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Research article

Nourishing minds: A longitudinal study on the effect of in-school breakfast programmes on learners' nutritional status in Mpumalanga

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ABSTRACT

This study evaluated the effectiveness of Tiger Brands Foundation in-school breakfast programme in primary schools in Mpumalanga Province, South Africa, and assessed learners' nutritional status over time using anthropometric measures. A longitudinal study was conducted across three phases - March, June, and November 2024. Anthropometric indicators, including Body Mass Index (BMI), height, weight, and Mid-Upper Arm Circumference (MUAC), were used to monitor trends in growth and nutritional status. Observational checklists were also used to assess learners' general health and well-being. Improvements were observed in weight, height, and BMI across all three phases for both male and female participants, with more pronounced gains among females. Mean height increased from 1.45m to 1.48m (males) and 1.43m to 1.51 (females). However, the MUAC did not increase during this period in either gender. Observational checklists indicated that learners were generally healthy and active. The findings suggest that the in-school breakfast programme contributes positively to learners' growth and overall well-being. While improvements in some anthropometric measures were evident, continued monitoring is essential. Therefore, strengthening in-school nutrition initiatives can play a significant role in reducing stunting and promoting optimal child development. Uniquely, this study provides longitudinal, school-level evidence on learners' nutritional status in Mpumalanga.

KEYWORDS
School breakfast; child nutrition; BMI; MUAC; nutritional assessment

Introduction

Although child nutrition has improved globally over the last 30 years, malnutrition rates, specifically stunting, remain quite high. This is a critical issue in South Africa, where research shows that 25% of children are stunted, and acute malnutrition causes one-third of all hospital deaths (May et al., 2021; UNICEF, WHO & World Bank, 2020). Furthermore, The Lancet Child Adolescent Health (2021) notes that despite the known risks to children's futures, only about a quarter of nations are on track to achieve the 2030 Sustainable Development Goals (SDGs) for stunting, wasting, and obesity. These figures highlight a widespread lack of adequate nutrition, primarily caused by ongoing food insecurity. According to the Food Security Information Network (FSIN) & Global Network Against Food Crises (GNAFC) (2025), widespread malnutrition poses a serious threat to child health (Devereux et al., 2008). To address this, SDG 2 targets the elimination of hunger by 2030, recognizing that nutrition is central to a child's life (FAO, 2024). As Stevenson & Humphrey (2022) state, a healthy diet is the basis for physical and cognitive growth. Children who receive adequate nutrition are more likely to succeed academically, possess higher IQs, and maintain better immune health. In contrast, early malnutrition may increase the risk of disease later in life (Biro & Wien, 2010). Over 1.5 million South African children are stunted, surpassing the numbers in countries with similar Human Development Indices (Amusa et al., 2022). Malnutrition has serious consequences for children; micronutrient deficiency is also called 'hidden hunger'. South Africa is characterised by a "double-

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burden" of nutrition-related health problems, that is, under-nutrition and obesity, often in the same household (Vorster, 2013). To mitigate these challenges, the South African government implemented the National School Nutrition Programme (NSNP), which currently provides meals to over nine million learners each school day. The programme is designed to meet 30–40% of a child's recommended dietary allowance (RDA), thereby contributing meaningfully to their daily nutritional requirements (Devereux et al., 2008).

School feeding programmes are increasingly recognised as one of the most cost-effective investments in child health, education and human capital development worldwide. Beyond addressing short-term hunger, these programmes improve school attendance, cognitive performance, dietary intake and social equity, particularly among children from disadvantaged households. Globally, more than 418 million children receive school meals, making school feeding one of the largest social protection interventions supporting progress towards Sustainable Development Goals 2 (Zero Hunger), 3 (Good Health and Well-being) and 4 (Quality Education) (World Food Programme, 2019). Evidence from low- and middle-income countries further demonstrates that combining school meals with nutrition-sensitive interventions, including breakfast programmes, enhances children's nutritional status, learning capacity and long-term health outcomes (Bundy et al., 2018). Within the hospitality and food systems sector, nutrition programmes enhance sustainable community development by improving access to healthy food and enhancing well-being (Nair, 2021). Overcoming pediatric malnutrition in all its forms - caloric undernourishment, micronutrient deficiencies, and overnutrition - requires the development of evidence-based interventions and the formulation of related health policies to guarantee the availability of and access to healthy diets. Hence, the aim of this research was to determine the effect of the in-school breakfast programme on the nutritional status of the learners in the Hazyview district of Mpumalanga Province in South Africa. Although numerous studies have evaluated school feeding programmes, much of the available evidence is derived from cross-sectional assessments that provide only a snapshot of children's nutritional status (Drake et al., 2017). Longitudinal evidence examining how anthropometric indicators change over time following participation in school breakfast programmes remains limited, particularly within South Africa. Furthermore, relatively few studies have simultaneously monitored Body Mass Index (BMI), Mid-Upper Arm Circumference (MUAC), height and weight over multiple assessment periods while incorporating programme implementation observations. This study addresses these gaps by providing longitudinal evidence from eight primary schools in Mpumalanga Province, evaluating changes in learners' nutritional status across three phases of a structured breakfast intervention. By generating context-specific evidence from a public-private partnership involving the Tiger Brands Foundation and the National School Nutrition Programme, the study contributes practical insights for strengthening school nutrition policy, programme implementation and future monitoring of child nutrition interventions in South Africa and similar resource-constrained settings. Subsequent research will compare outcomes in schools participating in the breakfast programme with those in schools not benefiting from the programme, serving as the control group. For this study, the baseline data served as a basis for comparison.

Literature review

Food insecurity and child health

Research identifies young children as the group most vulnerable to nutritional deficits. For example, Mafhungo et al. (2025) reviewed children under five in rural Limpopo and found high levels of stunting (38%) and underweight (13%), largely caused by diets consisting mainly of nutrient-poor staples. Typically, the nutritional status of school-aged children is assessed using anthropometric growth measures, which reflect both their dietary intake and health conditions such as infections or poor sanitation. The various influences on a child's dietary intake can be categorized as: (i) personal factors, (ii) interpersonal or social dynamics, (iii) community aspects, including culture and the physical environment, and (iv) societal or macro-environmental forces. Because schools engage regularly with children during their habit-forming years, they are an ideal setting for health promotion (Nyawo et al., 2021). The DPME/DBE (2016) notes that schools can use skilled personnel to encourage healthy lifestyles. Tomlinson (2007) describes food security as the ability to access enough quality food in a way that respects social and cultural norms. The DPME/DBE (2016) extends this with two further concepts: nutritional security, which recognizes that factors such as gender, education, and sanitation affect health beyond just food supply; and food sovereignty, which asserts the right of people to control production resources such as land and seeds. Because poverty makes marginalized groups vulnerable, the state acts as a safety net. If individuals cannot feed themselves, the government must intervene through economic support or direct food aid. Furthermore, food insecurity in South Africa is compounded by environmental and resource constraints, including water scarcity in some areas, highlighting the need for integrated nutrition interventions targeting vulnerable school-aged populations (Amoah, 2021).

Nutritional assessment methods

Nutritional assessment is the process of evaluating the health status of individuals or communities. As highlighted by Bates et al. (2017), these indicators are crucial for forecasting health risks. The main objective is to inform specific interventions such as dietary counseling or food support, that enhance overall well-being. This approach helps minimize the burden of diet-related conditions. These conditions vary from specific nutrient deficiencies, like scurvy and beriberi, to complex, multifactorial illnesses such as cancer and vascular disease, where diet interacts with other causes. There are both direct and indirect methods of nutritional assessment; the direct methods are: (a) anthropometry (b) biochemical tests (c) Clinical assessment and (d) dietary assessment methods (Gibson, 2005; Ray et al., 2023). The indirect methods include the use of ecological factors and vital statistics such as prevalence and incidence rates. Anthropometry is the scientific study of variation in the size and shape of the human body. Compared with the dietary, biochemical status, and functional and clinical status methods, anthropometry may provide a relatively quick and inexpensive means for the assessment of nutritional status. It measures typically weight and height (with BMI being calculated from these), MUAC, and perhaps others such as skinfold thickness. Weight-for-height can also be used to assess overnutrition in children, and the body mass index (BMI = weight (kg)/ height $(m)^2$) is now most used (Ray et al., 2023). WHO standards showing BMI-for-age are used for interpreting the results for children age of different age ranges. In addition, MUAC is a simple measurement that can be used to identify children who have malnutrition and are at risk. Children whose arm circumference falls within the red or yellow indicator (less than 18cm/180mm) on the coloured tape (see Table 1 below) should be referred to the nearest health or nutrition centre for urgent attention.

Table 1: MUAC Classifications and recommended actions for the target population (10-14years)

Colour	Values (in cm)	Nutritional status	Action
Red	Less than 16cm	Severe Acute Malnutrition (SAM)	Refer to the nearest health facility that provides therapeutic feeding.
Yellow	16cm – 18cm	Moderate Acute Malnutrition (MAM)	Refer to the nearest health or nutrition centre that provides supplementary feeding or take available food supplements.
Green	Above 18cm	Healthy	Continue with healthy dietary and lifestyle habits. Go for regular checkups at the hospital.

Adapted from WHO (2008)

Outcomes and impact of school nutrition programmes

School feeding initiatives have the potential to alleviate temporary hunger, helping learners focus better and handle more difficult academic tasks. Furthermore, these programmes often encourage students to be punctual and attend classes regularly, thereby increasing the total time spent in school (Beesley & Ballard, 2013). Nevertheless, to effectively address temporary hunger, food must be provided daily. If there are disruptions, such as delivery delays or a shortage of cooking gas, students will inevitably face hunger during lessons. Research indicates that school nutrition programmes also drive higher enrolment rates, particularly among female students (Jomaa et al., 2011; Tomlinson, 2007). Notable improvements have also been observed regarding student attendance as well as academic achievement in mathematics. However, while Poswell & Leibbrandt (2006) contend that receiving food is a powerful incentive for children to attend school, they note that the evidence linking this feeding to improved learning results is actually quite weak. Additionally, during the COVID-19 lockdowns, schools were shut, depriving children of outdoor physical activities. This lack of movement, combined with irregular dietary habits, was likely to cause psychological disturbances for many children (Ghosh et al., 2020). A review conducted by Kristjansson et al. (2016) incorporated an evaluation of processes to pinpoint specific elements that influence how effective school feeding schemes are. Tomlinson (2007) posits that temporary hunger impairs memory, concentration, and verbal skills, citing various studies demonstrating that nutritious meals enhance cognitive functions and performance. In terms of improving overall national nutrition, providing rations to take home may actually be the most efficient method for reaching the children who need assistance the most. A major obstacle to the nutritional benefit argument is the possibility of substitution; a child's nutritional status might not improve if their family reduces food portions at home because they know the child is being fed at school (Aliyar et al., 2012; Beesley & Ballard, 2013). Furthermore, data from SANHANES-1 reveals that a large portion of children in South Africa do not eat breakfast at home. Specifically, 19.0% of participants, nearly one out of every five students, reported this habit. Yet, the reasons behind this are ambiguous. It remains uncertain whether students skip the morning meal due to a lack of available food, or if parents intentionally withhold it because they are relying on the school meal.

Methods

The study employed quantitative approach in order to address the study objective, which was to assess the impact of the breakfast meals on the growth and nutritional status of the learners; a quantitative research method was employed which involved anthropometric measurements of the schoolchildren. The

measurements used in this study were weight, height and MUAC which were taken using a digital weighing scale, a stadiometer and the MUAC tape. The breakfast programme began in February; however, ethical approval for the study was only obtained in March, leading to the study's commencement that month rather than at the programme's outset. This study was a longitudinal survey carried out thrice over a period of nine months (From March 2024 to November 2024) at eight Primary schools in the province of Mpumalanga (all of which now have breakfast and lunch programmes as part of the NSNP in-school nutrition programme). Phase I of the study was carried out in March, Phase II in June and the third phase in November. The eight schools were randomly selected from the Hazyview district. The schools were selected from each of the three quintiles (Q1 – 3) eligible for the TBF breakfast; these schools have mostly children from disadvantaged backgrounds. Random sampling was applied to the TBF records to select the district and eight specific schools. Once officials agreed to the project over the phone, visit dates were finalised. The study then used convenience sampling, enrolling only those students who returned the signed consent forms provided to them. The total number of learners is the 8 schools was 7555. According to the Survey Monkey Sample Size calculator, a total number of 368 participants was sufficient for the study; that is about 46 children per school. Also, the higher classes – Grades 5, 6 & 7 were targeted for this study, bringing the number of students to 15 per grade and 16 in one of the grades (7 boys and 8 girls). Within each school, 46 students participated in the study (47 participated in three schools). Table 2 provides a breakdown of the study participants per school in the province.

Table 2: Study participants per school at Hazyview District, Mpumalanga

Schools	Celani	Mgco-baneni	Chweni	Tfolin-hlanhla	Siyamukela	Ifalethu	Mtimba	Mpunzana
Boys	23	24	23	23	23	24	23	23
Girls	24	23	23	23	23	23	23	23
Total	47	47	46	46	46	47	46	46
Grand Total								**371**

In the three phases of this study, an interview questionnaire was used. The first section captured the learner's age, gender and school grade, while the second section was used to document the learner's anthropometric measurements. A stadiometer was used to measure height; a weighing scale was used to measure weight while a non-stretchable MUAC tape was used to measure MUAC. In all the phases of the study, an observational checklist was also used to evaluate the nutritional/health status of the children, and the hygiene conditions in the kitchen. The survey instruments were piloted at a school in Gauteng Province with six participants; this school and the participants were not part of the main study. The quantitative anthropometric data and observational checklists per school were analysed using Microsoft Excel 365; significant difference was accepted at $p<0.05$. Statistical comparisons were also made between the anthropometric mean values for each gender across the three phases to assess positive or negative deviations from the baseline data collected in Phase I. This study followed the guidelines of the Declaration of Helsinki. All procedures involving participants were approved by the Faculty of Health Sciences Research Ethics Committee at the University of Johannesburg, under reference number REC-01-01-2024. Participation in the study was entirely voluntary, with informed consent obtained prior to engagement. Researchers secured written permission from caregivers, and also sought informed assent from the children, who signed forms to confirm their willingness to participate. To ensure understanding, information sheets were drafted in age-appropriate language and explained verbally by the research team. The data collection process prioritized a child-friendly environment. While participants provided names on interview forms solely to facilitate future follow-up, they were assured that the information was for research purposes only. Consequently, all data was de-identified during the analysis and reporting stages

Results and discussion

Socio-demographic characteristics of the learners

Table 3 provides the socio-demographic characteristics of the study participants.

Table 3: Socio-demographic characteristics of participants for Phase I (N=371), II (N=342), & III (N=353)

Characteristic	Phase I - N (%)	Phase II - N (%)	Phase III - N (%)
Age (in years), mean ± SD	11.09 ± 1.06	11.11 ± 1.06	11.07 ± 1.05
Grade			
5	122 (32.9)	113 (33)	119 (33.7)
6	121 (32.6)	110 (32.1)	115 (32.6)
7	128 (34.5)	119 (34.8)	119 (33.7)
Gender			
Male	174 (46.9)	156 (45.6)	164 (46.5)
Female	197 (53.1)	186 (54.4)	189 (53.6)

n = frequency; % = percentage; SD = standard deviation

In Phase I, a total of 371 learners were included in the research. The participants' ages ranged from 9 to 15 years old, with a mean age of 11.09 ± 1.06 years. The participants were almost equally distributed across three grades: 5th (33%), 6th (33%), and 7th (34%). In Phase II, a total of 342 learners were included in the research. The participants were almost equally distributed across three grades: 5th (33%), 6th (32.1%), and 7th (34.8%). The number of female participants (54.4%) was higher than that of male participants (45.6%). In Phase III, a total of 353 learners were included in the research. The participants were almost equally distributed across three grades: 5th (33.7%), 6th (32.6%), and 7th (33.7%).

Anthropometric data of the study participants (Phases I to III)

The anthropometric data of the study participants, categorized by gender, is detailed in Table 4. In Phase I, all four anthropometric data namely weight, height, BMI, and MUAC, were higher on average for male participants than female participants. But in Phases II and III, the mean values for these same measurements were higher among female participants than male participants and a progressive increase in the mean values was observed from Phase I to III except for the mean weight of the males which dropped by 0.3kg in Phase II, and their mean height remained same (1.45m). On the contrary, for the females, the mean height increased by 0.5m between Phase I and II and the mean weight increased by over 3kg.

Table 4: Gender-wise anthropometric information of participants for Phase I, II & III

	Phase	Gender	Mean	SD	Minimum	Maximum
Weight (kg)	Phase I	Male	38.94	10.17	20.6	96
		Female	38.09	10.83	22.1	83
	Phase II	Male	38.64	9.96	21.2	68.9
		Female	41.25	11.20	23.7	97
	Phase III	Male	40.40	10.75	21.9	76
		Female	43.66	11.45	26.3	98.3
Height (m)	Phase I	Male	1.45	0.09	1.2	1.7
		Female	1.43	0.09	1.1	1.7
	Phase II	Male	1.45	0.10	1.2	1.8
		Female	1.48	0.09	1.3	1.7
	Phase III	Male	1.48	0.10	1.3	1.8
		Female	1.51	0.08	1.3	1.7
BMI (kg/m^2)	Phase I	Male	18.23	3.40	12.4	38.5
		Female	18.16	3.94	11.9	32.4
	Phase II	Male	18.08	3.50	11.7	32.1
		Female	18.57	3.73	10.8	38.4
	Phase III	Male	18.28	3.65	10.6	34.2
		Female	19.06	3.88	12.2	38.4
MUAC (cm)	Phase I	Male	22.44	2.97	16.7	38
		Female	22.30	3.45	8	35
	Phase II	Male	22.44	3.50	16.5	32
		Female	22.95	3.30	16	36.5
	Phase III	Male	22.02	3.61	15.9	36
		Female	22.76	3.37	16.9	36

SD = Standard Deviation; kg = kilo gram; m = meter; cm = centi-meter; BMI = Body Mass Index; MUAC = Mid Upper Arm Circumference

Gender-based trends of anthropometric data across Phases I, II, and III

Figure 1 illustrates the gender-based trends of anthropometric data across Phases I, II, and III. The three anthropometric parameters, weight, height, and BMI, showed growth from Phase I to Phase III for both males and females. However, the MUAC did not exhibit any growth during this period for either gender. In fact, the mean MUAC decreased from Phase II to Phase III for both males and females. Additionally, the growth in anthropometric measurements was more pronounced among female participants compared to male participants.

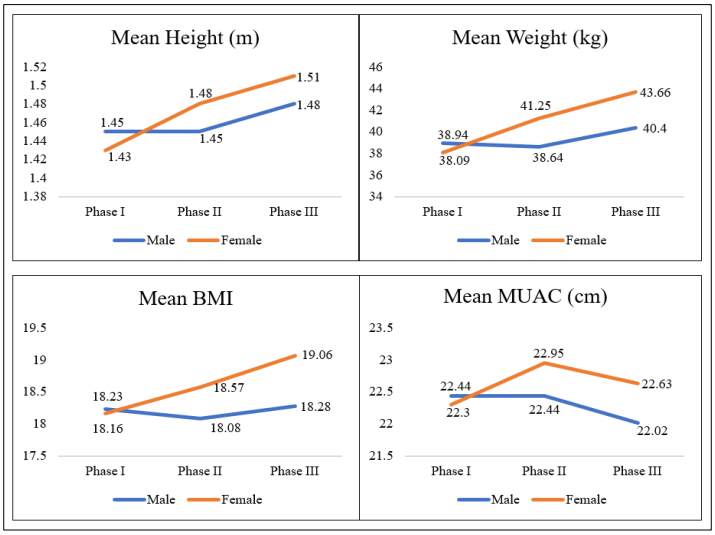

Figure 1: Gender-based trends of anthropometric data in Phase I, II & III

Trends in Prevalence rates of underweight, overweight and obesity among the learners

Table 5 and Figure 2 show the nutritional status of male and female participants across Phases I, II, and III. Among male participants, the prevalence of severe thinness (underweight) remained consistent at approximately 1% in all three phases. The prevalence of overweight increased from 16.2% in Phase I to 19.3% in Phase II and then to 20.2% in Phase III. Similarly, the obesity rate rose from 8% in Phase I to 10.9% in Phase II, then to 13.4% in Phase III. Among the female participants, the prevalence of thinness decreased from 4.6% in Phase I to 2.2% in Phase II, then rose slightly to 2.6% in Phase III. The prevalence of overweight individuals was 16.2% in Phase I, declined to 9.1% in Phase II, and then rose again to 14.8% in Phase III. Meanwhile, the prevalence of obesity increased from 9.2% in Phase I to 20.4% in Phase II, but decreased to 14.3% in Phase III.

Table 5: Nutritional status of participants in Phase I, II & III (by gender)

Gender	Category	Phase I		Phase II		Phase III	
		n	%	N	%	n	%
Male	Severe thinness	2	1.1	1	0.6	2	1.2
	Thinness	0	0	1	0.6	0	0
	Normal weight	130	74.7	107	68.6	107	65.2
	Overweight	28	16.2	30	19.3	33	20.2
	Obese	14	8	17	10.9	22	13.4
	Total	174	100	156	100	164	100
Female	Severe thinness	1	0.5	2	1.1	0	0
	Thinness	9	4.6	4	2.2	5	2.6
	Normal weight	137	69.5	125	67.2	129	68.3
	Overweight	32	16.2	17	9.1	28	14.8
	Obese	18	9.2	38	20.4	27	14.3
	Total	197	100	186	100	189	100

Z score cutoffs (BMI for age): Severe thinness = < -3; Thinness = ≥ -3 to < -2; Normal weight = ≥ -2 to ≤ +1; Overweight = > +1 to ≤ +2; Obese = > +2 Source: WHO Growth Reference (2007)

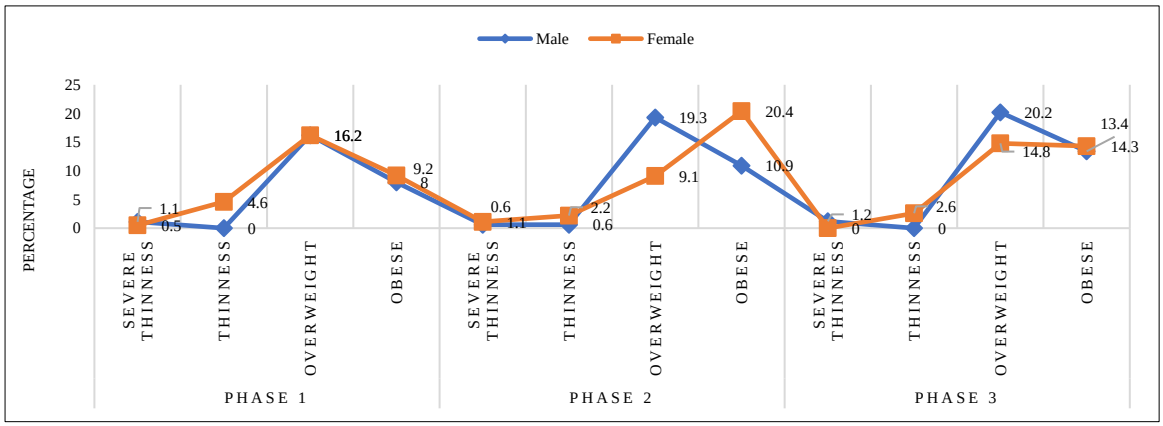

Figure 2: Nutritional status of participants in Phase I, II & III (by gender)

Overall assessment of the breakfast programme using the observational checklist

Table 6 reports the findings made at the eight schools in Phase I, II and III using the observational checklist consisting of nutrition evaluation, menu plan assessment and health. Breakfast timeliness and quality breakfast was consistently served on time and in good hygienic conditions across all three phases, with 100% affirmative responses. Most children finished their food, with a slight variation across phases. While 75% finished in Phase I, this increased to 100% in Phase II and slightly decreased to 87.5% in Phase III. The inclusion of fruits and vegetables was inconsistent. Only 25% reported receiving them in Phase I, none in Phase II, and 12.5% in Phase III. Additionally, serving fruits and vegetables on specific days was common in Phase II (100%) but less frequent in Phase I (37.5%) and Phase III (25%). All participants consistently agreed that different breakfast meals were served on various weekdays across all phases. A varying number of learners brought additional food or snacks from home, with 75% in Phase I, 37.5% in Phase II, and 62.5% in Phase III. However, none of the learners brought snacks in all cases as some of the schools stopped allowing learners to bring snacks and food from home because they encouraged learners to eat the meal at school. Food handlers followed the agreed menu in all phases. Correct portion sizes were served in Phases I and II (100%) but slightly decreased to 87.5% in Phase III due to the variation in numbers of learners consuming breakfast. The addition of fruits or other items to breakfast meals was more prevalent in Phase I (62.5%) and Phase II (87.5%) but declined sharply in Phase III (12.5%), it was mentioned that fruits were served with lunch. Analysis of the health checklist showed that children appeared healthy and active, with no negative feedback in this area. Most children were satisfied with the breakfast, though this declined slightly from 87.5% in Phases I and II to 75% in Phase III. A few children expressed dissatisfaction of some of the breakfast items in Phase III (25%). Children were reported to maintain good hygiene practices, though

this slightly decreased in Phase III (87.5%), poor infrastructure particularly dish washing facilities. Similarly, the cleanliness and health of food handlers were observed in most cases.

Table 6: Checklist for assessment of in-school breakfast programme Phase I to III (N = 8)

	Questions	Response	Phase I n (%)	Phase II n (%)	Phase III n (%)
1.	Breakfast served on time	Yes	8 (100)	8 (100)	8 (100)
2.	Breakfast served in good condition/hygiene	Yes	8 (100)	8 (100)	8 (100)
3.	Breakfast meals incorporate the various classes of food	Yes	8 (100)	8 (100)	8 (100)
		No	0 (0)	0 (0)	0 (0)
4.	The children generally finish their food	Yes	6 (75)	8 (100)	7 (87.5)
		No	2 (25)	0 (0)	1 (12.5)
5.	Fruits and vegetables served after breakfast	Yes	2 (25)	0 (0)	1 (12.5)
		No	6 (75)	8 (100)	7 (87.5)
6.	Fruits and vegetables served on certain days only	Yes	3 (37.5)	8 (100)	2 (25)
		No	5 (62.5)	0 (0)	6 (75)
7.	Different breakfast meals served on various week days	Yes	8 (100)	8 (100)	8 (100)
8.	Some learners bring additional food/snacks from home	Yes	6 (75)	3 (37.5)	5 (62.5)
		No	2 (25)	5 (62.5)	3 (37.5)
9.	All learners bring additional food/snacks from home	No	8 (100)	8 (100)	8 (100)
10.	Food handlers follow the agreed TBF menu for each day	Yes	8 (100)	8 (100)	8 (100)
11.	Actual and correct food portion sizes served	Yes	8 (100)	8 (100)	7 (87.5)
		No	0 (0)	0 (0)	1 (12.5)
12.	Feeding times adhered to	Yes	8 (100)	7 (87.5)	8 (100)
		No	0 (0)	1 (12.5)	0 (0)
13.1	Additions to the breakfast meals served	Yes	5 (62.5)	7 (87.5)	1 (12.5)
		No	3 (37.5)	1 (12.5)	7 (87.5)
13.2	Please tick: Drinks/Fruits/Pastry snacks/others	Not applicable	3 (37.5)	1 (12.5)	7 (87.5)
		Fruits	5 (62.5)	7 (87.5)	1 (12.5)
13.3	Day of the week	Not applicable	3 50)	1 (12.5)	7 (87.5)
		Tuesday	0 (0)	1 (12.5)	0 (0)
		Wednesday	4 (50)	5 (62.5)	1 (12.5)
		Friday	0 (0)	1 (12.5)	0 (0)
14.	Children looking healthy and active	Yes	8 (100)	8 (100)	8 (100)
		No	0 (0)	0 (0)	0 (0)
15.	Generally, health status of the children is good	Yes	8 (100)	8 (100)	8 (100)
16.	The breakfast satisfies the children	Yes	7 (87.5)	7 (87.5)	6 (75)
		No	0 (0)	0 (0)	2 (25)
		Not sure	1 (12.5)	1 (12.5)	0 (0)
17.	The children observe good hygiene practices	Yes	8 (100)	8 (100)	7 (87.5)
		Not sure	0 (0)	0 (0)	1 (12.5)
18.	The food handlers look clean and healthy too	Yes	8 (100)	8 (100)	7 (87.5)
		Not sure	0 (0)	0 (0)	1 (12.5)

N = number of schools; n = frequency; % = percentage

School breakfast programmes have emerged as vital interventions aimed at addressing child hunger, malnutrition, and poor educational outcomes in low- and middle-income countries, including South Africa. The implementation of in-school breakfast initiatives, such as the one supported by the Tiger Brands Foundation, has shown measurable benefits on the growth, development, and academic performance of learners, particularly in under-resourced communities. Nutrition plays a foundational role in children's physical and cognitive development. Inadequate nutrient intake, especially during school hours, has been linked to stunted growth, poor immunity, reduced concentration, and suboptimal academic performance (United Nations Children's Fund [UNICEF], 2019). In the context of South Africa, many learners attend school without having eaten breakfast due to food insecurity at home. Many families are now facing the global menace of food insecurity. Participating learners astutely noted that lack of nutritious food reduces their ability to concentrate and energy levels, which ultimately affects their ability to learn in school. The role of adequate nutrition in proper growth and cognitive development of children cannot be overemphasized. According to Eisenstein (2000), adolescence is a life period between 10 and 20 years of age, marked by intense body changes resulting from puberty and psychosocial development that influence nutritional requirements (Soliman et al., 2022). During the pubertal growth spurt, there is an increase in the protein, calorie, and nutrient requirements, in addition to the extras recommended for growth and for several activities, according to different lifestyles (Jacobson et al., 1997; Soliman et al., 2014). For these reasons, it is important to ensure that growing children have access to healthy and adequate nutrition, in addition to the fact that it also improves their ability to concentrate in school.

Kesa & Onyenweaku (2024) previously analysed weekly TBF breakfast menus collected from schools across five South African provinces. The study employed the NutriSurvey software alongside the South African Food Composition tables to assess dietary intake. By comparing these findings against the Recommended Dietary Allowance (RDA), the researchers were able to determine how significantly the school meals contributed to the children's nutritional needs. The menu evaluation revealed that most NSNP lunch meals fell short of providing 25–30% of the children's RDAs. However, the TBF breakfast helped bridge this gap by contributing an additional 10–20% of the RDAs. That study reports that school meals were the primary source of food for many learners throughout the day; some learners arrive at school early specifically to ensure they do not miss breakfast and avoid going hungry. Similarly, in this study conducted at Mpumalanga, analysis of the health checklist indicated that the children were generally in good health just like was reported for the learners at the participating schools in Gauteng, Western Cape, North West, and

KwaZulu-Natal, in the previous research. Some meals met the RDAs for select micronutrients, such as B vitamins and calcium while fruit was offered infrequently, typically only once a week in most of the schools. Other researchers have also highlighted the benefits of school feeding on children and adolescents, to include alleviating hunger, reducing micronutrient deficiency and anaemia, preventing over weight and obesity, improving school enrolment and attendance, increasing cognitive and academic performance, and contributing to gender equity in access to education (Aliyar et al., 2015; Drake et al., 2017). The results obtained from Phase I, II and III of this study also confirm these claims that the in-school breakfast also contributes to the growth of the learners. Providing a nutritious in-school breakfast ensures that learners begin their school day with improved energy levels and nutrient intake, thereby supporting optimal cognitive function and physical development (UNICEF, 2019). The South African National School Nutrition Programme (NSNP) primarily provides lunch meals to school children. However, evidence suggests that lunch alone may not be sufficient to meet daily nutrient requirements. Faber et al. (2014) assert that the NSNP has found that meals often fall short of delivering the recommended 25–30% of children's daily dietary needs. Breakfast supplementation, such as that offered by the Tiger Brands Foundation (TBF), helps bridge this nutritional gap by contributing an additional 10–20% of the daily recommended dietary allowances (RDAs), including key macronutrients and micronutrients like calcium, iron, and B-vitamins (TBF, 2022).

Beyond nutritional adequacy, school breakfast programmes have demonstrated positive effects on learners' school attendance, punctuality, and participation. A study by Roberts et al. (2022) found that children who received breakfast at school exhibited better memory recall and attention spans. Similarly, South African schools that have implemented structured breakfast feeding have observed improvements in learner punctuality and concentration during early morning classes (DPME/DBE, 2016). Learners indicated that the breakfasts provided a sense of fullness that suppressed their appetite for junk food. This suggests that the healthy meals supplied by the programme likely played a significant role in the decline of overweight cases among the students. Nonetheless, challenges remain. Although in-school breakfast programmes are effective, their success depends heavily on consistent implementation, adequate funding, and community involvement. Poor food quality, logistical issues in rural schools, and lack of nutrition education can diminish the potential impact of these programmes (Hochfield et al., 2016). Moreover, the infrequent inclusion of fruits and fresh produce in school menus, suggests that while energy needs may be met, micronutrient diversity still needs attention. Summarily, in-school breakfast programmes in South Africa represent an essential intervention for promoting child growth and development, particularly in underprivileged settings. By complementing the existing NSNP lunch programme, breakfast interventions not only improve nutritional intake but also enhance academic engagement, reduce absenteeism, and contribute to learners' overall well-being. Continued investment in and evaluation of these programmes are necessary to maximise their impact and ensure that learners benefit from a healthy start to their school day.

Conclusion

The role of adequate nutrition in proper growth and cognitive development of children cannot be overemphasized. Poor nutrition increases the risk of disease and infection; it also causes poor growth and even reduces population productivity. For adolescents who are possibly entering puberty stage, some of their nutritional requirements also increase. Longitudinal growth usually takes longer periods to observe, nevertheless the results show remarkable increase in the mean parameters except for the mean MUAC. Nevertheless, the mean MUAC values were still very much within the healthy range and not even in the 'danger zone'. Based on observations, the very low prevalence of stunting among the study participants indicates that the school meals are supporting their proper growth and development. This does not in any way undermine the additional nutrition they receive at home as well. On a general note, the children looked healthy and reported that the school feeding programmes had positively affected their health, school attendance, punctuality, attention in class and academic performance. Undoubtedly, the breakfast programme has positive impacts on both the physical, mental and emotional wellbeing of the learners.

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