Nor. Afr. J. Food Nutr. Res. 2022; 6(13): 29-38

https://doi.org/10.51745/najfnr.6.13.29-38

https://www.najfnr.com

ORIGINAL ARTICLE

Prevalence and determinants of overweight and obesity among in-school adolescents in Harare, Zimbabwe

Pauline Theresa Mapfumo, Tavonga Marilyn Muderedzwa, Tonderayi Mathew Matsungo *

Department of Nutrition, Dietetics and Food Sciences, University of Zimbabwe. PO BOX, MP 167, Mt Pleasant, Harare, Zimbabwe

Abstract

Background: Double burden of malnutrition reflects the co-existence of both under nutrition and obesity at individual, household or community levels. **Aims:** To assess the prevalence and determinants of overweight and obesity among in-school adolescents aged 15 years from Harare, Zimbabwe. **Subjects and Methods:** A cross-sectional study was conducted in two schools, involving 111 Form three learners. A structured interviewer administered questionnaire was used to collect quantitative data. Blood glucose and blood pressure levels were determined using a glucometer and sphygmomanometer. Anthropometry indicators were assessed using the WHO standard procedures. Data was analyzed using SPSS version 20. Ethical clearance was obtained from the Medical Research Council of Zimbabwe (MRCZ/B/1876). **Results:** The prevalence of overweight and obesity was 5.4 % and short stature (stunting) affected 13.5 %. Majority (91.1 %) of the learners had adequate nutrition knowledge score. In this study 9.9 % learners were pre-diabetic and 51.4 % had elevated blood pressure (BP). There was a significant association between overweight and obesity; and waist circumference ($p < 0.001$). Among the learners that were overweight, 83.3 % also had higher waist circumference. **Conclusions:** Overweight and obesity and short stature coexisted among adolescents in this setting, confirming presence of double burden of malnutrition. In addition, girls had central obesity thus at increased risk of cardiovascular diseases. Therefore, at policy and pragmatic levels there is need for a multi-sectoral response to address malnutrition in all its forms in this age group.

Keywords: Stunting, nutrition education, central obesity, adolescents, Zimbabwe.

Received: July 30, 2021 / **Accepted**: January 20, 2022 / **Published**: January 26, 2022

1 Introduction

Over-weight and obesity are huge public health issues considering that its consequences include hypertension, diabetes mellitus, cardiometabolic diseases and some cancers which are leading causes of death worldwide [1]. The double burden of malnutrition (DBM), is a state where under nutrition and over nutrition or diet related non-communicable diseases (NCDs) exist at the same time in individuals, households and whole populations; during the stages of the life course [1, 2]. The health effects of the DBM are also two pronged with consequences of both under nutrition (impaired childhood development and greater susceptibility to infectious diseases), and overweight (increased risk of NCDs) [1, 3]. Poor nourishment in early life is associated with a higher risk of obesity and associated NCDs in adulthood [3]. There is growing evidence on the economic effects of the DBM, notably lost wages and productivity, as well as higher medical expenses [4].

The World Health Organization (WHO) defines adolescents as individuals between the ages of 10 and 19 years [5, 6]. Although, adolescence is a critical period for growth and development little is known about the health and macroeconomic effects of DBM on adolescents from low- and middle-income countries (LMICs). However, an analysis of data from the global school-based student health and health behavior in school-aged children surveys in 57 low- and middle-income countries confirmed that DBM among adolescents in LMICs is common [2]. There are 1.2 billion adolescents, worldwide and nearly 90 % live in developing countries [7]. The remarkable growth that occurs in adolescent time is second only to that in the first year of life and this physical growth occurs concomitantly with dramatic cognitive and psychosocial changes [6]. However; to date, adolescents have been largely neglected in the public health agenda [8].

The global burden of diseases project reported that the prevalence of overweight and obesity had risen from 4 % to 18 % among adolescents, reflecting that this had doubled between 1990 to 2016 [9]. While in Zimbabwe, the prevalence of obesity in girls and boys in this age group (15 – 19 years) was 17.2% and 2.3 % respectively [10]. Whereas thinness of adolescent girls and boys was 13 % and 8.5 % correspondingly [10, 11].

Although the causes of the emerging problem of overweight and obesity among adolescents remains largely unclear, dietary habits such as lower and infrequent meals, breakfast skipping and higher intake of sugary beverages, snacks, cakes and red meat have been associated with overweight and obesity among children aged 6–17 years [12-14]. Overweight in adolescents has been found to be associated with increased risk of developing NCDs [15, 16]. Physical activity plays a crucial role in preventing the development of overweight and obesity in young people and stemming its progression into young adulthood [17, 18]. Therefore, improving nutrition knowledge can help them to adjust their eating and physical activity behaviors [19, 20]. Unfortunately, in low-income settings like Zimbabwe there are few studies reporting on health and nutrition and physical activity indicators for school age children and adolescents "grey area" [21, 23]. However, the limited evidence reveals an emerging concern of obesity that coexists with the traditional problem of food insecurity and undernutrition.

* **Corresponding author:** Tonderayi M. Matsungo, Department of Nutrition, Dietetics and Food Sciences, University of Zimbabwe, PO BOX, MP 167, Mt Pleasant, Harare, Zimbabwe. E-mail: tmatsungo@gmail.com

This gap in knowledge cripples any attempts by government to craft relevant policies and/or interventions. Therefore, this study was designed to assess the prevalence and determinants of overweight and obesity among in-school adolescents in selected schools in Harare, Zimbabwe.

2 Material and Methods

2.1 Study design and setting

A cross sectional study was carried out in Harare province. Harare has 232 high schools (government, n=72; private, n=162), with a total of 170 935 learners [24]. In Harare province, 46.1% of the schools have a school feeding program and health clubs. The schools have 81.2 % trained teachers [24]. The study was initially designed to be completed in eight schools from various areas of Harare province. However, the COVID-19 pandemic outbreak and associated lockdowns in Zimbabwe occurred after the start of the survey, and only two schools completed the survey. The two schools, namely Mount Pleasant High School and Tafara 1 High School representing the low- and high-density settings in Harare respectively. One of the schools involved in this study is located in low-income settings of Harare where food insecurity is elevated (46 %) and 12.6 % of children do not attend school [25].

2.2 Subjects, sampling and sample size determination

The study had conditional approval by the ministry of education in Zimbabwe to only target form three learners. These participants were selected using systematic random sampling method. An inclusion criterion of 14 – 16 years was used, given the varying nature of the age group enrolled for grade 1 in Zimbabwean schools. The two schools were selected using the stratified random sampling method by socio-economic zone. The strata included; high density and low density. The sample size of 235 learners was determined using a confidence level of 95 %, a confidence interval of 0.05 margin of error and a population size of the total number of the learners from the two selected schools [24, 26]. Only form three learners who had signed consent by their parents or guardians, and also assented to participate were included in the study. Due to the COVID-19 induced lockdown in Zimbabwe, schools have been closed since April 2020 [27] and this affected data collection efforts in all the 8 targeted schools.

2.3 Data collection and tools

A mixed method approach was used to collect quantitative data using a structured questionnaire for school learners and key informant interviews (KIIs) for qualitative data from school authorities. In addition, anthropometric measurements and blood glucose and blood pressure measurements of the learners were assessed using standard methods that are outlined in proceeding sections.

2.4 Structured questionnaire

An interviewer-administered questionnaire was used to collect data on demographics, adolescent nutritional status, nutritional knowledge, physical activity, and dietary practices from the learners. The questionnaire was adapted from; the Food and Agriculture Organization (FAO), Knowledge, Attitudes and Practices (KAP) questionnaire, General Nutrition Knowledge Questionnaire and [28] and the physical activity questionnaire (World Health Organization (WHO) and EPIC-Norfolk) [29, 30]. The final questionnaire had four sections: socio-demographic and anthropometry (10 questions), nutrition knowledge (31 questions), physical activity (4 questions), dietary patterns (10 questions) and dietary diversity (16 questions). All 111 learners completed the questionnaire and all four sections that were on it.

2.5 Anthropometry

Anthropometric measurements that were taken included; height, weight, waist circumference, and hip circumference. Height was measured with a Seca 213 stadiometer (Seca, GmbH & Co. KG, Germany) to the nearest 1mm. Weight was measured to the nearest 0.1kg using a Seca 813 digital scale (Seca, GmbH & Co. KG, Germany). Waist and hip circumference were measured using a Seca 201 non-stretchable tape measure (Seca, GmbH & Co. KG, Germany).

Nutritional status indicators were computed based on the WHO 2007 reference for children 5 – 19 years [31]. BMI-for-age Z-scores (BMIAZ) and Height-for-age Z-scores (HAZ) using the WHO AnthroPlus software. Waist hip ratio (WHR) was calculated as waist circumference in centimetres (cm) divided by hip circumference in cm [32]. WHR was classified such that males with ratio equal to or greater than 0.9 and females with ratio equal to or greater than 0.85 were abnormal [32]. Risk for metabolic diseases was also assessed using waist-to-height (WHtR) ratio, which has been classified as the best predictor of abdominal obesity [33]. WHtR was calculated by dividing waist circumference in cm by height in cm, and those with a ration ≥ 0.5 were classified as having high risk of abdominal obesity [33].

2.6 Physical activity

Physical activity was measured through the self-administered questionnaire. The learners were required to answer four questions on physical activity, for example; 'How many minutes do you spend a day on physical activity? How many minutes of physical activity are recommended that school-aged children do each day?' The criterion used to assess for adequacy of their physical activity was; physical activity below 60 minutes per day was considered inadequate whilst that ≥ 60 minutes was adequate [34].

2.7 Nutrition knowledge

Nutrition knowledge was collected using the FAO adapted questionnaire [28]. For each question, a correct response was coded as 1 and an incorrect response as 0. The Nutrition Knowledge scores (NKS) were calculated for each participant by dividing the total number of correct responses by the number of assessment questions [28]. The total score was then converted to a percentage. Scores below 50 % were categorized as having inadequate NKS whilst that greater than 50 % was categorized as having adequate NKS [28, 35].

2.8 Dietary practices

Dietary Diversity Scores (DDS) were computed to evaluate the quality of the diets for the learners. DDS was categorized as adequate or inadequate based on the FAO guidelines for calculating the individual DDS [36]. The categories were computed as follows; Inadequate DDS = < 5 groups consumed, whilst consumption of ≥ 5 groups in the previous 24 hours was considered as adequate DDS [36].

2.9 Blood glucose and blood pressure measurements

A registered nurse assessed blood glucose (BG) and blood pressure (BP). BG values were obtained using the SD Code Free glucometer (SD Biosensor Company, Korea). The process and procedure of obtaining random BG values utilizing portable glucometers has been previously described by [37]. The categories were derived as follows; Low = BG below 3.9 mmol/L, normal = BG between 3.9 – 7.2mmol/L, pre-diabetic = BG between 7.2-11mmol/L and diabetic was defined as a BG greater than 11mmol/L [38]. All the learners in the study had their blood glucose measured.

The BP was measured from the left arm using an automatic blood pressure machine (OMRON, HEM–7124), following the American Academy of Paediatrics Clinical Practice Guidelines for Screening and Management of High Blood Pressure in Children and Adolescents [39]. The hypertension categories were as follows: normal = BP ≤ 139/89 mmHg and hypertensive = BP ≥ 140/90 mmHg [39, 40].

2.10 Key informant interviews (KIIs)

The KIIs guide questions were used to conduct interviews with the teachers in charge and physical activity teachers from target schools. The objectives of the KIIs were to assess their knowledge and awareness of the learners' nutrition, physical activity and dietary behaviors within the school and community environment. The teachers were selected using purposive sampling approach. A total of 4 key informants' interviews were conducted (2 teachers per school). Examples of questions asked included the following: 'In what ways have parents and community perceptions, in your view influenced the nutrition attitudes of the pupils? Do you think the school food environment contributes to the learners' dietary practices and why?'

2.11 Data analysis

All collected data was entered in Microsoft Excel and analyzed in SPSS version 20. Data was checked for normality using the Shapiro Wilk test and visualized via Q-Q plots. Normally distributed data was presented as mean± standard deviation (SD), and in cases where variables were not normally distributed the median ± interquartile range (IQR) was used instead. Pearson`s Chi-Square were used to test for associations, in cases where counts were below 5, the Fisher`s Exact test was used. Determinants of obesity were explored using binary logistic regression analysis. Test for significance was set at P-value < 0.001

3 Results

3.1 Socio-demographic characteristics

The study enrolled in school adolescents (n=111), (Table 1). The age range for learners was 14-16 years and the median (IQR) age was 15 [14, 16] years and majority were girls (67.6 %). While 64.9 % stayed in Harare's high-density areas (low socioeconomic setting) and 32.4 % had residents in low-density areas (high socioeconomic setting). The median household size was 5 [2, 12].

Table 1. Relationship between overweight and obesity and participant characteristics

Variable	Total, n (%) (n=111)	Not overweight and obese, n (%) (n=105)	Overweight and obese, n (%) (n= 6)	¹p-Value
Sex of the adolescent				
- Boys	36 (32.4)	35 (33.3)	1 (16.7)	0.662
- Girls	75 (67.6)	70 (66.7)	5 (83.3)	
Who do you stay with?				
- Both parents	82 (73.9)	77 (73.3)	5 (83.30	ᵗ0.647
- Single parent	16 (14.4)	16 (15.2)	0 (0.0)	
- Guardian	13 (11.7)	12 (11.4)	1 (16.7)	
Education level of Household Head				
- Secondary	55 (49.5)	53 (50.5)	2 (33.3)	ᵗ0.679
- Tertiary	56 (50.5)	52 (49.5)	4 (66.7)	
Employment status of parents of Household Head				
- Employed	85 (76.6)	80 (76.2)	5 (83.3)	ᵗ 0.999
- Self-employed	22 (19.8)	21 (20.0)	1 (16.7)	
- Unemployed	4 (3.6)	4 (3.8)	0	
Residence				
- High density	74 (66.7)	70 (66.7)	4 (66.7)	
- Low density	37 (33.3)	35 (33.3)	2 (33.3)	ᵗ 0.683
Household size, median (IQR)	5 (2, 12)	-	-	-

Notes: ¹P-value is Pearson's Chi-squared test, in cases where cell values less than 5, ᵗFisher's Exact test was used. Where HH= Household head. Age and household size are presented as median± interquartile range (IQR).

3.2 Nutritional status

The results summarized in Figure 1 show that short stature (stunting) and; overweight and obesity were the predominant forms of malnutrition affecting 13.5 % and 5.4 % of the learners respectively. No thinness (wasting) cases were recorded in the study. There is a significant association between overweight and obesity; and waist circumference ($p \leq 0.001$). Of the learners that were overweight, 83.3 % had an increased risk of metabolic complications due to their high waist circumference an indicator of abdominal obesity. There was no significant association between overweight and obesity and DDS ($p \geq 0.999$), NKS ($p \geq 0.999$), physical activity ($p \geq 0.999$), blood glucose ($p = 0.108$) and hypertension ($p = 0.232$) (Table 2).

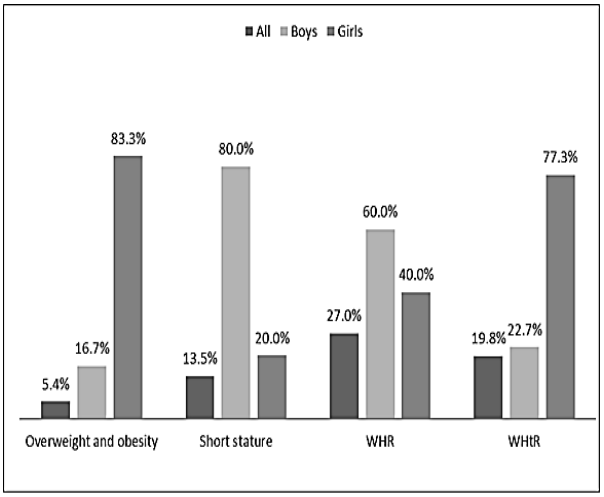

Figure 1. Prevalence of overweight and obesity and short stature among the adolescents

Table 2. Relationship between overweight and obesity and participant characteristics

Variable	Total, n (%) (n=111)	Not overweight and obese, n (%) (n=105)	Overweight and obese, n (%) (n= 6)	[1]P-Value
Short stature (stunting)				
Normal	96 (86.5)	92 (87.6)	4 (66.7)	[t] 0.186
Short stature	15 (13.5)	13 (12.4)	2 (33.3)	
[2]Waist circumference				
Normal	96 (86.5)	95 (90.5)	1 (16.7)	[t] 0.001*
Abnormal (high)	15 (13.5)	10 (9.5)	5 (83.3)	
Waist hip ratio (WHR)				
Normal	81 (73.0)	78 (74.3)	3 (50.0)	[t] 0.341
Abdominal (central) obesity	30 (27.0)	27 (25.7)	3 (50.0)	
Waist-to-height ratio (WHtR)				
Normal	89 (80.2)	88 (83.8)	1 (16.7)	[t] 0.001*
Abdominal (central) obesity	22 (19.8)	17 (16.2)	5 (83.3)	
[3]Dietary Diversity Score (DDS)				
Adequate	100 (90.1)	94 (89.5)	6 (100)	[t] > 0.999
Inadequate	11 (9.9)	11 (10.5)	0	
[4]Nutrition Knowledge Score (NKS)				
Adequate	102 (91.9)	96 (91.4)	6 (100)	[t] > 0.999
Inadequate	9 (8.1)	9 (8.6)	0	
Having breakfast before going to school				
Yes	79 (71.2)	75 (71.4)	4 (66.7)	[t] 0.559
No	32 (28.8)	30 (28.6)	2 (33.3)	
Where do you buy your snacks from?				
Home	49 (44.1)	48 (45.7)	1 (16.7)	[t] 0.199
Tuck shop	46 (41.4)	43 (41.0)	3 (50.0)	
Vendors	16 (14.4)	14 (13.3)	2 (33.3)	
[5]Physical Activity level				
Adequate	27 (24.3)	26 (24.8)	1 (16.7)	[t] > 0.999
Inadequate	84 (75.7)	79 (75.2)	5 (83.3)	
[6]Blood Glucose				
Normal	100 (90.1)	96 (91.4)	4 (66.7)	[t] 0.108
Pre-diabetic	11 (9.9)	9 (8.6)	2 (33.3)	
[7]Hypertension (n=70)				
Normal BP	34 (48.6)	32 (47.1)	2 (100)	[t] 0.232
Hypertensive	36 (51.4)	36 (52.9)	0	

Notes: [1]P-value is Pearson's Chi-squared test, in cases where cell values less than 5, tFisher's Exact test was used. * indicates significance. BP= Blood pressure. [2]WC (waist circumference): for females, normal is < 80 and risky when ≥80; for males, normal is < 94 and risky when ≥ 94. [3]DDS (dietary diversity score): < 5 is inadequate and ≥5 is adequate. [4]NKS (nutrition knowledge score): < 50 % is inadequate and ≥ 50 % is adequate. [5]PAL (physical activity level): adequate ≥ 60 minutes and inadequate < 60 minutes. [6]Blood Glucose: normal is < 7.2mmol/L and pre-diabetic is ≥ 7.2. [7]Hypertension: normal is ≤ 139/89 mmHg, and hypertensive is ≥ 140/90 mmHg.

3.3 Physical activity levels (PAL)

Majority of the learners had inadequate physical activity (75.7 %) and only 14.4 % reported that they spend at approximately 60 minutes on organized physical activity daily. This was reflected in the finding that only 38 % of the learners were aware of the World Health Organization (WHO) recommendation that they should spent at least 60 minutes daily engaged in moderate to rigorous physical activity. Table 2 shows that there was no significant association between overweight and obesity and physical activity ($p > 0.999$). However, amongst those who were overweight and obese larger proportion (83.3 %) had inadequate PAL. Interestingly, in low density areas, the most learners (48.1 %) archived the minimum recommended PAL threshold (Figure 2).

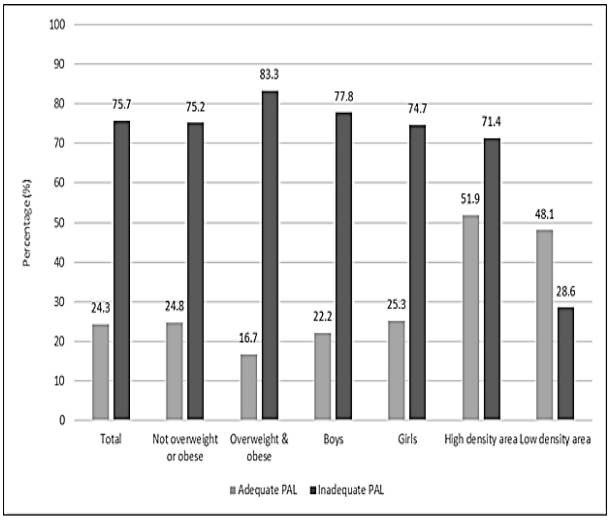

Figure 2. Physical activity level by overweight and obesity, gender, and residence among the participants

3.4 Nutrition knowledge scores (NKS)

The results showed that, the vast majority (91.9 %) of the learners had an adequate NKS (Table 2). The main sources of nutrition related information for the learners were the school (27.9 %), health facilities (20.7 %) and internet and social media (19.8 %). It's interesting to note that all participants being overweight and

obese had adequate NKS. In this study, 93.3 % of girls appeared to have higher proportion of adequate NKS compared to boys (88.9 %). The quantitative results were collaborated with the findings from the KIIs. Specifically, teachers from the high-density strata reported that: "*The parents and community have a great influence on the nutrition attitudes of the learners. The community itself is not very nutrition sensitive as most people are more concerned about obtaining food to eat and not exactly what type of food they are having*." In addition; according to one of the teachers: "*The school environment is limited to cater to the nutritional needs of the learners. The tuck shops and the vendors mostly sell junk food*."

3.5 Dietary practices

The majority of the learners (90.1 %) had an adequate DDS. There was no significant association between DDS and NKS (p ≥ 0.999). Of the learners, 87.4 % consume breakfast every morning and 53.2 % received at least three meals per day. Breakfast and supper were the most frequently consumed meals; 87.4 % and 98.2 % respectively. In this study, most of the children (68.5 %) consumed snacks between meals. The learners reported that they obtained their snacks from school tuck shop (41.4 %), home (44.1 %), and vendors (14.4 %). The most frequently consumed snack was corn snacks (extrusion products), with 32.4 % purchasing their corn snacks from the school tuck shop and 36.9 % from the vendors located by the main entrances to the schools. Interestingly, only 18.9 % of the learners purchase fruits from the vendors. The learners` choices are largely influenced by organoleptic attributes and hygienic environment (45 %), personal preferences (24.3 %) and cost of the food (21.6 %). According to the teachers, the school environment has a considerable influence of the learner's diet and nutrition knowledge/behavior. A face-to-face interview with one teacher: "*The parents and community perceptions on nutrition have influence on the learners' attitudes but not as great as that of the school.*" In addition, school tuck shops provide both cooked food and dry foods (snacks) to cater for the learners' different preferences.

3.6 Blood glucose and blood pressure

In the current study, 9.9 % of learners were found to be pre-diabetic based on the random blood glucose assessments. Only 70 learners agreed to have their blood pressure (BP) measured and of these, 51.4 % were found to have elevated blood pressure with 52.4 % of these being boys.

3.7 Determinants of overweight and obesity

Table 3 shows a summary of overweight and obesity determinants among the high school learners (Model 1 and Model 2). Model 1 used waist circumference (WC) that was replaced with WHtR in model 2 as an indicator for assessing cardiometabolic risk among the learners. Model 2 was motivated by the growing evidence that the waist-to-height ratio (WHtR) is more strongly associated with cardiovascular disease risk factors than is the body mass index (BMI) [41]. All variables had P>0.05, except in model 1 were WC (p = 0.034) and model 2 were WHtR (p = 0.044) showed significant associations with overweight and obesity.

Table 3. Determinants of overweight and obesity among the adolescents

Model 1	B	S.E	p-value	Odd Ratio (OR)	95% C.I. for OR	
					Lower	Upper
NKS	-0.18	0.14	0.202	0.84	0.64	1.10
PA (mins/day)	0.05	0.04	0.183	10.5	0.98	1.14
WC (cm)	0.59	0.28	0.034*	1.81	1.05	3.13
HAZ	-2.80	1.71	0.101	0.06	0.002	1.73
Goodness of fit: R^2=0.613, **P=0.999						
Model 2	**B**	**S.E**	**P value**	**Odd Ratio (OR)**	**95% C.I. for OR**	
					Lower	Upper
Glucose (mg/dL)	1.03	0.62	0.097	2.81	0.83	9.54
DDS	-0.58	0.58	0.317	0.56	0.18	1.75
NKS	-0.12	0.12	0.307	0.89	0.70	1.12
WHtR	-3.67	1.82	0.044*	0.03	0.001	0.90
DBP (mm/Hg)	-0.03	0.05	0.483	0.97	0.88	1.06
PA (mins/day)	0.03	0.02	0.109	1.03	0.99	1.08
Goodness of fit: Model 2: R^2=0.512, **P=0.851						

Notes: Model goodness of fit: Nagelkerke R^2; **P-value from Hosmer and Lemeshow test, CI: confidence interval, SE: standard error. DDS (dietary diversity score): < 5 = inadequate and ≥5 = adequate; NKS (nutrition knowledge score); < 50 % = inadequate and ≥ 50 % = adequate; Physical activity: adequate activity = ≥ 60 minutes and inadequate activity = < 60 minutes; Blood Glucose: normal = < 7.2mmol/L and pre-diabetic = ≥ 7.2. Where: PA (Physical activity); WC (Waist circumference); HAZ (Height-for-age z score); DBP (Diastolic blood pressure).

4 Discussion

The objective of the paper was to assess the prevalence and determinants of overweight and obesity among adolescent school children in Harare, Zimbabwe. The results showed that overweight and obesity (5.4 %) and short stature (13.5 %) coexist among adolescents in this setting implying the presence of "double burden" of malnutrition. Interestingly, no learners were found to have thinness (wasting). Our results are in line with findings from the 2015 Zimbabwe Demographic Health Survey (ZDHS) [42] and studies from other African countries [43]. The emerging problem of obesity is postulated to be mainly driven by nutrition transition and increasing obesogenic environment.

Our finding of a 5.4 % prevalence of overweight and obesity among the adolescents agree with a study carried out by Azzopardi *et al.* [9] who reported a high prevalence of overweight and obesity among adolescents at global scale. According to a study conducted by Shisana *et al.* [44] the global prevalence of overweight and obesity in school children was 10%, supporting the notion that overweight and obesity is increasing among the adolescent population. Our current study was only conducted in Harare, considering the gap in data for this age group, we recommend future national level surveys to determine the overweight and obesity prevalence.

In our study, girls have higher prevalence of overweight and obesity compared to boys (83.3 % vs. 16.7 %), this agrees with previous studies in Zimbabwe; 2015 ZDHS results [42], among adolescent girls aged 13 – 19 years [45], in adolescents aged 15 – 19 years [10]. Girls were also found to display higher obesity rates in the Transition and Health during Urbanization of South African children (THUSA-BANA) [46]. In the contrary, in our study, boys were more stunted than girls (80 % vs. 20 %). Factors contributing to the observed gender disparities in obesity and stunting warrant further investigation.

Cardiometabolic risk

Our results showed a significant association between overweight and obesity and waist circumference (p = 0.001). In the contrary, in this study we reported no significant association between short stature and risk of being overweight and obese (p = 0.186). This confirms that learners who are obese are at increased risk of developing cardiovascular diseases [33]. These results are identical to those obtained in a Mexican study among adolescents aged 14 – 17 years [47].

Socioeconomic factors

The current investigation results showed no significant associations between any of the sociodemographic variables and overweight and obesity, as shown in Table 1 and Table 3. This agrees with findings from Cyprus, Hungary and Italy where no association between socioeconomic status (SES) and childhood overweight was found [48]. However, contradict findings from other studies from Belgium, Estonia, Germany, Spain and Sweden, where authors showed that the prevalence of childhood overweight followed an inverse relationship with SES [48]. A study in India reported that the risk of overweight was two times higher among the adolescents of high SES [49]. Considering that, we did not interview the parents or guardians and therefore we recommend further studies that include the family and community variables to obtain more conclusive results.

Physical activity level (PAL)

We report in this study that no significant association was observed between physical activity levels (PAL) and overweight and obesity (Table 2). This result agrees with findings from a study across seven African countries involving adolescents aged 11 – 17 years which also reported relationship between overweight and obesity, and PAL [50]. This finding is bit surprising considering the established inverse relationship between physical activity levels and risk of obesity. For example, a study in India reported that the risk of overweight was 21 times higher among those participating less than two hours per week in any type of physical activity [49]. In South Africa the THUSA BANA study reported that physical inactivity was a significant determinant of overweight or obesity [46]. A study that compared overweight and obesity prevalence in school-aged youth from 34 countries with physical activity reported that PAL were lower and television viewing times were higher in overweight compared to normal weight youth [51]. This supports the opinion that screen time is more strongly associated with overweight and obesity than physical activity in children and adolescents [52, 53]. Unfortunately, we did not assess screen time and sedentary behavior in the current study and we strongly recommend these indicators in future studies.

Nutrition Knowledge Scores (NKS)

Despite the majority (91.9 %) of the learners in this study, having adequate KNS our results showed that there were no significant associations (p > 0.05) between higher NKS and DDS with overweight and obesity. This result agrees with a study in Belfast, Northern Ireland that also found no significant correlation between levels of nutrition knowledge and BMI [54]. In addition, a study in Mexico among adolescents and women from low-income strata also reported no association between nutrition knowledge and BMI [55]. Furthermore, key informant interviews in our study confirmed that although schools provide nutrition education as part of the curriculum, there are certain nutrition knowledge gaps that can only be bridged by the parents or community as a whole. Therefore, other contextual factors at family and community levels determine how the adolescents utilize the nutrition knowledge they would have acquired [56].

These results support the view that adequate nutrition knowledge does not translate to having good nutrition practices and/or an upright nutritional status [57]. This suggests that body weight loss interventions for overweight individuals should deliver more than nutrition information and deliberately target underlying attitudes and perceptions that hinder behavior change.

Dietary practices

There is evidence that poor dietary practices are associated with risk of obesity [56]. However, in our study there was no clear relationship between dietary practices and indicators of overweight and obesity. Similar findings were reported in a study of Canadians aged 11 – 16 [58]. Although, in the current study, we observed that most of the learners (87.4 %) were having breakfast, we found no significant relationship between NKS, dietary practices (breakfast consumption) and obesity status. This is contrary to a study carried out in Greece among adolescents aged 13 – 19 years, reporting that skipping breakfast was related to overweight and obesity [59]. However, our finding agrees with a study conducted by on in-school adolescents aged 10 – 19 years in Kwara State, Nigeria; where 77 % of the participants consumed breakfast at home before leaving for school [60]. In addition, a study on school children aged 6 – 14 years in Brazil reported that a daily consumption of breakfast is associated with less overweight and obesity development [61].

According to our key informant interviews, school tuck shops sell unhealthy "junk" foods at very affordable prices facilitating access by in-school adolescents. On the other divide we also recorded low consumption of fruits and vegetables, contrary to the recommendation by WHO to increase fruit and vegetables in order to limit energy intake from fats and free sugars [62]. Learners' choice of unhealthy foods was mostly driven by their taste preferences [63]. Although in our study we found no significant association between consumption of these snacks with overweight and obesity ($p > 0.05$), there is evidence that these processed and high-calorie snacks are contributory factors to the development of overweight and obesity among adolescents [56].

Determinants of overweight and obesity

The binary logistic regression analysis revealed that only waist circumference ($p = 0.034$) and WHtR ($p = 0.044$) showed significant associations with overweight and obesity in model 1 and model 2 respectively (Table 3). This means that there is a significant relationship between overweight and obesity, and waist circumference and WHtR. These results are identical to those of a Mexican study on adolescents aged 14 – 17 years [47] and indicate that these adolescents present a higher risk of developing NCDs in their adulthood [33]. Our result from model 1 is supported by a Moroccan study undertaken by Mehdad *et al.*, [64] on adolescents (11 – 17 years), where results indicated a significant association between overweight and obesity, and waist circumference, thereby presenting a risk of the learners developing excess body fat and NCDs.

Limitations of the study

The study enrolment was disrupted by COVID-19 induced national lockdowns which had bearing on the final sample size and number of schools participating in this study. However, the two schools represent both the low- and high-income settings in Harare. Therefore, the results though not representative are useful to show the adolescent nutrition situation in greater Harare. In addition, the inherent potential for recall bias in the frequency of physical activity and dietary practices cannot be excluded completely. We also acknowledge that blood pressure and blood glucose results are not conclusive as ideally repetitive measurements taken on different days are recommended for more definitive results.

5 Conclusions

Overweight and obesity and short stature (stunting) were the leading forms of malnutrition affecting adolescents, thus confirming the presence of "double burden" of malnutrition in this setting in this setting. The emerging problem of obesity and associated cardio metabolic risk appeared to be more pronounced among adolescent girls. Considering that adolescence is a second window of opportunity to address nutrition issues we recommend the adoption of multisectoral social behavior change themed interventions promoting increased physical activity and healthy food choices. These should be coupled national policies ensuring that school environments are support the adoption of healthy and active lifestyles in line with the sustainable development goals 2030 agenda.

Acknowledgments: None.
Author contribution: Conception, design and data collection of study: PM, TMM and TM, data curation: TM. Data analysis and/or interpretation of data: PM, TMM and TM. Drafting the manuscript: PM. Revising the manuscript critically for important intellectual content: TMM and TM. All authors read and approved the final manuscript for submission.
Data availability statement: The anonymized datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.
Funding: This research received no external funding.
Conflict of interest: The authors declare no conflicts of interest.

References

[1] Popkin, B. M., Corvalan, C., & Grummer-Strawn, L. M. (2020). Dynamics of the double burden of malnutrition and the changing nutrition reality. *The Lancet*, *395*(10217), 65-74. https://doi.org/10.1016/s0140-6736(19)32497-3

[2] Caleyachetty, R., Thomas, G. N., Kengne, A. P., Echouffo-Tcheugui, J. B., Schilsky, S., Khodabocus, J., & Uauy, R. (2018). The double burden of malnutrition among adolescents: Analysis of data from the Global School-Based Student Health and Health Behavior in School-Aged Children surveys in 57 low- and middle-income countries. *The American Journal of Clinical Nutrition*, *108*(2), 414-424. https://doi.org/10.1093/ajcn/nqy105

[3] Wells, J. C., Sawaya, A. L., Wibaek, R., Mwangome, M., Poullas, M. S., Yajnik, C. S., & Demaio, A. (2020, January). The double burden of malnutrition: aetiological pathways and consequences for health. *The Lancet*, *395*(10217), 75-88. https://doi.org/10.1016/S0140-6736(19)32472-9

[4] Nugent, R., Levin, C., Hale, J., & Hutchinson, B. (2020). Economic effects of the double burden of malnutrition. *The Lancet*, *395*(10218), 156-164. https://doi.org/10.1016/S0140-6736(19)32473-0

[5] De Onis, M. D., Onyango, A. W., Borghi, E., Siyam, A., Nishida, C., & Siekmann, J. (2007). Development of a WHO growth reference for school-aged children and adolescents. *Bulletin of the World health Organization*, *85*, 660-667. https://doi.org/10.2471/BLT.07.043497

[6] Sawyer, S. M., Azzopardi, P. S., Wickremarathne, D., & Patton, G. C. (2018). The age of adolescence. *The Lancet Child and Adolescent Health*, *2*(3), 223-228. https://doi.org/10.1016/S2352-4642(18)30022-1

[7] Cappa, C., Wardlaw, T., Langevin-Falcon, C., & Diers, J. (2012). Progress for children: A report card on adolescents. *The Lancet*, *379*(9834), 2323-2325. https://doi.org/10.1016/S0140-6736(12)60531-5

[8] Akseer, N., Al-Gashm, S., Mehta, S., Mokdad, A., & Bhutta, Z. A. (2017). Global and regional trends in the nutritional status of young people: a critical and neglected age group. *Annals of the New York Academy of Sciences*, *1393*(1), 3-20. https://doi.org/10.1111/nyas.13336

[9] Azzopardi, P. S., Hearps, S. J., Francis, K. L., Kennedy, E. C., Mokdad, A. H., Kassebaum, N. J., ... & Patton, G. C. (2019). Progress in adolescent health and wellbeing: tracking 12 headline indicators for 195 countries and territories, 1990–2016. *The Lancet*, *393*(10176), 1101-1118. https://doi.org/10.1016/S0140-6736(18)32427-9

[10] Benedict, R. K., Schmale, A., & Namaste, S. (2018). Adolescent nutrition 2000-2017: DHS data on adolescents Age 15-19. DHS Comparative Report No. 47, (June), 1–75. Available at: https://dhsprogram.com/pubs/pdf/CR47/CR47.pdf

[11] USAID. (2018). Zimbabwe: Nutrition Profile. United States Agency for International Development (USAID), Washington DC, USA. Available at: https://www.usaid.gov/sites/default/files/documents/1864/Zimbabwe-Nutrition-Profile-Mar2018-508.pdf

[12] Sedibe, M. H., Pisa, P. T., Feeley, A. B., Pedro, T. M., Kahn, K., & Norris, S. A. (2018). Dietary habits and eating practices and their association with overweight and obesity in rural and urban black South African adolescents. *Nutrients*, *10*(2), 145. https://doi.org/10.3390/nu10020145

[13] Smetanina, N., Albaviciute, E., Babinska, V., Karinauskiene, L., Albertsson-Wikland, K., Petrauskiene, A., & Verkauskiene, R. (2015). Prevalence of overweight/obesity in relation to dietary habits and lifestyle among 7-17 years old children and adolescents in Lithuania. *BMC Public Health*, *15*(1), 1-9. https://doi.org/10.1186/s12889-015-2340-y

[14] Liu, D., Zhao, L. Y., Yu, D. M., Ju, L. H., Zhang, J., Wang, J. Z., & Zhao, W. H. (2019). Dietary patterns and association with obesity of children aged 6–17 years in medium and small cities in China: Findings from the CNHS 2010–2012. *Nutrients*, *11*(1), 3. https://doi.org/10.3390/nu11010003

[15] Freedman, D. S., Mei, Z., Srinivasan, S. R., Berenson, G. S., & Dietz, W. H. (2007). Cardiovascular Risk Factors and Excess Adiposity among Overweight Children and Adolescents: The Bogalusa Heart Study. *Journal of Pediatrics*, *150*(1), 12-17. https://doi.org/10.1016/j.jpeds.2006.08.042

[16] Oduwole, A. A., Ladapo, T. A., Fajolu, I. B., Ekure, E. N., & Adeniyi, O. F. (2012). Obesity and elevated blood pressure among adolescents in Lagos, Nigeria: A cross-sectional study. *BMC Public Health*, *12*(1), 1-6. https://doi.org/10.1186/1471-2458-12-616

[17] Stankov, I., Olds, T., & Cargo, M. (2012). Overweight and obese adolescents: What turns them off physical activity? *International Journal of Behavioral Nutrition and Physical Activity*, *9*(1), 1-15. https://doi.org/10.1186/1479-5868-9-53

[18] Jayaraj, R., Whitty, M., Thomas, M., Kavangh, D., Palmer, D., Thomson, V., & Nagel, T. (2013). Prevention of Alcohol-Related Crime and Trauma (PACT): Brief interventions in routine care pathway - A study protocol. *BMC Public Health*, *13*(1), 1-5. https://doi.org/10.1186/1471-2458-13-49

[19] Bonaccio, M., Di Castelnuovo, A., Costanzo, S., De Lucia, F., Olivieri, M., Donati, M. B., ... & Moli-sani Project Investigators. (2013). Nutrition knowledge is associated with higher adherence to Mediterranean diet and lower prevalence of obesity. Results from the Moli-sani study. *Appetite*, *68*, 139-146. https://doi.org/10.1016/j.appet.2013.04.026

[20] Wagner, M. G., Rhee, Y., Honrath, K., Blodgett Salafia, E. H., & Terbizan, D. (2016). Nutrition education effective in increasing fruit and vegetable consumption among overweight and obese adults. *Appetite*, *100*, 94-101. https://doi.org/10.1016/j.appet.2016.02.002

[21] UNICEF. (2011). The State of the World's Children 2011. Adolescence an Age of Opportunity. United Nations Children's Fund (UNICEF). New York, USA. Available at: https://www.unicef.org/reports/state-worlds-children-2011

[22] Muderedzwa, T. M., & Matsungo, T. M. (2020). Nutritional status, physical activity and associated nutrition knowledge of primary school learners. *Nutrition and health*, *26*(2), 115-125. https://doi.org/10.1177/0260106020910625

[23] Chapoterera, B., Chideme Maradzika, J., Marume, A., & Zikiti, A. (2017). Determinants of Dietary Patterns and Obesity among Secondary School Adolescents in Harare, Zimbabwe, 2016. *International Journal of Child Health and Nutrition*, *6*(4), 144-158. https://doi.org/10.6000/1929-4247.2017.06.04.4

[24] MoPSE. (2017). Annual education statistics profile Harare province 2017. Ministry of Primary and Secondary Education (MoPSE), Harare, Harare. Available at: http://mopse.co.zw/sites/default/files/public/downloads/2017_Harare_Province_Statistics_Profile.pdf

[25] FNC. (2018). The Zimbabwe Vulnerability Assessment Committee (ZimVAC) 2018 Urban Livelihoods Assessment. Food and Nutrition Council (FNC), Harare, Zimbabwe. Available at: http://fnc.org.zw/wp-content/uploads/2019/01/2018-ZimVAC-Urban-Livelihoods-Assessment-Report-1.pdf

[26] Dobson. (1984). Calculating Sample Size. *Trans Menz Foundation*, *7*, 75–79.

[27] Matsungo, T. M., & Chopera, P. (2020). Effect of the COVID-19-induced lockdown on nutrition, health and lifestyle patterns among adults in Zimbabwe. *BMJ Nutrition,*

Prevention & Health, bmjnph-2020-000124. https://doi.org/10.1136/bmjnph-2020-000124

[28] FAO. (2014). Guidelines for assessing nutrition-related Knowledge, Attitudes and Practices manual. Food and Agriculture Organisation of the United Nations (FAO), Rome, Italy. Available at: http://www.fao.org/3/i3545e/i3545e.pdf

[29] Wareham, N. J., Jakes, R. W., Rennie, K. L., Mitchell, J., Hennings, S., & Day, N. E. (2002). Validity and repeatability of the EPIC-Norfolk physical activity questionnaire. *International Journal of Epidemiology*, *31*(1), 168-174. https://doi.org/10.1093/ije/31.1.168

[30] WHO. (2006). Global Physical Activity Questionnaire Analysis Guide GPAQ Analysis Guide Global Physical Activity Questionnaire (GPAQ) Analysis Guide. World Health Organisation (WHO), Geneva, Switzerland. Available at: https://www.who.int/ncds/surveillance/steps/resources/GPAQ_Analysis_Guide.pdf

[31] WHO. (2007). Computation of centiles and z-scores for height-for-age, weight-for-age and BMI-for-age, World Health Organisation (WHO), Geneva, Switzerland. Available at: https://www.who.int/growthref/computation.pdf

[32] WHO. (2011). Waist Circumference and Waist–Hip Ratio. WHO Expert Consultation. World Health Organisation (WHO), Geneva, Switzerland. Available at: https://www.who.int/publications/i/item/9789241501491

[33] Ashwell, M., Gunn, P., & Gibson, S. (2012). Waist-to-height ratio is a better screening tool than waist circumference and BMI for adult cardiometabolic risk factors: Systematic review and meta-analysis. *Obesity Reviews*, *13*(3), 275-286. https://doi.org/10.1111/j.1467-789X.2011.00952.x

[34] WHO. (2010). Global recommendations on physical activity for health. World Health Organisation (WHO), Geneva, Switzerland. Available at: https://doi.org/10.1080/11026480410034349

[35] Fasola, O., Abosede, O., & Fasola, F. A. (2018). Knowledge, attitude and practice of good nutrition among women of childbearing age in Somolu Local Government, Lagos State. *Journal of Public Health in Africa*, *9*(1), 42–46. https://doi.org/10.4081/jphia.2018.793

[36] Kennedy G, B. T. & D. M. (2010). Guidelines for measuring household and individual dietary diversity. Food and Agriculture Organisation of the United Nations (FAO), Rome, Italy. Available at: http://www.fao.org/3/i1983e/i1983e.pdf

[37] Zhang, L., Gu, C., Ma, H., Zhu, L., Wen, J., Xu, H., … Li, L. (2019, January). Portable glucose meter: trends in techniques and its potential application in analysis. *Analytical and Bioanalytical Chemistry*, *411*(1), 21-36. https://doi.org/10.1007/s00216-018-1361-7

[38] Saudek, C. D., Herman, W. H., Sacks, D. B., Bergenstal, R. M., Edelman, D., & Davidson, M. B. (2008). A new look at screening and diagnosing diabetes mellitus. In *Journal of Clinical Endocrinology and Metabolism*, *93*(7), 2447-2453. https://doi.org/10.1210/jc.2007-2174

[39] Sinha, R., Saha, A., & Samuels, J. (2019). American Academy of Pediatrics Clinical Practice Guidelines for Screening and Management of High Blood Pressure in Children and Adolescents: What is New? *Indian Pediatrics*, *56*(4), 317-321. https://doi.org/10.1007/s13312-019-1523-5

[40] Zanchetti, A. (2003). 2003 European Society of Hypertension-European Society of Cardiology guidelines for the management of arterial hypertension. *Journal of Hypertension*, *21*(6), 1011-1053. https://doi.org/10.1097/00004872-200306000-00001

[41] Savva, S. C., Tornaritis, M., Savva, M. E., Kourides, Y., Panagi, A., Silikiotou, N., Kafatos, A. (2000). Waist circumference and waist-to-height ratio are better predictors of cardiovascular disease risk factors in children than body mass index. *International Journal of Obesity*, *24*(11), 1453-1458. https://doi.org/10.1038/sj.ijo.0801401

[42] ZIMSTAT. (2015). Zimbabwe Demographic and Health Survey. ZDHS. Harare, Zimbabwe. Available at: https://doi.org/10.1017/CBO9781107415324.004

[43] Twig, G., Yaniv, G., Levine, H., Leiba, A., Goldberger, N., Derazne, E., … Kark, J. D. (2016). Body-mass index in 2.3 million adolescents and cardiovascular death in adulthood. *New England Journal of Medicine*, *374*(25), 2430-2440. https://doi.org/10.1056/NEJMoa1503840

[44] Shisana, O., Labadarios, D., Rehle, T., Simbayi, L., Zuma, K., Dhansay, A., … Faber, M. (2013). The South African National Health and Nutrition Examination Survey, 2012: SANHANES-1: the health and nutritional status of the nation. Human Sciences Research Council (HSRC), Cape Town, RSA. Available at: http://hdl.handle.net/20.500.11910/2864

[45] Reese-Mastorson, A., & Murakwani, P. (2016). Assessment of adolescent girl nutrition, dietary practices and roles in Zimbabwe. *Field Exchange*, *52*, 113. Avaiulale at: https://www.ennonline.net/fex/52/adolescentgirlnutrition

[46] Kruger, R., Kruger, H., & MacIntyre, U. (2006). The determinants of overweight and obesity among 10- to 15-year-old schoolchildren in the North West Province, South Africa – the THUSA BANA (Transition and Health during Urbanisation of South Africans; BANA, children) study. *Public Health Nutrition*, *9*(3), 351-358. https://doi.org/10.1079/phn2006849

[47] Rodea-Montero, E. R., Evia-Viscarra, M. L., & Apolinar-Jiménez, E. (2014). Waist-to-height ratio is a better anthropometric index than waist circumference and BMI in predicting metabolic syndrome among obese Mexican

adolescents. *International Journal of Endocrinology*, Volume (*2014*). https://doi.org/10.1155/2014/195407

[48] Bammann, K., Gwozdz, W., Lanfer, A., Barba, G., De Henauw, S., Eiben, G., & IDEFICS Consortium. (2013). Socioeconomic factors and childhood overweight in Europe: results from the multi-centre IDEFICS study. *Pediatric Obesity*, *8*(1), 1-12. https://doi.org/10.1111/j.2047-6310.2012.00075.x

[49] Kotian, M. S., Kumar S, G., & Kotian, S. S. (2010). Prevalence and determinants of overweight and obesity among adolescent school children of South Karnataka, India. *Indian Journal of Community Medicine*, *35*(1), 176. https://doi.org/10.4103/0970-0218.62587

[50] Manyanga, T., El-Sayed, H., Doku, D. T., & Randall, J. R. (2014). The prevalence of underweight, overweight, obesity and associated risk factors among school-going adolescents in seven African countries. *BMC Public Health*, *14*(1), 1-11. https://doi.org/10.1186/1471-2458-14-887

[51] Janssen, I., Katzmarzyk, P. T., Boyce, W. F., Vereecken, C., Mulvihill, C., Roberts, C., Woynarowska, B. (2005). Comparison of overweight and obesity prevalence in school-aged youth from 34 countries and their relationships with physical activity and dietary patterns. *Obesity Reviews*, *6*(2), 123-132. https://doi.org/10.1111/j.1467-789X.2005.00176.x

[52] LeBlanc, A. G., Katzmarzyk, P. T., Barreira, T. V., Broyles, S. T., Chaput, J. P., Church, T. S., ... & ISCOLE Research Group. (2015). Correlates of total sedentary time and screen time in 9–11 year-old children around the world: the international study of childhood obesity, lifestyle and the environment. *PLoS ONE*, *10*(6), e0129622. https://doi.org/10.1371/journal.pone.0129622

[53] Maher, C., Olds, T. S., Eisenmann, J. C., & Dollman, J. (2012). Screen time is more strongly associated than physical activity with overweight and obesity in 9- to 16-year-old Australians. *Acta Paediatrica*, *101*(11), 1170-1174. https://doi.org/10.1111/j.1651-2227.2012.02804.x

[54] O'brien, G., & Davies, M. (2007). Nutrition knowledge and body mass index. *Health Education Research*, *22*(4), 571-575. https://doi.org/10.1093/her/cyl119

[55] Gómez, C. G., Martínez, L. J., Levy, T. S., Guerra, A. G., Curiel, A. Á., & Aguilar, M. A. Q. (2011). Nutritional knowledge and its association with overweight and obesity in Mexican women with low socioeconomic level. *Archivos Latinoamericanos de Nutricion*, *61*(4), 396-405.

[56] Upreti, Y. R., Bastien, S., Bjønness, B., & Devkota, B. (2021). The socio-ecological model as a framework for understanding junk food consumption among schoolchildren in Nepal. *Nutrition and Health*. Mar 9 2021. https://doi.org/10.1177/02601060211000169

[57] Kigaru, D. M. D., Loechl, C., Moleah, T., Macharia-Mutie, C. W., & Ndungu, Z. W. (2015). Nutrition knowledge, attitude and practices among urban primary school children in Nairobi City, Kenya: a KAP study. *BMC Nutrition*, *1*(1), 1-8. https://doi.org/10.1186/s40795-015-0040-8

[58] Janssen, Ian, Katzmarzyk, P. T., Boyce, W. F., King, M. A., & Pickett, W. (2004). Overweight and obesity in Canadian adolescents and their associations with dietary habits and physical activity patterns. *Journal of Adolescent Health*, *35*(5), 360-367. https://doi.org/10.1016/S1054-139X(04)00058-8

[59] Kapantais, E., Chala, E., Kaklamanou, D., Lanaras, L., Kaklamanou, M., & Tzotzas, T. (2011). Breakfast skipping and its relation to BMI and health-compromising behaviours among Greek adolescents. *Public Health Nutrition*, *14*(1), 101–108. https://doi.org/10.1017/S1368980010000765

[60] Lateef, O. J., Njogu, E., Kiplamai, F., Haruna, U. S., & Lawal, R. A. (2016). Determinants of overweight and obesity among adolescent students in public secondary schools in Kwara state, Nigeria. *Current Research in Nutrition and Food Science*, *4*(2), 96–106. https://doi.org/10.12944/CRNFSJ.4.2.03

[61] Coelho, L. G., Cândido, A. P. C., Machado-Coelho, G. L., & Freitas, S. N. D. (2012). Association between nutritional status, food habits and physical activity level in schoolchildren. *Jornal de Pediatria*, *88*(5), 406-412. https://doi.org/10.2223/JPED.2211

[62] Bauman, A., & Craig, C. L. (2005). The place of physical activity in the WHO Global Strategy on Diet and Physical Activity. *International Journal of Behavioral Nutrition and Physical Activity*. *2*(1), 1-6. https://doi.org/10.1186/1479-5868-2-10

[63] Kubik, M. Y., Lytle, L. A., & Story, M. (2005). Schoolwide food practices are associated with body mass index in middle school students. *Archives of Pediatrics and Adolescent Medicine*, *159*(12), 1111-1114. https://doi.org/10.1001/archpedi.159.12.1111

[64] Mehdad, S., Hamrani, A., El Kari, K., El Hamdouchi, A., Barakat, A., El Mzibri, M., & Aguenaou, H. (2012). Body mass index, waist circumference, body fat, fasting blood glucose in a sample of Moroccan adolescents aged 11-17 years. *Journal of Nutrition and Metabolism*. Volume (*2012*), https://doi.org/10.1155/2012/510458

Cite this article as: Mapfumo, P.T., Muderedzwa, T.M., & Matsungo, T.M. (2022). Prevalence and determinants of overweight and obesity among in-school adolescents in Harare, Zimbabwe. *The North African Journal of Food and Nutrition Research, 6*(13): 29-38. https://doi.org/10.51745/najfnr.6.13.29-38