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A COMPARATIVE ANALYSIS OF THE NUTRITIONAL STATUS OF CHILDREN ATTENDING EARLY CHILDHOOD DEVELOPMENT CENTRES IN GAUTENG, NORTH-WEST AND LIMPOPO PROVINCE, SOUTH AFRICA

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ABSTRACT

The nutritional status of children is a valuable indicator of health status and can indicate inequalities in health faced by the populations. The preschool period is the critical stage of active development and growth of physical, social, and mental well-being of children. Children eating patterns and food preferences develop over a lifetime and are influenced by family, ethnicity, and social environment. The purpose of the study was to do a comparative analysis of the nutritional status of children aged 2 to 5 years attending early childhood development centres in South Africa. A quantitative descriptive design was used to assess the nutritional status of 872 children attending preschool in the Soshanguve, Moretele, and Makhuduthamaga areas, and data was collected using a structured, researcher-administered questionnaire. The variables collected were age, sex, weight, height, mid-upper arm circumference. Gender and age-specific BMI cut-off points were used to determine the nutritional status. The study sample consisted of 872 preschool children, of which 422 (48%) were males, and 450 (52%) were females. The prevalence of overweight; obesity, and undernutrition were 7.7%, 3.4%, and 3.2%, respectively. The findings of this study showed that in all ECDs areas, most of the male children had normal weight. In this study, the age of children ($p=0.007$), as well as ECDs area ($p=0.000$), influenced the BMI of the children ($p=0.007$), and that overweight was higher amongst older children, 4 & 5 years from rural ECD area. The prevalence of overweight amongst children was 4.2% (Soshanguve), 9.3% (Moretele), and 9.6% (Makhuduthamaga), and the prevalence of underweight amongst children was 3.9% in Soshanguve, 2.7% in Moretele, and 3.1% in Makhuduthamaga. The prevalence of underweight was higher in urban ECD areas as compared to ECDs in rural areas. In this study, overnutrition was more prevalent as compared to undernutrition. Therefore, there is a need for nutritional intervention which promotes a healthy lifestyle in preschools.

Key words: Weight, height, preschool children, nutritional status, overnutrition, undernutrition

INTRODUCTION

Early childhood is a critical stage of active development and growth of children's physical, social, and mental well-being [1]. Lack of nutritious foods during childhood stage can lead to poor health and inadequate learning – undernutrition, stunting, and wasting, leading to failure in mental and physical growth and reduced schooling and productivity afterward. At the same time, adequate nutrition is essential for children to achieve their full developmental potential [2].

Undernutrition affects the nutritional and health status of children, with long-term consequences such as low productivity as well as being economically costly; it is also linked to low intellectual capacity, delayed mental development and growth delays [2]. Health, nutrition, responsive caregiving, and early learning; are essential for nurturing care for children to reach their developmental potential [3]. Growth is a critical indicator of a child's health, and the WHO identifies growth assessment as the best single measure to define a child's nutritional status and health. Therefore, failure to grow at an appropriate rate may be associated with a primary growth disorder, infections, or poor nutrition [4].

Early Childhood Development centres (ECDs) play a crucial role in malnutrition prevention and serve as a community engagement platform where nutrition interventions can be intensified to improve and manage the nutritional status of children, to reduce the risks of adverse effects that may hinder growth and development in children [3,4]. Most children between ages 2 and 5 years attend ECDs, spend most of the day in these centres, and consume most meals, such as breakfast, lunch, and the afternoon snack provided. Thus, ECDs are expected to improve and maintain healthy nutritional status by providing nutritious meals for optimum nutrition and promoting rapid growth and development in children [4].

Globally, each year undernutrition, fetal growth restriction, stunting, wasting, and micronutrient deficiencies result in about 3,1 million deaths of children younger than five years [4]. Globally, more than 43 million children under the age of five years were overweight in the year 2017, with the highest prevalence of childhood obesity reported in developed countries such as Canada, the USA, Greece, and many European countries due to excessive intake of ultra-processed foods as well as a sedentary lifestyle [5]. If effective nutrition intervention programs are not implemented, the numbers were estimated to reach 60 million in 2020 [6]. The World Health Organization reported that 149 million children under age five years are stunted while 49 million were wasted worldwide in 2019[7]. While in Bhutan, a developing country in South Asia, children under five years experienced double the burden of malnutrition, with undernutrition and overnutrition being 5% and 6%, respectively [8].

Sub-Saharan African countries have the highest number of undernourished children (336 million) compared to other developed countries [5]. In Tanzania, undernutrition, weak growth, stunting, wasting, and micronutrient deficiencies were the leading causes of almost half of deaths among children under five [12]. The prevalence rate of underweight and stunting in children under five years in sub-Saharan countries was

reported as 13.2% in Lesotho, 13.4% in Namibia, while 28.7% in Nigeria, and 25.7% in Burkina Faso. A Tanzanian study reported that 19% of children between 2 -5 years were at risk of malnutrition while 3% were moderate acute malnutrition [13] while in Mozambique, the prevalence rate of stunting, underweight, wasting was reported as 51%, 13% and 5% respectively [14]. Undernutrition in developing countries in Sub-Saharan Africa is common and mainly attributed to food shortages, food insecurities, inadequate food access, financial constraints, infectious illnesses, and insufficient health care services access [13,14].

Additionally, in Africa, the number of children under the age of 5 years with overweight increased from 6.6 million to 9.5 million by 2018, and the prevalence of overweight and obesity is 4.9% [13]. However, the prevalence of overweight and obesity in children varies within countries, as some are more affected than others; for example, in South Africa and North Africa, the prevalence of overweight and obesity is 13% and 10.6%, respectively [14]. While in Sierra Leone & Malawi, the prevalence of overweight and obesity amongst children under five years is 16.9% and 16.2%, respectively. Urbanization, industrialization, lack of access to affordable foods, sedentary lifestyle, and environmental factors were risk factors for childhood obesity in Africa [13].

In South Africa, Gauteng Province, stunting was more prevalent amongst children attending health care services and may be attributed to the low socioeconomic status of the mothers [15]. Also, the prevalence of overweight and obesity among children aged 2-5 years in South Africa was higher than the global average of 6.1% in 2016 [16]. Furthermore, overweight and obesity among children were found to be higher in urban settings as compared to rural settings [15]. Malnourished children are susceptible to infectious diseases such as pneumonia, diarrhoea, malaria, measles, diarrhoea, non-communicable diseases (NCDs), and HIV/AIDS, leading to death [13,14,15,16]. Consequently, the reported stunting in children may lead to changes in the immune system, subsequently putting children at risk of frequent infections such as respiratory and gastrointestinal growth failures, and such children are more likely to die [13]. Overweight and obesity lead to a burden of non-communicable diseases such as type 2 diabetes, asthma, fatty liver disease, cardiovascular disease, high cholesterol, sleep apnea, glucose intolerance, and insulin resistance [16]. Furthermore, excess weight gain in childhood increases to a longer duration as children grow; it also affects children's physical, mental, and health status [15,16].

The WHO [10] estimated the economic cost of obesity globally to be between 2-7% of total healthcare costs per year. In South Africa, obese children have high care costs of 10-21% more than children with normal weight [17]. The higher health care cost amongst overweight and obese children compared to children with normal weight were also reported by a study done in Sydney [10]. Preventing childhood obesity reduces health care costs and economic burden as it improves the quality of life by preventing chronic diseases that can occur later in life [10].

Most preschool children worldwide consume high energy-dense foods and fewer vegetables, leading to an increased risk for overweight and obesity [18]. Furthermore,



high energy-dense snack intake among preschool children is associated with overweight and obesity in children [19]. Energy-dense, nutrient-poor, high sugar, high salty snacks, and sugar-sweetened beverages (SSBs) contribute to overweight and obesity in children [20]. The nutritional status of children may be influenced by the food ration scales and the type of food items consumed. Also, high consumption of snacks and SSBs may contribute to overweight and obesity and growth delays in children under the age of 5 years [19,20].

In South Africa, ECDs menus in Kwazulu Natal and Limpopo provinces were inadequate, as they did not meet 60% daily requirements of nutrients as recommended by Department of Social Services ECD guidelines [21, 22]. The menu inadequacies were due to insufficient funding of R9-R12 per day per child. Furthermore, in Vhembe district (Limpopo province), ECDs menus in Vhembe district preschools lacked various foods and did not meet children's daily needs due to financial constraints and untrained staff [22]. In addition, urbanization is linked with increased consumption of processed foods high in energy, fat, and refined sugars, which eventually lead to excessive calorie intake and obesity [23]. Furthermore, children in rural areas consume limited variety and inadequate fruits and vegetables compared to children in urban areas [22,23] - contributing to insufficient intake of vitamins, minerals, and other essential nutrients and can lead to undernutrition and overweight children.

In Korea, a 10-week nutrition education program that included lessons on food groups, a balanced diet, and the importance of drinking water was implemented in ECDs. The intervention led to increased intake of fruits and vegetables and less consumption of energy-dense foods and snacks, preventing obesity amongst children [24]. However, in Germany, the intervention used for obesity prevention amongst preschool children included health games, nutrition education, and physical activities. After four weeks of implementation, there were no changes in children's weight status due to a lack of commitment to the intervention program [25]. The authors [26] implemented a multicomponent intervention program (entailing nutrition education to caregivers and children and sending daily mobile health-promoting messages) in Tunisia. Post-intervention found that the program did not impact reducing overweight and obese children [26]. In South Africa, Nutritional Guidelines for ECDs (which provide food-based standards) were launched in 2018 to improve the nutritional status of children attending ECDs. However, no studies were found in South Africa that reported implementing these guidelines by ECDs.

Most studies on the nutritional status of children 2-5 years were conducted in registered ECDs. Early Childhood Development centres provide an excellent environment to promote healthy eating and physical activities, and nutrition education [27]. The assessment of the nutritional status of preschool children is critical to identify children who require nutrition intervention to improve their health and well-being [28]. Therefore, the purpose of the study was to do a comparative analysis of the nutritional status of children attending early childhood development centres in Gauteng, the North-West, and Limpopo.

MATERIALS AND METHODS

Using a quantitative descriptive design, data was collected from a sample of 872 children between the ages of 2- 5 years in ECDs registered with the Department of Social Services in three provinces of South Africa, namely; Gauteng (Soshanguve), North West (Moretele) and Limpopo (Makhuduthamaga) to determine their nutritional status. A Cluster sampling strategy was used to select ECDs that participated in the study in the selected provinces. In Soshanguve, an urban area, there are 11 municipality sections; therefore, the ECDs were grouped according to their sections which was 11 clusters. In Moretele, a rural area, there are 4 municipality sections; therefore, the ECDs were placed according to their sections. In Makhuduthamaga, a rural area, there were 3 municipality sections; therefore, the ECDs were grouped according to their sections which was 3 clusters. After clustering of ECDs, simple random sampling technique was applied by writing the names of all ECDs on a paper, thereafter, all the names were placed in a bowl and mixed thoroughly. The researcher was blind-folded and picked the number of ECDs which were included in the study in each province.

Data Collection

Data was collected within two months in all the areas (Soshanguve, Moretele, and Makhuduthamaga). The researcher trained fieldworkers in the different provinces to take anthropometric measurements. After obtaining the ethical clearance for the study, i.e., two months before the study commencement, the research team consisting of the researcher and the supervisors visited the study sites to meet with the ECDs management to recruit ECDs interested to participate in the study. A convenience sampling, where all children who met study criteria were available during data collection day, and whose parents had completed consent forms and were willing to participate, was used to select participants. The researchers collected data in the private room allocated by the ECDs, where children entered one at a time to take measurements. Measuring equipment such as an electronic scale and HM 200P stadiometer were placed on a flat surface and were calibrated with 1kg weight before each measurement. The participant's gender and age were recorded on the data collection tool. Weight and height measurements were taken according to Standard Operating Procedure (SOP) in light clothing and without shoes, to nearest 0.1kg, 0.1cm, respectively. Body mass index (BMI) in kg/m² was calculated from the measured height and weight and recorded. Children's BMI percentile value which is gender and age-specific (41), was used to classify the nutritional status of children as follows: Underweight: < 5th percentile; Normal or healthy weight; 5th percentile to less than the 85th percentile; overweight: 85th to less than the 95th percentile; Obese: 95th percentile or greater.

Data Analysis

Data collected was entered on an excel sheet and exported to the Statistical Package for Social Sciences (SPSS) version 23 for analysis. Descriptive statistics were used to describe the participants' characteristics, and the chi-squared t-test was used to determine the relationship between BMI and the nutritional status of children.

Ethical approval

The study was approved by the School of Health Care Sciences Research Committee (SHCSRC) and an ethical clearance certificate referenced (SMUREC/H/97/2019/PG.) was issued by the Sefako Makgatho University Research Ethics Committee (SMUREC). In addition, permission to conduct the study was granted by the South African National Department of Social Services, Limpopo, Gauteng, and North West province, and consent was obtained from the principal and parents of children according to the Helsinki Declaration. Measurements procedures were explained to the caregivers, parents, and children before the commencement of data collection.

RESULTS AND DISCUSSION

Participant's characteristics

The total sample consisted of 872 preschool children aged 2- 5 years, of which 422 (48%) were males, and 450 (52%) were females (Table 1). The mean age of the total sample was 2.90 (0.92 SD), mean weight was 14.44 (2.77 SD), mean height was 98.5 (8.10 SD), mean BMI was 14.86 (2.21 SD).

BMI of male children aged 2-5 years

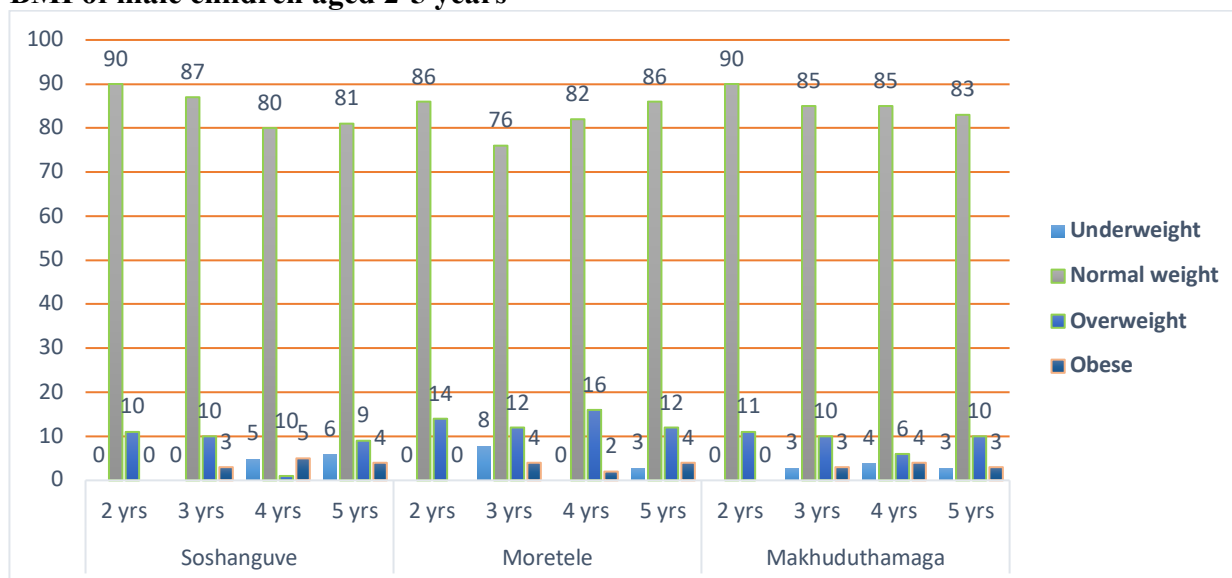


Figure 1: BMI classifications for male children in Soshanguve, Moretele, and Makhuduthamaga ECDs

Figure 1 above indicates that in Soshanguve ECDs, the majority of male children, 8 (90%) aged two years had normal weight; 6 (10%) of children aged four years were obese, and 4 (8.5%) of children aged five years were overweight. In Moretele ECDs, the majority of male children 6 (85.7%) aged two years had normal weight; 9 (16%) of the children aged four years were overweight, and 2 (4%) of the children aged five years were overweight. In Makhuduthamaga ECDs, the majority of male children 17 (89.5%) aged two years had normal weight; 4 (10.2%) of the children aged three years were overweight; 3 (6.2%) of the children aged four years were overweight.

The findings of this study showed that in all ECD areas, most of the male children were of normal weight. Furthermore, the results also show that male children within the age group 2 and 4 years in Moretele were overweight, and some of the 3-year-old male children were underweight (Figure 1). In terms of overweight and obesity, this is the age at which most children are enrolled in ECDs and are already eating various foods that are not necessarily healthy. A Cape Town study reported that the overweight rate was higher among preschool children from urban areas than children from other settings, which may be due to low physical activities and consumption of high-energy foods [17]. On the contrary, according to the South African Demographic and Health Survey (2016), undernutrition was the most prevalent and mostly in rural areas and higher in boys than girls due to low purchasing power and consumption of non-nutritious diet [29]. This was in contrast to a study done in Afghanistan, which reported prevalence of underweight for children under the age of 5 years as 30% in children due to poverty and food insecurities, due to the type of complementary foods introduced [9]. A Nigerian study also reported the prevalence of underweight amongst preschool children (4 years old) in urban areas, which was credited to poverty, food insecurity, and rapid growth [30], while another Nigerian study reported a peak of undernutrition at three years [31]. Therefore, during growth monitoring in the clinics, children's nutritional status should be monitored and ensure that healthy eating is discussed with caregivers for all ages, primarily 2- 5 years.

Interestingly, underweight was observed only among male children in the study. A South African study reported that underweight was higher in boys in rural areas [32]. The prevalence of undernutrition found among male children in Makhuduthamaga was consistent with the findings from other studies done in Tshwane, South African and Sri Lanka preschools which reported that male children were most likely to be underweight as compared to the female children because male dietary requirements are higher [15, 33]. However, this was in contrast to a Nigerian study that reported no difference in gender for the nutritional status of preschool children; due to similar feeding practices amongst children, there was no gender discrimination [1].

The double burden of malnutrition was also reported by the study done in Afghanistan, a developing country, the prevalence of undernutrition and overweight for children between 2-5 years as 5% and 15% respectively [9]. In Australia, a developed country, more than 28% of children under five were overweight and obese, attributed to increased energy, fat intake, and lack physical activities [10]. As a result of unhealthy eating practices and low physical activities, the rate of overweight and obesity is increasing amongst children 2-5 years in both developed and developing countries; additionally, in developing countries, undernutrition and obesity are being reported as increasing public health problems amongst children [8].

BMI of female children aged 2-5 years

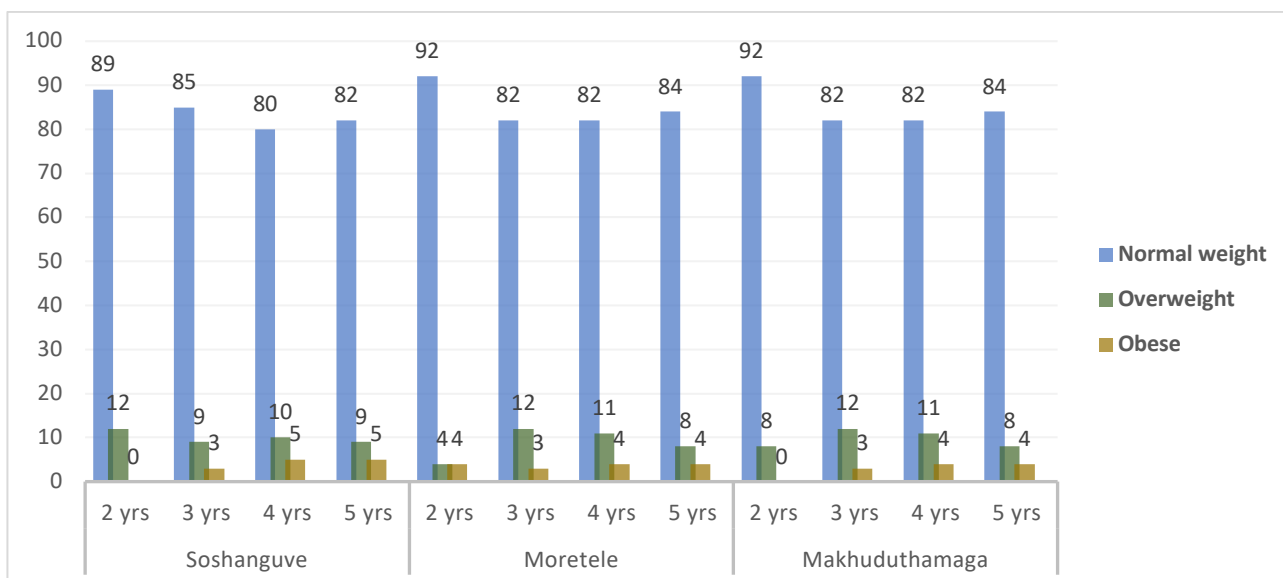


Figure 2: BMI classifications for female children in Soshanguve, Moretele, and Makhuduthamaga ECDs

Figure 2 above indicates that in Soshanguve ECDs, the majority of female children aged two years, 16 (88.9%) were normal weight; 6 (9.9%) of children aged four years were overweight, and 6 (9.2%) of children aged five years were overweight. In Moretele ECDs, the majority of female children 7 (91.6%) aged two years were normal weight; 5 (10%) of children aged four years were overweight, and 6 (13%) of children aged five years were overweight. In Makhuduthamaga ECDs, the majority of female children 11 (91.6%) aged two years were normal weight; 4 (11.9%) of children aged three years were overweight and 6 (11.1%) of children aged four years were overweight.

The findings show that most female children were normal weight in all age groups and ECD areas. However, most female children aged two years in Soshanguve, three and four years in Moretele, three and four years in Makhuduthamaga were overweight. (Figure 2). A South African study reported that overweight and obesity were higher in girls in urban areas than in rural areas [32]. However, the findings show that most female children were normal weight, similar to that of a study conducted in Limpopo, South Africa, which reported that most children aged two years had good nutritional status [34]. The assumption is that these female children were breastfed until the age of 2 years, with appropriate food items introduced and regular visits to primary health care clinics for immunization and growth monitoring.

Despite most children having normal weight in the study, overweight and obesity among the children were still prevalent. Similarly, a study conducted in Mpumalanga and Gauteng provinces in South Africa reported a 12% prevalence of overweight among children under the age of five years, and this was attributed to energy-dense foods and lack of variety in the children's diet [35]. Even though overweight and obesity rates are lower in the study, over nutrition in children is of concern as the South

African Demographic and Health Survey (SANHANES) 2016 reported the prevalence of childhood over nutrition for children under that age of 5 years at 13 % [29] and this was reportedly higher than the global average of 6.1% in 2016 [16]. A Nigerian study reported a prevalence of overweight as 7.7 % amongst preschool children [31], while another study in China reported prevalence of overweight (8.4%) and obesity (3.1%) among preschool children in China [24]. The over nutrition may be attributed to high energy-dense foods, sedentary lifestyles such as watching T.V. and eating fewer vegetables and fruits [1,17]. In South Africa, energy-dense foods such as fat cakes, cookies, candy, and chocolate cost less per unit than fruits, vegetables, and animal products and were consumed mainly by children in ECDs [35]. Childhood obesity is also linked to the marketing of unhealthy foods, drinks, and non/low nutritious foods and their ease of availability [36]. These marketing strategies contribute to the increased rate of obesity as they lead to high consumption of the advertised food items. The rise in the consumption of energy-dense and fatty foods and lack of physical activity play a role in increasing the risk of overweight and obesity.

The nutritional status of children attending ECDs is most likely to be affected compared to children who stay at home [37]. The risk of overweight and obesity in children attending ECDs can be influenced by the menus offered. In Kwazulu Natal and Vhembe district, Limpopo province, of South Africa, menus in ECDs were reported to be inadequate, as they included mainly refined starch such as porridges with low fibre foods, and did not meet 60% daily requirements of nutrients as recommended by Department of Social Services ECD guidelines [21,22]. Therefore, even children who come to the ECDs at a normal weight will be at risk of overweight and obesity in the long run. Additionally, the prevalence of overweight and obesity might differ in the informal ECDs not registered with the Department of Social Development as they do not receive government funding. These ECDs rely on parents paying fees to ECDs, which might lead to a lack of nutritious meals. According to the South African Food-Based Dietary Guidelines Report, children consume low nutrient, high energy-dense foods, contributing to mortality and morbidity; therefore, nutrition during early years is critical [38].

The prevalence of underweight in this study was low (3%), this is in line with the South African Demographic and Health Survey (2016), which reported underweight at 3% in the Eastern Cape and a national rate of 6% [29]. The low underweight rate of preschool children in this study is in contrast with another South African study, which reported an underweight rate of 20.5% among ECD children in Tshwane district [15] and a Nigerian study which reported 21% underweight amongst ECD children [30]. Undernutrition in children is associated with nutritional deprivation, food insecurity, lack of variety of foods and household poverty [32].

The nutrition intervention in ECDs can promote healthy eating and the adoption of a healthy lifestyle. Proactively, preventing childhood obesity reduces health care costs and economic burden as it improves the quality of life by preventing chronic diseases that can occur later in life [13, 14, 39]. Preschool children need foods with good nutritional value for growth and development and it is the period of developing food choices leading up to adulthood, while parents shape children early experiences with food and also provide environment as well as genes [40].

The relationship between BMI, age, ECD area, and gender

In this study, it was found that age influences the BMI of the children ($p=0.007$) (Figure 2). Overweight prevalence was higher amongst older children (four & five years); this may be due to increased intake of saturated fats, exposure to poor diets, and lack of physical activities. Therefore, caregivers must be educated on the importance of healthy eating and physical activities for the growth and development of children, and nutrition education on healthy eating and physical activities should be done regularly in the ECDs [40].

In this study, it was also found that the ECD area ($p=0.000$) influenced the BMI of the children. For example, Makhuduthamaga, a rural area, had a high prevalence of overweight children than Moretele (rural area) and Soshanguve (urban area). Similarly, a study done in Oklahoma ECDs reported that children from rural preschool are 25% higher at risk of overweight than other settings; this may be exposure to energy-dense foods that lack variety. Therefore, children should be offered nutritious meals which ensure proper growth and development. The increasing prevalence of overweight and obesity in ECD children was also reported in other developing countries because of changes in diet patterns such as westernized ones, adopting a more sedentary lifestyle with less physical activity and less sleeping duration amongst preschool children [37].

The scope of the study was to examine the nutritional status of children attending ECDs in 3 provinces of South Africa. Limitation of the study is that the sample analysed is not a representative of all ECDs in Soshanguve, Moretele and Makhuduthamaga, as some children attend ECDs in private ECDs not subsidised by Department of Social Services which were not included in the study. Other factors that are associated with childhood obesity such as child eating characteristics such as food responsiveness or food phobia, children sleep durations, genetics as well as maternal factors were not investigated. Because of the above-mentioned limitations, the results of the study should not be generalized to the wider population, but should be interpreted only in the context of the children and caregivers in ECDs listed in the study.

CONCLUSION

The study highlights the burden of overnutrition and undernutrition amongst children aged 2-5 years in South African preschools. Therefore, assessment of the nutritional status of children attending ECDs is crucial, to be able to identify children at risk of malnutrition and to prioritize allocation of resources in the different areas. Nutritional screening of children in ECDs by health care workers during community outreach programmes is recommended at least twice a year, to identify children at risk of malnutrition and to refer them to health facilities for further management.

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Table 1: Descriptive characteristics of participants

Characteristics		N		%
Age (years)				
	Soshanguve ECD	n=325		
2 years		27		8.3
3 years		64		19.7
4 years		121		37.2
5 years		135		41.5
	Moretele ECD	n= 284		
2 years		15		5.3
3 years		67		23.6
4 years		107		37.7
5 years		95		33.5
	Makhuduthamaga ECD	n=261		
2 years		27		10.3
3 years		135		51.7
4 years		121		46
5 years		64		25.5
Gender				
Males		422		48
Females		450		52

Table 2: BMI of children, age, ECD area, and gender

Variables	BMI				Total	P-value
	Not overweight		Overweight			
Age of infant	N	%	N	%	0.007	
2 years	54	74	19	26	73	
3 years	179	88	25	12	204	
4 years	297	90	34	10	331	
5 years	233	88	31	12	264	
ECD area	N	%	N	%	0.000	
Soshanguve	292	90	33	10	325	
Makhuduthamaga	209	80	52	20	261	
Moretele	262	92	24	8	286	
Gender	N	%	N	%	0.818	
Male	369	87	54	13	423	
Female	394	88	55	12	446	

REFERENCES

1. **Kpurkpur T, Abubakar MS, Ucheh BI, Achadu AE and NH Madugu** Nutritional status of preschool children in a semi-urban area of Benue State, Nigeria. *Afr. Journ. Biom.* 2017; **20**:145-149.
2. **Hayse A, Chevalier A, Souza M, Baur L, Wen LM and J Simpson** Early childhood obesity: Association with healthcare expenditure in Australia. *Journ. Clin. Nutr.* 2016; **24(8)**:1752-1758.
3. **Black MM, Walker SP, Fernald LCH, Anderson CT, DiGirolano AM, Lu C, McCoy DC, Fink G, Shawar YR, Shiffman J, Devercelli AE, Wodon QT, Vargas-Barón E and S Grantham-McGregor** Early childhood coming of age, Science through the life-course. *Lanc.* 2016; **10(16)**:1-9.
4. **Ritcher LM, Tomlinson M, Watt K, Hunt X and EH Lindland** Early means early: understanding popular understandings of early childhood development in South Africa. *Intern. Res. Journ.* 2019; **39(3)**: 295-309.
5. **Daniels SR and AS Kelly** Paediatric severe obesity, time to establish serious treatments for a serious disease. *Child Obes.* 2014; **10**: 283-284.
6. **Dessie ZB, Fentie M, Abebe Z, Ayele TA and KF Munchie** Maternal characteristics and nutritional status among 6-59 months of children in Ethiopia. *BMC Ped.* 2019; **19(83)**: 1-20.
7. **United Nations Children's Fund.** Levels and Trends in Child Malnutrition: Key Findings of the 2019 Edition of the Joint Child Malnutrition Estimates. Available at www.who.int/nutgrowthdb/jme-2019 (Accessed in August 2020).
8. **Campbell RK, Aguago VM, Kang Y, Dzed L, Josji V, Waid J, Gupta SD, Haselow N and KP West** Infant and young child feeding practices and nutritional status in Bhutan. *Matern. & Child Hea. Nutr.* 2018; **14**:1-6.
9. **Akseer N, Bhatti Z, Mashal T, Soofi S, Moineddin R, Black RE and Z Bhutta** Geospatial inequalities and determinants of nutritional status among women and children in Afghanistan. *Lanc. Glob. Hea.* 2018; **6**:447-458.
10. **Allender S, Millar L, Hovmand P, Bell C, Moodie M, Carter R, Swinburn B, Strugnell C, Lowe J, Haye K, Orellana L and S Morgan** WHO STOPS Childhood obesity. *Intern. Journ. Env. Pub. Hea.* 2016; **13(11)**: 1143-1153.
11. **Akombi BJ, Agho KE, Merom D, Renzaho AM and JJ Hall** Child malnutrition in sub-Saharan Africa: a meta-analysis of demographic and health survey (2006-2016). *Plos One*, 2017; 121-129.

12. **Tluway FD, Leyna GH and EJ Mmbaga** Magnitude and factors associated with overweight and obesity among children in a semi-rural area of Babati District. *Tanz. Journ. Hea. Res.* 2020; **20**(2): 1-9.
13. **Gebremedhin S** Prevalence and differentials of overweight and obesity in preschool children in Sub-Saharan Africa. *Brit. Med Journ.* 2015; **5**(12): 1-10.
14. **Rose ES, Blevins M, González-Calvo L, Ndatimana E, AF Green, Lopez M, Olupona O, Vermund SH and TD Moon** Determinants of undernutrition among children aged 6 to 59 months in rural Zambézia Province, Mozambique: results of two population-based serial cross-sectional surveys. *BMC Nutr.* 2015; **1**(41):1-10.
15. **Madiba S, Chelule PK and MM Mokgatle** Attending informal preschools and daycare centers is a risk factor for underweight, stunting, and wasting in children under the age of five years in underprivileged communities in South Africa. *Int. Journ. Envir. Res. Pub. Hea.* 2019; **16** (2589):1-13.
16. **International Food Policy Research Institute.** Global Nutrition Report, 2016; Available from www.ifpri.org/global-nutrition-report-2016-promise-impact-ending-malnutrition (Accessed in January 2020).
17. **Draper CE, Tomaz SA, Jones RA, Hinkley T, Twine R, Kahn K and SH Norris** Cross-sectional associations of physical activity and gross motor proficiency with adiposity in South African children of preschool age. *Pub. Hea. Nutr.* 2018; **22**(4): 614-623.
18. **Labree W, Van de Mheen D, Rodenburg G, Koopmans G and M Foets** Difference in overweight and obesity among children from migrant and native origin: the role of physical activity, dietary intake and sleep duration. *Plos One.* 2015; **10**:1-11.
19. **Jahns L and S Kranz** High proportions of foods recommended for consumption by United States Dietary Guidelines contain solid fats and added sugar: results from the National Health and Nutrition Examination Survey (2007- 2008). *Nutr. Journ.* 2014; **13**(23):1-10.
20. **Pries AM, Filteau S and EL Ferguson** Snack foods and beverage consumption and young child nutrition in low and middle-income countries. *Matern. & Child Nutr. Journ.* 2019; **15**(4):1-10.
21. **Nzama PF and CE Napier** Nutritional adequacy of menus offered to children of 2-5 years in registered childcare facilities in Inanda, KwaZulu- Natal Province, South Africa. *SA Journ. of Child Hea.* 2017; **11**(2): 80-85.
22. **Motadi SA, Mbhenyane XG, Mbhatsani HV, Mabapa MS and RL Mamabolo** Prevalence of iron and zinc deficiencies among preschool children ages 3 to 5 y in Vhembe district, Limpopo province, South Africa. *Nutr.* 2014; **31**(3): 452-458.

23. **Priorreschi A, Wrottesley S, Draper CE, Tomaz SA, Cook CJ, Watson ED, Van Poppel MNM, Said- Mohamed, Norris SA, Lambert EV and LK Micklesfield** Maternal and early nutrition and physical activity: setting the research and intervention agenda for addressing the double burden of malnutrition in South African children. *Glob. Hea. Act.* 2017; **10(1)**: 1-6.
24. **Kim J, Kim G, Park J, Wang Y and H Lim** Effectiveness of teacher-led nutritional lessons in altering dietary habits and nutritional status in preschool children. *Nutri.* 2019; **11(1590)**: 1-12.
25. **Mack I, Reiband N, Etges C, Eichhorn S, Schaeffeler N, Zurstiege G, Gawrilow C, Weimer K, Peeraully R, Teufel M, Blumenstock G, Giel KE, Junne F and S Zipfel** The kids obesity prevention program. *Journ. Med. Intern. Res.* 2020; **22(4)**: 1-17.
26. **Maatoug J, Ben Fredj S, Msakni Z, Dendana E, Sahli J, Dendana E, Sahli J, Harrabi I, Chouikha F, Boughamoura L, Slama S, Farpour-Lambert N and H Ghannem** Challenges and results of a school-based intervention to manage excess weight among school children in Tunisia 2012-2014. *Intern. Journ. Adoles. Med. Hea.* 2015; **2(10)**:15-35.
27. **Guerra PH, Da Silverira JA and EP Salvador** Physical activity and nutrition education at the school environment aimed at preventing childhood obesity. *Journ. Braz. Peds.* 2015; **92 (1)**:15-23.
28. **Kirsten AP, Marais D and C Schubll** The influence of socio-demographic factors on the nutritional intake of overweight and obese children in Stellenbosch area, Western Cape. *SA Journ. of Clin. Nutri.* 2013; **26(3)**: 124-131.
29. **Shisana O, Labadarios D, Rehle T, Simbayi L and K Zuma** National Health and Nutrition Examination Survey (SANHANES-1), 2016; Cape Town: HSRC Press.
30. **Amadi OF, Ezenwosu OU and OI Odetunde** A Cross-sectional study on nutritional status of preschool-aged children in Enugu urban, Nigeria. *Journ. Exp. Res.* 2018; **6(2)**: 19-26.
31. **Akinpelu AO, Oyewole OO, Odole A and BA Tella** Nutritional status of Nigerian children from the urban community using different reference cut-offs. *Afr. Journ. Bio. Res.* 2014; **17(2)**: 61-67.
32. **Monyeki MA, Awotidebe A, Strydom GL, De Ridder JH, Mamabolo RL and CCG Kemper** The challenges of being underweight and overweight in South Africa children. *Int. Journ. Envir. Res. Pub. Hea.* 2015; **12(2)**: 1156-1173.

33. **Galgamuwa LS, Iddawela D, Dharmaratne SD and GLS Galgamuwa** Nutritional status and correlated socioeconomic factors among preschool and school children in plantation communities, Sri Lanka. *BMC Pub. Hea.* 2017; **17** (377):1-11.
34. **Mushapi LF, Dannhauser A, Walsh CM, Mbhenyane XG and FC Van Rooyen** Effect of a nutrition education programme on nutritional status of children ages 3-5 years in Limpopo Province, South Africa. *SA Journ. Child Hea.* 2015; **9**(3):98-102.
35. **Symington E, Gericke GJ, Nel JH and D Labadarios** The relationship between stunting and overweight among children from South Africa. *SA Med. Journ.* 2016; **106**(1): 65-69.
36. **Nyati LH, Pettifor JM and SN Norris** The prevalence of malnutrition and growth percentiles for urban South African children. *BMC Pub. Hea.* 2019; **19**(412): 1-13.
37. **Said-Mohamed R, Micklesfield LK, Pettifor JM and SA Norris** Has the prevalence of stunting in South African children changed in 40 years? *BMC Pub. Hea.* 2015; **15**(534): 1-10.
38. **Vorster HH, Badham J and CS Venter** An introduction to the revised food-based dietary guidelines for South Africa. *SA Journ. Clin. Nutri.* 2013; **26**(3):5-12.
39. **Carson V, Kuzik N, Hunter S, Wiebe SA, Spence JC, Friedman A, Tremblay MS, Slater LG and T Hinkley** Systemic review of sedentary behaviour and cognitive development in early in childhood. *Prev. Med.* 2015; **78**:115-122.
40. **Mardhiah D, Ekayanti I and B Setiawan** The relationship between mothers' nutritional knowledge towards fruits, vegetables consumption kindergarten Salman Jakarta, *KnE Life Scie.* 2019; **3**(1): 47-52.