Chapter 4 Results

4.1 Introduction

This chapter will discuss the results of the baseline measurements which were used to plan the intervention programme. It will also focus on the results of the five different school feeding strategies that were implemented.

4.1.1 Phase 1: Pre-intervention (Baseline results)

The procedures which were used for planning the intervention programmes were discussed in 3.3.1, namely, the dietary intake and anthropometric and biochemical measurements. These measurements were compared at baseline, thus before the implementation of the intervention study, and again at follow-up at the end of the seven-month intervention period. Initially, 519 children in the Eatonside community were asked to participate in the preliminary cross-sectional survey on a voluntarily basis. A total of 160 parents agreed that their children could take part in the intervention study, and completed a letter of consent. The sample consisted of 160 boys and girls (15% of the school), aged six to thirteen years.

In Orange Farm, a total of 182 respondents completed the consent forms and took part in the intervention study. However, a limitation of this study was that different measurements were taken at four different data-gathering sessions and not all the respondents attended all four of the sessions. For the baseline survey, therefore, the anthropometric, socio-demographic and biochemical results include a varying number of respondents.

4.1.2 Respondents lost to follow-up

This study commenced with a total of 332 participants, of which 160 were from Eatonside and 172 from Orange Farm. The intervention phase commenced with a total of 90 participants in the CSB group, 82 in the Sejo group, 60 in the Vetkoek group, 40 in the PSNP group, and a total of 60 in the control group (fruit). During the study in both the Eatonside and Orange Farm communities the number of respondents that did not take part in the final measurements was minimal. Four children were lost from the vetkoek group, 20 from the PSNP, nine from the CSB, three from the Sejo and five participants were lost to follow-up from the fruit group, which acted as the control group. Respondents from the Reitumetsi, Sinqobile and Vulindlela Primary Schools in Orange Farm and Sinqobile School in Eatonside participated in this study.

The main purpose of the study in Eatonside was to determine the effect of added zinc, iron and calcium intake in the form of the vetkoek on the nutritional status of primary school children in an informal settlement. The results were compared to the PSNP and control groups, in order to take into account normal growth patterns of primary school children, which could confound the anthropometric results. The biochemical results of those children in Eatonside and Orange Farm who completed the intervention were compared to the measurements of the participants who were lost to follow-up (dropouts), as indicated in Tables 4.1 and 4.2 respectively. The results indicated that no statistically significant difference was observed between the biochemical measurements and the weight, height or BMI variables of the groups and the participants lost to the study.

Table 4.1 Pre-intervention measurements of dropouts compared to those of participants in Eatonside Community.

Variable	**Normal range and units of measurement**	**Participants n=117**		**Participants lost n=29**	
		Mean	**SD**	**Mean**	**SD**
Vitamin A	20 µg/dl	31.00	19.95	30.63	9.7
Zinc	70-150 µg/dl	86.14	12.56	83.74	14.56
Total protein	64-83 g/l	74.21	12.19	75.04	7.93
Iron	9-31 µmol/l	30.51	19.48	33.36	22.69
Transferrin	2-4g/l	3.13	0.59	3.04	0.49
Ferritin	12-200 µg/l	30.10	18.21	29.58	15.67
Albumin	37-52 g/l	43.46	6.37	42.48	5.28
Red blood cell count	4.0-5.4 x 10^6/µl	4.62	0.46	4.63	0.42
Haemoglobin	12.0-14.0 g/dl	13.35	0.81	13.20	0.93
Haematocrit	36.0-44.0 %	39.61	3.61	39.52	2.97
Mean red cell volume	77-9l fl	85.91	3.97	85.51	3.91
White cell count	4.5 -13.5 x 10^6 /ul	6.74	2.32	6.54	1.7
Triglycerides	< 1.80 mmol/l	0.75	0.47	0.76	0.33
Total serum cholesterol	<5.2 mmol/l	3.63	0.87	3.71	0.79
HDL cholesterol	>0.9 mmol/l	1.04	0.26	1.07	0.31

The high number of participants in both the PSNP and CSB groups who did not complete the final measurements can possibly be ascribed to the fact that they did not benefit from this particular intervention because they already received the PSNP school meals in Eatonside, or the CSB in the Orange Farm community.

The assumption can therefore be made that in both Eatonside and Orange Farm, the children who did not complete the final measurements after the intervention would not have influenced the results differently. At the end of the intervention period, a total of 248 completed the study protocol successfully and those lost to the study, therefore, made up 27 percent of the total.

Table 4.2 Pre-intervention measurements of dropouts compared to those of participants in Orange Farm Community.

Variable	**Normal range and units of measurement**	**Participants n=131**		**Participants lost n=12**	
		Mean	**SD**	**Mean**	**SD**
Vitamin A	20 µg/dl	31.03	10.05	30.30	9.32
Zinc	70-150 µg/dl	85.14	10.60	82.44	10.56
Total protein	64-83 g/l	78.22	8.59	82.50	10.02
Iron	9-31 µmol/l	17.04	5.69	16.03	7.21
Transferrin	2-4g/l	3.23	0.56	3.39	0.33
Ferritin	12-200 µg/l	99.88	46.51	34.03	18.86
Red blood cell count	4.0-5.4 x 10^6/µl	4.89	0.39	4.85	0.42
Haemoglobin	12.0-14.0 g/dl	13.89	0.89	13.27	1.38
Haematocrit	36.0-44.0 %	42.63	2.76	41.05	3.33
Mean red cell volume	77-9l fl	87.33	4.65	84.90	6.07
White cell count	4.5 -13.5	5.17	2.23	5.55	1.71
Triglycerides	< 1.80 mmol/l	1.06	0.65	1.09	0.48
Total serum cholesterol	<5.2 mmol/l	4.69	4.51	4.39	0.84
HDL cholesterol	<0.9 mmol/l	0.84	0.47	0.82	0.31

4.2 Comparison of dietary intake results of Eatonside and Orange Farm

4.2.1 Food consumption patterns

The food consumption patterns were determined from the information gathered from the 24-hour recall questionnaire, which was administered before and after the intervention period. The different food consumption patterns will be discussed for each group individually.

4.2.1.1 Vetkoek group

As indicated in Table 4.3, the results for pre- and post-intervention testing for the 24-hour recall show that the five food items consumed in the largest amount were stiff maize porridge, brown bread, tea, vetkoek and milk. Results for the National Food Consumption Survey (NFCS) indicated similar food consumption patterns, and the top five foods consumed in Gauteng were white sugar, maize, whole milk, tea and bread (Labadarios *et al.* 1999:288).

Other foods high in carbohydrates (white bread, mabela, rice and potatoes) were consumed by half of the sample. Full cream milk was the only dairy product indicated in both pre- and post-testing. Protein foods consumed were chicken, boerewors, eggs and polony. Fruit and vegetable consumption was limited, with only apples, spinach and potatoes indicated in both pre- and post-testing. Items of low nutrient density, such as cold drink squash as well as carbonated cold drinks such as Coca-cola and Fanta, were amongst the top twenty food items most frequently consumed.

The results further showed that vetkoek was amongst the top five. The pre-intervention results were used to determine the top ten food items most commonly consumed, and vetkoek was identified as a product that could be developed to meet certain criteria. In post-intervention testing, vetkoek was again amongst the five most commonly consumed food items in the vetkoek group, proving, that these children consumed the vetkoek given to them during the intervention programme.

Because the results for the vetkoek group in both pre- and post-testing are similar, they are an indication that the eating patterns of the group did not change substantially during the seven-month intervention period.

Table 4.3 Top twenty food items most frequently consumed by children in the vetkoek group as determined by the 24-hour recall method (mean intake per child who consumed the item)

Pre-intervention (group n=52)				Post-intervention (group n=55)			
Rank	Food Item	Mean (±SD) daily intake g / ml	Number	Rank	Food Item	Mean (±SD) daily intake g / ml	Number
1	Maize porridge, stiff	323.40 ± 231.23	47	1	Maize porridge, stiff	379.65 ± 230.15	43
2	Tea, brewed	231.67 ± 71.30	30	2	Bread, brown	163.70 ± 80.96	27
3	Bread, brown	145.48 ± 79.58	42	3	Tea, brewed	239.33 ± 27.89	15
4	Milk, full cream	202.89 ± 109.66	19	4	Vetkoek *	81.62 ± 13.65	37
5	Vetkoek	235.45 ± 90.37	11	5	Milk, full cream	170.59 ± 126.71	17
6	Cold drink, squash	196.15 ± 62.79	13	6	Cold drink, squash	233.64 ± 158.18	11
7	Potato chips	208.75 ± 78.64	8	7	Coffee	210.00 ± 31.62	10
8	Maize porridge, soft	329.10 ± 187.07	5	8	Potato chips	100.20 ± 39.13	20
9	Chicken, boiled	63.53 ± 30.25	17	9	Bread, white	124.67 ± 44.82	15
10	Rice, white	102.83 ± 67.72	7	10	Rice, white	185.36 ± 69.53	7
11	Boerewors	87.14 ± 49.23	7	11	Chicken, roasted	72.33 ± 59.82	15
12	Egg, boiled	100.00 ± 77.46	6	12	Apple	160.00 ± 54.77	5
13	Soup powder, average	119.00 ± 90.44	5	13	Potato, boiled	83.13 ± 55.99	8
14	Tomato, onion stewed	59.44 ± 72.99	9	14	Maize porridge, soft	325.00 ± 176.78	2
15	Apple	173.33 ± 40.41	3	15	Tomato, onion stewed	62.50 ± 38.53	10
16	Cold drink, carbonated	250.00 ± 0.00	2	16	Spinach, boiled	83.86 ± 59.78	7
17	Spinach, boiled	70.00 ± 28.28	5	17	Atchar, mango	28.13 ± 19.72	20
18	Pear	165.00 ± 0.00	2	18	Polony	23.18 ± 7.91	22
19	Bread, white	63.40 ± 31.90	5	19	Chicken, boiled	68.57 ± 59.49	7
20	Potato, boiled with skin	59.00 ± 39.12	5	20	Cookies, commercial plain	51.11 ± 32.19	9

* Vetkoek developed for the intervention

Number – number of occasions the product was consumed

4.2.1.2 PSNP group

Table 4.4 indicates the top twenty food items most frequently consumed by the children in the PSNP group, as measured before and after the intervention (Napier 2006:182). Food consumption patterns were similar in both pre- and post-intervention testing. Stiff maize meal porridge was the food consumed in the largest amount in both pre- and post testing. Milk, boerewors / beef sausage and chicken were the only protein-rich foods in the top twenty in both pre- and post testing.

Pre-testing showed that potatoes prepared in various forms, as well as soybeans and beef (chuck and brisket), were on the list; however, this was not the case for post-testing results. This can be an indication that, because they participated in the PSNP, children received red meat less often at home.

Fruit and vegetable consumption patterns indicate that apples and oranges were the only fruit on the top twenty list, and potatoes, spinach and cabbage were the only vegetables consumed. The vegetable consumption patterns were similar to the results for the NFCS (Labadarios *et al.* 1999:288).

Reconstituted powdered cold drink, jam and plain cookies indicate that the children definitely consumed the drink, bread and jam and fortified biscuits provided as part of the PSNP.

The results for the first five items in the PSNP group are similar to the consumption patterns of the vetkoek group.

Table 4.4 Top twenty food items most frequently consumed by children in the PSNP group as determined by the 24-hour recall method (mean intake per child who consumed the item)

Pre-intervention (group n=36)				**Post-intervention (group n=38)**			
Rank	Food Item	Mean (±SD) daily intake g / ml	Number	Rank	Food Item	Mean (±SD) daily intake g / ml	Number
1	Maize porridge, stiff	446.67 ± 238.11	29	1	Maize porridge, stiff	426.01 ± 205.19	37
2	Tea	256.25 ± 60.21	16	2	Bread, brown	152.26 ± 65.86	31
3	Milk, full cream	221.43 ± 234.38	14	3	Milk, full cream	279.09 ± 157.38	11
4	Bread, brown	115.00 ± 72.51	26	4	Tea	263.64 ± 63.60	11
5	Cold drink, squash	210.00 ± 65.19	5	5	Cold drink, squash	235.56 ± 111.82	9
6	Potato, mashed	170.00 ± 188.25	5	6	Rice	171.79 ± 113.99	7
7	Rice, white	165.00 ± 67.58	4	7	Vetkoek	82.86 ± 24.63	14
8	Boerewors	118.00 ± 84.01	5	8	Coffee	275 ± 50.00	4
9	Chicken, boiled	86.6 ± 28.23	6	9	Powder drink, reconstituted	192.50 ± 6.85	5
10	Maize meal, Soft	247.50 ± 180.31	2	10	Chicken roasted	82.73 ± 41.97	11
11	Vetkoek	165.00 ± 67.64	3	11	Potato chips	114.29 ± 37.80	7
12	Tomato, onion stewed	59.38 ± 78.17	8	12	Apple	150.00 ± 0.00	5
13	Apple	150.00 ± 0.00	3	13	Cookies, commercial	68 ± 33.93	10
14	Spinach, boiled	57.14 ± 23.78	7	14	Bread, white	96.43 ± 35.67	7
15	Soybeans, cooked	185.00 ± 190.92	2	15	Boerewors	74.44 ± 38.28	9
16	Potato chips	165.00 ± 120.21	2	16	Maize porridge, soft	275 ± 35.36	2
17	Potato, boiled with skin	105.00 ± 126.79	3	17	Tomato & onion stew	60 ± 31.52	9
18	Beef, chuck	280.00 ± 0	1	18	Jam	41.67 ± 37.86	12
19	Beef, brisket	50.00 ± 30.82	5	19	Orange	100.00 ± 113.14	2
20	Cold drink, low-cal	250.00 ± 0	5	20	Cabbage, boiled	87 ± 47.12	5

Number – number of occasions the product was consumed

4.2.1.3 CSB group

Results of pre- and post-intervention testing for the 24-hour recall of the CSB group, as indicated in Table 4.5, show that the five food items consumed most frequently were mainly foods high in carbohydrates: maize porridge, brown bread and rice.

Other carbohydrate-rich foods consumed were white bread, mabela, rice and potatoes. Full cream milk was the only dairy product indicated in both pre- and post-testing. Protein foods consumed were chicken, boerewors, eggs and polony. Chicken prepared in different ways (boiled, stewed, grilled and fried) was consumed by the majority of the children. Fruit and vegetable consumption was limited, with only apples, spinach and potatoes indicated in both pre- and post-testing, and cabbage showed in the post-testing results. Cold drink squash as well as carbonated cold drinks such as Coca-cola and Fanta were amongst the top twenty food items most often consumed.

Pre-testing results show a high consumption of maize porridge, as well as tea and rice. The amount of juice consumed in the post-testing results indicates that the children consumed this item more than once a day.

In the Orange Farm community, the consumption of brown and white bread indicates either bread or rolls, which may be as a result of the different infrastructure in the two communities. In Orange Farm the community have access to public transport, whereas in Eatonside, public transport is limited and people have to walk long distances to buy food. The socio-demographic results indicated that, unlike those who live in Eatonside, more people in Orange Farm buy from supermarkets than from spaza shops, where the variety is limited,.

Table 4.5 Top twenty food items most frequently consumed by children in the CSB group as determined by the 24-hour recall method (mean intake per child who consumed the item)

Pre-intervention (group n=34)				Post-intervention (group n=34)			
Rank	Food Item	Mean (±SD) daily intake g / ml	Number	Rank	Food Item	Mean (±SD) daily intake g / ml	Number
1	Maize porridge, stiff	326.49 ± 197.02	117	1	Rice, white	317.27 ± 220.26	22
2	Tea, brewed	297.87 ± 283.79	66	2	Maize porridge, soft	191.11 ± 106.04	36
3	Rice, white	195.4722 ± 151.00	72	3	Tea, brewed	232.35 ± 35.094	17
4	Maize porridge, soft	272.89 ± 122.22	45	4	Maize porridge, soft	152 ± 78.37	25
5	Bread/rolls, brown	120.65 ± 71.27	77	5	Bread/rolls, brown	86.90 ± 36.16	29
6	Chicken, boiled	102.58 ± 50.80	53	6	Bread/rolls, white	115.79 ± 36.10	19
7	Bread/rolls, white	107.98 ± 32.28	47	7	Fruit juice	211.11 ± 33.33	90
8	Fruit juice	255.26 ± 187.75	19	8	Coffee	258.33 ± 20.41	6
9	Coffee	232.81 ± 76.77	16	9	Gravy, brown	86.63 ± 90.83	16
10	Milk, full cream	114.84 ± 91.40	31	10	Milk, full cream	100 ± 84.68	13
11	Cold drink, squash	176.88 ± 77.09	16	11	Chicken, roasted	124 ± 66.53	10
12	Vetkoek	138.82 ± 68.45	17	12	Chicken, stew	105.63 ± 42.71	8
13	Chicken stew, tomato and onion	110 ± 52.63	21	13	Chicken, boiled	164 ± 134.46	5
14	Cold drink, carbonated	203.64 ± 33.84	11	14	Cold drink squash	216.67 ± 28.87	3
15	Beef, chuck, cooked	142.14 ± 48.07	14	15	Beef stew with cabbage	130 ± 70.24	4
16	Water	236.25 ± 74.25	8	16	Cold drink, carbonated	220 ± 169.71	2
17	Fruit juice	205.56 ± 16.67	9	17	Beetroot, salad	48.33 ± 31.42	9
18	Chicken, grilled	107.5 ± 48.48	16	18	Fried chicken	105 ± 30	4
19	Milk shake	227.14 ± 25.64	7	19	Sugar, white	13.27 ± 4.69	28
20	Mabela/ sorghum, cooked	308 ± 257.04	5	20	Cabbage	91 ± 72.97	4

Number – number of occasions the product was consumed

4.3.1.4 Sejo group

Food consumption patterns for the Sejo group were similar to those of the other groups, as indicated in Table 4.6. This was the only group that indicated the consumption of breakfast cereal.

Commercial potato crisps were consumed by a large percentage of the group, which may be because children are able to buy small packets of crisps made up by street vendors and sold at the school tuck shop, or they buy them at the supermarkets.

In pre-intervention testing results, brown bread consumption was very high, indicating that the children consumed brown bread more than once a day.

In the Orange Farm community, coffee was consumed by both the CSB and Sejo groups, whereas in Eatonside only tea featured amongst the top twenty. The Sejo group was the only group that consumed ice-cream, possibly because mobile ice cream vendors operate in the area.

Pre-testing results show a high consumption of maize porridge and brown bread, as do the post-testing results, which also include sugar. This indicates that the items were consumed more than once a day.

Table 4.6 Top twenty food items most frequently consumed by children in the Sejo group as determined by the 24-hour recall method (mean intake per child who consumed the item)

Pre-intervention (group n=34)				Post-intervention (group n=34)			
Rank	Food Item	Mean (±SD) daily intake g / ml	Number	Rank	Food Item	Mean (±SD) daily intake g / ml	Number
1	Maize porridge, stiff	248.64 ± 105.65	88	1	Maize porridge, stiff	273.68 ±95.88	95
2	Fruit juice	195.00 ± 47.79	53	2	Maize porridge, soft	204.91 ±107.48	53
3	Bread, brown	87.13 ± 30.37	115	3	Tea, brewed	265.15 ±87.04	33
4	Tea, brewed	247.22 ± 60.88	36	4	Rice	205.19 ±128.49	27
5	Maize porridge, soft	238.75 ± 102.33	24	5	Bread, white	92.18 ±34.09	55
6	Rice	199.70 ± 103.48	26	6	Bread, brown	91.53 ±30.35	49
7	Milk, full cream	169.04 ± 89.25	25	7	Cold drink, squash	172.94 ±63.71	47
8	Bread, white	97.81 ± 36.23	32	8	Chicken, boiled	76.49 ±24.74	37
9	Potato crisps	58.03 ± 23.67	38	9	Milk, full cream	127.31 ±83.13	13
10	Chicken, boiled	95.00 ± 37.20	20	10	Fruit juice	182.22 ±30.73	9
11	Potato chips	90.63 ± 45.24	19	11	Potato crisps	48.66 ±45.70	32
12	Chicken, roasted	90.00 ± 39.03	14	12	Boerewors / beef sausage	149.50 ±41.26	10
13	Coffee	250.00 ± 0.00	5	13	Cookies, commercial, plain	220.00 ±255.73	20
14	Egg, fried	95.33 ± 57.96	12	14	Ice cream / sorbet	57.78 ±68.73	18
15	Cold drink, powdered	222.00 ± 38.34	5	15	Chicken, stew with vegetables	80.00 ±40.68	12
16	Cold drink, squash	104.13 ± 48.22	10	16	Orange	180.00 ±0	5
17	Beef, stew	102.0 ± 56.92	10	17	Breakfast cereal	136.67 ±71.18	6
18	Breakfast cereal	153.33 ± 81.65	6	18	Coffee	250.00 ±0	3
19	Potato, boiled	71.67 ± 26.91	12	19	Sugar white/brown	14.68 ±5.53	44
20	Cabbage	59.64 ± 24.84	14	20	Egg, fried	78.00 ±39.31	8

Number – number of occasions the product was consumed

4.2.1.5 Fruit group

As with the PSNP group, stiff maize porridge was the food item most frequently consumed in the top twenty. Other carbohydrate-rich foods consumed were brown and white bread, rice and potatoes. Full cream milk was the only dairy product indicated in both pre- and post-intervention testing. The consumption of vetkoek was indicated in the post-testing results. The children in the fruit group did not receive vetkoek at school; the assumption can be made that the vetkoek was consumed at home, most probably after the training was provided to community workers and the vetkoek recipe leaflets handed out in the community. Protein foods consumed were milk, eggs, chicken, beef and boerewors. Both the fruit and PSNP groups indicated the consumption of cooked soybeans.

Spinach was the only vegetable on the list, and bananas and apples the only fruits in the pre-intervention phase. This indicated a low overall intake of fresh fruit and vegetables. The food consumption patterns of the fruit group indicated foods with high energy and low nutritional values, such as cold drinks (squash and carbonated) and biscuits. Table 4.7 shows the food most frequently consumed in terms of weight (g) or volume (ml) as measured by the 24-hour recall method.

Cold drink squash as well as carbonated cold drinks such as Coca-cola and Fanta and apple and orange juice were amongst the top twenty food items most often consumed in the fruit group.

Table 4.7 Top twenty food items most frequently consumed by children in the fruit group as determined by the 24-hour recall method (mean intake per child who consumed the item)

Pre-intervention (group n=27)				Post-intervention (group n=35)			
Rank	Food Item	Mean (±SD) daily intake g / ml	Number	Rank	Food Item	Mean (±SD) daily intake g / ml	Number
1	Maize meal, Stiff	436.80 ± 333.00	25	1	Maize meal, Stiff	341.75 ± 180.95	20
2	Milk, full cream	239.64 ± 192.52	14	2	Tea, brewed	269.29 ± 143.23	14
3	Tea, brewed	238.46 ± 93.88	13	3	Bread, Brown	106.05 ± 56.83	19
4	Bread, Brown	137.82 ± 88.49	22	4	Milk, full cream	265.00 ± 202.46	7
5	Cold drink, squash	222.22 ± 36.32	9	5	Cold drink, squash	240.00 ± 155.72	5
6	Potato chips	216.00 ± 76.03	5	6	Bread, White	112.86 ± 23.60	7
7	Vetkoek	276.67 ± 177.86	3	7	Vetkoek	180.00 ± 151.44	4
8	Cold drink, carbonated	340.00 ± 0.00	2	8	Energy / Power drink	229.17 ± 61.66	3
9	Rice, white	102.50 ± 33.04	4	9	Orange, juice	200.00 ± 0.00	2
10	Cookies, commercial plain	48.75 ± 42.57	8	10	Potato chips	100.00 ± 0.00	4
11	Chicken, boiled	70.00 ± 22.08	5	11	Stew chicken, tomato & onion	126.67 ± 64.29	2
12	Banana, raw (peeled)	150.00 ± 0.00	2	12	Apple, Average, Raw	150.00 ± 0.00	2
13	Tea, rooibos, brewed	300.00 ± 0	1	13	Apple juice	250.00 ± 0	1
14	Cake, plain	250.00 ± 0	1	14	Coffee	250.00 ± 0	1
15	Maas	250.00 ± 0	1	15	Rice, white	125.00 ± 35.36	2
16	Soybeans, cooked	125.00 ± 35.36	2	16	Cookies, commercial plain	57.50 ± 22.17	4
17	Spinach, boiled	52.50 ± 5.00	4	17	Butternut	210.00 ± 0	1
18	Beef, Brisket	200.00 ± 0	1	18	Egg, fried in oil	104.00 ± 0.00	2
19	Egg, boiled	100.00 ± 0.00	1	19	Potato, boiled	100.00 ± 113.14	2
20	Boerewors	95.00 ± 7.07	2	20	Chicken, roasted	48.75 ± 31.19	4

Number – number of occasions the product was consumed

4.2.2 Breakfast pattern results

Breakfast consumption questionnaires (Annexure I) were drawn up to determine the number of children who ate breakfast before going to school, and what specific food items were consumed. However, the breakfast patterns were determined only in the Eatonside community. The questionnaires were captured on Excel spreadsheets and statistically analysed for descriptive statistics to determine the breakfast consumption patterns of the schoolchildren. From the data, a list of the top 20 food items most frequently consumed for breakfast food was compiled. The results were similar to the 24-hour recall results from the baseline survey. The results further indicated that 13.2 percent of the children did not eat any breakfast before going to school. Breakfast consumption patterns indicated that of those children who consumed breakfast before school, 86.8 percent had bread and tea, 26 percent consumed maize porridge, 11 percent had rice or potatoes and only one percent indicated that they ate breakfast cereal for breakfast. Although rice and potatoes seemed like a strange choice for breakfast, the participants indicated that this was left-over food from the previous night's meal.

The results of the breakfast consumption questionnaire were used together with the results of the 24-hour recall to determine the ingredients available in the households, and formed the basis of the development of the vetkoek.

4.3 Macronutrient distribution in the diet

The macronutrient intake of the groups before and after the intervention, as indicated in Table 4.8, and the comparison of the mean of the dietary intake variables between and within the intervention groups, as measured by 24-hour

recall at p≤0.05 (Levene's test for equal variance), and mean intake of micronutrients, as indicated in Table 4.9, will be discussed for all groups.

4.3.1 Macronutrients

4.3.1.1 Energy

Dietary analysis (Tables 4.8 and 4.9) of the nutrient intake indicated that the mean daily energy intake of all the children was below the DRIs for children aged seven to ten years. The estimated energy requirements (EER) for active individuals in the age group from three to eight years is 6896 kJ for girls and 7316 kJ for boys, and 8698 kJ for girls between 9 and 13 years and 9572 kJ for boys between 9 and 13 years (IOM 2002).

Pre-testing results indicated that the mean energy intake of the Sejo group was the highest, but during the post-testing, energy intake of the fruit group was significantly higher. There was a significant difference between vetkoek and CSB in both pre- and post-testing, as well as between CSB (6214 kJ) and PSNP (4815 kJ) in the pre-testing period. In the post-testing results, significant differences existed between CSB, which had the lowest energy value and the Sejo, PSNP and fruit groups. When comparing pre-testing to post-testing results within products, a significant difference was present in the vetkoek group (4928 kJ pre-testing and 8415 kJ post-testing), PSNP (4815 kJ pre-testing and 6388 kJ post-testing) and the fruit group (6178 kJ pre-testing and 8444 kJ post-testing). These results indicate that the vetkoek, PSNP and fruit groups had a significant increase in energy during the intervention. This could be an indication that these products contributed to the children's daily food intake and therefore the energy intake was higher after the intervention. However, for the CSB and Sejo groups, the energy was lower after the intervention, which suggests that these children

consumed less, even when receiving the school feeding products. It can be speculated that parents may have reduced the food intake at home of the children who received food at school, in order to feed other family members. This possibility was pointed out by Beaton and Ghassemi (1982:901) and mentioned in the WFP global school feeding report (2006).

4.3.1.2 Protein

Pre-testing results indicated that the mean protein intake was lowest in the PSNP and vetkoek groups. Significant differences within the groups existed between the vetkoek and CSB groups and between the CSB, PSNP and fruit groups. Post-testing results indicate that the protein intake of the vetkoek group increased from 38 g to 72 g, which can be as a result of the tinned pilchard fish and dried full cream milk powder that was added to the recipe. The final vetkoek contained 12.64 g of protein per 100 g portion. Both the PSNP and fruit groups also showed an increase in protein intake after the intervention. The increase for the PSNP group may be as a result of the protein-rich items, such as pilchards and peanut butter, included in the daily menu.

4.3.1.3 Fat

Both the PSNP and vetkoek groups had lower fat intakes than the other groups in the pre-testing phase. The results before the intervention indicated a significant difference between vetkoek and CSB, as well as between CSB and PSNP. Results within the groups showed a difference between pre- and post -testing for CSB (47 g at pre-testing and 31 g at post-testing) as well as for fruit (42 g at pre-testing and 56 g at post-testing). The post-testing results indicate that differences existed between the vetkoek and CSB groups, as well as between the CSB group and the Sejo, PSNP and fruit groups.

Table 4.8 Mean daily macronutrient intake of the groups before and after the intervention

Table 4.9 Dietary intake results for all groups as measured by 24-hour recall method before and after the intervention.

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4.3.1.4 Carbohydrate

For carbohydrates, the Sejo and fruit groups showed the highest mean intakes and vetkoek the lowest mean intakes in pre-testing. Significant differences were indicated between vetkoek (161 g) and CSB (198 g). The post-testing results showed differences between CSB and all the other groups (vetkoek, Sejo, PSNP and fruit). The results of pre- and post-testing indicated significant differences within vetkoek (161 g pre-testing and 266 g post-testing), PSNP (167 g pre-testing and 223 g post-testing), as well as the fruit group (215 g pre-testing and 295 g post-testing).

4.3.1.5 Fibre

Mean fibre intakes in the pre-testing phase of the vetkoek, CSB, PSNP, Sejo and fruit groups were similar (between 13 g and 15 g). A statistically significant difference was found between CSB and fruit before the intervention. Measurements after the intervention indicate the following: significant differences were present within the groups for vetkoek (an increase from 13 g pre-intervention to 17 g post-intervention), PSNP (an increase from 13 g to 19 g) and fruit (an increase from 15 g to 24 g). However, Sejo showed a decrease from 15 g before intervention to 12 g for the post-testing results. Post-testing measurements between the groups indicate that there were significant differences between the CSB group and PSNP and all the other groups.

4.3.2 Micronutrients

4.3.2.1 Minerals

The pre-testing results indicated that for calcium, a difference existed between the CSB and fruit groups. Post-testing results showed differences between vetkoek and CSB, and between CSB and fruit. The only significant difference within the groups was reported for vetkoek (209 mg pre-testing to 283 mg post-testing), which may be ascribed to the milk powder and spinach included in the vetkoek recipe.

The results for iron showed a difference between CSB and Sejo pre-testing. In post-testing, the results showed differences between CSB and all the other groups (vetkoek, Sejo, PSNP and fruit). Increases within the groups were reported for vetkoek (4.9 mg pre-testing to 12.7 mg post-testing), PSNP (4.8 mg pre-testing to 9.9 mg post-testing) as well as for fruit (5.7 mg pre-testing to 11.8 mg post-testing).

Results of mean zinc intake showed significant differences within the vetkoek group (4.5 mg - 55.1 mg) in pre-and post-testing. Results showed differences between CSB (6.3 mg) and Sejo (7.8 mg) in pre-testing. For CSB, the zinc results in post-testing were lower than those in pre-testing, despite the fact that CSB provided 5 mg zinc sulphur per 100 g portion. Post-testing results indicated a difference between CSB (5.3 mg) and fruit (8.4 mg) and within groups for PSNP (4.9 mg – 6.9 mg) and fruit (5.1 mg – 8.4 mg).

4.3.2.2 Vitamins

The results for vitamin A showed no significant differences between the groups in pre-testing. However, in post-testing various differences occurred between

CSB (99.3 µg) and the following groups: vetkoek (836.2 µg), PSNP (390 µg) and fruit (472.7 µg). Vitamin C results indicated that a significant difference existed between the groups when CSB was compared to vetkoek, Sejo, CSB and PSNP, in the pre-testing. Post-testing results indicated a difference between vetkoek and CSB as well as between CSB and Fruit.

4.4 Anthropometric results

Data was categorised according to the percentile system, in accordance with the NCHS indicators (NCHS 2000). The following anthropometric indicators were used: weight-for-age, height-for-age and BMI-for-age. This information was used to indicate underweight, stunting and wasting at the following cut-off points, ≤5th percentile, indicating severely malnourished children, >5th and <25th percentile, indicating children at risk of being malnourished, and between ≥25th and ≤75th /85th percentile, normal. Higher than the >75th /85th and <95th percentile indicated a risk of being overweight and ≥95th percentile, overweight. The anthropometric results as indicated in Tables 4.10, 4.11, 4.12 and 4.13 will be discussed.

Table 4.10, 11, 12

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Table 4.13

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4.4.1 Weight-for-age (underweight)

Before the intervention, 18.4 percent of the children in the vetkoek group were severely underweight (≤5) percentile. This figure decreased to 14.3 percent when post-testing was conducted. The children at risk of being underweight in this group increased from 34.7 percent to 36.7 percent; however, the children in the normal group stayed the same, at 40.8 percent. The results showed a slight increase for the group at risk of being overweight, from 6.1 percent to 8.2 percent (Table 4.11). Post-testing results showed a significant decrease in the CSB group, with severely underweight children decreasing from 18.8 percent to 4.7 percent, while the children at risk of being underweight decreased from 25.6 percent to 18.6 percent. Results in the normal group (≥25th - ≤75th percentile) indicated an increase from 41.9 percent to 51.2 percent.

The results showed an increase for the group at risk of overweight from 11.6 percent to 16.3 percent and an increase in the overweight category from 2.3 percent to 9.3 percent (Table 4.11). In general, the weight-for-age numbers shifted towards normal-to-overweight for all the groups.

Before the intervention, 10.4 percent of the children in the Sejo group were severely underweight. This figure decreased to 7.8 percent after intervention. The children at risk of being underweight in this group decreased significantly from 39 percent to 24.7 percent, and the normal group increased from 37.7 to 51.9 percent. The results indicated in Table 4.11 showed that the group at risk of overweight remained the same at 2.6 percent; however, there was a slight increase for the overweight group from 6.1 percent to 8.2 percent.

The PSNP group showed a decrease in severely underweight children, from 29.3 percent to 19.5 percent. The children at risk of being underweight

decreased from 36.6 percent to 34.1 percent. Results in the normal group indicated an increase from 29.3 percent to 39 percent. The results showed a slight increase in the group at risk of overweight, from 4.9 percent to 7.3 percent, which was also evident in both the vetkoek and CSB groups (Table 4.11).

Table 4.11 also indicates that for the fruit group, the children who were severely underweight declined from 9.1 percent to 4.5 percent. The cases at risk of underweight showed a decrease from 13.6 percent to 9.1 percent and there was an increase for the normal group from 45.5 percent to 50 percent. The results showed an increase from 27.3 percent to 31.8 percent for the group at risk of overweight, while the overweight group remained the same at 2.6 percent.

4.4.2 Height-for-age (stunting)

In the vetkoek group, prior to the intervention 18.2 percent of the children were stunted, as shown in the height-for-age at or below the 5^{th} percentile of the NCHS growth chart (NCHS 2000). This indicates a chronic shortage of food experienced, which did not improve notably, and measurements after the intervention indicated that 20.4 percent of the children were stunted, as indicated in Table 4.12. Children in the normal category decreased from 36.7 to 34.7 percent and the group at risk of being overweight increased from 10.2 to 14.3 percent.

Post-testing results for the CSB group showed a significant decrease in stunting, from 34.9 percent to 11.6 percent, and the group at risk decreased from 27.9 percent to 20.9 percent. Children in the normal category increased from 23.3 to 27.9 percent and those at risk of overweight showed a significant increase from 9.3 to 20.9 percent.

The Sejo group experienced a decrease after the intervention in the number of children categorised as stunted. The number decreased from 16.9 percent to 9.1 percent, as can be seen in Table 4.12. In all the groups, the number of children at risk of being stunted (>5 and <25th percentile) declined, with the exception of the Sejo group, which experienced an increase from 37.7 percent to 39 percent.

Table 4.12 shows that the fruit group experienced a total decline in the number of stunted children, with 4.5 percent dropping to zero in both the stunted group (≤5th percentile) and the group at risk of being stunted (>5th and <25th percentile). The number in the group at risk (>5th percentile and <25th percentile) decreased from 27.3 percent to 18.2 percent.

4.4.3 BMI for age (wasting)

Wasting occurs when a severe shortage of food has been experienced and is indicated where the BMI-for-age is at or below ≤5th percentile of the NCHS chart.

Results of the vetkoek sample indicated that 16.3 percent of the children were wasted. After the intervention period, the results indicated wasting at 10.2 percent. The group at risk of being wasted increased from 32.7 percent to 36.7 percent (Table 4.13).

The CSB group included 4.7 percent wasted children before the intervention period; however, after the intervention, 9.3 percent were underweight (≤5th percentile). The group at risk (>5th percentile and <25th percentile) went up from 11.6 percent to 14.0 percent, as shown in Table 4.12. The healthy weight group (≥25th and ≤ 75th) showed an increase from 55.8 percent to 65.1 percent, and the group at risk of overweight (>75th and <95th) showed a significant decrease from 23.3 percent to 7 percent.

Results of the Sejo sample before the intervention indicated that 10.4 percent of the children were wasted. After the intervention period the results showed a decline at 3.9 percent in this category. The risk of being wasted decreased from 20.8 percent to 16.9 percent (Table 4.13). Results for the healthy weight group showed an increase from 55.8 percent to 61 percent and the group at risk of overweight (>75th and <95th) showed a notable increase from 11.7 percent to 16.9 percent.

The PSNP presented similar results to the vetkoek group for wasting. Before the intervention, the severely malnourished children formed 12.2 percent of the sample, which decreased to 7.3 percent. The results showed an increase in the group at risk (>5th percentile and <25th percentile) of being wasted from 20.8 percent to 36.6 percent. Results for the healthy weight group showed an increase from 53.7 percent to 56.1 percent, as indicated in Table 4.13.

The fruit group indicated a 9.1 percent wasted status before the intervention period. After receiving only fruit of various kinds for the seven-month period, the children's underweight status declined to zero percent. The group at risk (>5th percentile and <25th percentile), however, went up from 18.2 percent to 27.3 percent, as shown in Table 4.12. The healthy weight group (≥25th and ≤ 75th), as well as the group at risk of overweight (>75th and <95th), stayed exactly the same at 54.5 percent and 9 percent respectively. The number in the overweight group decreased.

The significant increase in weight, height, and BMI may be due to the normal growth process that took place in the children during the intervention. For the purpose of this study, children who had their birthdays during the intervention and automatically moved to the next age category were taken into account. In the fruit group, a significant increase ($p \leq 0.05$) was observed in the boys' height.

The girls in the fruit group showed a significant increase ($p \leq 0.05$) in their weight, height and BMI between the pre-intervention and post-intervention measurements (Table 4.13).

4.5 Biochemical analyses

Table 4.14 illustrates the biochemical results, and Table 4.15 the patterns and biochemical changes of the five different groups as measured before and after the intervention

Normal values were present for the majority of the biochemical parameters at baseline. Mean red cell volume decreased in all the groups. When an iron deficiency is present, the mean red cell volume usually decreases; however, the results of this study indicated that red cell volume was still within the normal range. The dietary intake patterns confirmed low iron intake. Values for high-density lipoprotein (HDL) cholesterol increased in all the groups.

Table 4.14 Biochemical results for all the groups before and after the intervention

Table 4.15 Patterns and changes in biochemical variables of the different groups at baseline compared to follow-up (p≤0.05)

Variables	Vetkoek	CSB	Sejo	PSNP	Fruit
Red blood cell count	▲	▲	▼	▲	▼
Haemoglobin	▼	▲	▼	▼	▼
Haematocrit	▼	▼	▼	▼	▼
Mean red cell volume	▼	▼	▼	▼	▼
White cell count	▼	▲	●	●	▼
Total protein	▲	▲	▼	●	▼
Albumin	▼	▲	●	▲	▼
Total cholesterol	●	▼	▼	▼	▲
HDL cholesterol	▲	▲	▲	▲	▲
Triglycerides	▲	▲	▲	▲	▲
Ferritin	▼	▲	●	▼	▲
Transferrin	▲	▲	▲	●	▼
Serum iron	▼	▼	▲	▲	▼

▲ increased

▼decreased

● stayed the same

Total serum cholesterol levels decreased in all the groups except for the fruit group, where it increased, and the vetkoek group, where it stayed the same. However, these changes were not significant and were within the normal ranges at pre- and post-intervention measurements.

Statistically significant changes for triglycerides were observed, with an increase for the vetkoek, Sejo and PSNP groups; however, the increased levels are still below the cut-off of <1.80 mmol/l.

4.5 Results Phase 2: Product development, selection, acceptance and shelf life testing

4.5.1 Vetkoek results

4.5.1.1 Results of acceptance testing

The results showed that in the paired preference testing (Annexure J), 56 percent of the consumers preferred sample C, the maize and whole wheat vetkoek. Thirty-one percent of the consumers indicated that sample A (maize vetkoek) was preferred and 23 percent preferred sample B (whole wheat vetkoek). In the final acceptance testing (Annexure K), 65 percent of the consumers liked the maize and whole wheat vetkoek very much, and 90 percent found it to be acceptable for inclusion in a school-feeding program.

4.5.1.2 Results of shelf life testing

Shelf life testing results indicated that the vetkoek stored at 4 ºC had a seven day shelf life period, as depicted in Figures 4.1 and 4.2. The vetkoek stored at 25 ºC had only a two day shelf life. Although moulds were visible on day 4 on the vetkoek stored at 25 ºC, the counts were very low throughout the trial. This could be due to the fact that the 10 g aliquot of sample was taken from the middle of the vetkoek each time, and the visible mould growth was on the upper crust of the vetkoek.

Result of Vetkoek stored at 4°C

Sample	Total Aerobic Plate Count Cfu/g	Yeast and Moulds Cfu/g
Day 0	2.0×10^1	< 10
Day 2	$1,0 \times 10^2$	< 10
Day4	$5,0 \times 10^1$	<10
Day 7	$1,6 \times 10^2$	<10

Cfu/g = Colony forming units per gram of sample

Figure 4.1 Results of shelf life testing of vetkoek stored at 4 ºC

Result of Vetkoek stored at 25°C

Sample	Total Aerobic Plate Count Cfu/g	Yeast and Moulds Cfu/g
Day 0	$1,9 \times 10^2$	< 10
Day 2	$1,3 \times 10^6$	< 10
Day4	$2,4 \times 10^6$	<10
Day 7	$>3,0 \times 10^7$	1

Cfu/g = Colony forming units per gram of sample

Figure 4.2 Results of shelf life testing of vetkoek stored at 25 ºC

The total bacterial count (Figure 4.3) and the yeast and mould counts for the vetkoek stored at 4 ºC remained low throughout the seven day trial. The total bacterial count and the yeast and mould counts for the vetkoek stored at 25 ºC increased from log 2 to log 6 on the second day and increased to more than log 7 on the last day of the shelf life trial. Although the yeast and mould count remained very low throughout the 7 days, moulds were visibly detected on day 4 of the trial.

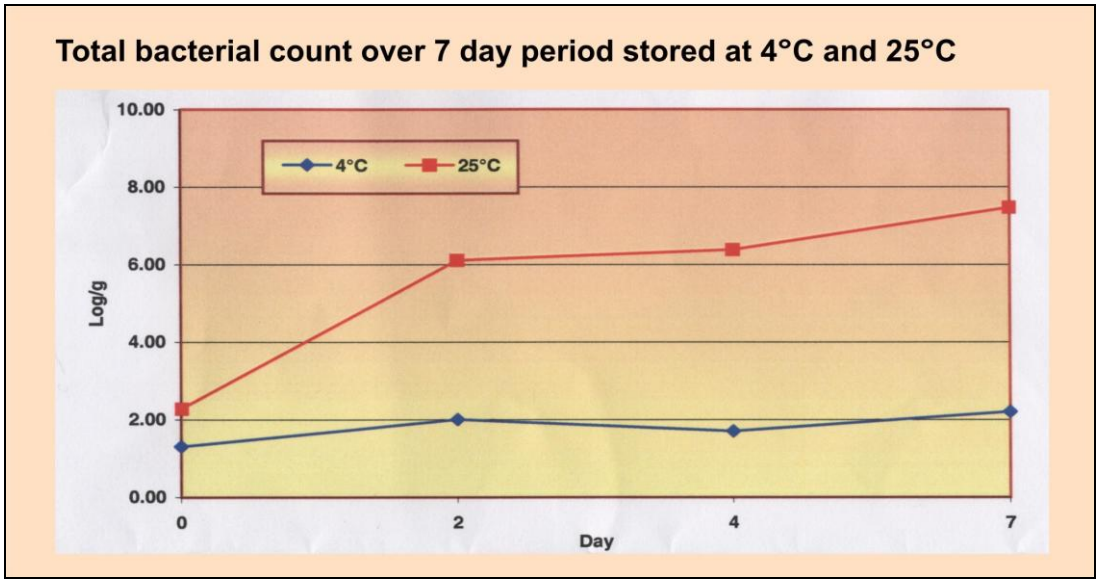

Figure 4.3 Total bacterial count over a seven day period stored at 4 ºC and 25 ºC.

4.5.2 PSNP results

4.5.2.1 Results of acceptance testing

No formal sensory and shelf life testing were conducted for the PSNP group by the researcher, because of the fact that the DoE monitored the school feeding programme and visited the school regularly; however, the researchers did observe consumption patterns of the PSNP on every occasion the school was visited.

4.5.2.2 Results of shelf life testing

No shelf life testing was conducted on any of the PSNP products used in the school feeding programme. The commercial products used included tinned pilchard fish, peanut butter, dry cold drink powder, fortified biscuits and margarine, and all these products had the nutrition information as well as expiry

dates printed on the package. The researchers visited the storage space to monitor availability of products used in the PSNP.

4.5.3 CSB results

4.5.3.1 Results of acceptance testing

An acceptance evaluation sheet was developed and used by Chibe in the Reitumetse and Sinqobile schools (Annexure O). During the development of the sensory assessment sheet, certain aspects, including the comprehension level of the children and the information needed from the respondents, were taken into consideration. The main objective of this testing was to determine whether the acceptance of CSB porridge made it suitable for long-term use (Chibe 2007: 41).

The sensory perception of the participating primary school learners regarding CSB indicated that the respondents perceived the texture of the CSB porridge to be good (74%), and the results for taste were similar (75 percent).

4.5.3.2 Results of shelf life testing

No formal chemical analysis was conducted for CSB as this is a commercial product manufactured by JAM and the nutritional information as well as the shelf life date is given on the packaging material, as discussed in 3.4.3.1. The shelf life for the dry product as indicated on the packaging material is one year from date of manufacture. Product specification suggests consumption directly after preparation. The researcher (Chibe) visited the Reitumetse and Sinqobile schools regularly to assess the preparation and kitchen areas in both schools. Standard storage conditions were adhered to.

4.5.4 Sejo results

4.5.4.1 Results of acceptance testing

One of the limitations of the study is that there was no acceptance testing conducted for the Sejo group by the researchers; however, JAM monitored the feeding scheme and consumption patterns regularly to ensure that all the children consumed the product.

4.5.4.2 Results of shelf life testing

No formal microbiological analysis was conducted on Sejo as, like CSB, this product is a commercial product available and used by JAM for this project. The nutritional information as well as the shelf life date is given on the packaging material, as discussed in 3.4.3.2. The shelf life for the dry product as indicated on the packaging material is one year from date of manufacture. Product specification suggests consumption directly after preparation.

4.5.5 Fruit results

4.5.5.1 Results of acceptance testing

The fruit group in Eatonside were observed when consuming the fruit. Children indicated that they enjoyed the fruit and ate it immediately.

4.5.5.2 Results of shelf life testing

No formal shelf life testing was conducted on the fruit, since delivery took place twice a week at the school and the fruit was consumed within three days after

delivery. Fruit was stored with all the vetkoek ingredients in the kitchen built on the school premises, as discussed in 3.5.2.1

4.6 Results Phase 3: Intervention

4.6.1 Eatonside

4.6.1.1 Product compliance

As mentioned in 3.5.2 and 3.5.2.3, the portioning, preparation and serving of the vetkoek was observed on a daily basis for the first month after the intervention, after which random weekly visits were conducted for quality control, and to observe compliance. Samples were randomly collected and weighed to estimate the average portion size of the vetkoek.

During these visits, the PSNP and fruit groups were also observed. The researcher observed the type and amount of food distributed to the school children as part of the PSNP. The researcher noticed that children did not always receive the food as indicated on the menus. Community workers used their own initiative and adapted the menu according to what was available. If bread was delivered too late in the morning, biscuits were given instead. The community workers knew the children in the PSNP group and would reprimand children who were not part of the group if they tried to get food. A small room in the main office building was used as a storage facility for the ingredients for the PSNP. This storeroom was utilised for storing as well as preparing the sandwiches and mixing the cold drinks. The limited space available created overcrowding and made it difficult for the community workers preparing the sandwiches. However, during 2007, a large steel container which was delivered

at the school was used as storeroom and preparation area, which improved the situation.

Observations were also conducted amongst the fruit group. The researcher observed that the fruit was very popular and children ate it immediately, whereas they occasionally packed away in their suitcases or bags the sandwiches received from the PSNP. The children enjoyed the variety of fruit and commented that they liked the fruit very much.

In a discussion with the school principal of the Sethlabotja School in January 2008, he confirmed that at present all the children in the school form part of the National School Nutrition Programme, as it is currently called.

4.6.2 Orange Farm

4.6.2.1 Product compliance

The preparation, serving method and portioning of both the CSB and Sejo products were observed at the primary schools in Orange Farm. The learners' response towards the CSB and Sejo porridge was also monitored. Adjustments to the porridge preparation, portioning and serving procedures were made where necessary. Three different observations were conducted by the researchers to identify the portion size of the porridge. During the three occasions when observing for CSB, seven samples in both Reitumetse and Sinqobile primary schools were randomly collected and weighed to estimate average portion size. In total, 42 samples were collected. The findings indicated that in the Reitumetse Primary School an average serving of 234 g prepared porridge was served to grades 0 and 1; 408 g prepared porridge was served to grades 2 and 3; 447 g to grades 4 and 5, and grades 6 and 7 received an average serving size of 571 g. At the Sinqobile Primary School an average

serving size of 287 g was served to grades 0-3; 471.4 g to grades 4 and 5, while grades 6 and 7 received an average of 599 g prepared porridge. From the above results it is clear that no standardised guidelines were applied to regulate the provision of the correct portion of CSB to the school children.

Different proportions were used for the preparation of the CSB porridge by the schools before the intervention. At the Reitumetse Primary School an average of 475 ml porridge was served, providing the equivalent of 67 g dry CSB mix, whereas at Sinqobile Primary School, an average of 429 ml porridge was served, providing the equivalent of 73 g dry CSB mix.

For the intervention, the preparation methods were standardised to ensure optimal utilisation of the existing 100 litre cooking pots available at both schools and to ensure comparability for the sensory evaluation of the CSB porridge. The suggestion was to make use of the highest ratio of CSB dry mix to water, which was 100 g dry CSB mix added to 473 ml water per serving.

To keep the texture of the prepared product similar in both schools, the ratio of 81 ℓ water to 17 kg CSB mix was used to prepare 100 ℓ porridge, which could provide 205 servings of ±488 ml/day. This ratio of ingredients resulted in a stiffer porridge, which the children in the Reitumetse School were not used to.

Follow-up observations of the preparation and serving of the CSB porridge were conducted, and proved satisfactory. The volunteers preparing the porridge reported on a daily calendar the amounts of all ingredients used and the total portions served; these reports were collected on a monthly basis (Chibe 2007:49).

Results from the Reitumetse School indicated that 84.8 percent of the children consumed CSB porridge at least five times a week whereas 10.9 percent of the respondents indicated that they consumed the CSB porridge only once a week. At the Reitumetse School, 3.7 percent of the children went for a second serving at least once a week (Chibe 2007:57)

4.6.2.2 Consumption patterns

In Sinqobile School a large percentage (75%) consumed the CSB porridge five times a week, 26.5 percent indicated consumption of the CSB porridge twice a week and 2.6 percent of the children went for second servings at least twice a week.

JAM monitored the daily intakes and checked that all the children received food as part of the school feeding programme. However, the consumption of the CSB and Sejo by the children who participated in this study was not separately recorded and documented. This was identified as one of the limitations of this study.

4.6.2.3 Compliance with the recommended guidelines

JAM recommends that the equivalent of 100 g dry CSB mix should be provided per child for each school day, in an attempt to meet 70 percent of the RDA as stipulated by UNICEF. However, this was not possible in both the Reitumetse and Sinqobile primary schools, owing to limitations in the preparation. The results indicated that the equivalent of only 83 g dry CSB mix could be provided per child per serving. The South African guidelines for school feeding indicated that the food option or combination thereof should provide a balance of nutrients, and not less than 25 percent of the RDA for energy for the target

group between seven and ten years old, and not less than 20 percent of the RDA for energy for the group between 11 and 14 years old. As the equivalent of 100 g dry CSB mix provides 1464 kJ, 83 g of the CSB mixture provided an intake of 1215 kJ, which compared favourably with the energy requirements for school feeding as stipulated by the DoH, but did not fully meet the requirements as stipulated by UNICEF, especially for the older boys aged 11-14 years (Chibe 2007:50).

4.6.3 Cost

The vetkoek was developed at a cost of R1.51 per day for a 120 g vetkoek. This fell close to the cost margin of R1.50 per learner per day for 2004/05, as stated by Wildeman & Mbebetho (2005), which was utilised for the PSNP in South Africa. As the vetkoek was prepared with ingredients bought at the local supermarket, this could have had an influence on its cost.

Fruit was provided at an average cost of R1.00 per unit. The cost of CSB was R2.40 per kg of raw product, which, if calculated per 100 g portion, was R0.24 per portion. The cost of Sejo was calculated at R0.21 per portion (Table 4.16). CSB is manufactured by Jam, as described in 2.5.2, and is partially subsidised by USDA, resulting in the low cost.

Sejo is a commercial product used by JAM in the school feeding programmes, as discussed in 3.4.4. It is manufactured on a large scale, which reduces the cost considerably.

The cost of the five products were for raw ingredients only, and did not include the cost of putting the infrastructure in the different schools in place, or the

training of fieldworkers and community workers assisting in the food programmes.

Table 4.16 Cost per portion for each product

Cost of serving	Vetkoek	PSNP	CSB	Sejo	Fruit
Cost margin R1.50	R1.51	R1.50	R0.24	R0.21	R1.00

4.6.4 School attendance

School attendance was recorded by an appointed teacher on a daily basis in a school attendance register for all the children in the study in Eatonside. The register was divided into four terms and was completed for the year 2004. As reflected by the school register, the school absenteeism of the children taking part in the intervention decreased during the second term when the intervention commenced, as depicted in Table 4.17.

Table 4.17 School absenteeism in Eatonside (percentage).

Category	Term 1 %	Term 2 %	Term 3 %	Term 4 %
Vetkoek group	60.1	37.9	8.2	17
PSNP group	26.3	21.3	14.9	0
Fruit group	68.1	40.7	0	0

After the first term, absenteeism dropped to 37.9 percent in the vetkoek group, 21.3 percent in the PSNP and 40.7 percent in the fruit group. For the PSNP and fruit groups, absenteeism decreased gradually towards the end of the year; however, term 4 showed an increase of 17 percent in absenteeism in the

vetkoek group, without any reasonable explanation. No statistically significant difference was found between the attendance ratios of the three groups.

School attendance was not formally observed in the schools in Orange Farm. All the children in the school took part in the school feeding programmes, and received either CSB or Sejo on a daily basis. However, in an interview with the teachers, it was mentioned that the school feeding projects implemented by JAM resulted in less absenteeism amongst learners; unfortunately no theoretical or statistical results were available to prove this statement. However, the Cochrane review on school feeding programmes found that children who were fed at school attended school more frequently than those in the control group; this indicated an average increase of four to six days per child, per year (Kristjansson *et al* 2007).

4.6.5 Summary of the intervention

The results of the intervention study showed that although few statistically significant differences were observed between the five groups with regard to nutritional status indices, positive changes were observed in each of the groups, indicating that any one of these products may have a positive effect on hungry, malnourished children. The new knowledge generated by this research project is discussed in section 4.7, where all these strategies are further statistically analysed and compared in order to identify the most appropriate school feeding strategy for the Vaal Region.

4.7 Phase 4 Post-intervention comparison of the five feeding strategies

4.7.1 Objectives

The objectives of the post-intervention comparison were to:

- Compare the five products in terms of the nutritional content of the product (by means of chemical analyses).
- Determine the impact of the product on the nutritional status of primary school children (by analysing their dietary intakes, as well as the biochemical and anthropometric results).

4.7.2 Methods

4.7.2.1 Statistical analyses

All the dietary intake, anthropometric and biochemical data were cleaned and captured on Excel spreadsheets, and transferred to SPSS version 15.0 computer software package for statistical analyses.

The data were analysed using the following statistical techniques:

- Chi-square is commonly used to compare categorical data and was used in this study to compare children on the 5th percentile for anthropometric status to children on the >5th percentile for anthropometric status, with regard to nutritional intake below the recommended DRIs.
- Analysis of variance (ANOVA) method was used to test for Homogeneity of Variances if the significance was > 0.05; however, if the significance was < 0.05, the Welch and Brown-Forsythe method was used.

- When the ANOVA method was used, if the significance was < 0.05, the Post Hoc method – Bonferroni method was used, and significance for >= 0.05 indicated no statistical significance.
- During the application of the Welch and Brown-Forsythe method, the Post Hoc method or Tamhane method was used for significance < 0.05, and >= 0.05 indicated no statistical significance.
- Pearson correlation was used to compare numerical data for pre-intervention and post-intervention data.
- Paired t-tests were used to compare the pre-intervention and post-intervention data within the five groups.

4.7.3 Results

4.7.3.1 Dietary intake parameters

The ANOVA results for the nutrient intakes for all five feeding strategies are summarised in Tables 4.18, 4.19 and 4.20. The tables indicate the statistically significant differences before and after the intervention as observed between two feeding strategies. Only those changes that were statistically significant ($p \leq 0.05$) were included in the tables. The feeding strategy that performed the better of the two compared for the specific parameter is indicated as the recommended strategy. This information will be used to decide on the optimal feeding strategy among the five.

- Macronutrients

The results with regard to the changes in dietary intakes indicate that for most of the macronutrients, the fruit and vetkoek groups showed significant improvement when compared to the PSNP, CSB and Sejo groups. As indicated

in Table 4.18, both the fruit and vetkoek groups experienced increased intakes of energy, protein and carbohydrate.

Table 4.18 Statistically significant changes in macronutrients of the various feeding strategies after the intervention ($p \leq 0.05$)

Parameter	Statistically significant difference between	Actual difference		Recommended strategy
Energy (kJ)	Sejo - Fruit	Sejo -237	Fruit +2266	Fruit
	Sejo - Vetkoek	Sejo -237	Vetkoek +3487	Vetkoek
	CSB - Fruit	CSB -1152	Fruit +2266	Fruit
	CSB - PSNP	CSB -1152	PSNP +1573	PSNP
	CSB - Vetkoek	CSB -1152	Vetkoek +3487	Vetkoek
Protein (g)	Sejo - Fruit	Sejo -6	Fruit +18	Fruit
	Sejo - Vetkoek	Sejo -6	Vetkoek +34	Vetkoek
	CSB - Fruit	CSB -8	Fruit +18	Fruit
	CSB - Vetkoek	CSB -8	Vetkoek +34	Vetkoek
Fat (g)	Sejo - Vetkoek	Sejo -2	Vetkoek +29	Vetkoek
	CSB - Fruit	CSB -16	Fruit +14	Fruit
	CSB - Vetkoek	CSB -16	Vetkoek +29	Vetkoek
Carbohydrate (g)	Sejo - Fruit	Sejo -3	Fruit +80	Fruit
	Sejo - Vetkoek	Sejo -3	Vetkoek +105	Vetkoek
	CSB - Fruit	CSB -1152	Fruit +80	Fruit
	CSB - PSNP	CSB -1152	PSNP +9	PSNP
	CSB - Vetkoek	CSB -1152	Vetkoek +105	Vetkoek
Fibre (g)	Sejo - Vetkoek	Sejo -3	Vetkoek +9	Fruit
	CSB - Fruit	CSB -1	Fruit +9	Fruit
	CSB - PSNP	CSB -1	PSNP +6	PSNP
	CSB - Vetkoek	CSB -1	Vetkoek +4	Vetkoek

For fat and fibre intake, it seems that the vetkoek contributed the most fat, and that the fruit group had the highest fibre intake. This can be attributed to the fact that the vetkoek was specifically fried in vegetable oil to increase the energy intake and that fruit usually contains more fibre than processed foods do.

- Minerals

The results of the dietary intake indicate that for all the minerals (Table 4.19), the vetkoek group showed significant improvement when compared to the fruit, PSNP, CSB and Sejo groups. The vetkoek group showed a higher intake of calcium, iron and copper after the intervention when compared to all the other groups.

The canned pilchard fish and spinach added to the vetkoek recipe most probably improved the calcium and iron intake levels. This proves, therefore, that the researcher's initial objective in developing the vetkoek as part of her master's studies was achieved with regard to intakes of calcium and iron, as indicated in Table 4.18. The fruit group, as well as the vetkoek and PSNP groups, showed a statistically significant improvement in intakes of magnesium. The fruit group showed significant improvement in zinc and selenium intakes when compared to the vetkoek, PSNP, CSB and Sejo groups. CSB did not contribute statistically significant amounts of any of the minerals.

Table 4.19 Statistically significant changes of the various feeding strategies for minerals after the intervention (≤0.05)

Parameter	Statistical significant difference between	Actual difference		Recommended strategy
Calcium (mg)	Sejo - Vetkoek	Sejo -21	Vetkoek +217.5	Vetkoek
	CSB - Vetkoek	CSB -30.9	Vetkoek +217.5	Vetkoek
	Fruit - Vetkoek	Fruit -36	Vetkoek +217.5	Vetkoek
	PSNP - Vetkoek	PSNP -40.4	Vetkoek +217.5	Vetkoek
Iron (mg)	Sejo - Fruit	Sejo -0.7	Fruit +6.1	Fruit
	Sejo - PSNP	Sejo -0.7	PSNP +5.1	PSNP
	Sejo - Vetkoek	Sejo -0.7	Vetkoek +7.8	Vetkoek
	CSB - Fruit	CSB -0.2	Fruit +6.1	Fruit
	CSB - PSNP	CSB -0.2	PSNP +5.1	PSNP
	CSB - Vetkoek	CSB -0.2	Vetkoek +7.8	Vetkoek
	Fruit - Vetkoek	Fruit +6.1	Vetkoek +7.8	Vetkoek
	PSNP - Vetkoek	PSNP +5.1	Vetkoek +7.8	Vetkoek
Magnesium (mg)	Sejo - Fruit	Sejo -26.5	Fruit +20.9	Fruit
	Sejo - PSNP	Sejo -26.5	PSNP +59	PSNP
	Sejo - Vetkoek	Sejo -26.5	Vetkoek +15.4	Vetkoek
	CSB - Fruit	CSB -24.2	Fruit +20.9	Fruit
	CSB - PSNP	CSB -24.2	PSNP +59	PSNP
	CSB - Vetkoek	CSB -24.2	Vetkoek +15.4	Vetkoek
Zinc (mg)	Sejo - Fruit	Sejo +0.7	Fruit +3.3	Fruit
	Sejo - PSNP	Sejo +0.7	PSNP +2.0	PSNP
	Sejo - Vetkoek	Sejo +0.7	Vetkoek +0.6	Sejo
	CSB - Fruit	CSB -1.0	Fruit +3.3	Fruit
	CSB - PSNP	CSB -1.0	PSNP +2.0	PSNP
	CSB - Vetkoek	CSB -1.0	Vetkoek +0.6	Vetkoek
	Fruit - Vetkoek	Fruit +3.3	Vetkoek +0.6	Fruit

	PSNP - Vetkoek	PSNP +2.0	Vetkoek +0.6	PSNP
Copper (mg)	Sejo - Vetkoek	Sejo =	Vetkoek +1.4	Vetkoek
	CSB - Vetkoek	CSB -0.08	Vetkoek +1.4	Vetkoek
	Fruit - Vetkoek	Fruit +0.27	Vetkoek +1.4	Vetkoek
	PSNP - Vetkoek	PSNP +0.08	Vetkoek +1.4	Vetkoek
Selenium (µg)	Sejo - Fruit	Sejo +5.6	Fruit +28.4	Fruit
	CSB - Fruit	CSB -4.6	Fruit +28.4	Fruit
	CSB - Vetkoek	CSB -4.6	Vetkoek +25.9	Vetkoek

- Vitamins

Similar results for vitamins as for the macronutrients and minerals are evident in all the groups. The fruit, vetkoek and PSNP groups showed significant improvement in vitamin intakes when compared to the CSB and Sejo groups, which did not contribute statistically significantly to vitamin intake, as indicated in Table 4.20.

For riboflavin, vitamins B12 and E, the vetkoek group was the only group that showed a statistically significant improvement in intake. Vetkoek featured strongly in all the vitamin intakes, which may be attributed to the fact that, prior to the intervention, information was provided to the parents of those participants consuming the vetkoek, regarding the importance of keeping meals regular and not skipping any meals even though the children received a product at school in the school feeding programme. With regard to vitamins A, B6 and niacin intakes, the fruit group showed a statistically significantly improvement.

Table 4.20 Statistically significant changes of the various feeding strategies for vitamins after the intervention (p ≤0.05).

Parameter	Statistical significant difference between	Actual difference		Recommended strategy
Vit A (µg RE)	CSB - Fruit	CSB -111.2	Fruit +333.4	Fruit
	CSB - Vetkoek	CSB -111.2	Vetkoek +546.6	Vetkoek
Thiamine (mg)	Sejo - Fruit	Sejo -0.1	Fruit +0.34	Fruit
	Sejo - PSNP	Sejo -0.1	PSNP +0.18	PSNP
	Sejo - Vetkoek	Sejo -0.1	Vetkoek +0.26	Vetkoek
	CSB - Fruit	CSB -0.06	Fruit +0.34	Fruit
	CSB - Vetkoek	CSB -0.06	Vetkoek +0.26	Vetkoek
Riboflavin (mg)	Sejo - Vetkoek	Sejo -0.11	Vetkoek +1.0	Vetkoek
Niacin (mg)	Sejo - Fruit	Sejo -2.3	Fruit +8.9	Fruit
	Sejo - PSNP	Sejo -2.3	PSNP +7.0	PSNP
	Sejo - Vetkoek	Sejo -2.3	Vetkoek +13.2	Vetkoek
	CSB - Fruit	CSB -1.6	Fruit +8.9	Fruit
Vitamin B6 (mg)	Sejo - Fruit	Sejo -0.2	Fruit +0.91	Fruit
	Sejo - PSNP	Sejo -0.2	PSNP +0.64	PSNP
	Sejo - Vetkoek	Sejo -0.2	Vetkoek +2.45	Vetkoek
	CSB - Fruit	CSB -0.03	Fruit +0.91	Fruit
	CSB - PSNP	CSB -0.03	PSNP +0.64	PSNP
	CSB - Vetkoek	CSB -0.03	Vetkoek +2.45	Vetkoek
	PSNP - Vetkoek	PSNP +0.64	Vetkoek +2.45	Vetkoek
Folate (µg)	Sejo - Fruit	Sejo +11.0	Fruit +307.5	Fruit
	Sejo - PSNP	Sejo +11.0	PSNP +248.2	PSNP
	Sejo - Vetkoek	Sejo +11.0	Vetkoek +1379	Vetkoek
	CSB - Fruit	CSB -11.5	Fruit +0.91	Fruit
	CSB - PSNP	CSB -11.5	PSNP +248.2	PSNP
	CSB - Vetkoek	CSB -11.5	Vetkoek +1379	Vetkoek

	Fruit - Vetkoek	Fruit +307.5	Vetkoek +1379	Vetkoek
	PSNP - Vetkoek	PSNP +248.2	Vetkoek +1379	Vetkoek
Vitamin B12 (µg)	Sejo - Vetkoek	Sejo -0.2	Vetkoek +10.7	Vetkoek
	CSB - Vetkoek	CSB +0.1	Vetkoek +10.7	Vetkoek
	Fruit - Vetkoek	Fruit =	Vetkoek +10.7	Vetkoek
	PSNP - Vetkoek	PSNP =	Vetkoek +10.7	Vetkoek
Vitamin C (mg)	Sejo - Fruit	Sejo -59.7	Fruit +22.6	Fruit
	Sejo - PSNP	Sejo -59.7	PSNP -5.5	PSNP
	Sejo - Vetkoek	Sejo -59.7	Vetkoek +7.4	Vetkoek
Vitamin E	Sejo - Vetkoek	Sejo +0.6	Vetkoek +5.2	Vetkoek
	CSB - Vetkoek	CSB -1.8	Vetkoek +5.2	Vetkoek

4.7.3.2 Biochemical and haematological parameters

Differences between the Sejo, PSNP, CBS, vetkoek and fruit were determined (post-test minus pre-test). Data for biochemical and haematological parameters were analysed using the following statistical techniques:

- Test for Homogeneity of Variances:
  If the significance was > 0.05, the ANOVA was used.
  If the significance was < 0.05, the Welch and Brown-Forsythe method was used.
- For the ANOVA:
  If the significance was < 0.05, the Post Hoc method – Bonferroni method was used.
  If the significance was >= 0.05, no statistical significance.
- For the Welch and Brown-Forsythe method:
  If the significance was < 0.05, the Post Hoc method –Tamhane method was used.
  If the significance was >= 0.05, no statistical significance.

Statistically significant changes in biochemical and haematological parameters after the intervention can be observed for all the feeding strategies, as shown in Table 4.21. Fruit showed statistically significant changes only for transferrin in the post-intervention results. Sejo showed a statistically significant change in haematocrit, as confirmed in Table 4.14.

Table 4.21 Statistically significant changes in biochemical and haematological parameters after the intervention for the various feeding strategies (≤0.05).

Parameter	Expected outcome	Statistically significant difference between	Actual difference		Recommended strategy
Red blood cell count (x10^6/µl)	▲	CSB - Sejo	CSB + 0.1	Sejo - 0.1	CSB
Haematocrit (%)	▲	CSB - Sejo	CSB - 4.0	Sejo - 0.1	Sejo
		Sejo - Vetkoek	Sejo -0.1	Vetkoek -2	Sejo
White cell count (x10^6/µl)	▼	CSB - PSNP	CSB +1.2	PSNP ~	PSNP
		CSB -Vetkoek	CSB +1.2	Vetkoek -0.2	Vetkoek
		Sejo - Vetkoek	Sejo ~	Vetkoek -0.2	Vetkoek
Transferrin (g/l)	▲	CSB - PSNP	CSB +0.3	PSNP =	CSB
		CSB - Fruit	CSB +0.3	Fruit -0.2	CSB
Total protein (g/l)	▲	CSB - Sejo	CSB + 3.2	Sejo - 1.0	CSB
		CSB - Fruit	CSB +3.2	Fruit -2.7	CSB
		Sejo - Vetkoek	Sejo -1.0	Vetkoek +2.3	Vetkoek
		Vetkoek - Fruit	Vetkoek +2.3	CSB +3.2	Vetkoek
Albumin (g/l)	▲	CSB - Sejo	CSB +4.4	Sejo =	CSB

▲ increase

▼ decrease

CSB showed the most significant expected results for red blood cell count, albumin and transferrin. Vetkoek showed significant results for the white blood cell count. For total protein, CSB and vetkoek both showed positive results. However, CSB showed a higher increase than vetkoek did.

For iron, no statistically significant changes were observed in any of the groups and this confirms, as indicated in the baseline survey, that the children in both the Eatonside and Orange Farm communities did not have a significant iron deficiency problem.

The results showed inconclusive evidence as to which product would be the best strategy to recommend for improved biochemical status. However, the fact that all the blood values were within normal ranges before and after the intervention could have confounded the results.

4.7.3.3 Anthropometric parameters

Differences between the Sejo, PSNP, CBS, vetkoek and fruit were determined (post-test minus pre-test). Data for anthropometric parameters were analysed using the following statistical techniques

- Test for Homogeneity of Variances:
  If the significance was > 0.05, the ANOVA was used.
  If the significance was < 0.05, the Welch and Brown-Forsythe method was used.
- For the ANOVA:
  If the significance was < 0.05, the Post Hoc method – Bonferroni method was used.
  If the significance was >= 0.05, no statistical significance.

- For the Welch and Brown-Forsythe method:
  If the significance was < 0.05, the Post Hoc method –Tamhane method was used.
  If the significance was >= 0.05, no statistical significance.

Results for CSB indicate statistically significant changes in anthropometric parameters, especially in height. This may, however, also be as a result of the normal growth that takes place in children and cannot be solely attributed to the inclusion of CSB in the diet. Results for BMI indicate statistically significant changes in the Sejo group (Table 4.22). The fact that CSB and Sejo were the two products indicating most statistically significant changes in anthropometric parameters is a strange result, since the total dietary intake (of both macronutrients and micronutrients) showed that in both the CSB and Sejo groups, intakes were reduced after implementation of the intervention.

Table 4.22 Statistically significant changes in anthropometric parameters of the various feeding strategies after the intervention (p ≤0.05).

Parameter	**Statistically significant difference between**	**Actual difference**		**Recommended strategy**
BMI	Sejo - Vetkoek	Sejo +2.3	Vetkoek +0.2	Sejo
	Sejo - Fruit	Sejo +2.3	Fruit +0.3	Sejo
Height	Sejo - Vetkoek	Sejo +2.0	Vetkoek +3.6	Vetkoek
	Sejo - PSNP	Sejo +2,0	PSNP +4.4	PSNP
	Sejo - CSB	Sejo +2.0	CSB +10.8	CSB
	Fruit - CSB	Fruit +3.4	CSB +10.8	CSB
	Vetkoek - CSB	Vetkoek +3.6	CSB +10.0	CSB
	PSNP - CSB	PSNP +4.4	CSB +10.8	CSB

4.8 Conclusion

The baseline survey results confirmed the results of the preliminary study, which found that the socioeconomic status of both the communities was poor, that household food security was a problem and that health problems existed.

The results of the food consumption patterns for the five groups, as measured by the 24-hour recall method, showed similar consumption patterns for all groups. These patterns indicated that maize porridge (soft or stiff) was number one on the list. Most of the food items were present in different ranking order, in both pre- and post-testing for the top twenty, and show similarities to the results of the NFCS (Labadarios *et al.* 1999:288). The first five items were similar, with tea and brown bread present in all the groups. Rice, milk, and similar types of protein-rich foods were consumed in all groups. Similar consumption patterns for fruit and vegetables were present; however, no fresh fruit or vegetables were ranked amongst the first ten items consumed by any of the groups. The food consumption patterns indicated that the vetkoek, PSNP and fruit groups had a significant increase in energy during the intervention; however, in the CSB and Sejo groups, the energy was lower after the intervention, which suggests that these children consumed less even when receiving the school feeding products.

One of the reasons why the vetkoek, PSNP and fruit groups showed significant increases in the dietary intake parameters was possibly the fact that the importance of children receiving food at home as usual was stressed. Parents were clearly informed that children should not be deprived of any food at home just because they received food at school in the school feeding programme. However, this was not done in the Orange Farm schools where children received CSB and Sejo, and the fact that neither Sejo nor CSB contributed significantly to the dietary intake parameters may be as a result of parents'

assuming that since their children received food at school, the amount of food given at home could be reduced. Fruit was also seen by the parents as a ‘snack’ and not as food. It is evident in various studies conducted worldwide that in malnourished communities, parents often provide food to the younger siblings and neglect the feeding of children who receive food as part of school feeding programmes (Beaton & Ghassemi 1982;901, WFP 2006).

The Sejo strategy attempted to address 100 percent of RDA for vitamins and minerals, as can be seen in Chapter 3 in Table 3.5. However, evidence from this study suggests that this was not achieved, as Sejo did not make a statistically significant contribution to the vitamin and mineral intakes. However, Sejo has a low glycemic index, as mentioned in 3.4.4, and therefore meets the criterion of the DoH that food provided in school feeding should take ‘’longer’’ to digest.

Anthropometric results indicated that children in the severely underweight category, as well as the group at risk of being underweight, decreased in the Sejo, PSNP, and fruit groups. Post-testing results for the groups showed a significant decrease in stunting for CSB, Sejo, fruit and the PSNP groups, but not for vetkoek, which indicated an increase in the risk of overweight. This may be because the vetkoek was deep-fried in oil. The significant increases in mean weight, height, and BMI, which occurred in all the groups, may be due to the normal growth process that took place in the children during the intervention.

Results of acceptance testing for both the vetkoek and CSB showed that 65 percent of the vetkoek group liked the maize and whole wheat vetkoek very much and 90 percent found it to be acceptable for inclusion in a school-feeding programme, while the respondents receiving CSB indicated that both the texture (74%) and the taste (75%) of the CSB porridge was good. No formal acceptance testing was conducted in the PSNP, fruit and Sejo groups. However, no

problems were observed when the PSNP and fruit groups were monitored by the teachers and observed by the researcher during visits to the school, or when the Sejo group was monitored by JAM.

Formal shelf life testing was conducted only for vetkoek and the results indicated that the vetkoek stored at 4 ºC had a seven day shelf life period. No formal chemical analysis was conducted on PSNP, fruit, Sejo and CSB. CSB and Sejo, as well as some items used for PSNP, are products specifically developed and manufactured for school feeding programmes and the nutritional information as well as the shelf life date is given on the packaging material.

Compliance results for Eatonside showed that the children in all the groups consumed the products daily. However, problems with the preparation in Orange Farm resulted in portions that varied and that were smaller than the 100 g dry portion suggested by JAM. Frequent delivery of the five products discussed in this study ensured daily availability of the products in the schools, and storage facilities proved to be satisfactory for short-term utilisation.

The cost of all the products proved to be within the limits of the budget of the Gauteng DoE (Wildeman & Mbebetho (2005:24-27).

School attendance seemed to improve; however, it was formally recorded only in Eatonside and informally observed in the schools in Orange Farm, as reflected by the register kept by the teachers (Table 4.17).

The overall results are summarised in Table 4.23, where all the criteria for the school feeding programmes are tabulated and the results for all the products are given. The results regarding the change in dietary intake indicate that for most of the macronutrients and micronutrients, the vetkoek, PSNP and fruit groups

showed significant improvement when compared to the CSB and Sejo groups (Tables 4.18 to 4.20). Table 4.23 indicates whether the different products met the criteria stated in the objectives of this study. Compliance was not formally recorded for the fruit group; however, the children remarked that they liked the fruit.

Results for anthropometric parameters for height indicate a statistically significant change in the CSB group, while Sejo was the product which had the biggest influence on BMI.

Table 4.23 Results of the criteria met by the five school feeding products evaluated in this study.

Criteria	Vetkoek	PSNP	CSB	Sejo	Fruit
25% Energy RDA	√	√	√	√	X
Macronutrients	√	√	X	X	√
Micronutrients	√	√	X	X	√
BMI	X	X	X	√	X
Height for age	X	X	√	X	X
Biochemical	X	X	√	X	X
Acceptability	√	√	√	√	√
Shelf life	√	√	√	√	√
Compliance	√	*	√	*	*
Cost within prescribed limits	√	√	√	√	√
School attendance	√	√	*	*	√

√ met the criteria

X did not meet specific criteria

* not formally recorded

Statistically significant changes in biochemical and haematological parameters after the intervention were observed mainly for CSB, Sejo and vetkoek. However, all the blood values were within normal ranges before and after the intervention.

CSB indicates statistically significant changes in anthropometric parameters, especially in height, and the Sejo group showed statistically significant changes for BMI. The weight that was gained during the intervention may be attributed to normal growth or to the feeding received at school, as was found in the Cochrane review (Kristjansson *et al* 2007), where it was established that children who were fed at school gained 0.39 kg more than the control group. The Cochrane review reports on studies conducted on school feeding programmes for the socioeconomically disadvantaged, which included eighteen studies (Kristjansson *et al* 2007).

All the products evaluated in this study were food-based approaches. Two of the products made use of natural ingredients, specifically the fruit and the vetkoek that was developed utilising only natural, locally available ingredients. The PSNP made use of fortified biscuits, fortified maize porridge and fortified cold drink. Both CSB and Sejo were enriched with vitamins and minerals. However, McCoy (1997) and Tomlinson (2007) discouraged the use of fortified commercial foods as they promote unhealthy eating habits.

Extensive research, which investigates whether either fortification or food-based strategies are sufficient, indicates that both these strategies have immense potential and must be maximised (WB 2006:142). No statistically significant differences were observed in this study between commercial and home-made products. This study has proved, therefore, that a food-based approach can

result in positive changes in the nutritional status of children receiving products as part of a school feeding programme.