Assessment of Bone Mineral Density in Relation to Nutritional Status and Physical Activity of Early Adolescent Girls in the Public and Private Schools of Peshawar City

Sumbla Yousaf[1*], Pervaiz.I. Paracha[2], Sareer Badshah[3]

[1]Higher Education Department,Khyber Pakhtunkhawa, Pakistan.
[2]Faculty of Nutritional Sciences, Khyber Pakhtunkhawa Agriculture University, Peshawar, Pakistan.
[3]Islamia College University, Peshawar, Pakistan.

*Corresponding author: Sumbla Yousaf (Email: SumblaYousaf@gmail.com)

ABSTRACT

Adolescence could be the last window of opportunity to replenish nutrient stores. This study was conducted to assess and examine the interrelationship between bone mineral density, nutritional status, nutrient intake, physical activity and socioeconomic status of early adolescent girls of Peshawar. Six hundred early adolescent girls of 10-13 years were selected by systematic sampling method from three public and three private schools. The results revealed that several anthropometric measurements of adolescents girls from private schools was lower than those of the Public schools. Conversely, the mean bone mineral density (BMD) of adolescent girls from Private school was significantly higher than that of the Public schools. A greater proportion of adolescent girls from the Private schools were underweight and wasted than those of Public schools. Energy, protein and phosphorus intakes of adolescent girls from both Public and Private schools were higher than the RDAs set for the corresponding age group adolescents. But calcium and vitamin D intakes of about 50% or more of the adolescents were below the RDAs. Self-reported PAL of adolescent girls from the Private schools was higher than that of the Public schools. Family income was significantly correlated with WAZ, HAZ, BMIZ, MUACZ and WHZ ($P<0.05$). Early adolescent girls from Public schools were better in anthropometric measurements but had significantly lower mean bone mineral density than that of the Private schools. Adolescent girls from both Public and Private schools were taking inadequate amount of calcium and vitamin D and were more prone to nutritional osteomalacia.

Keywords: *Nutritional status, Bone Mineral density, Physical activity, Anthropometric measurement*

1. INTRODUCTION

Adolescents are defined as those whose ages fall between 10-19 years (WHO, 2013). There are 1.2 billion adolescents, makeup 18 % of the world population , more than half live in Asia (UNICEF, 2012).They are classified into three groups- the early, the middle and the late adolescents based on biological, psychological and developmental basis (Hendee, 1991). It is a period of transition between childhood and adulthood. Biologically, adolescence is a period of development from the onset of puberty till the termination of growth; cognitively, it is the ability to reason and think abstractly; socially, one begins to take on adult roles (Ryan, 2017). As they physically and psychologically mature they leave behind childhood and take on new roles: as earners and citizens – and as adult rights holders and duty bearers in their communities and societies (UNICEF, 2012). In this turbocharged neurological, physical, and emotional transition from childhood to adulthood, young people face a range of health risks (WHO, 2018). Especially adolescent girls constitute an important segment of the population. Their health status influences their reproductive functioning, pregnancy outcomes, child's birth weight, pregnancy wastage etc. Presently almost three-fourth of adolescent girls are anemic, likely to worsen during pregnancy (Baliga, Naik, & Mallapur, 2014).

Physical activity provides fundamental health benefits for adolescents, including improved cardiorespiratory and muscular fitness, bone health, maintenance of a healthy body weight, and psychosocial benefits. WHO recommends for adolescents to accumulate at least 60 minutes of moderate- to vigorous-intensity physical activity daily (WHO, 2018).Increased regular PA during the age of peak bone mineral accrual appeared to be beneficial in fostering bone acquisition as a whole. Thus, implementation of regular PA started at early life particularly during adolescence is the key towards achieving healthy bone and a practical way to overcome the increasing incidence of osteoporosis and future risk of fracture (Zulfarina et al., 2016).This rapid and fast accumulation of calcium in bones requires appreciable amount of dietary calcium and vitamin D which can only be met by taking at least three to four servings of dairy products per day which unfortunately is too high for the majority of Pakistani population to meet their daily calcium needs thus making them more vulnerable to nutritional osteomalacia.

Assessment of nutritional status of adolescent is pre-requisite for early identification of nutritional deficiencies, their management and to prevent increased morbidity and mortality. As genetic, dietary, physical activity and other

Nurture*: Volume 12, Issue 1, 22-30,* ***2018***
Online ISSN*: 1994-1633/* ***Print ISSN****: 1994-1625*
DOI*: 10.55951/nurture.v12i1.93|* ***URL****: www.nurture.org.pk*

environmental factors determining bone mineral density varies between countries, ethnic groups and cultures. It is highly imperative to assess the nutritional status of adolescent as early as possible. Improving adolescent girl's nutrition and delaying their first pregnancy may be a promising intervention point to break this intergenerational cycle of malnutrition (ACC/SCN, 1992; UNICEF, 1998).

Pakistan being blessed with a lot of resources and big force of youths still it is lagged behind from its neighbors and other low-income countries in terms of health, nutrition and human resource development. Small cross sectional hospital based studies revealed the prevalence of vitamin D deficiency and nutritional rickets in children which may be considered a public health problem (Atiq, Suria, Nizami, & Ahmed, 1998; Majeed et al., 2007; Siddiqui & Rai, 2005).

Pakistani adolescent girls are being confronted with under-nutrition, overweight and obesity owing to economic, dietary, social and cultural reasons (Ondrak & Morgan, 2007). Adolescent period could be the last window of opportunity to replenish nutrient stores and to increase energy and strength for the improved physical and mental performances of the present and future responsibilities. Many habits acquired during adolescence will last a life time. So it is important to consider bone mineral density in relation to nutritional status and physical activity during adolescence because it is a time to prepare for the nutritional demands of pregnancy, lactation, and heavy workloads.

The objectives of the study were to Assess bone mineral density, nutritional status and physical activity and examine the interrelationship between bone mineral density, body mass index, dietary intake, physical activity and socioeconomic status of early adolescent girls.

2. METHODOLOGY

This study was institutionalized cross sectional study to assess bone mineral density in relation to nutritional status and physical activity of early adolescent girl in Peshawar. The data were collected from 600 girls selected by systematic sampling technique from six schools (317 from Public and 283 from Private schools) of Peshawar. The study was limited due to resources, cooperation and security while delimited to 10-13 years old girls, due to growth spurt, of Public and Private schools within Peshawar. The age of adolescents was reconfirmed by looking at the admission register. Since it was institution based study written Permission to conduct study was obtained from the Directors and Principals of Public and Private schools, Peshawar. The data was collected through questionnaires filled by researcher herself. Questionnaires were designed to collect data about Demographic detail, family history and Physical activity by questions about 24 hour's activity, and Dietary intake by semi-structured food frequency, and physical activity level by self-reported questionnaire of 3 days. Research tools were pre-tested before they were used in the field. About 25 questionnaires were filled by the Subjects other than the targeted population for necessary amendments.

ANTHROPOMETRICS: Anthropometric measurements including weight (Wt), height (Ht.), triceps skin-fold thickness (TSFT) and mid upper arm circumference (MUAC) adolescent girls were taken using the standard anthropometric measurement procedure (WHO, 1983). Participants were asked to put off the shoes and heavy outer garments like (sweater, shawl, coat, jackets etc.).

Weight (Wt) and Height (Ht.) of the respondents was measured on Detecto scale, USA. . The scale was calibrated with 10 Kg weight after 10 samples for accuracy check. Body mass index (BMI) for age was generated on WHO AnthroPlus 2007 (WHO, 2007).Mid Upper Arm Circumferences was measured by the non-stretchable tape. Triceps Skin Fold Thickness was measured by the Accumeasure-for- body fat skin fold clipper.

BONE MINERAL DENSITY: Bone Mineral Density (BMD) was measured by Clinical Bone Sonometer (SAHARA) based on ultrasound measurement of calcaneus (heel bone).

DIETARY INTAKE: A food frequency questionnaire was developed by listing all the commonly consumed foods and drinks at the left side of the column of the questionnaire while on the right side of the columns, the frequency with which food and drinks were consumed were added. All the food items were grouped according to their qualitative characteristics. The girls were interviewed for frequency of foods and beverages along with portion sizes that they had consumed during the last week. The responses were recorded in the appropriate column of the questionnaire. An individual food portion sizes were converted into grams of food consumed. The nutritive value (energy, protein, calcium, phosphorus, vitamin D) of food consumed in one week was calculated by consulting (Food Composition Table for Pakistan, 2001) and USDA (2008) and divided by seven for daily consumption and compared with the International RDA and analyzed.

PHYSICAL ACTIVITIES LEVEL (PAL): Physical activities of adolescent girls were assessed by interviewing the girls and recording their responses in the questionnaire. The interview was followed by distributing proforma for self-reporting their 24 hours activities. These proformas were collected after a week. Physical activity level (PAL) was calculated according to FAO criteria (2001). Energy cost of activities expressed as multiples of BMR. PAL was expressed as a multiples of 24-hour basal metabolic rate (BMR), dividing total energy expenditure by the estimated BMR (i.e. PAL=TEE/BMR) and multiplied by 1.01 (i.e. to make it 1 percent higher and classified into Sedentary, Low Active, Active and Very Active.

Data regarding demographic and socioeconomic characteristics, bone mineral density, anthropometric measurements, dietary intake and physical activity were entered into a computer for statistical analysis using SPSS -10 programs. Data

Nurture**: Volume 12, Issue 1, 22-30, **2018
***Online ISSN**: 1994-1633/ **Print ISSN**: 1994-1625*
***DOI**: 10.55951/nurture.v12i1.93| **URL**: www.nurture.org.pk*

were rechecked for completeness and internal consistency. Descriptive statistics were run for error checking and tabulation. Means and standard deviation were use to examine the mean difference in variables between schools. Student t test and ANOVA was applied to test significance of differences between 2 or more sampling means. Correlation and Regression analysis was done to examine the relationship between dependent and independent variables.

3. RESULTS

There was no significant differences ($p>0.01$) in the mean Wt, Ht, MUAC and BMI of adolescent girls between the Public and Private schools (Table 1). The mean TSFT values of 11-12 and 12-13 year-old girls from Private Schools were significantly ($p<0.01$) higher than those of Private schools.

There were no significant ($p>0.05$) differences in the means WAZ, HAZ and MUACZ within the same age group of girls between the Public and Private Schools. However, the TSFTZ indicate that 11-12 and 12-13 year-old girls from the Private schools had significantly ($p<0.01$) higher TSFTZs than those of the Public schools (Table 2). Conversely, the BMIZ of 11-12 and 12-13 years old girls of Public school were significantly ($p<0.05$) higher than of the Private schools.

The girls from Private school had significantly ($p<0.01$) higher means TSFTZ and BMIZ than that of Public school while means of WHZ and HAZ had significantly ($p< 0.05$) different means.

Prevalence of underweight, wasted of girls from Private schools was higher than those of Public schools (Table 3). Similarly, prevalence of overweight/obesity of girls from Private schools was higher than that of Public schools.

The mean BMD of girls from Public schools was significantly ($p<0.01$) higher than that of the Private schools (Table 4). The mean weight, height, body mass index, mid upper arm circumference and triceps skin fold thickness of early adolescent girls from the Public school were increasing with activity (Table 5).

Energy and phosphorus intake was slightly higher than RDA in all activity level while protein intake was double but calcium and vitamin D intake was lower than half of RDA in all four level of -physical activity of both schools.

Seventeen and twenty nine percent of adolescent girls of Public and Private schools had normal BMD status at sedentary level (Table 6). In Low Active PAL 10% of Public school and 32% of Private school were normal while remaining were below normal. At active PAL, no one of the Private school had normal BMD while in the Public school 14% of the adolescent girls had normal BMD. At very active PAL, no one from the Public school could qualify for this group while in the Private school 33% of the girls had normal BMD and 67% below normal BMD.

The percentage prevalence of malnutrition in relation to bone mineral density levels was presented in Table 7. The prevalence percentage of normal Z-score of adolescent was almost same for normal BMD and Below normal of both schools. Most of the remaining early adolescent girls of Public and Private school had Z-score >2 indicating overweight while remaining high percentage of early adolescent from Private school were underweight, wasted and depleted adiposity (<-2 Z-score) at both BMD levels as compared to Public school. Four to seven percent adolescent from Public school had depleted muscle as compared to 1 % of Private schools adolescent at Normal and Below normal BMD respectively.

The prevalence percentage of normal Z-score of active and very active adolescent was lower than sedentary and low activity PAL (Table 8). The percentage prevalence of normal WAZ and WHZ was high in early adolescent girls of Public school than those of Private school at active PAL while percentage of MUACZ was almost same in both schools but normal TSFTZ percentage was high in Private school (100%) as compared to Public school (86%).Most of the remaining early adolescent girls of Public school had Z-score >2 indicating overweight while remaining early adolescent of Private school were underweight (<-2 Z-score) at active PAL. There was no early adolescent girl of Public school at very active PAL while only 33 early adolescents of the Private school had normal Z-score at very active but most of them (approx. 67%) were under nourished (<-2) at WAZ and WHZ . All the early adolescent girls were lied in normal Z-score (-2< Z-score<2) in TSFTZ at active and very active PAL.

Nurture**: Volume 12, Issue 1, 22-30, **2018
***Online ISSN**: 1994-1633/ **Print ISSN**: 1994-1625*
***DOI**: 10.55951/nurture.v12i1.93| **URL**: www.nurture.org.pk*

Table 1. Anthropometrics of early adolescent girls by school and age.

Age Group	SCHOOL	Weight(kg)		Height(cm)		MUAC (cm)		TSFT(mm)		BMI	
		Mean± SD	Prob>ITI	Mean± SD	Prob>ITI	Mean± SD	Prob>ITI	Mean± SD	Prob>ITI	Mean± SD	Prob>ITI
10-11	PUBLIC N=33	35.22± 8.11	1.305	143.47± 8.48	1.028	21.10± 2.84	1.155	11.60± 5.21	0.201	16.99± 2.66	0.997
	PRIVATE N=69	33.14± 7.73		141.68± 8.107		20.48± 2.37		11.41± 4.07		16.38± 2.96	
11-12	PUBLIC N=103	39.42± 9.64	1.479	146.72± 7.321	0.369	21.81± 2.89	0.946	10.96± 5.08	3.463*	18.16± 3.52	1.936
	PRIVATE N=98	37.17± 11.84		146.27± 9.69		21.38± 3.53		13.31± 4.50		17.12± 4.11	
12-13	PUBLIC N=181	40.50± 8.21	0.654	148.32± 6.14	0.827	22.05± 2.78	0.898	11.54± 5.06	4.830*	18.30± 2.95	1.060
	PRIVATE N=116	39.35± 12.31		148.63± 8.57		22.34± 3.52		14.67± 5.19		17.74± 5	

Note: *t significant at p<0.01.

Table 2. Z-score of early adolescent girls by age and schools.

Age group (Yrs)	SCHOOL	WAZ Mean± SD	HAZ Mean± SD	WHZ Mean± SD	MUACZ Mean± SD	TSFTZ Mean± SD	BMIZ ± SD
10-11	PUBLIC	0.23	0.304	-0.35	0.04	-0.22	0.112
	N=33	± 1.35	± 1.38	± 1.14	± 1.29	± 1.44	± 1.11
	PRIVATE	-0.12	0.052	-0.52	-0.23	-0.27	-0.25
	N=69	± 1.29	± 1.24	± 1.54	± 1.08	± 1.13	± 1.45
11-12	PUBLIC	0.04	-0.254	-0.04**	-0.21	-0.53*	0.097**
	N=103	± 1.32	± 1.13	± 1.52	± 1.26	± 1.33	± 1.29
	PRIVATE	-0.26	-0.230	-0.46	-0.39	0.08	-0.641
	N=98	± 1.62	± 1.44	± 1.81	± 1.53	± 1.13	± 1.76
12-13	PUBLIC	-0.57	-1.897	-0.08	-0.46	-0.45*	-0.269**
	N=181	± 1.10	± 0.84	± 1.35	± 1.22	± 1.33	± 1.24
	PRIVATE	-0.63	-0.710	-0.19	-0.29	0.33	-0.715
	N=116	± 1.57	± 1.24	± 2.32	± 1.47	± 1.35	± 1.86
10-13	PUBLIC	-0.28	-0.563**	-0.095**	-0.328	1.344*	-0.563*
	N=317	+1.24	+1.09	+1.39	+1.20	+0.70	+1.090
	PRIVATE	-0.38	-0.361	-0.369	-0.314	1.263	-0.361
	N=283	+1.53	+1.33	+1.98	+1.40	+0.075	+1.33

Note: *Difference significant at p<0.01, **difference t significant at p<0.05.

Nurture**: Volume 12, Issue 1, 22-30, **2018
***Online ISSN**: 1994-1633/ **Print ISSN**: 1994-1625*
***DOI**: 10.55951/nurture.v12i1.93| **URL**: www.nurture.org.pk*

Table 3. Prevalence of malnutrition of early adolescent girls by school.

Anthropometric. Indicator		Type of School Public N=317		Private N=283	
		N	%	N	%
WAZ group (%)	Normal WAZ <2 to <-2	289	91	233	82
	Under Weight WAZ <-2	14	4	28	10
	Over weight WAZ >2	14	4	22	8
WHZ group (%)	Normal -2< WHZ <2	287	91	213	75
	Wasted WHZ<-2	7	2	43	15
	Overweight WHZ >2	27	10	23	7
TSFTZ group (%)	Normal-2< TSFTZ<2	277	87	266	94
	Depleted Muscle TSFTZ<-2	22	7	2	1
	Over nourished TSFTZ>2	15	5	18	6
MUACZ group (%)	Normal -2< MUAC <2	282	89	250	88
	Depleted Adiposity MUAC<-2	18	6	18	7
	Over nourished MUACZ>2	15	5	17	5

Table 4. Bone mineral density status of early adolescent girls by school.

SCHOOL	BONE MINERAL DENSITY (T- SCORE)		
	MEAN	±SD	PROB> ITI
PUBLIC N=317	-1.7168	±1.136	-3.731*
PRIVATE N=283	-1.4068	±0.862	

*t significant at p<0.01

Table 5. Nutritional status and dietary intake in relation to physical activity levels.

Physical Activity Level (PAL)	Schools	NUTRITIONAL STATUS Weight (Kg) Mean ± SD	Height (cm) Mean ± SD	BMI Mean ± SD	MUAC (cm) Mean ± SD	TSFT (mm0 Mean ± SD	DIETARY INTAKE (%RDA) Energy Mean ± SD	Protein Mean ± SD	Calcium Mean ± SD	Phosph. Mean ± SD	Vit.D Mean ± SD
Sedentary	Public	39.93	147.35	18.26	22.03	11.57	110.50	189.84	40.30	108.09	30.18
	N=254	±8.81	±6.86	±3.21	±2.94	±5.28	±33.88	±64.29	±19.12	±51.72	±26.56
>1 <1.4	Private	38.17	146.49	17.62	21.82	13.79	115.32	197.48	40.12	108.60	30.31
	N=218	±11.63	±9.19	±4.46	±3.48	±4.96	±33.49	±62.73	±16.98	±39.38	±25.54
Less	Public	38.25	147.11	17.57	21.24	10.91	116.98	201.83	39.90	108.60	30.37
Active	N=56	±7.45	±6.69	2.70	±2.52	±4.89	±36.23	±75.23	±18.77	±39.39	±25.34
>1.4 <1.6	Private	35.84	146.79	16.42	21.06	12.19	133.06	233.39	49.48	110.13	31.26
	N=57	±10.27	±8.75	±3.41	±2.86	±4.66	±37.11	±95.19	±25.39	±40.68	±28.15
Active	Public	46.01	149.07	20.31	22.14	8.85	100.58	182.65	41.59	110.13	30.30
	N=7	±18.28	±7.44	±7.04	±4.45	±5.14	±29.23	±48.91	±7.34	±29.34	±24.66
>1.6 <1.9	Private	26.82	141.45	13.44	19.20	11.80	99.81	179.16	37.53	103.93	34.32
	N=5	±6.33	±11.55	±2.67	±2.88	±5.11	±23.54	±39.29	±13.71	±24.77	±27.34
Very Active	Public N=0	_	_	_	_	_	_	_	_	_	_
>1.9 <2.5	Private	23.60	132.00	13.60	18.66	10.66	116.06	199.12	43.07	98.51	27.92
	N=3	±0.00	±6.08	±1.30	±1.15	±1.15	±0.17	±42.99	±15.67	±7.37	±26.67

Nurture**: Volume 12, Issue 1, 22-30, **2018
***Online ISSN**: 1994-1633/ **Print ISSN**: 1994-1625*
***DOI**: 10.55951/nurture.v12i1.93| **URL**: www.nurture.org.pk*

Table 6. Bone Mineral Density Status in Relation to Physical Activity Levels.

Physical Activity Level (PAL)	Schools	BONE MINERAL DENSITY STATUS			
		Normal		Below Normal	
		N	%	N	%
Sedentary	Public n=254	43	17	211	83
PAL >1 <1.4	Private n=218	63	29	155	71
Low Active	Public n=56	6	10	50	90
PAL >1.4 <1.6	Private n=57	18	32	39	68
Active	Public;N=7	1	14	6	86
PAL >1.6 <1.9	Private;N=5	0	0	5	100
Very Active	Public;N=0	-	-	-	-
PAL >1.9 <2.5	Private;N=3	1	33	2	67

Table 7. Prevalence of malnutrition in relation to bone mineral density.

Anthropometric. Indicator		Bone Mineral Density (BMD)			
		Normal		Below Normal	
		Public N=50	Private N=82	Public N=267	Private N=201
WAZ group (%)	Normal -2< WAZ <2	86	85	92	81
	Under Weight WAZ<-2	4	5	5	12
	Over weight WAZ >2	10	10	3	7
WHZ group (%)	Normal -2< WHZ <2	92	77	90	75
	Wasted WHZ<-2	0	12	3	16
	Overweight WHZ >2	8	11	7	9
TSFTZ group (%)	Normal -2< TSFTZ<2	86	92	88	95
	Depleted Muscle TSFTZ<-2	4	1	7	1
	Over nourished TSFTZ>2	10	7	5	4
MUACZ group (%)	Normal -2< MUAC <2	90	88	89	88
	Depleted Adiposity MUAC<-2	4	5	6	7
	Over nourished MUACZ>2	6	7	5	5

Table 8. Prevalence of Malnutrition in Relation to Physical Activity levels.

Anthropometric. Indicator		Physical Activity Level (Pal)							
		Sedentary		Low Active		Active		Very Active	
		Public N=254	Private N=218	Public N=56	Private N=57	Public N=7	Private N=5	Public N=0	Private N=3
WAZ group (%)	Normal -2< WAZ <2	91	84	93	82	71	40	-	33
	Under Weight WAZ<-2	4	8	7	11	0	60	_	67
	Overweight WAZ >2	5	8	0	7	29	0	_	0
WHZ	Normal -2< WHZ <2	91	76	89	77	86	40	_	33

Nurture**: Volume 12, Issue 1, 22-30, **2018
***Online ISSN**: 1994-1633/ **Print ISSN**: 1994-1625*
***DOI**: 10.55951/nurture.v12i1.93| **URL**: www.nurture.org.pk*

group (%)	Wasted WHZ<-2	2	13	6	18	0	60	_	66
	Overweight WHZ >2	7	11	5	5	14	0	_	0
	Normal-2< TSFTZ <2	87	93	88	96	86	100	_	100
TSFTZ group (%)	Depleted Muscle TSFTZ<-2	7	1	7	2	14	0	_	0
	Over nourished TSFTZ>2	6	6	5	2	0	0	_	0
	Normal -2<MUAC <2	88	88	93	90	86	80	-	67
MUACZ group (%)	Low Adiposity MUAC<-2	6	6	5	5	0	20	_	33
	Over nourished MUACZ>2	6	6	2	5	14	0	_	0

4. DISCUSSION

The study showed that means Wt, Ht, MUAC, and BMI of girls were increasing with age in both schools except for TSFT. The results revealed that there was no significant differences ($p>0.01$) in the mean Wt, Ht, MUAC and BMI of adolescent girls between the Public and Private schools except the mean TSFT values of 11-12 and 12-13 year-old girls from Private Schools were significantly ($p<0.01$) higher than those of Public schools. Same results were found when Z-score of the anthropometrics was calculated. The results revealed that there were no significant ($p>0.05$) differences in the means WAZ, HAZ and MUACZ within the same age group of girls between the Public and Private Schools. However, the TSFTZ of 11-12 and 12-13 year-old girls from the Private schools had significantly ($p<0.01$) higher TSFTZs than those of the Public schools. Conversely, the BMIZ of 11-12 and 12-13 years old girls of Public school were significantly ($p<0.05$) higher than of the Private schools.

Our results show that the prevalence of underweight, wasted of girls from Private schools was higher than those of Public schools. The WHZ results of Private schools adolescent girls were almost similar to those of Parveen and Begum (2003) who reported that 13.5% of adolescent girls were wasted. Similarly, prevalence of overweight/obesity of girls from Private schools was higher than that of Public schools. The finding about overweight was in consistent with the finding of Bhutta (2017). This may be due to improper selection of food. Bone mineral density (BMD) status of early adolescent girls from Private schools was significantly ($p<0.01$) higher than that of the Public schools.

The analysis on relationship between the PAL nutritional status, dietary intake prevalence of malnutrition and BMD reveals that anthropometric measurements of adolescent girls from Public school were increased as the level from sedentary to light and active was changed while opposite was the case for adolescent girls from the Private school. Energy, protein and phosphorus intakes of adolescent girls increased with the change at the level of physical activity while calcium and vitamin D intakes didn't change significantly with the change of activity levels. The adolescents from both the schools could only take about 30-50% of their RDAs. The result is in fair agreement with result of Greer, Krebs, and Nutrition (2006) that many children and adolescent fail to achieve adequate calcium intake for their age group and UNICEF (2017) who observed that only 20-40 percent of south Asian adolescent girls meet their recommended dietary intake .Higher percentage of early adolescent girls from both school had below normal BMD at different PAL.

The prevalence percentage of malnutrition in relation to bone mineral density of normal adolescent was almost same for normal Bmd and Below normal of both schools. Most of the remaining early adolescent girls of Public and Private school had Z-score >2 indicating overweight while remaining high percentage of early adolescent from Private school were underweight, wasted and depleted adiposity (<-2 Z-score) at both BMD levels as compared to Public school while only few adolescent from Public school had depleted muscle.

The prevalence percentage of normal Z-score of active and very active adolescent was lower than sedentary and low activity PAL. The percentage prevalence of normal WAZ and WHZ was high in early adolescent girls of Public school than those of Private school at active PAL while percentage of MUACZ was almost same in both schools but normal TSFTZ percentage was high in Private school (100%) as compared to Public school (86%).Most of the remaining early adolescent girls of Public school had Z-score >2 indicating overweight while remaining early adolescent of Private school were underweight (<-2 Z-score) at active PAL. There was no early adolescent girl of Public school at very active PAL while only 33% early adolescents of the Private school had normal Z-score at

Nurture**: Volume 12, Issue 1, 22-30, **2018
***Online ISSN**: 1994-1633/ **Print ISSN**: 1994-1625*
***DOI**: 10.55951/nurture.v12i1.93| **URL**: www.nurture.org.pk*

very active but most of them (approx. 67%) were under nourished (<-2) at WAZ and WHZ . All the early adolescent girls were lied in normal Z-score (-2< Z-score<2) in TSFTZ at active and very active PAL.

5. CONCLUSION

It may be concluded from the study that nutritional status depicted in anthropometric measurement of both school is normal except for few adolescents of Private schools who were stunted and wasted, about 58-79% adolescent of both schools were thin. But bone mineral density was better in adolescent girls of Private school as compared to their counterparts in the Public schools which may be due to difference in diet, income and low disease history of family.

It has been suggested that BMD may become better if diet is based on proper amount of calcium, vitamin D and phosphorus. They are intimately related with each other and can be achieved by eating four servings of dairy products daily. Sun light is also good inexpensive source of Vitamin D. Policymakers can help to improve women and children's nutrition by addressing women's low status in society. Nutritional education program may be arranged for guidance of family. It will lead to selection of inexpensive good food sources and balanced diet and improving living style of low income family.

FUNDING

This study received no specific financial support.

CONFLICT OF INTEREST

The authors declare that they have no competing interests.

ARTICLE HISTORY

Received: 2 May 2018/ Revised: 10 October 2018 / Accepted: 30 November 2018 / Published: 14 December 2018

ACKNOWLEDGEMENT

The author is grateful to Chairperson Dr. Nomana Anjum, Dr. Hajra Ahmad, Associate Professor and staff of Home and Health sciences, Allama Iqbal Open University, Islamabad for their kindness and cooperation in solving research related problems. The author thanks the following for their contributions: Novartis and Pharmevo Pharmaceutical companies for generous provision of BMD Facilities; Authorities, Principals, staff and students of Public and Private schools for their cooperation in data collections; my friend Asia (lecturer) and students Amber, Zeenat and Sadiqa for their assistance in collection of data.

REFERENCES

ACC/SCN. (1992). Nutrition and population links. Breastfeeding, Family planning and Child Health. ACC/SCN symposium Report. Nutrition Policy Discussion Paper No 11, Geneva.

Atiq, M., Suria, A., Nizami, S., & Ahmed, I. (1998). Vitamin D status of breastfed Pakistani infants. Acta Paediatrica, 87(7), 737-740.Available at: https://doi.org/10.1111/j.1651-2227.1998.tb01739.x.

Baliga, S., Naik, V., & Mallapur, M. (2014). Nutritional status of adolescent girls residing in rural area: A community-based cross-sectional study. Journal of the Scientific Society, 41(1), 22-25.Available at: https://doi.org/10.4103/0974-5009.126712.

Bhutta, Z. A. (2017). Embodying the future: How to improve the nutrition status of adolescent girls in Pakistan?" Retrieved from; https://www.gainhealth.org/-knowledge-centre/improve-nutrition-status-adolescent-girls-pakistan.

Food Composition Table for Pakistan. (2001). Department of agricultural Chemistry. Peshawar: NWFP Agricultural University.

Greer, F. R., Krebs, N. F., & Nutrition, C. o. (2006). Optimizing bone health and calcium intakes of infants, children, and adolescents. Pediatrics, 117(2), 578-585.Available at: https://doi.org/10.1542/peds.2005-2822.

Hendee, W. R. (1991). Sociodemographic trends and projections in the adolescents' population. The health of adolescents: A Publication of American Medical Association Jossey-Bass Publications.

Majeed, R., Memon, Y., Khowaja, M., Majeed, F., Ali, M. U., & Rajar, U. (2007). Contributing factors of rickets among children at Hyderabad. JLUMHS, 6(2), 60-65.Available at: https://doi.org/10.22442/jlumhs.07620118.

Ondrak, K. S., & Morgan, D. W. (2007). Physical activity, calcium intake and bone health in children and adolescents. Sports Medicine, 37(7), 587-600.Available at: https://doi.org/10.2165/00007256-200737070-00003.

Parveen, M. M., & Begum, K. (2003). Nutritional Status and Associated Factors among Urban Adolescent Girls in Bangladesh. Paper presented at the Asian Conference on Diarrheal Diseases and Nutrition. (ASCODD) / Scientific Session 6.

Ryan, G. (2017). Adolescence is an important time of change:Keeping young women healthy isn't limited to the doctor's office. Retrieved from: https://uihc.org/health-topics/adolescence-important-time-change.

Siddiqui, T. S., & Rai, M. I. (2005). Presentation and predisposing factors of nutritional rickets in children of Hazara Division. Journal of Ayub Medical College Abbottabad, 17(3), 29-32.

UNICEF. (1998). UNICEF strategy for improved nutrition of children and women developing countries: UNICEF.

UNICEF. (2012). Progress for children A report card on adolescents. 10(4-6), 37.

UNICEF.. (2017). Adolescent and women's nutrition.UNICEF is working in South Asia to improve the nutrition of adolescent girls and women. Retrieved from: https://www.unicef.org/rosa/what-we-do/nutrition/adolescent-and-womens-nutrition.

USDA. (2008). USDA national database for standard reference, Release 21.

WHO. (2007). WHO, Retrieved from: http://www.who.int/growthref/en/.

WHO.. (2013). WHO, Retrieved from: https://www.who.int/hiv/pub-guidelines/arv2013/intro/keyterms/en/.

WHO... (2018). Adolescents: Health risks and solutions. Retrieved from: https://www.who.int/en/news-room/fact-sheets/detail/adolescents-health-risks-and-solutions.

Zulfarina, M. S., Sharkawi, A. M., AQILAH-SN, Z.-S., Mokhtar, S.-A., Nazrun, S. A., & Naina-Mohamed, I. (2016). Influence of adolescents' physical activity on bone mineral acquisition: A systematic review article. Iranian Journal of Public Health, 45(12), 1545–1557.

Nurture**: Volume 12, Issue 1, 22-30, **2018
***Online ISSN**: 1994-1633/ **Print ISSN**: 1994-1625*
***DOI**: 10.55951/nurture.v12i1.93| **URL**: www.nurture.org.pk*