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Food Intakes and Determinants of Under-5 Health Outcomes in South Africa

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ABSTRACT

Background: Inadequate food intake has been implicated as the major cause of poor nutritional and health outcomes among children under the age of 5. However, little empirical evidence exists on the role of different food classes in promoting good health outcomes among under-5 children. Therefore, this study analysed the effect of food intakes on the occurrence of wasting, stunting and underweight among under-5 children in South Africa.
Subjects and Method: The data were the Demographic and Health Survey (DHS) collected in 2016 with two stage stratified sampling. The z-scores for wasting, stunting and underweight were the indicators of child's health outcomes, which were analysed with logistic regression model.
Results: The logistic regression results revealed that the probability of stunting decreased with being discharged same time with the mother (0.90), residing in wealthy homes (0.90), and being a boy (0.82), but increased with sharing toilet (0.43), and number of children (0.90). In addition, wasting reduced with milk consumption (0.23), high birth weight (1.00) and number of children (1.50). In comparison with Western Cape, a child has 4.92, 7.29, 11.65 and 8.33 higher chances of being underweight when they reside in Kwazulu-Natal, North West, Gauteng and Limpopo province, respectively, while consumption of fruit and vegetables increased underweight.
Conclusion: It can be concluded that there is still a nutritional problem on children under 5 in South Africa. It is recommended that government, especially the health department should advise mothers with child health related matters at clinics and encourage them to breastfeed their children and have recommended diet for them.
Keywords: health outcomes, underweight, stunting, wasting, child.

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BACKGROUND

Malnutrition among children is one the major public health challenges in the world today (World Health Organization, 2021a). The magnitude of this problem is reflected in the Sustainable Development Goals (SDGs), which have some targets on the promotion of child's health by eradicating poverty, malnutrition, and hunger (United Nations, undated). Globally, malnutrition remains a significant development hurdle in an effort towards

the promotion of child's health. Available statistics show that in 2020, 149.2 million under-5 children were stunted, while 45.4 million and 38.9 million were respectively wasted and overweight (World Health Organization, 2021b). It is also pathetic to realize that over the past few years, Africa remains the only continent where the number of stunted children is increasing (World Health Organization, 2021b).

Malnutritional status is caused by inadequate consumption of nutrient dense foods, lack of adequate sanitation practices, and lack of efficient healthcare facilities (Mutisya, 2019). Specifically, poorly managed incidences of diarrhoea and other diseases can adversely affect child's health outcomes (Tibilla, 2007). It should also be noted that imbalances in food nutrients account for 15.9% of total global health problems and more than one third of child mortality (Merchant et al. 2003).

Several socioeconomic factors have been found to influence child's health outcomes. Specifically, stunting was found to be influenced by households' wealth (Darteh, 2014; Mutisya, 2019; Kaur et al, 2008; Groeneveld et al. 2007; Currie et al., 2007), and the age of the child (Nyaruhucha et al., 2006; Kamiya, 2011). Other studies found that the gender of a child influences nutritional outcomes (Lefebvre, 2006), although boys were found to be more susceptible to being stunted (Kandala et al., 2011) and underweight (Kumar et al., 2006). It was also found that children from large households are more susceptible to being underweight (Maganga and Maganga, 2018; Kabubo-Mariara and Ndenge, 2008).

Some empirical studies have demonstrated the role of mother's age at first conception (Allen and Gillespie, 2001; Latham, 2001; Smith et al., 2003), mother's education (Behrman and Déolalikar, 1988; Boccanfuso and Bruce, 2010; Chen, 1986; Sufiyan et al., 2012; Ali et al., 2005; Ukwuani and Suchindran, 2003), mother's employment status (Ssewanyana, 2003), exclusive breastfeeding for the first six months (Dhall and bagga, 1995; Kumar et al., 2006), years of birth intervals (Molitoris et al, 2019), and birth weights (Chungkham et al., 2020). Other causes of child's poor health outcomes are poor feeding habit, lack of adequate access to health care services, incomplete immunization (Charkaborty, 2011; United Nations children's Fund, 2008; Chowdhury et al., 2006; Semba et al, 2007), inadequate access to clean water (Jalan and Ravallion, 2003; Wondimu, 2016), lack of improved sanitation (Dobe, 2014) and the area where the child resides (Hien and Kam, 2008; Kandala et al., 2011).

This paper is adding to existing literature by empirically analysing the effect of food intakes on the health outcomes of under-5 children in South Africa. This is significant for public health policy because adequate nutrition occupies a significant position in facilitating and promoting desirable health outcomes among children.

SUBJECTS AND METHOD

1. Study Design

This study used the data from the 2016 Demographic and Health Survey (DHS). The sampling frame was the 2011 national census enumeration areas that were provided by the Statistics South Africa (SSA).

2. Population and Sample

Two stage stratified sampling procedures were followed with the first stage being sample sizes allocation in proportion to the size of the Primary Sampling Units (PSUs) and the second stage involved systematic sampling of some dwelling units. Comprehensive listing of the dwelling units within the PSUs was carried out between January and March 2016 to facilitate the conduct of systematic sampling. Twenty dwelling units

were selected from each of the PSUs, and questionnaires were allocated to selected subjects within the odd and even dwelling units following some predefined protocols. The data were collected by trained enumerators and experienced supervisors from the Statistics South Africa. The listing identified 15,292 eligible households, of which 13,288 were occupied and 11,083 were successfully interviewed. The study used the file comprising information on children that were less than 5 years of age within each of the households (National Department of Health et al., 2019).

3. Study Variables

The dependent variables were stunting, wasting and underweight, which were generated with z scores. The independent variables were currently breastfeeding, gave child juice, gave child coke, gave child butter, gave child chocolate, gave child snacks, gave child grain, root and tuber, gave child legumes and nuts, gave child meats or flesh, gave child eggs, gave child vitamin A fruits and vegetables, gave child milk and dairy products, gave child fruits and vegetables, child discharged same time with mother, gender of child, covered by health, mother working, provinces, shared toilet, child's birth weight, household's wealth index, mother's years of education, number of living children.

4. Operational Definition of Variables

Food intakes: Any substance that can be eaten or drunk and can provide a certain nutrient(s).

Health outcomes: Manifestation of stunting, wasting and underweight.

5. Study Instrument

The data were collected with structured questionnaires, which were administered by trained enumerators. Sampling was implemented with stratification of each province into three geographical settings: urban, farm, and traditional areas.

6. Data analysis

We used the z-score to compute three indicators of child's health outcomes. These are wasting, stunting and underweight. Conventionally, a cut-off point of -2 standard deviation is the most commonly adopted cut off for all nutrition indicators. Consequently, children with weight-for-height z-scores less than -2 standard deviation WHO Child Growth Standards median are wasting, those with weight-for-age z-scores less than -2 standard deviation WHO Child Growth Standards median are underweight and those with height-for-age z-scores less than -2 standard deviation WHO Child Growth Standards median are stunting. The z-scores were generated using the procedures provided by the zscore06 command invoked in STATA 17 software. The determinants of child's health outcomes were analysed with logistic regression (Sperandei, 2014).

7. Research Ethics

The study observed ethical approval from the Ethics Committee of the Faculty of Natural and Agricultural Sciences at the North-West University, Mafikeng Campus. Moreover, the ethical mandates for the utilization of DHS datasets were also observed.

RESULTS

1. Children's demographic characteristics

The results in Figure 1 revealed that 71.93%, 40.24% and 1.25% of the 0-5, 6-23 and 24-59 old children were breastfeeding, respectively. It also revealed that 3.48% of the 0-5 children were drinking juice, which can be compared to 32.32% for 6-23 and 3.81% for 24-59. The children who were consuming coke constituted 0.53% of the 0-5, 15.62% of the 6-23, and 1.47% of the 24-59. The Figure further shows that 1.34% of the 0-5, 25.05% of the 6-23 and 2.61% of 24-59 were consuming butter. In addition, chocolates were consumed by 0.53% of 0-5, 31.78% of 6-23

and 3.27% of 24-59. Snacks were consumed by 0.80% of the 0-5, 38.61% of 6-23, and 4.25% of 24-59. Legumes and nuts were consumed by 0.8% of 0-5, 14.53% of 6-23 and 1.52% of 24-59.

2. Distribution of Health Outcomes Among the Children

Figure 2 presents the results of height-for-age, weight-for-age and weight-for-height among under-5 children. The results revealed that among the 0-5, 26.00% were stunted, compared to 24.00% and 22.00% of the 6-23- and 24-59, respectively. Regarding wasting, the figure shows that 53.00% of the 24-59 were wasted. Moreover, 30.00% of the 0-5 were wasted. Underweight was most prevalent among the 6-23 with 26%, compared to the 0-5 with 25.00% and 24-59 with 21.00%.

3. Determinants of Child's Health Outcomes (0-5 months)

Table 1 presents the results of logistic regression for 0-5 children. It shows that being discharged at the same time with the mothers significantly decreased the chance of being stunted by 90% ($p<0.05$). This is expected and in line with the finding of Jones et al. 2(021). A boy child possessed 82% significantly ($p<0.05$) less chance of being stunted.

4. Determinants of Child's Health Outcomes (6-23 months)

Table 2 shows that breastfed 6-23 children were 50% less likely to be stunted.

5. Determinants of Child Health Outcomes (24-59 months)

Table 3 presents the results for 24-59 children. It reveals that consumption of legumes and nuts decreased the chances of stunting by about 95%.

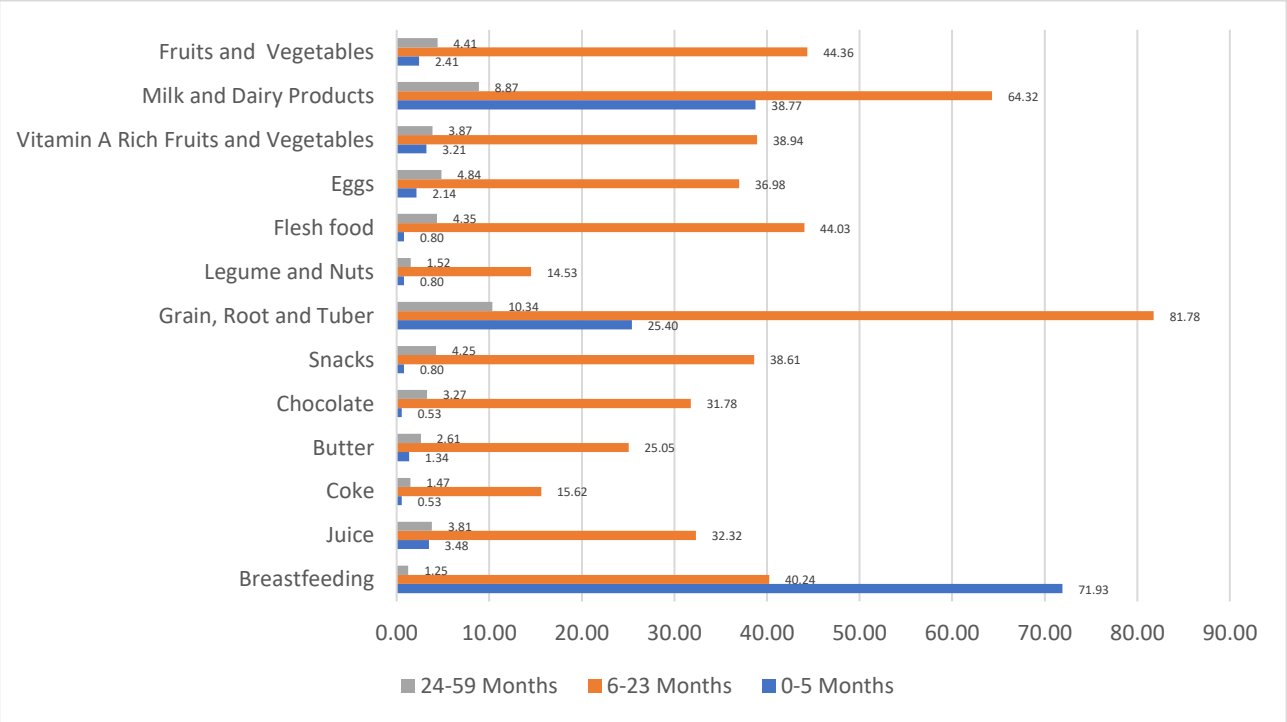

Figure 1. Distribution of Food Products Consumed by the Children Across Their Age Groups

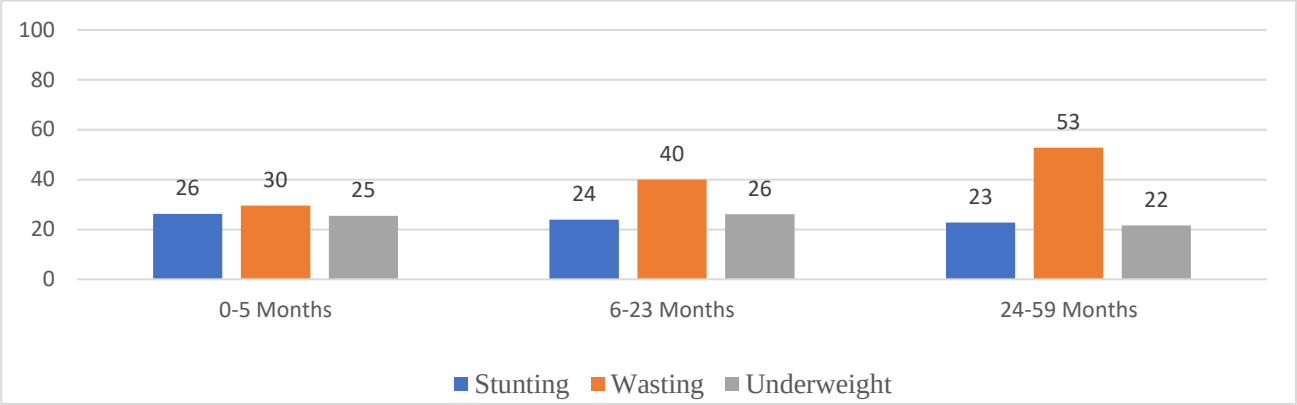

Figure 2. Percentage Distribution of Children's Health Outcomes

Table 1. Logistic regression results on the determinants of health outcomes among 0-5 months old children

Variables	Stunting		Wasting		Underweight	
	OR	p	OR	p	OR	p
Breastfeeding	3.31	0.328	0.57	0.480	0.96	0.963
Juice	1		1		1	
Coke	1		1		1	
Butter	1		1		1	
Chocolate	1		1		1	
Snacks	1		1		1	
Grains, roots and tubers	0.31	0.228	0.83	0.780	1.83	0.395
Legume and Nuts	1		1		1	
Flesh Foods	1		1		1	
Eggs	1		1		1	
Vitamin A Rich Fruits and Vegetables	1		1		1	
Milk and Dairy Products	0.67	0.560	0.23	0.042	0.18	0.022
Fruits and Vegetables	1		1		1	
Discharged same time	0.09	0.033	0.34	0.248	0.47	0.437
Male Child	0.18	0.017	0.83	0.724	1.19	0.752
Health Insured	34.53	0.006	2.61	0.287	0.74	0.757
Employed	0.37	0.321	0.59	0.508	1.25	0.765
Province						
Western Cape	1		1		1	
Eastern Cape	1.71	0.701	0.63	0.652	2.19	0.474
Northern Cape	19.70	0.048	1.95	0.532	2.07	0.496
Free State	42.89	0.015	0.87	0.899	1.78	0.622
KwaZulu-Natal	8.14	0.109	0.79	0.811	1.19	0.872
North West	1.38	0.836	0.91	0.924	0.99	1.000
Gauteng	70.42	0.011	1.08	0.948	1.69	0.654
Mpumalanga	4.96	0.250	1.33	0.772	0.39	0.487
Limpopo	1		1		1	
Urban residence	0.33	0.154	0.71	0.605	1.88	0.349
Shared Toilet	1.43	0.043	0.93	0.663	0.90	0.560
Birth Weight	0.99	0.111	0.99	0.001	0.99	0.190
Wealth Index	0.99	0.045	1.00	0.759	1.00	0.482
Number of Living Children	1.67	0.045	1.55*	0.062	1.37	0.201
Constant	6.72	0.438	315.66	0.009	1.23	0.922
LR Chi2 (19)	41.57		26.55		21.68	
Prob> Chi2		0.002		0.116		0.301

Table 2. Logistic regression results on the determinants of health outcomes among 6-23 months old children

Variables	Stunting		Wasting		Underweight	
	OR	p	OR	p	OR	p
Breastfeeding	0.50	0.048	1.07	0.835	1.00	0.989
Juice	0.64	0.255	0.84	0.637	0.76	0.417
Coke	2.04	0.130	0.47	0.131	1.73	0.194
Butter	1.84	0.128	0.78	0.555	1.68	0.169
Chocolate	0.51	0.147	1.08	0.871	0.79	0.570
Snacks	1.01	0.978	1.13	0.740	0.46	0.031
Grain root butter	0.94	0.912	2.34	0.124	0.57	0.229
Legume nuts	0.67	0.384	0.54	0.249	0.88	0.773
Flesh Food	1.62	0.198	0.95	0.871	0.96	0.904
Eggs	1.82	0.143	0.84	0.655	1.29	0.487
Vitamin A fruits and Vegetables	0.90	0.778	1.51	0.229	2.15	0.021
Dairy milk	0.54	0.097	1.01	0.975	0.99	0.990
Fruit and vegs	0.77	0.557	0.69	0.351	0.53	0.086
Discharged same time	0.47	0.133	1.85	0.290	0.49	0.123
Male Child	2.12	0.022	1.26	0.451	1.42	0.213
Insure	0.34	0.148	1.87	0.288	0.77	0.642
Employed	0.53	0.156	0.89	0.781	0.65	0.238
Province						
Eastern Cape	0.16	0.033	0.68	0.646	1.68	0.584
Northern Cape	0.37	0.281	1.63	0.575	1.94	0.510
Free State	0.23	0.100	0.28	0.185	4.18	0.136
KwaZulu-Natal	0.48	0.355	0.62	0.557	4.92	0.081
North West	0.44	0.325	1.54	0.604	7.29	0.033
Gauteng	0.39	0.267	1.14	0.873	11.65	0.009
Mpumalanga	0.08	0.007	1.14	0.870	2.85	0.263
Limpopo	0.15	0.030	2.48	0.282	8.33	0.025
Urban resident	0.95	0.907	2.38	0.026	1.39	0.348
Share toilet	1.32	0.209	0.34	0.028	0.78	0.322
Birth weight	0.99	0.001	0.99	0.237	0.99	<0.001
Years of education	0.87	0.015	1.05	0.532	0.85	0.014
Number of living children	1.16	0.216	1.21	0.084	1.24	0.039
Constant	118.05	0.001	0.06	0.066	27.14	0.021
LR Chi2 (30)	66.28		46.33		77.84	
Prob> chi2		<0.001		0.028		<0.001

DISCUSSION

Determinants of Child's Health Outcomes (0-5 months)

Table 1 presents the results of logistic regression for 0-5 children. It shows that being discharged at the same time with the mothers significantly decreased the chance of being stunted by 90% ($p<0.05$). This is expected and in line with the finding of Jones et al. 2(021). A boy child possessed 82% significantly ($p<0.05$) less chance of being stunted. This is in line with findings of Sapkota and Gurung (2009) but contrary to those of Lesiapeto et al. (2010), Khan et al. (2019) and Blankenship et al. (2020). Contrary to expectation, medically insured children were 34.5 times more likely to be stunted (Nshakira-Rukundo et al. (2020); Chen and Chu, 2019).

Also, with reference to Western Cape, a child has 19.7, 42.9, and 70.5 higher chances of being stunted when residing in the Northern Cape, Free-State and Gauteng provinces, respectively. Similarly, Sambu (2019) showed that stunting was highest in the Gauteng and Free State provinces.

The results further showed a 1.43 higher chance of stunting for children who were resident in a household where toilets are shared with other households. Omotayo (2018) noted that toilet sharing can predispose children to infections that may lead to poor health. In line with Habyarimana et al. (2016), wealth index reduced stunting by 0.0001%. Also, the results conformed with Raj et al. (2016) given that the number of children in a household increased stunting by 1.7 times.

Table 3. Logistic regression results on the determinants of health outcomes among 24-59 months old children

Variables	Stunting		Wasting		Underweight	
	OR	p	OR	p	OR	p
Breastfeeding	2.29	0.359	0.34	0.209	1	
Juice	3.69	0.161	2.71	0.184	1.98	0.368
Coke	0.15	0.239	0.10*	0.074	0.69	0.779
Butter	0.18	0.247	0.48	0.481	0.14	0.157
Chocolate	4.08	0.270	3.96	0.238	2.41	0.504
Snacks	0.84	0.874	3.22	0.165	0.65	0.648
Grain root butter	0.60	0.406	0.87	0.794	1.50	0.470
Legume nuts	0.05*	0.075	3.16	0.339	9.44	0.102
Flesh Food	0.78	0.832	0.59	0.587	0.39	0.437
Eggs	2.54	0.297	0.42	0.254	1.08	0.934
Vitamin A fruit and vegs	0.22	0.248	0.71	0.758	1.86	0.521
Dairy milk	0.37	0.146	0.67	0.451	0.76	0.662
Fruit and vegs	35.54***	0.007	0.76	0.784	0.91	0.950
Discharged same time	0.67	0.165	0.61*	0.069	1.01	0.961
Child sex	1.11	0.636	0.90	0.589	0.87	0.523
Insure	0.65	0.351	1.00	0.991	1.12	0.780
Employed	0.93	0.784	0.62**	0.022	0.41***	0.002
Province						
Western Cape	1					
Eastern Cape	1.22	0.636	0.96	0.942	0.54	0.338
Northern Cape	0.94	0.906	1.59	0.407	0.43	0.212
Free State	2.37*	0.071	0.99	0.995	0.42	0.181
KwaZulu-Natal	1.96*	0.094	0.67	0.463	0.26**	0.045
North West	1.30	0.547	1.29	0.643	0.78	0.704
Gauteng	1.66	0.332	1.71	0.340	0.49	0.297
Mpumalanga	0.95	0.900	1.52	0.434	0.49	0.265
Limpopo	1	Empty	1.74	0.322	0.88	0.850
Urban resident	0.55**	0.029	0.71	0.124	1.04	0.877
Share toilet	0.84	0.121	0.90	0.153	0.88	0.242
Birth weight	0.99***	<0.001	0.99***	0.000	0.99***	<0.001
Years of education	0.92**	0.044	0.95	0.162	0.97	0.537
Number of living children	1.06	0.504	1.06	0.413	1.07	0.396
Constant	7.87**	0.019	109.68***	0.000	15.46	0.013
LR Chi2 (29)	68.75***		100.10***		66.06***	
Prob > Chi2		<0.001		<0.001		<0.001

The results further revealed a 77% reduction in the chance of being wasted when a child consumes dairy milk. This is contrast to submissions that 0-5 children cannot digest dairy milk as they can do for breast milk or formula foods. Also, there is 0.002% less chance of wasting as the birth weight increases by 1kg. This is in line with Abbas (2021), who found that children with low birth weight had the highest odds of being wasted. Also, the chance of wasting increased by 1.5 times as the household size increases by one.

The model for underweight among 0-5 reveals that only one parameter is statistically significant at 5% level. The result showed that the children who were consuming milk and other dairy products had about 33% less chance of being underweight. This is in line with Nguyen et al. (2018) who reported a lower risk of underweight with dairy consumption.

Determinants of Child's Health Outcomes (6-23 months)

Table 2 shows that breastfed 6-23 children were 50% less likely to be stunted. This is in line with the finding of Muldiasman et al. (2018). Furthermore, in line with the findings of Nguyen et al. (2018), 6-23 children who consumed dairy milk had 46% lower chance of being stunted. The results also revealed that in line with the findings of Ali et al. (2017) and Khan et al. (2019), a boy child had 2.12 higher chance of being stunted. There are 80%, 90% and 80% lower chances of being stunted when a 6-23 child resides in Eastern Cape, Mpumalanga, and Limpopo provinces, respectively. There is also a 90% lower chance of being stunted as the child's birthweight increases by 1kg. This conforms with the findings of Aryastami (2017). In addition, in line with the submission of Abuya et al. (2012), a child has 15% lower chance of being stunted as the mother's years of education increase.

Table 2 also presents the results pertaining to wasting of 6-23 children. It shows that urban children had 4.45 lower chance of being wasted. This is in line with those of Kang et al (2018) and Banerjee et al (2021). In compliance with the results of Sinha et al. (2018), a child who resides in a household where toilets are shared had 66% lower chance of being wasted. In addition, as the number of living children increased, the likelihood of being wasted increased by 1.21 times.

Table 2 further showed the determinants of underweight among 6-23 children. The results showed that a child who consumes snacks had 54% less chance of being underweight. Contrary to the findings of Khamis et al. (2019) and Ali et al. (2017), a child who consumes vitamin A rich fruits and vegetables had 2.14 higher chance of being underweight. However, Semba et al. (2010) noted that a child who consumes vitamin A rich foods and still suffers from underweight may not have met their recommended vitamin A recommended nutrient intake. In addition, in accordance with the findings of Abedi et al. (2015), there is 47% less chance of being underweight when a 6-23 child consumes fruits and vegetables.

Table 2 further shows that taking Western Cape as a reference, a children had 4.9, 7.3, 11.6 and 8.3 higher chances of being underweight when they reside in Kwazulu-Natal, North West, Gauteng and Limpopo provinces, respectively. These results are in agreement with those of Bomela (2007). Furthermore, there is a 0.001% less chance of being underweight as the birthweight increases by 1kg. This result is in line with those of Abbas (2021). In addition, as the mothers' years of education increase, there is 14% less chance 6-23 child being underweight. These results are in line with those of Chowdhury et al (2018) and Amaha and Woldeamanuel (2021). In addition, as the number of living

children increased, the chance of being underweight increased by 1.24 times.

Determinants of Child Health Outcomes (24-59 months)

Table 3 presents the results for 24-59 children. It reveals that consumption of legumes and nuts decreased the chances of stunting by about 95%. These results are in line with those of Jager et al. (2019) and Esfarjani et al. (2013). Also, there is 35.5 higher chance of being stunted when a child consumes fruit and vegetables. These results are in line with those of Aguayo et al. (2016). There is also a 2.4 higher chance of being stunted when a child resides in Free-State. Pilditch (2020) previously revealed that stunting was prevalent in the Free State province. The results further revealed that the chance of being stunted increases by 2.0 when a child resides in KwaZulu-Natal province. This is line with the findings of Kaldenbach et al. (2022). The results showed that a child who resided in urban areas had 45% less chances of being stunted ($p<0.05$). This is in line with those of Kang et al. (2018) and Banerjee et al. (2021) who revealed that compared to children in rural areas, children from urban areas had a better nutritional status. Furthermore, as the level of education increases, the child had 8.04% lower chance of being stunted ($p<0.01$). These results are in line with those of Torlesse et al. (2016) and Makoka and Masibo (2015). The results revealed that a child born with normal birth weight had 0 07% less chances of being stunted ($p<0.05$). These results are also in line with those of Aryastami et al. (2017).

Table 3 further shows that consumption of coke reduced the chance of wasting in 24-59 children by 0.1. This may be attributed to high energy composition of sugary drinks (Zhang et al., 2020). Also, a child has 0.6 lower chance of being wasted when discharged from hospital after birth at the same time as the mother. The results also revealed that a child whose mother is employed had 0.6 lower chance of being wasted. This is in line with the findings of Eshete et al. (2017).

In children between 24-59 months, there are 0.74% lower chances of a child being underweight when a child resides in Kwazulu-Natal. In addition, as the birthweight of children 24-59 months increased, there is a 0.001% less chance of being underweight. This can be supported by a study conducted by Machira and Chirwa (2020) who revealed that smaller weight of a child after birth had effect to increase the chance of being underweight.

AUTHOR CONTRIBUTION

Thonaeng Charity Molelekoa: Study's conceptualization and interpretation of results. Abayomi Samuel Oyekale: Contributed towards econometric modeling and data analysis.

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None.

CONFLICT OF INTERESTS

There are no conflicts of interest.

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