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A Correlational Study on Glycemic Index and Glycemic Load of Foods Consumed by Adolescents in Relation to Their Nutritional Status

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ABSTRACT
Background: A cross sectional study with random sampling over 442 adolescent of 14 to 19 years age studying in Govt & Private Schools in Mansehra was done to assess nutritional status by selective anthropometric measurements.
Methods: Food frequency questionnaires were distributed among the students and nutritional assessment was done by selective anthropometric measurements. Descriptive data and correlation was measured by latest SPSS.
Results: Among 450 students of 14 to 19 years 442 students responded the study including (53%) male and (47%) female students, 205 girls participated in the study, 286 (64.7%) participants showed interest in daily exercise while 156 (35.3 %) participants showed no interest in exercise. out of 442 (100%) students 66 (14.9%), were on diet while 376 (85.1%) were not on diet. Out of (100%) students (25.5%), perceived diet impact on nutritional status while (73.7%) perceived no impact on nutritional status, minimum weight of the participants was 41 kg with maximum 84 kg and a mean of 57.25 kg.while (σ) of the Data was 9.74 minimum height was 132 cm and maximum was 185 cm with a mean of 162.97 cm; (σ) was 9.56 of the participant.
Conclusion: Z- Scores and Glycemic loads had correlation with p values 0.5 but with 2 **. There was very strong correlation between waist hip ratio and Glycemic loads of foods and *p* values 0.36 with 2** in Pearson correlation and *p* values 0.00 in 2-tailed showed strong correlation.

KEY WORDS: Anthropometric measurements, Circumference, Correlation, FFQ (Food Frequency Questionnaire, Glycemic loads.

INTRODUCTION

Prevalence of Obesity and increase in body weight has now become a global issue; it has not only adversely affected the health of the adolescent but also contributes in development of risk factors for metabolic disorders and chronic heart diseases in the later phase of the life. It has been found to difficult treat the fatness in adolescents but study of modifiable lifestyle factors which influence body fatness in adolescents is considered public health priority. In this regard Glycemic index (GI) and glycemic load (GL) have received attention over the years. GI can be defined an incremental area under the blood glucose response curve of carbohydrates in a food expressed as a percentage in a reference food response to carbohydrate (usually glucose), and thus represents the quality of carbohydrate [(1)] .The glycemic index (GI) an indicator ranks carbohydrates according to effects on the body's postprandial glycemic response, was introduced 20 years ago to facilitate glycemic control in diabetic patients [(2)] .Most of the prospective observational studies have found independent association between higher dietary glycemic index or lower intakes of fiber and whole grain with weight gain. With respect to dietary glycemic index and glycemic load, only cross-sectional evidence is available for children and adolescents [(3)]·A low-GI diet is hypothesized to increase satiety level and reduce voluntary food intake, whereas a high-GI diet is observed to increase hunger and voluntary food intake, and in turn increase the accumulation of fat on the body [(4)] . The extension of the research to the role of GI and GL in the management and prevention of obesity and overweight ,cardiovascular diseases, cancer and other health problems, such as age-related macular degeneration showed inconsistent findings always, and consensus about the incorporation of the GI and GL concepts into dietary guidelines has not been reached yet [(5)]·In a study conducted by Sayhoun et al dietary glycemic index showed positive association with 2-h glucose and fasting insulin, inversely association with thigh intramuscular fat and not significantly association with fasting glucose, glycated hemoglobin, or visceral abdominal fat [(6)]. In one study it was found a positive association between insulin resistance index and GI in the Framingham Offspring Cohort but not

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in the Atherosclerosis Study with Insulin resistance [7]. There is positive association between GI and glycated hemoglobin (HbA1c) in diabetic patients but in general populations findings are contradictory [8] .Several evidences regarding the effects of dietary GI on diabetes, obesity and hypertension in adults have been marked [9] There was neutral effects of low fat diet, LGI on obesity in adulthood, several clinical trials in different protocols were conducted. Some studies focused on a single meal, following appetite, satiety, food intake and energy intake [10] Epidemiologic data shows correlation between lower food intake and body weight with low dietary glycemic index (GI) [11]. In addition, low dietary GI and glycemic load (GL) favor lipid profiles and lower concentrations of C-reactive protein only in obese and overweight persons, It also reveals that the metabolic effects of dietary carbohydrates are very much important particularly in persons with insulin-resistance [12].

RESEARCH METHODOLOGY

Across sectional consisting of 442 students between 13 to 19 years age group with no apparent metabolic disorder was conducted in selected Govt and private schools of city Mansehra. Students were selected by simple random sampling including girls and boys .To conduct this research in the study area different study tools were used (annex 1, 2, 3, 4), research was mainly concerned with the observation of diet habits of the students with respect to Glycemic loads of the study population. School going age is more prone to develop dietary irregularities so choice of this age group was ideal and to calculate Glycemic loads of the foods FFQ was used, nutritional status of the students was assessed by selective anthropometric measurements (Height, weight, Hip circumference, Waist circumference, Hip/Waist ratio)

EXCLUSION CRITERIA

1. Students of adolescent ages b/w 13 to 19 Years of age with apparent metabolic disorder
2. Students below 13 years and above 19 Years of age

Dietary intake was measured with a food-frequency questionnaire (FFQ) & Dietary recall. For this purpose Teachers help was taken, teachers were trained about questionnaire interpretation & each questionnaire was filled under the supervision of the teacher in the school. Pictorial view about the amount of the food mentioned in the questionnaire was provided to teachers & students along with questionnaire.

For each food, a commonly used unit or portion size (e.g., one slice of bread) was specified and each participant was asked for amount used during past week consumed that amount. Each individual was shown different portion size of the food being asked & a FFQ was filled under the supervision of the teacher in the school. Nutritional assessment was done by anthropometric measurement like Weight, Height, BMI, WC (waist circumference) & Performa was used to tabulate the results. Demographical information was asked like ages, sex & noted in the Performa. Primary Data consisted of Anthropometric measurements (Height, weight, BMI, Waist Circumference etc).Diet History with Glycemic load by FFQs and Demographic DATA like Age, sex. Secondary Data included reference DATA like GI and GL from website, Food Composition table etc. DATA Collection tools included FFQ, Nutritional assessment chart, and demographic DATA recovery form, Symbols chart. Analysis was done by descriptive statistics for Mean, Standard deviation to find out the mean and descriptive statistical values of the DATA. Gaunt charts & loading charts were used for the graphical analysis of the DATA; especially Correlation graphs were used to study the correlation between the different variables.

RESULTS

Demographic DATA of the participants

Study was carried out on 442 students including adolescent age students between 13 to 19 years, but cases between 14 to 19 years responded the study and it includes 237 (53%) male and 205 (47%) female students. This study includes Govt School 238 (53.8%) and Private school 204 (46.2%) students participated in the study. Findings were based on Nutritional measurements like anthropometric measurements, nutritional behavior, and Glycemic consumption of the food.

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Table 1: Descriptive statistics of Demographic DATA

Descriptive statistics	N	Minimum	Maximum	Mean	Std. Deviation
Years	442	14.00	19.00	17.4514	.98883
Sex	442	1.00	2.00	1.4638	.49925
School	442	1.00	2.00	1.4615	.49908
Kg	442	41.00	84.00	57.2715	9.74196
Height (Cm)	442	132.50	185.00	162.9740	9.56982
Waist Circumference (cm)	442	65.00	95.00	76.7579	6.69435
Hip Circumference (cm)	442	78.50	100.00	86.4615	4.14801
Waist Hip Ratio	442	.76	.97	.8815	.05518
Glycemic Load	442	94.00	168.00	120.4253	13.15579
Z Scores	442	-1.67	2.74	.0002	1.00020
Daily caloric count	442	1521.91	2720.00	1949.7440	212.99862
Valid N (list wise)	442				

(σ)=standard deviation

Table.1 shows clearly the descriptive statistics of the whole study, minimum age of the participant was 14 years and maximum was 19 years, while standard deviation (σ) for years was .988, for sex .499 and for school it was .499, minimum weight of the participants was 41 kg with maximum 84 kg and a mean of 57.25 kg.

While (σ) of the Data was 9.74.minimumheight was 132 cm and maximum was 185 cm with a mean of 162.97 cm; (σ) was 9.56 of the participant. Waist circumference was minimum 65 cm and maximum 95 cm with a mean of 76 cm and (σ) was 6.69.Hip circumference was minimum 78.5 cm and maximum 100 cm with a mean of 86.46 cm and (σ) was 4.41. Waist/Hip ratio was minimum .76 cm and maximum .97 with a mean of .88 and (σ) was .055. Glycemic load was 94 minimum and maximum was 168 with 120.42 mean and standard deviation (σ) was 13.15. Z scores was -1.67 minimum and maximum was 2.74 with .0002 mean and standard deviation (σ) was 1.0002. Daily caloric count was 1521 minimum and maximum was 2720 with 1949 mean and standard deviation (σ) was 212.

Fig: 1.1 a linear pattern of waist/Hip ratio of the Participants

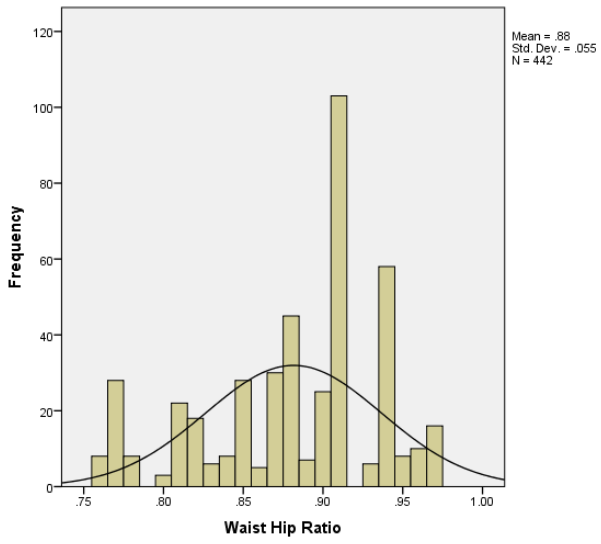

Fig 1.1 shows waist Hip ratio line graph

Fig 1.1 shows that a big group of students 26% had hip/waist ratio 0.91 which is included at risk point while only 14% students at an ideal level, while almost 15% students were included at very high risk point while average students were 27% students only.

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Fig 1.2 Glycemic Load pattern of the participants

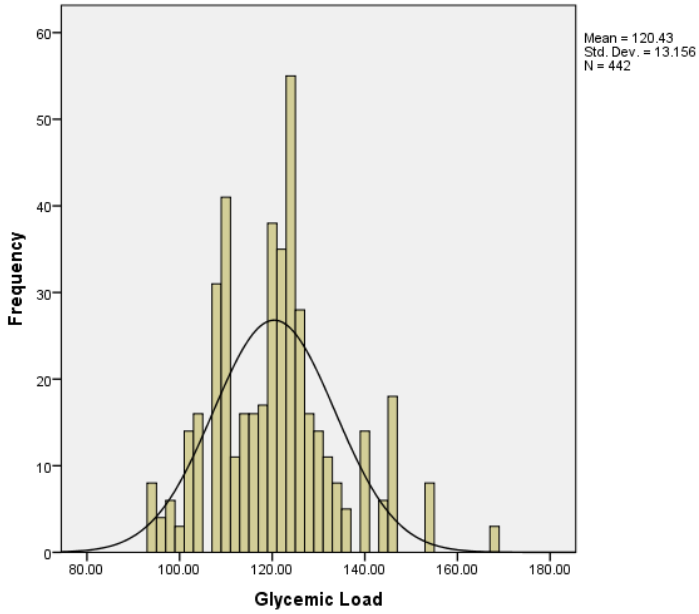

Fig 1.2 shows Glycemic loads of the students consumed in their diets, graph shows that majority of the students (45%) consumed 120 to 125 Glycemic loads in their diets,14 % students had above 130 Glycemic loads in their diets, while only 0.15% cases had very high glycemic loads consumed which may be a special case in the study.

Fig 1.3: Z-Scores based at weight of the participants

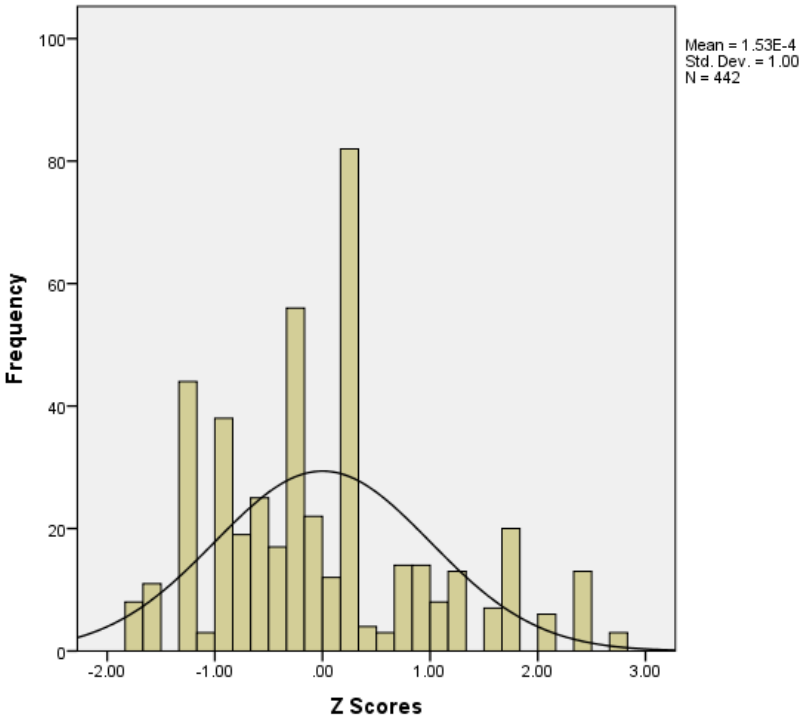

Fig 1.3 shows Z scores of the study population, it ranges between- 02.0 t0 3.0.a large group about 27% was between 0.01 to 0.3.

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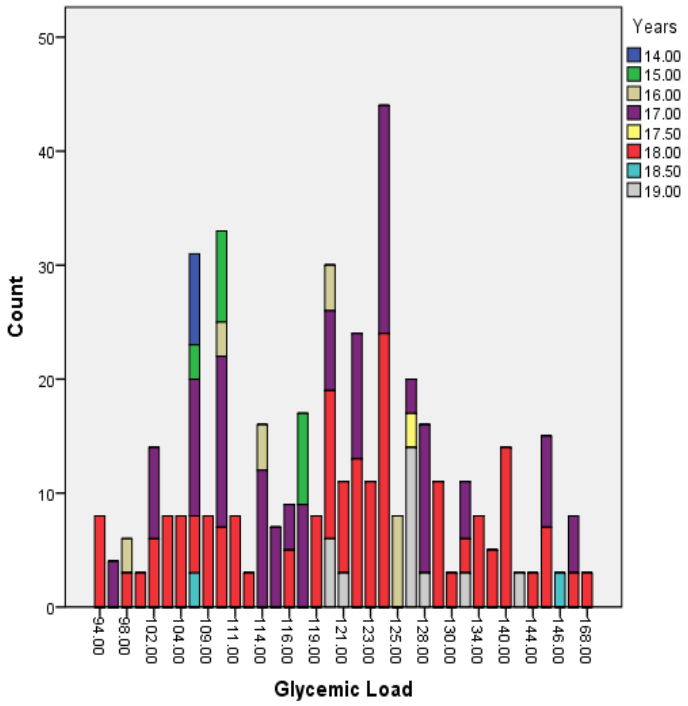

Fig 2.1shows the Glycemic load with respect to the age of the population under study, it shows that in lowest 94 values is exhibited by 18 years of participants and perhaps girls and maximum also I8 year's age group and boys' participants. All other data has mix picture.

Fig 2.2 pattern of Glycemic loads with respect to Schooling of the participants

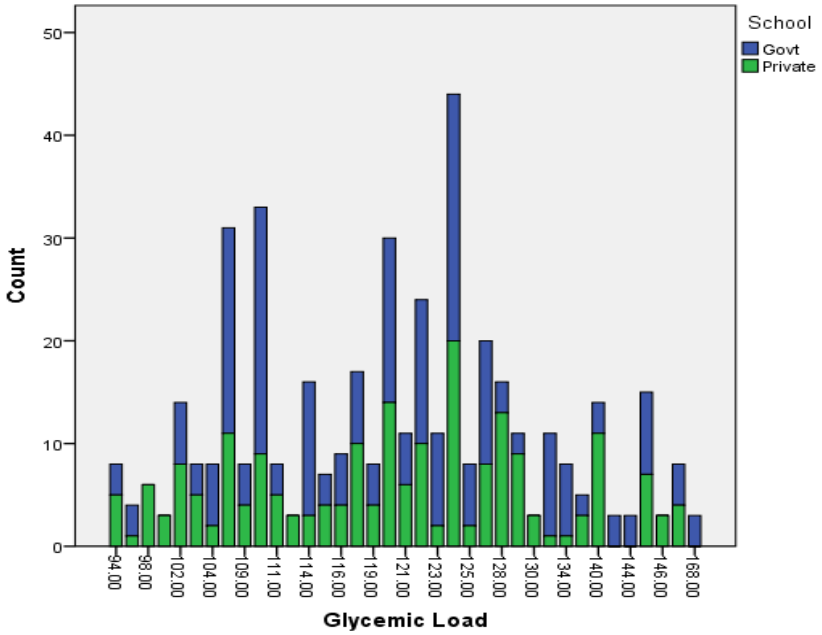

Fig 2.2 shows the Glycemic load with respect to the schooling of the population under study, it shows that in lowest 94 values is exhibited by mostly private school students perhaps due to awareness while maximum value is exhibited by Govt school students and surely boy. All other data has mix picture

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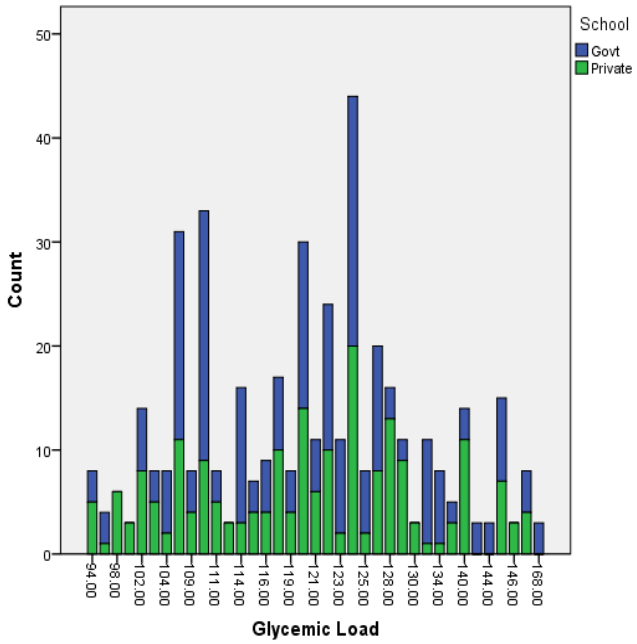

Fig 2.3 shows the Glycemic load with respect to the schooling of the population under study, it shows that in lowest 94 values is exhibited by mostly private school students perhaps due to awareness while maximum value is exhibited by Govt school students and surely boy. All other data has mix picture.

2. Correlation of the Demographic DATA to Nutritional DATA

Table 2 shows the correlation of the different variables with *p* values and 2-tailed Pearson correlation.

Variables Correlation		Sex	Kg	Glycemic Load	Z Scores	School	Waist Hip Ratio
Sex	Pearson Correlation	1	-.399**	-.310**	-.399**	-.051	-.639**
	Sig. (2-tailed)		.000	.000	.000	.284	.000
	N	442	442	442	442	442	442
Kg	Pearson Correlation	-.399**	1	.596**	1.000**	-.027	.573**
	Sig. (2-tailed)	.000		.000	.000	.575	.000
	N	442	442	442	442	442	442
Glycemic Load	Pearson Correlation	-.310**	.596**	1	.596**	-.014	.362**
	Sig. (2-tailed)	.000	.000		.000	.773	.000
	N	442	442	442	442	442	442
Z Scores	Pearson Correlation	-.399**	1.000**	.596**	1	-.027	.573**
	Sig. (2-tailed)	.000	.000	.000		.575	.000
	N	442	442	442	442	442	442
School	Pearson Correlation	-.051	-.027	-.014	-.027	1	-.079
	Sig. (2-tailed)	.284	.575	.773	.575		.096
	N	442	442	442	442	442	442
Waist Hip Ratio	Pearson Correlation	-.639**	.573**	.362**	.573**	-.079	1
	Sig. (2-tailed)	.000	.000	.000	.000	.096	
	N	442	442	442	442	442	442

**. Correlation is significant at the 0.01 level (2-tailed).

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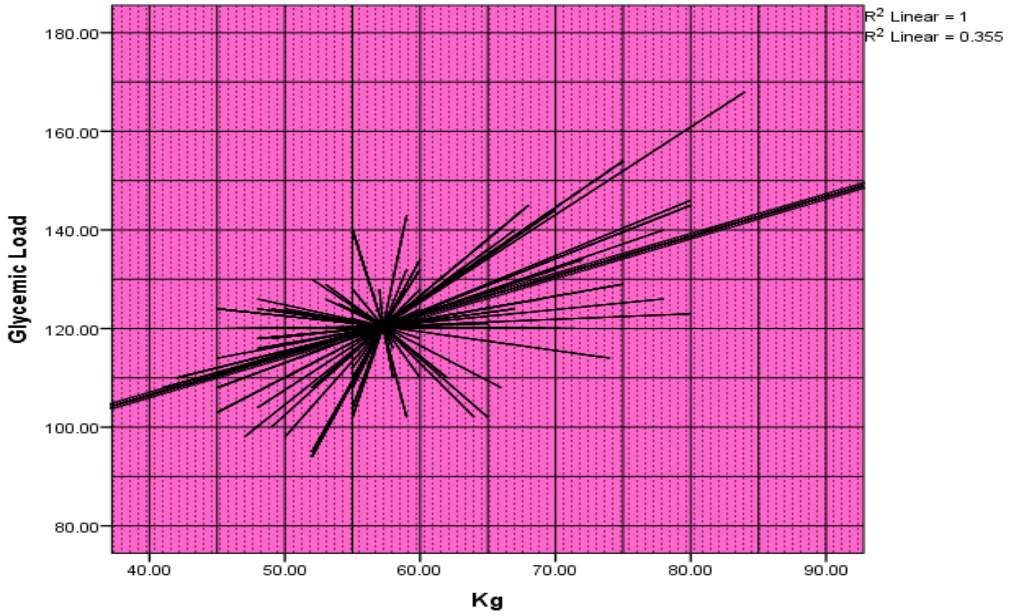
Table shows a positive correlation with significant *P* values 0.000 with sex and weight, Glycemic loads scores and Glycemic loads also correlation with p values 0.5 but with 2 **. There is very strong correlation between waist hip ratio and Glycemic loads of foods and *p* values 0.36 with 2** in Pearson correlation and *p* values 0.00 in 2-tailed.It shows strong correlation.

Fig; 2.1 Correlation of Glycemic load with Weights of the study population



Fig; 2.1 shows strong positive correlation of Glycemic load with Weights of the study population

Fig 2.2 Correlation of Glycemic load with Z Scores

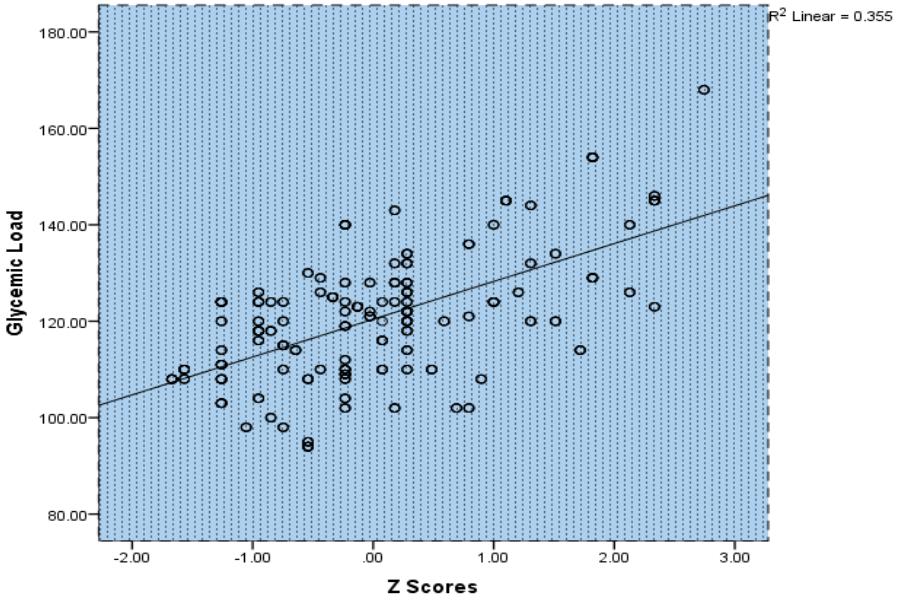


Fig 2.2 shows strong Correlation of Glycemic load with Z Scores

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Fig 2.3 Correlation of Glycemic load with waist/Hip ratio

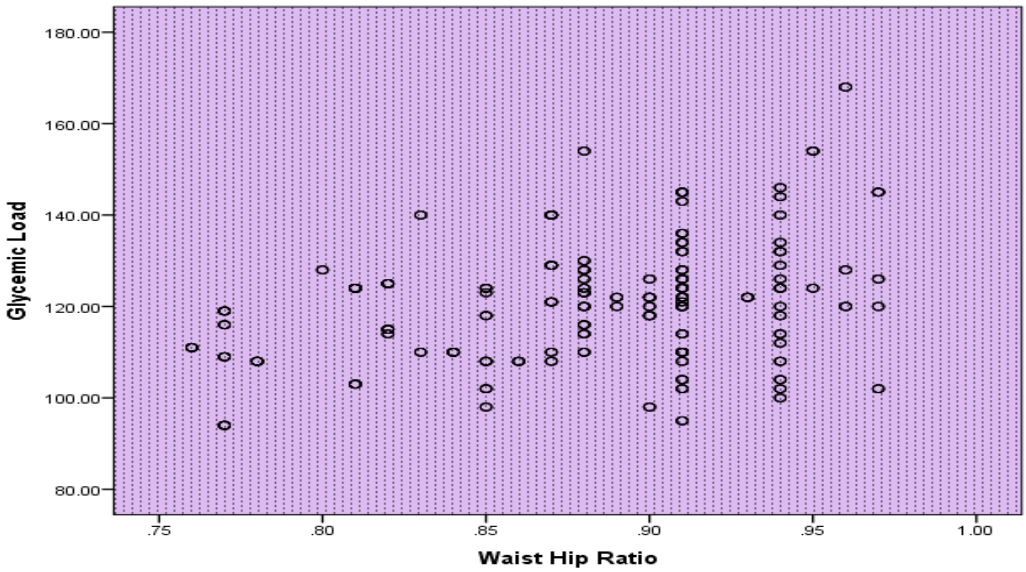

Fig 2.3 shows very clear Correlation of Glycemic load with waist/Hip ratio which is positive means positive change in Glycemic load is positively correlated with waist/Hip ratio.

DISCUSSION

This study was conducted on adolescent age group students belonging to Govt and private school background in Mansehra between August 2019 to December 2019.Age group was selected between 13 years to 19 years and total population sample was 450±.Responded sample was 442 students with age group between 14years to 19 years. Objectives were to assess Data collected by FFQ and Anthropometric measurements and assess nutritional status by selective anthropometric measurements (Height, Weight, Z Scores. study was done by Food frequency questionnaires as dietary assessment tools that are often used to determine individuals' food consumption and nutrient intake and it found significant correlations between the variables.

Study shows the correlation of the different variables with *p* values and 2-tailed Pearson correlation. Table 4.4.1 shows a positive correlation with significant *P* values 0.000 with sex and weight, Glycemic loads scores and Glycemic loads also correlation with p values 0.5 but with 2 **. There is very strong correlation between waist hip ratio and Glycemic loads of foods and *p* values 0.36 with 2** in Pearson correlation and *p* values 0.00 in 2-tailed.It shows strong correlation. Correlation of sex with Glycemic loads with *p* values 0.31** and 2-tailed Pearson correlation.

Strong correlation was found of waist hip ratio with Glycemic loads and weight in kg with *p* values 0.362**and 2-tailed Pearson correlation with *p* values 0.00.weight to glycemic load *p* value .596**, weight to waist Hip ratio *p* value was 0.573**. All 3 variables have significant correlation Sig. (2-tailed) with *p* value 0.00.Study also showed strong correlation of Glycemic loads with hip circumference and Z scores. Glycemic loads with hip circumference with *p* values .221**and 2-tailed Pearson correlation with *p* values 0.00.

FFQ have been used to measure the dietary habits of the study population however before FFQs can be used to assess dietary intake, these tools must be properly validated to demonstrate that they are accurate and reliable instruments. A study by Mullen et al (1984) focused on validating a food frequency questionnaire designed to assess daily food intake, nutrient profiles gathered from the FFQ were compared with profiles of nutrients obtained from a self-report assessment form that was compiled following every meal [(13)]. In all these studies regression analysis and correlation coefficients were calculated using the data obtained from the food frequency questionnaire and the self-report forms. Correlation coefficients ranged from 0.23 to 0.91 with 85% of the values >.50 and 55% >.71. All of the correlations done were significant (p<0.002), demonstrating that the FFQ tested in this study

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was a valid dietary assessment tool Kristal et al investigated the development and validation of a Food Behavior Checklist (FBC) for calculating food intake [14]

In many studies BMI were high which is contradictory to Sam Graci study. our study also has positive correlation with Glycemic loads of foods and increase Z scores and weights of the population [15], With respect to total CHO intake and BMI data is consistent across the various cohorts, but those with respect to GI and GL are anything but consistent. In some Cohorts as GI increased BMI decreased. In cohort of both genders, BMIs were unrelated to dietary GI.GL and Body Weight - For GL and BMI, the results were inconsistent. Either the GL of the diet is unrelated to BMI or related inversely. In other words as GL went up, BMI went down. , the BMI was between 0.3 to 2.1 for those ingesting diets with the highest GL compared to those ingesting with the lowest BMI, our findings are contradictory to these studies perhaps participants role in daily exercise may be high or some other factors like ethnic and genetic may play key role in interest in exercise and attitude towards dieting [16]. Our study shows 286 (64.7%) participants having interest in daily exercise while 156 (35.3 %) participants showed no interest in exercise. Our study shows students trend on diet pattern, which clears that out of 442 (100%) students 66 (14.9%), were on diet while 376 (85.1%) were not on diet. An Italian study in both gender also showed an inverse association between GI and GL and BMI [16]. There was a positive association between GI (and not GL) and BMI in sedentary Danish women (not men) with the more remarkable association. Children and teenagers association also show inconsistency both across and within populations.

our study shows the waist/Hip ratio of the participants based on schooling, a big group of Govt school students was 76(17.1%) at 0.91 by waist/Hip ratio and 31 (7.3%) group of private school students were at.94 by waist/hip ratio. Additionally, it should be point out that the mean BMI; WC values were significantly higher among students from public schools. Based on these findings, it can be assumed that overweight/obese adolescents from public schools were more responsive to the study recruitment, and more homogeneously interested in being evaluated [17] .

Adolescent females in Jamaica had risk factors significantly higher number and were less physically active than males ($p<0.05$),likewise our study shows daily exercise pattern based on Sex, which clears that out of 237(53.6%) male students 194 (43.8%),male students do exercise while 43 (9.7%) do not have any interest in daily exercise [18].

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