International Journal of Health Sciences and Research
www.ijhsr.org ISSN: 2249-9571

Original Research Article

Risk Factors for Obesity and Overfat among Primary School Children in Mashonaland West Province, Zimbabwe

Kambondo George[1], Sartorius B[1], Mhlanga Maxwell[2]

[1]Discipline of Public Health, School of Nursing and Public Health, University of KwaZulu Natal, Durban, South Africa
[2]University of Zimbabwe, College of Health Sciences

Corresponding Author: Mhlanga Maxwell

ABSTRACT

Background: childhood obesity is a major and emerging public health problem in developed and developing countries respectively. Associated risk factors are not well established in developing countries such as Zimbabwe and this information is essential for tailored intervention development. This study aimed to identify prominent risk factors for obesity and overfat among primary school children of Mashonaland West Province in Zimbabwe.
Methods: A school based cross sectional study was conducted using a multi-stage random cluster sampling approach (30x30). Overweight/ obese was defined using international obesity task force (IOTF) classification by Cole 2000 reference (BMI for age >85th -100th centile), and overfatness /obese (>85th centile, McCarthy reference) as outcomes. Bivariate and multivariable logistic regression was employed to identify risk factors for overfat/obese classification.
Results: A total of 974 participants were enrolled. After multivariable adjustment, age and gender were not statistically associated with risk of obesity or over fat. Children in schools in rural areas were significantly less likely to be obese/overfat with significant heterogeneity across the districts within the province. Other prominent risk factors that were identified from the multivariable analyses were higher household SES and when one of the parents had diabetes mellitus. Children with unemployed fathers or father with lower education status were at lower risk of obesity/overfat.
Conclusion: This study has identified prominent high risk determinants of obesity/overfat among primary school children in Zimbabwe. More aggressive interventions should be tailored and targeted to the most affected urban areas within high risk districts. Health education and promotion interventions must target parents with diabetes mellitus to break the parent-child cycle.

Keywords: school children, obesity, risk factors, Zimbabwe

INTRODUCTION

Childhood obesity has been found to be a major public health problem especially in both developed and developing countries. Its impact is being felt by the increase of NCD's morbidity and mortality in adult populations. [1,2] This scenario has contributed to a drastic increase of metabolic syndrome conditions of which obesity is the major risk factor both children and adults. [2] Recent research have demonstrated that diabetes mellitus, cardiovascular diseases, stroke, hypertension, osteoarthritis, respiratory disorders, hyperlipidemia, and certain cancers begin in childhood, of which obesity is a major risk factor. [3-5] Furthermore childhood obesity appears to continue into adulthood in 70% of the cases. [6-11] These conditions lead to impaired quality of life for a prolonged period and contribute to premature mortality. [12] The

World Health Organization (WHO) estimated that globally in 2010, overweight children under the age of five was estimated to be over 43 million and almost 35million (81.4%) of these were living in developing countries mainly in urban setting. [13,14]

Obesity is a complex and multifactorial condition caused by multiple factors. [15-17] Children with a sedentary lifestyle, being a girl, born overweight and from a family with low income or low educational attainment of parents were found to be more at risk to be obese in adulthood. [18-20] Ethnicity of being an African child has been found to be an independent risk factor of childhood obesity as compared to Asian and white/European. [19] These factors have been implicated to individual energy balance due to exposure to high caloric western diet and refined fast food including sedentary lifestyle. [17,21-24]

To the best of our knowledge, few studies have been conducted to identify prominent local risk factors of childhood obesity among primary school children in developing countries such as Zimbabwe. Furthermore risk factor heterogeneity across geographic and SES strata further compound this problem within developing countries. There is growing evidence that childhood obesity can be more effectively averted by interventions compared to adults, thus interventions aiming at modifying risk factors to reduce/prevent childhood obesity in developing settings should be considered. [25]

The prevalence of overfat/obese has been found to be increasing among primary school children in Mashonaland West province in Zimbabwe [26] but modifiable risk factors for overfat/obesity has not been examined to our knowledge. An essential step in the prevention and control of childhood overfat/obese is the identification of locally relevant modifiable risk factors. Understanding the fundamental pathways to childhood obesity will assist in the development of efficient polices and effective preventive interventions against child obesity. This study thus aimed to identify prominent risk factors for overfat/obesity among primary school children in Mashonaland West Province in Zimbabwe.

METHODS

Study setting and sample

A school based cross sectional study was conducted among school- going children aged 6 to 12years in Mashonaland west Province of Zimbabwe with seven administrative Districts. The Provincial town is Chinhoyi and it has an area of approximately 57 441 Km^2. The Province has a population of 1 449 938 of which 65% of the population resides in the rural areas. The Provincial Primary school enrolment is at 310 308 composed of 157 867 males and 152 441 females. The Province has a total of 707 primary schools both government and private schools. Data was collected during the month of September 2015.

Multi stage cluster sampling was under taken to get a representative sample of primary school children aged 6 to 12 years across the province. The first stage of sampling schools was selected with probability proportional to size (PPS) across the five districts within the province. Thirty primary schools from the five strata were having 238 931 primary school children aged 6-12 years.

A sample size of 900 children was required based on the traditional 30x30 cluster survey design which is proposed by WHO for acute malnutrition surveys. [27,28] It assumes a design effect of 2 and it estimates prevalence with ±5% precision at 95% confidence interval width of 10%.Assuming a response rate of 90% the total sample size was increased to 990. Within each selected school, children were randomly selected from each class register and all children selected were invited to participate into the study. A total of 974 children were recruited i.e. a response rate of 98%. One grade seven class from Karoi School was excluded as the consent forms were issued to children who were perceived to be obese only.

Data collection

All data were entered using Epidata version 3.1 software [29] with built in validation checks.

Anthropometric measurements

Anthropometric measurements were conducted by trained nurses, environmental health technicians and a physiotherapist during the morning break and afternoon lunch time. The participants' height, weight, MUAC, waist circumference, hip circumference and % body fat were taken while observing standard precautions. [30,31]

Overweight/obese was defined in the present study using IOTF classification by Cole 2000 reference where BMI for age percentiles were normal weight, included who were underweight and healthy weight at BMI for age of below 84.9th percentile, overweight BMI for age of 85th -94.9th percentile and obese at BMI for age between 95th -100th percentile. [32]

Overfat was described using McCarthy 2006 body fat reference curves for school children and bio impedance (TANITA SC240MA) analysis scale was used. Over fatness in this study was defined using cut-offs for excess fatness that were age and sex specific and defined as 85th percentile of body fat % between 19.5-22.7% as overfat for males and 23-25.2% as overfat for females respectively from McCarthy reference 2006. [33] The descriptive statistics for body fat are classified Normal, overfat and obese; Normal includes individuals who were either under fat or healthy.

The agreement of the methods used on BMI for age percentiles (IOTF Cole, 2000) and overfat (McCarthy, 2006) was evaluated by Kappa (K) statistic and the agreement was very high at 86.55% [expected agreement = 73.29 % at $p<0.001$].

Socio-demographic information

A structured questionnaire was used to collect socio-demographic and detailed risk factor information from the participating school children. This was administered by trained research assistants. The following information was collected for example: age group, gender, district, location, religion, educational/occupational status of parents or guardians, socio-economic status, number of siblings and parental diabetes status.

Statistical Analysis

All statistical analysis were performed using STATA 13.0. [34] Survey weights were incorporated into the analysis given the complex multistage sampling design. Association between the outcome variables association with both BMI for age by (IOTF) and over fatness by (McCarthy, 2006) and categorical variables were compared using a survey weight chi-square (χ^2) test or Fisher's exact test. Odds ratios OR and their 95% confidence interval (CI) were estimated in Bivariate and multivariable analyses to investigate all potential risk factors of childhood obesity. An adjusted p-value of <0.05 was deemed statistically significant.

Ethics

Ethical clearance was approved by the biomedical research ethics committee, University of KwaZulu Natal (BE074/15) and medical research council of Zimbabwe (MRCZ\A\1972). Written informed consent was obtained from parents or guardians including written authority from the ministry of primary and secondary education and each participating school head. Assent was also obtained from the participants.

Confidentiality of information was adhered to by using unique identification numbers on the data collection tools. Questionnaires after each field visit were locked in a cabinet at the Provincial medical officers' offices and were accessible to the researchers only.

RESULTS

A total of 974 children participated in this cross-sectional study and anthropometric measurements taken. [26] The

average age of participants was 10 years with a median age of 9 years (range 6-12 years). All were of the black African Zimbabweans nationality, and the gender distribution was 463 (48%) males and 511(52%) females.

Table (1) Descriptive characteristics of overweight/obese and overfat/obese study of school children, as defined by IOTF Cole, 2000 BMI-for –age reference and McCarthy 2006 body fat reference [32,33]

Characteristics: n=974 (% i)			Overweight defined from BMI with IOTF reference				Overfat defined from bioelectrical impedance with the McCarthy reference			
	Category	Total (N=974) ii	Normal (N=840)	Overweight (N=59)	Obese (N=75)	p-value	Normal (N=815)	Overfat (N=75)	Obese (N=84)	p-value
Age group	6 years	19 (1.95)	14 (73.68)	3 (15.79)	2 (10.53)	0.013	17 (89.47)	1 (5.26)	1 (5.26)	0.001
	7-9 years	246 (25.26)	200 (81.3)	18 (7.32)	28 (11.38)		185 (75.2)	26 (10.57)	35 (14.23)	
	10-12 years	709 (72.79)	626 (88.29)	38 (5.36)	45 (6.35)		613 (86.46)	48 (6.77)	48 (6.77)	
Gender	Male	463 (47.54)	402 (86.83)	27 (5.83)	34 (7.34)	0.88	399 (86.18)	33 (7.13)	31 (6.7)	0.089
	Female	511 (52.46)	438 (85.71)	32 (6.26)	41 (8.02)		416 (81.41)	42 (8.22)	53 (10.37)	
District	Hurungwe	164 (16.84)	163 (99.39)	0 (0)	1 (0.61)	<0.001	156 (95.12)	7 (4.27)	1 (0.61)	<0.001
	Makonde	452 (46.41)	365 (80.75)	38 (8.41)	49 (10.84)		367 (81.19)	25 (5.53)	60 (13.27)	
	Mhondoro-Ngezi	99 (10.16)	83 (83.84)	9 (9.09)	7 (7.07)		89 (89.9)	6 (6.06)	4 (4.04)	
	Sanyati	99 (10.16)	82 (82.83)	8 (8.08)	9 (9.09)		80 (80.81)	12 (12.12)	7 (7.07)	
	Zvimba	160 (16.43)	147 (91.88)	4 (2.5)	9 (5.63)		123 (76.88)	25 (15.63)	12 (7.5)	
Location	Urban	538 (55.24)	426 (79.18)	42 (7.81)	70 (13.01)	<0.001	412 (76.58)	52 (9.67)	74 (13.75)	<0.001
	Rural	436 (44.76)	414 (94.95)	17 (3.9)	5 (1.15)		403 (92.43)	23(5.28)	10 (2.29)	
Religion	None	40 (4.11)	36 (90)	4 (10)	0 (0)	0.008	37 (92.5)	3 (7.5)	0 (0)	<0.001
	Catholic	85 (8.73)	71 (83.53)	5 (5.88)	9 (10.59)		68 (80)	7 (8.24)	10 (11.76)	
	Protestant	265 (27.21)	221 (83.4)	15 (5.66)	29 (10.94)		217 (81.89)	21 (7.92)	27 (10.19)	
	Traditional	18 (1.85)	13 (72.22)	1 (5.56)	4 (22.22)		10 (55.56)	1 (5.56)	7 (38.89)	
	Apostolic	295 (30.29)	270 (91.53)	15 (5.08)	10 (3.39)		265 (89.83)	14 (4.75)	16 (5.42)	
	Pentecostal	271 (27.82)	229 (84.5)	19 (7.01)	23 (8.49)		218 (80.44)	29 (10.7)	24 (8.86)	
Mother's education	None	35 (3.59)	32 (91.43)	1 (2.86)	2 (5.71)	<0.001	31 (88.57)	2 (5.71)	2 (5.71)	<0.001
	Primary	144 (14.78)	130 (90.28)	7 (4.86)	7 (4.86)		126 (87.5)	11 (7.64)	7 (4.86)	
	Secondary	665 (68.28)	583 (87.67)	41 (6.17)	41 (6.17)		566 (85.11)	49 (7.37)	50 (7.52)	
	Tertiary	111 (11.4)	76 (68.47)	10 (9.01)	25 (22.52)		73 (65.77)	13 (11.71)	25 (22.52)	
Mother Occupation	Formally employed	231 (23.72)	182 (78.79)	18 (7.79)	31 (13.42)	0.001	172 (74.46)	26 (11.26)	33 (14.29)	0.002
	Self employed	228 (23.41)	204 (89.47)	13 (5.7)	11 (4.82)		194 (85.09)	19 (8.33)	15 (6.58)	
	Unemployed	136 (13.96)	128 (94.12)	3 (2.21)	5 (3.68)		123 (90.44)	6 (4.41)	7 (5.15)	
	House wife	360 (36.96)	307 (85.28)	25 (6.94)	28 (7.78)		307 (85.28)	24 (6.67)	29 (8.06)	
Father Educational level	None	23 (2.36)	20 (86.96)	0 (0)	3 (13.04)	<0.001	17 (73.91)	3 (13.04)	3 (13.04)	0.005
	Primary	53 (5.44)	52 (98.11)	1 (1.89)	0 (0)		49 (92.45)	4 (7.55)	0 (0)	
	Secondary	683 (70.12)	604 (88.43)	38 (5.56)	41 (6)		584 (85.51)	47 (6.88)	52 (7.61)	
	Tertiary	165 (16.94)	125 (75.76)	15 (9.09)	25 (15.15)		123 (74.55)	18 (10.91)	24 (14.55)	
	Died	50 (5.13)	39 (78)	5 (10)	6 (12)		42 (84)	3 (6)	5 (10)	
Father Occupation	Formally employed	486 (49.9)	401 (82.51)	36 (7.41)	49 (10.08)	<0.001	375 (77.16)	52 (10.7)	59 (12.14)	<0.001
	Self employed	313 (32.14)	276 (88.18)	17 (5.43)	20 (6.39)		279 (89.14)	14 (4.47)	20 (6.39)	

Table 1 to be continued…										
	Unemployed	125 (12.83)	124 (99.2)	1 (0.8)	0 (0)		119 (95.2)	6 (4.8)	0 (0)	
	Died	50 (5.13)	39 (78)	5 (10)	6 (12)		42 (84)	3 (6)	5 (10)	
Number of siblings	One	43 (4.41)	30 (69.77)	4 (9.3)	9 (20.93)	0.002	31 (72.09)	5 (11.63)	7 (16.28)	0.006
	Two-four	659 (67.66)	562 (85.28)	45 (6.83)	52 (7.89)		539 (81.79)	56 (8.5)	64 (9.71)	
	>5	272 (27.93)	248 (91.18)	10 (3.68)	14 (5.15)		245 (90.07)	14 (5.15)	13 (4.78)	
Socio-economic status	≤$200 Low	547 (56.16)	503 (91.96)	21 (3.84)	23 (4.2)	<0.001	488 (89.21)	35 (6.4)	24 (4.39)	<0.001
	$201-$500 Medium	254 (26.08)	216 (85.04)	20 (7.87)	18 (7.09)		212 (83.46)	17 (6.69)	25 (9.84)	
	≥$501	173 (17.76)	121 (69.94)	18 (10.4)	34 (19.65)		115 (66.47)	23 (13.29)	35 (20.23)	
Mother Vital status	Alive	955 (98.05)	821 (85.97)	59 (6.18)	75 (7.85)	0.429	796 (83.35)	75 (7.85)	84 (8.8)	0.197
	Dead	19 (1.95)	19 (100)	0 (0)	0 (0)		19 (100)	0 (0)	0 (0)	
Parental Diabetes status	No	941 (96.61)	818 (86.93)	55 (5.84)	68 (7.23)	0.004	794 (84.38)	73 (7.76)	74 (7.86)	0.001
	Yes	33 (3.39)	22 (66.67)	4 (12.12)	7 (21.21)		21 (63.64)	2 (6.06)	10 (30.3)	
i: row percentage; ii: column percentage										

Table (2) Bivariate and Multivariable regression analysis of primary school children demographics to analyse risk of overweight, defined from BMI with IOTF (Cole 2000), BMI for age reference [32]

Overweight regression analysis					
		Bivariate		Multivariable	
Characteristics: n=974 (% i)	Category	COR (95% CI)	p-value	AOR (95% CI)	p-value
Age group	6 years	1 (ref)		1 (ref)	
	7-9 years	0.64 (0.22-1.88)	0.42	0.64(0.19-2.80)	0.642
	10-12 years	0.37 (0.13-1.06)	0.063	0.33(0.09-1.26)	0.106
Gender	Male	1 (ref)		1 (ref)	
	Female	1.1 (0.76-1.58)	0.615	1.06(0.70-1.60)	0.767
District	Hurungwe	1 (ref)		1 (ref)	
	Makonde	38.85 (5.37-281.35)	0.001	27.43(3.66-205.50)	0.001
	Mhondoro-Ngezi	31.42 (4.1-241.05)	0.001	21.81(2.68-177.27)	0.004
	Sanyati	33.79 (4.42-258.37)	0.001	26.50(3.30-212.57)	0.002
	Zvimba	14.41 (1.86-111.54)	0.011	11.06(1.36-89.73)	0.024
Location	Urban	1 (ref)		1 (ref)	
	Rural	0.35 (0.23-0.52)	0.001	0.57(0.35-0.95)	0.031
Religion	None	1 (ref)		1 (ref)	
	Catholic	1.77 (0.54-5.78)	0.341	0.77(0.19-3.12)	0.719
	Protestant	1.79 (0.61-5.29)	0.291	0.64(0.18-2.30)	0.500
	Traditional	3.46 (0.8-14.9)	0.095	1.64(0.27-9.78)	0.588
	Apostolic	0.83 (0.27-2.53)	0.748	0.53(0.14-1.93)	0.333
	Pentecostal	1.65 (0.56-4.88)	0.365	0.76(0.21-2.75)	0.678
Mother educational	None	1 (ref)		1 (ref)	
	Primary	1.15 (0.31-4.24)	0.835	1.23(0.28-5.33)	0.782
	Secondary	1.5 (0.45-5.01)	0.51	1.00(0.26-3.93)	0.998
	Tertiary	4.91 (1.41-17.13)	0.013	1.14(0.24-5.34)	0.865
Mother occupation	Formally employed	1 (ref)		1 (ref)	
	Self employed	0.44 (0.26-0.74)	0.002	0.85 (0.41-1.77)	0.667
	Unemployed	0.23 (0.11-0.51)	0.001	0.54(0.21-1.36)	0.193
	House wife	0.64 (0.42-0.99)	0.043	1.33 (0.71-2.50)	0.372
Father Educational level	None	1 (ref)		1 (ref)	
	Primary	0.13 (0.01-1.31)	0.083	0.12 (0.01-1.50)	0.100
	Secondary	0.87 (0.25-3)	0.828	0.62 (0.14-2.72)	0.528
	Tertiary	2.13 (0.6-7.56)	0.24	0.62 (0.13-2.91)	0.548
Father Occupation	Formally employed	1 (ref)		1 (ref)	
	Self employed	0.63 (0.42-0.96)	0.031	1.06(0.63-1.76)	0.832
	Unemployed	0.04 (0.01-0.28)	0.001	0.07(0.01-0.54)	0.011
Number of siblings in the family	One	1 (ref)		1 (ref)	
	two -four	0.4 (0.2-0.79)	0.008	0.59(0.25-1.40)	0.229
	>5	0.22 (0.1-0.48)	0.001	0.39(0.15-1.01)	0.053
Socio-economic status	≤$200 Low	1 (ref)		1 (ref)	
	$201-$500 Medium	2.01 (1.27-3.19)	0.003	0.96(0.55-1.68)	0.893
	≥$501	4.91 (3.14-7.69)	0.001	2.03(1.03-3.96)	0.038
Mother vital status	Alive	1 (ref)		1 (ref)	
	Dead			omitted	omitted
Parental Diabetes Status	No	1 (ref)		1 (ref)	
	Yes	3.33 (1.57-7.03)	0.002	3.12(1.25-7.83)	0.015

Table (3) Bivariate and Multivariable regression analysis of primary school children demographics to analyse risk of overfatness, defined from Bioelectrical Impedance measures with the McCarthy et al. 2006 body fat-for-age reference [33]

Overfat regression analysis					
		Bivariate		Multivariable	
Characteristics: n=974 (% i)	Category	COR (95% CI)	p-value	AOR (95% CI)	p-value
Age group	6 years	1 (ref)		1 (ref)	
	7-9 years	2.8 (0.63-12.48)	0.176	3.76(0.71-19.85)	0.119
	10-12 years	1.33 (0.3-5.85)	0.705	1.27(0.25-6.57)	0.776
Gender	Male	1 (ref)		1 (ref)	
	Female	1.42 (1.01-2.01)	0.045	1.31(0.89-1.93)	0.172
District	Hurungwe	1 (ref)		1 (ref)	
	Makonde	4.52 (2.14-9.55)	0.001	2.84(1.24-6.48)	0.013
	Mhondoro-Ngezi	2.19 (0.83-5.75)	0.111	1.27(0.44-3.71)	0.659
	Sanyati	4.63 (1.94-11.04)	0.001	3.20(1.22-8.36)	0.018
	Zvimba	5.87 (2.64-13.05)	0.001	4.71(1.93-11.50)	0.001
Location	Urban	1 (ref)		1 (ref)	
	Rural	0.3 (0.21-0.44)	0.001	0.46(0.29-0.74)	0.001
Religion	None	1 (ref)		1 (ref)	
	Catholic	3.08 (0.85-11.21)	0.087	1.93(0.47-8.03)	0.363
	Protestant	2.73 (0.81-9.22)	0.106	1.51(0.39-5.79)	0.551
	Traditional	9.87 (2.2-44.2)	0.003	4.56(0.82-25.55)	0.084
	Apostolic	1.4 (0.41-4.8)	0.597	1.08(0.28-4.19)	0.911
	Pentecostal	3 (0.89-10.1)	0.076	1.88(0.49-7.24)	0.357
Mother educational	None	1 (ref)		1 (ref)	
	Primary	1.11 (0.35-3.51)	0.863	1.48(0.41-5.35)	0.548
	Secondary	1.36 (0.47-3.92)	0.575	1.12(0.34-3.71)	0.849
	Tertiary	4.03 (1.33-12.27)	0.014	1.32(0.33-5.20)	0.694
Mother occupation	Formally employed	1 (ref)		1 (ref)	
	Self employed	0.51 (0.32-0.82)	0.005	1.14(0.59-2.18)	0.699
	Unemployed	0.31 (0.16-0.59)	0.001	0.56(0.25-1.23)	0.149
	House wife	0.5 (0.33-0.76)	0.001	1.12(0.63-1.10)	0.699
Father Educational level	None	1 (ref)		1 (ref)	
	Primary	0.23 (0.06-0.92)	0.038	0.22(0.05-1.02)	0.053
	Secondary	0.48 (0.18-1.25)	0.132	0.36(0.12-1.09)	0.071
	Tertiary	0.97 (0.36-2.62)	0.948	0.29(0.09-0.98)	0.047
Father Occupation	Formally employed	1 (ref)		1 (ref)	
	Self employed	0.41 (0.27-0.62)	0.001	0.43(0.26-0.72)	0.001
	Unemployed	0.17 (0.07-0.4)	0.001	0.21(0.08-0.56)	0.002
Number of siblings in the family	One	1 (ref)		1 (ref)	
	two -four	0.58 (0.29-1.15)	0.119	0.68(0.291.56)	0.362
	>5	0.28 (0.13-0.62)	0.002	0.37(0.15-0.94)	0.036
Socio-economic status	≤$200 Low	1 (ref)		1 (ref)	
	$201-$500 Medium	1.64 (1.07-2.51)	0.023	0.79(0.47-1.33)	0.379
	≥$501	4.17 (2.75-6.32)	0.001	1.62(0.88-2.99)	0.125
Mother Vital status	Alive	1 (ref)		1 (ref)	
	Dead		0	omitted	
Diabetes Mellitus status of parents	No	1 (ref)		1 (ref)	
	Yes	3.09 (1.49-6.41)	0.003	2.85(1.20-6.76)	0.018

Table (1) presents the results of the descriptive analyses of demographic characteristics of the school children and their association with overweight and obese using the BMI for age classification by international obesity task force (IOTF). [32] Gender and mother vital status were the only variables which were not significantly associated with BMI-defined overweight/obese (p=<0.88) and (p=0.429) respectively.

Similarly, to the classification using body fat categorization. [33] Age group, districts, location o school, religion, mothers education, and occupation, fathers education and occupation, number of siblings in a family, socio-economic status and parental diabetes status were prominent variables significantly associated with overweight and overfatness (p<0.001) except for gender and mothers vital status which were again not significantly associated with overweight or overfat/obese classification.

Socio-demographic risk factors associated with childhood obesity among Primary school children

Table (2) presents results for the bivariate and multivariable logistic regression analyses between various

independent factors associated with over weight/obesity status. Based on the bivariate results district, socio-economic status (SES), mother educational level and parental diabetes status were significantly associated with increased odds of the child being overweight/obese. Location of the school being in rural area, mother and father occupation, and number of siblings in the family were associated with reduced odds of being overweight/obese.

Following the multivariable analyses, children in Makonde district were 27 times likely to be overweight/obese AOR (27.45 95%CI: 3.66-205.50) compared to Hurungwe district. SES and parental diabetes mellitus also remained significant risk factors for overweight/obese status with AOR of 2.03 (95% CI: 1, 03, 3.98) and 3.12 (95% CI: 1.25, 7.83) respectively. Location of the school being in rural and the father being unemployed were the variables which were associated with reduced odds of being overweight/obese, 43% and 93% reduced odds respectively (Table 2).

Table 3 presents results for Bivariate and multivariable regression analysis between various independent factors associated with overfat/obese categorisation. Based on the univariables results gender, district, religion, mother educational level, socio-economic status and parental diabetes status were significantly associated with increased odds of the child being overfat/obese. Location of the school being in rural area compared to urban, mother and father occupation, father educational and number of siblings in the family were associated with reduced risk of being overfat/obese.

Following the multivariable logistic regression, children in Makonde district were 3times likely to be overfat/obese AOR 2.84 (95%CI: 1.24-6.48) compared to Hurungwe district. Mhondoro-Ngezi district remained not associated with children who were overfat/obese. Parental diabetes status remained significant risk factors for overfat/obese status AOR of 2.85(95% CI: 1.20-6.76). location o the school being rural, father educational level being tertiary, fathers occupation being self employed and unemployed, and number of siblings in a family being more than five were the variables which were independently associated with reduced odds of being overfat/obese in school children (Table 3).

DISCUSSION

Few studies have been conducted in southern Africa on risk factors among school children especially in Zimbabwe with classification of overweight and overfat using BMI and over fatness respectively in this study. After adjusting for other dependent variables with BMI for age, all the districts, socio-economic status of earning more than us$501 per month and parental diabetes status were the most significant independent risk factors which were associated with overfat/obese in primary school children. This study also found out that the location of the school being in rural area, father's education being at tertiary level, father being unemployed, and living in a family of more than five siblings had a protective effect of being overfat/obese. This study did not find any association of gender, age and other prominent risk factors reported in other similar studies in both developed and developing countries. Martinez et al. 2006 indicated that obesity was associated with age, sex, SES, urbanisation and ethnicity. Other studies also indicated that when obesity and gender difference are evaluated, girls are reported to be more affected than boys [35-37] in the present study, gender and age was not associated with overfat/obesity. SES has been found to be an important predictor in childhood obesity, lower SES has been reported to be an important predictor of obesity in many industrialised and developing countries. [38-44] Our study finding is consistent with findings in studies conducted in developing countries for SES to be significantly associated with overweight/obese. This study, higher socio-economic class showed a significant direct association (p=0.038) with overweight/

obese with BMI, but no association with overfat/obese. Our results are consistent with what was found by Ness et al (2007) that associations between adiposity and social economic status in children were detectable with body fatness measures, but not when BMI-z score was used as the outcome. [17, 45]

This study found that location of the school being in rural area was associated with reduced risk of overfat/obese as compared to urban schools (p=0.001). The relationship observed may be associated with the non exposure of sedentary lifestyle and non exposure to processed foods of those in higher SES category living in urban areas. This may be contributed to non energy –dense processed food and walking to school by the majority school children in rural areas. In urban areas there are also uncontrolled food and beverages advertisements on print and TV as compared to rural areas where advertisements are limited. [46] During the data collection the researcher observed vending of chips at the majority of school premises in urban schools which exposed the children to junk food.

This study found that fathers education being at tertiary level was associated with 71% lower odds of being overfat/obese (p=<0.047). These results demonstrated that variables of the father's higher educational level, being self employed and being unemployed reduced the risk of overfat/obese. The results contradicts with what was found by Kimani-Murage et al (2012) in South Africa in adolescents where the household head had education less than secondary level certificate was protective, while secondary and tertiary educational level which may lead to higher SES were not significantly associated with overweight/obese. [40] Our finding is contrary to an Indian and Ghana studies which reported maternal unemployment to be a risk factor for childhood overweight/obese. [47,48] These results are mixed as usually in developing countries higher educational level is associated with overfat/obese as the parent is rated to be in higher SES with ability to purchase enough food. Our results are inverse to those found in developed countries where higher educational level of the father, and mother being unemployed in lower occupations was associated with higher risk of overweight/obese. [49] This study suggests that unemployment had a protective effect of being overfat/obese and there was no significant association of mothers employment and level of education with risk of being overfat/obese. This finding is contrary to other studies which found an increased risk of overweight among children of mothers with higher educational level in developing countries. [50,51] This finding has been revealed by overfat/obese measure as an outcome of which it has revealed associations not detected by use of BMI in our study. [45]

Our study found an independent significant association of parental diabetes status and being overfat/obese. These results are consistent with many studies conducted which concluded that development in a diabetic intrauterine environment results in excess foetal growth as maternal glucose freely crosses the placenta. [52-54] Study in Indian women found that offspring of pre-existent type 2 diabetes and gestational diabetes mellitus were larger for gestational age at birth and at every age, were heavier than the offspring of pre diabetic or non diabetic women. [55-58] There is need to evaluate the effects of exposure to diabetes in utero on childhood growth and body size among children as it is critical for development of interventions of offspring adiposity by maternal glucose-insulin metabolism as it can lead to an increasing childhood obesity and becomes a vicious cycle of a generation. [59]

Strengths and weakness

There have been few studies of childhood obesity risk factors in both rural and urban population in primary school children in Zimbabwe. The results of the study are applicable at a population level as a result of applying the sampling weights. A

further strength was use of a body composition measure as an outcome using bioelectrical impedance analysis as it is a recommended method for measuring actual body fat in children, comparing with BMI as it has revealed associations not detected by use of BMI alone. [45] The anthropometric measurements in this study were taken by trained health professional who were trained to use the instruments, and measurements were not from self reported data.

Our study had several limitations. The study did not assess other risk factors for childhood obesity which include maternal smoking, no or short breast feeding, infant size and growth weight gain during pregnancy and maternal obesity. [60] Further research is recommended to assess the relationship of unhealthy dietary pattern, physical inactivity and risk factors which must include (TV exposure, short sleep duration, and consumption of sugar-sweetened beverages, less than 30 minutes of daily activities duration and mode of transport to school). The present research is a cross-sectional therefore; a causal relationship cannot be inferred though the risk factors partly predicted the onset o obesity among school children.

CONCLUSION

In conclusion, the most justifiable target school districts in Mashonaland west for school children obesity prevention interventions were the four except Mhondoro-Ngezi district. Schools which were located in urban areas were to be given priority on interventions. Educational programmes about childhood obesity and risk factors should start at an early age in schools. The protective effects need to be reinforced and maintained during the educational programmes. The higher risk of diabetes mellitus parents with overfat/obese, prenatal education which must include supply good prenatal nutrition and health care, avoid excessive maternal weight increase, control diabetes, help mother's lose weight post partum and offer nutrition education will prevent the vicious cycle of childhood obesity. These findings indicate a need for childhood obesity in school children to be considered a crisis, make it a funded government and public health priority, and join forces across disciplines of health professionals and educationists to mount an effective public campaign in the prevention and implementation of strategies. Further research into dietary patterns and physical activity among school children in the study area and related settings, and their associations using other acceptable measurements of direct adiposity as an outcome in school children is necessary for effective interventions.

ACKNOWLEDGEMENTS

This study received financial support from the College of Health Sciences University of KwaZulu Natal through PhD scholarship bursary awarded to Kambondo G. Many thanks go to Ministry of primary and secondary education Zimbabwe for supplying information on school enrolments and permission to conduct the study in Mashonaland West Province. The authors would like to thank the school children, their parents and school heads who participated in this study.

Author Contributions: George Kambondo and Benn Sartorius conceived and designed the study. George Kambondo performed field work and data collection. George Kambondo and Benn Sartorius analysed the data. George Kambondo wrote and compiled the manuscript. All authors read and approved the final version of the manuscript.

Conflict of interest: The authors declare that they have "no" competing interests.

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How to cite this article: George K, Sartorius B, Maxwell M. Risk factors for obesity and overfat among primary school children in Mashonaland West Province, Zimbabwe. Int J Health Sci Res. 2017; 7(7):236-247.

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