	104	
All	Pre	46.2	19.6	833	< 0.001	15.3 (7.6)	700*	NS	11.5 (4.3)	328	< 0.001
	Post	50.7	18.2	889		14.8 (8.0)	889		13.0 (4.1)	482	

Note 133 cases are missing due to not attempting the DAP test.
Source Authors' own.

score ± SD) 11 ± 1.7 at non-feeding to 16.4 ± 4.9 SD 4.4 at feeding group ($p<0.023$).

Table 4: Overall a significant improvement was revealed in the grade performance and Raven's test: from a mean of 46.2 (SD 19.6) before the intervention to 50.7 (SD 18.2) after the intervention ($p<0.001$) for grade performance, and a mean of 13.9 (SD 4.8) before the intervention to 11.5 (SD 4.3) after the intervention ($p<0.001$) for Raven's test. No significant improvements were shown for the DAP test.

4 Discussion

The TPP Impact Assessment and Evaluation objectives are commonly associated with the Tawana school feeding programmes: (1) to improve the nutritional status of children in school; (2) to improve the cognitive or academic performance of these children; and (3) to increase school enrolment and attendance among school-age children. This study directly examines and assesses empirical evidence regarding academic performance, child maturity and cognition outcomes using data on a cohort of girls assessed before initiation of intervention among recipient and non-recipient school girls using standardised metrics (Grade Performance Assessment (GPA), Draw-a-Person (DAP) test and the Raven's Coloured Progressive Matrices (RCPM). The programme impact on nutrition indicators is reported in Hussein *et al.*, this *IDS Bulletin*. Information regarding attendance and enrolment was also collected at both visits of the impact assessment team from the respective schools.

These results show an overall improvement, albeit small in some cases, in the non-verbal intelligence and educational performance; perhaps they were less hungry due to the provision of meals and the improved concentration of the students may be attributed to this. The correlation analyses in terms of the effects of intervention on child cognitive development confirmed the positive correlation in all aspects. The DID regressions estimates which were used to validate the impact of the programme, and attribution of causality suggest a positive impact of the programme on cognitive development. The baseline scores on the DAP and RCPM as a percentage of the total allocated score for the matched group was 33.1 and 31.7 per cent and improved to 41.1 and 38 per cent respectively, denoting scores that are about a third of the total and though improved at the end of one year of the feeding programme, are still substantially low. Severe malnutrition can lead to an 8–18 point decrease in the intelligence quotient (IQ) scores (Fishman and Caulfield 2004) while school-based nutrition interventions can improve the IQ levels by 4–6 points (Bundy *et al.* 2006), and an increase in IQ of 1 SD can lead to a 6–11 per cent increase in wages in the USA, with a similar relationship to earnings in Pakistan (Alderman 1997). Simultaneously similar information was also collected at two points in time (before and after intervention) irrespective of matching cohort to assess the programme impact over the period on academic performance and cognitive outcomes. The findings of the unpaired data revealed a significant improvement in academic performance and cognitive outcomes over the time period, but it was not significant for child maturity (Table 4). School attendance and enrolment data reported an increase in enrolment from 3,762 (pre) to 4,125 (post) and attendances from 2,218 (pre) to 2,713 (post).

In an evaluation of the nutritional status of these girls as part of this project (see Hussein *et al.*, this *IDS Bulletin*), we found that almost a third of these girls were underweight or stunted before the initiation of the school-based feeding and more than two-thirds were anaemic. A significant improvement of the nutritional status was noted at the end of the intervention, proving the effectiveness of such programmes at a cost of as little as Rs. 7 (US$0.12) per meal per child (Badruddin *et al.* 2008). Focus group discussions with the mothers of these children revealed that most of them were skipping breakfast due to poverty or tardiness. A potential problem with the provision of school feeding programmes is that of 'substitution' whereby children fed at school are given less at home, blunting any positive effect of the school meal. Also the provision of one balanced meal in the day may be inadequate in improving the cognitive capacities of growing children.

The school-based Tawana feeding programme was associated with a 40 per cent increase in school enrolment in these rural areas (Badruddin *et al.* 2008) where girls are commonly not schooled. One of the attractions of the Madrassas (religious schools) is the provision of

free meals, which is a boon for parents in hardship (Zaidi 2013). By providing subsidised, low-cost, nutritious school meals the government can expect to increase the enrolment and retention of children into the mainstream school system, thereby increasing the cognitive capacity and improving their chances for attaining a better future for themselves and the country. Recent global reviews of school feeding strategies (Gelli *et al.* 2009; Mahfuz 2010; Lawson 2012) also suggest and recommend that school feeding programmes may be a worthy and cost-effective approach to get children into school and to keep them there. Once the children are in school, the programmes can contribute to their learning, through avoiding hunger and enhancing cognitive abilities (Taras 2005). However, the evidence in support of the benefits of these programmes to learning and developmental gains other than nutrition is sparse and is an important policy question. The total fertility rate in Pakistan is 3.6 births per woman, which is one of the highest in this region with an average household size of 6.8 (Nasir *et al*. 2009). The largest percentage of households in the lowest wealth quintiles house ten or more people (Mahfuz 2010). Given that there is a 40 per cent chance that a child born in the developing world will face a life of extreme poverty (Lawson 2012), controlling family size would enable gains in maternal health as well as ensuring better allocation of whatever limited resources are available for the physical and mental nurturing of children. Combining nutrition incentives with other poverty alleviation strategies and schooling could potentially have much impact on outcomes.

The association of undernutrition with decreased cognitive abilities has been well documented globally. Much of the global interventions to address childhood undernutrition have focused on the first 1,000 days with little evidence of benefits among school-age children. The Tawana Pakistan Project provided evidence of nutrition gains as this study indicates. These findings underscore the need for integrated strategies to address childhood undernutrition and improve educational opportunities for young children from poor families.

References

Aartsen, M.J.; Martin, M. and Zimprich, D. (2004) 'Gender Differences in Level and Change in Cognitive Functioning: Results from the Longitudinal Aging Study Amsterdam', *Gerontology* 50: 35–8

Aartsen, M.J.; Smits, C.H.M.; Van Tilburg, T.G.; Knipscheer, C.P.M. and Deeg, D.J.H. (2002) 'Activity in Older Adults: Cause or Consequence of Cognitive Functioning? A Longitudinal Study on Everyday Activities and Cognitive Performance in Older Adults', *Journal of Gerontology* 2: 153–62

Alderman, H.; Behrman, J.R.; Khan, S.; Ross, D.R. and Sabot, R. (1997) 'The Income Gap in Cognitive Skills in Rural Pakistan', *Economic Development and Cultural Change* 46, 97–122

Ashenfelter, Orley and Card, David (1985) 'Using the Longitudinal Structure of Earnings to Estimate the Effect of Training Programs', *The Review of Economics and Statistics*: 648–60

Badruddin, S.H.; Agha, A.; Peermohamed, H.; Rafique, G.; Khan, K.S. and Pappas, G. (2008) 'Tawana Project – School Nutrition Program in Pakistan – Its Success, Bottlenecks and Lessons Learned', *Asia Pacific Journal of Clinical Nutrition* 17.S1: 357–60

Barrett, C.B. and Maxwell, D.G. (2005) *Food Aid after Fifty Years*, New York: Routledge

Black, M.M. (2003) 'Micronutrient Deficiencies and Cognitive Functioning', *Journal of Nutrition* 133: 3927S–31S

Bundy, D.A.P.; Shaeffer, S. *et al.* (2006) 'School Based Health and Nutrition Programs', in D.T. Jamison, J.G. Breman and A.R. Measham *et al*. (eds), *Disease Control Priorities in Developing Countries*, 2nd edn, New York: Oxford University Press: 1091–1108

Chandler, A. (1993) 'The Short Term Effects of Giving Breakfast on the Cognitive Function of School Children', *West Indian Medicine Journal* 42.1: 38

Dennis, W. (1966) *Group Values through Children's Drawings*, New York: John Wiley

Drewnowski, A. and Darmon, N. (2005) 'The Economics of Obesity: Dietary Energy Density and Energy Cost', *American Journal of Clinical Nutrition* 82.1: 265S–73S

Durrant, V.L. (2000) *Adolescent Girls and Boys in Pakistan: Opportunities and Constraints in the Transition to Adulthood*, Islamabad, Pakistan: The Population Council

Fernald, L.; Anni, C.C. and Grantham-McGregor, S. (1997) 'Does School Breakfast Benefit Children's Educational Performance?', *African Health* 19.6: 19–20

Fishman, S. and Caulfield, L. (2004) 'Childhood and Maternal Underweight', in Majid Ezzati, Alan D. Lopez, Anthony Rodgers, and Christopher J.L. Murray, *Comparative Quantification of Health Risks: Global and Regional Burden of Disease Attributable to Selected Major Risk Factors*, Vol 1, Geneva: World Health Organization: 39–162

Gelli, A.; Al-Shaiba, N. and Espejo, F. (2009) 'The Costs and Cost-efficiency of Providing Food through Schools in Areas of High Food Insecurity', *Food and Nutrition Bulletin* 30.1: 68–75

Glewwe, P.; Jacoby, H. and King, E. (1999) 'Early Childhood Nutrition and Academic Achievement: A Longitudinal Analysis', *Journal of Public Economics*, May

Goodenough, F.L. (1926) *The Measurement of Intelligence by Drawings*, New York: World Book Company

Grantham-McGregor, S. (1995) 'A Review of Studies of the Effect of Severe Malnutrition on Mental Development', *Journal of Nutrition* 125: 2233S–8S

Harris, D.B. (1963) *Children's Drawings as Measures of Intellectual Maturity: A Review and Extension of the Goodenough Draw-A-Man Test* (1926) New York: Harcourt, Brace & World

Hoddinott, J. and Maluccio, J.A. (2008) 'Effect of a Nutrition Intervention during Early Childhood on Economic Productivity in Guatemalan Adults', *The Lancet* 371: 411–6

Isaacs, E.B.; Gadian, D.G. *et al.* (2008) 'The Effect of Early Human Diet on Caudate Volumes and IQ', *Paediatric Research* 63.3: 308–14

Koppitz, E.M. (1982) 'Projective Drawings with Children and Adolescents', *School Psychology Review* 12.4: 421–7

Kudat, A.; Keyder, C. and Peabody, S. (2000) *Social Assessment and Agricultural Reform in Central Asia and Turkey*, World Bank Technical Papers, Washington DC: World Bank

Lawson, Ty (2012) *Impact of School Feeding Programs on Educational, Nutritional, and Agricultural Development Goals: A Systematic Review of Literature*, Master's Plan B Paper, Michigan State University

Lechner, Michael (2011) *The Estimation of Causal Effects by Difference-in-Difference Methods*, Discussion Paper 2010–28, Department of Economics University of St Gallen

Mahfuz, Mustafa (2010) 'Impact of School Feeding Programmes on Growth of Children – A Systematic Review', in Bhutta, Z.A. (ed.), *Nutrition Interventions for Maternal and Child Health and Survival*, Pakistan: OUP

Massow, F.V. (2001) *Access to Health and Education Services in Ethiopia: Supply, Demand*, Oxford: Oxfam

Mathieu, A. (2006) *Reaching the Girls in South Asia: Differentiated Needs and Responses in Emergencies*, United Nations Children's Fund (UNICEF) Regional Office for South Asia; and the United Nations Girls' Education Initiative (UNGEI)

McEwan, Patrick J. (2010) *The Impact of School Meals on Education Outcomes: Discontinuity Evidence from Chile*, https://aefpweb.org/sites/default/files/webform/mcewan.pdf (accessed 8 March 2013)

Nasir, J.A.; Akthar, M. and Tahir, M.H. (2009) 'Productivity and Age Specific Fertility Rates in Pakistan after 1981', *Pakistan Journal of Statistics* 25, 251–63

Raven, J.C. (1965) *The Colored Progressive Matrices Test*, London: Lewis

Richards, M.; Hardy, R.; Kuh, D. and Wadsworth, M.E.J. (2002) 'Birthweight, Postnatal Growth and Cognitive Function in a National UK Birth Cohort', *International Journal of Epidemiology* 31: 342–8

Taras, H. (2005) 'Nutrition and Student Performance at School', *Journal of School Health* 75.6: 199–213

UNICEF (2007) *The State of the World's Children 2008. Child Survival*, New York: United Nations Children's Fund

Whaley, Shannon, E. (2003) 'The Impact of Dietary Intervention on the Cognitive Development of Kenyan School Children', *Journal of Nutrition* 133: 3965S–71S

Zaidi, S.M.A. (2013) *Madrassa Education in Pakistan: Controversies, Challenges and Prospects*, SISA Report 3, http://strategiskanalyse.no/publikasjoner%202013/2013-03-04__SISA3_Madrassa_Education_-_Syed_Manzar_Abbas_Zaidi.pdf (accessed 8 April 2013)

Zimprich, D.; Hofer, S. and Aartsen, M.J. (2004) 'Short-term versus Long-term Changes in Processing Speed', *Gerontology* 50: 17–21