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A STUDY TO ASSESS THE PREVALENCE OF CALCIUM DEFICIENCY IN ADOLESCENT GIRL STUDENTS RESIDING IN GOVERNMENT RESIDENTIAL SCHOOLS OF TELANGANA STATE

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ABSTRACT:

The aim of this study was to determine the Prevalence of Calcium Deficiency and to assess the dietary habits of Adolescent Girl Students, to determine the Prevalence of Calcium Deficiency through a Serum Calcium Test and to assess the dietary habits & calculate their daily calcium intake. A total of 4 schools under The Telangana Social Welfare Residential Educational Institutions Society (TSWREIS) were selected via Cluster sampling. There were 140 subjects, all adolescent girl students between 14-18 years of age. The Serum Calcium Test was done using the Arsenazo III Method. Out of 140 subjects, 135 had normal calcium levels between (8.8-10.6 mg/dL), 1 had high calcium levels (>10.6 mg/dL) and 4 had low calcium levels. (<8.8 mg/dL). Dietary pattern was assessed using their Standard Weekly Menu Plan and nutritive value calculations were done to determine their daily energy, protein, fat, carbohydrate, and calcium intake. Using Excel, SPSS software, the mean, range, standard deviation, Karl Pearson's coefficient of correlation & Chi Square test, the collected data was compiled, organized, tabulated, and statistically analysed.The chi-square test found an association between age and calcium levels at 12%, not very significant.Karl Pearson's coefficient of correlation between age and calcium levels at 0.14, not showing any significant linear correlation. The p-value of the Chi-square test is <0.12 resulting in a false hypothesis.The Standard Weekly Menu should include Energy-dense, foods rich in Protein & Calcium to meet the latest RDA Requirements.

KEYWORDS:
Calcium Deficiency, Calcium levels, Dietary Habits

INTRODUCTION

Introduction to TSWREIS:

The Telangana Social Welfare Residential Educational Institutions Society (TSWREIS), under the patronage of the Ministry of Welfare, has been passionately and impeccably rendering its services for the past 35 years to improve the living standards of the Scheduled Caste students by providing them quality and sustainable education in English medium up to graduation.

The Society with 268 institutions and around 1,50,000 students believes in seamless experimentation, syncing itself with the emerging trends in the education space. The Society also started venturing into specialised

schools, reflecting upon the aims and aspirations of its clientele. The assiduous, diligent, and meticulously planned functioning of the Society has allowed it to grow by leaps and bounds, sculpting thousands of ordinary boys and girls into outstanding personalities over the last three decades.

Given its indomitable status in the worldwide public residential education domain, TSWREIS continues to attract educationalists from different parts of India and the world every year. With 1,45,485 students, TSWREIS covers roughly 10% of cohorts among all Schedule Castes in Telangana. It runs high schools, junior colleges, and degree colleges covering both arts and sciences. These institutions are more female-centric, with 175 of them imparting education to 1,04,360 girls. This includes 17,185 young women, who escaped the clutches of early marriage to pursue higher education.

Besides giving much needed foundational education, TSWREIS also started venturing into specialized schools to prepare students to work in an array of settings in the 21st century. The TSWREIS team comes with an advantage of more than 3 decades of experience in residential education system and has well-trained and experienced teachers who play a pivotal role in moulding students into socially responsible citizens. TSWREIS also introduced many programs in the annals of the government education sector in India to liberate marginalized children from all forms of poverty, despondency, and inferiority complex, and eventually placing them in the orbit of higher education and self-respect. [1]

Introduction to Synergy India Foundation (SIF):

Synergy India Foundation (SIF) headquartered in Hyderabad, is an NGO that strives to change the lives of the poor and underserved through community participation and promotes a safer society by synergizing different stakeholders to attain a larger impact on the community. SIF focuses on the areas of health, education, environment, and sustainable livelihoods to bring a positive change in the lives of the people and communities and the society at large.

Panacea project – A comprehensive school Health Monitoring Program, started in 2015 With 3.5 lakh kids from more than 600 schools around the state of Telangana, this comprehensive school health project is for the residential educational institutions in the Social, Tribal, and BC Welfare Societies.
Most children from low socioeconomic families are stunted and malnourished. With the aim of providing comprehensive 24-hour healthcare services to more than 3 lakh marginalised children attending government-run social, tribal, BC, and minority residential educational institutions, SIF established PANACEA COMMAND CENTRE' 24X7 in collaboration with the Government of Telangana. Their primary goal is to improve the quality and accessibility of healthcare services at Welfare Residential Educational Institutions to reduce the burden of disease and deliver efficient healthcare.

Introduction to Calcium:

Calcium, the mineral - its significance:
Calcium is a major element present in the human body and an adult man weighing 60 kg has around 1 kg of Ca, which is mostly present as a component of bone. The development of bones is one of calcium's key bodily functions. Despite its tiny size, non-skeletal calcium plays several crucial roles, including membrane permeability,

neuromuscular stimulation, and blood coagulation. The accuracy with which plasma Ca level is controlled reflects the significance of Ca in these processes. Even in the presence of insufficient dietary calcium intake, calcium in bones helps to maintain blood levels. By regulating absorption, excretion, and bone turnover, vitamin D interacts with various hormones, including parathyroid hormone (PTH), thyrocalcitonin, cortisol, and gender-specific steroids, to keep blood calcium levels within specific ranges.

An adult man needs calcium to replenish the calcium lost through faeces, urine, bile, and sweat. In children, endogenous faecal losses are thought to be around 1.4 mg/kg, but in adults, they are thought to be around 2.1 mg/kg. In comparison to median sweat losses, which have been estimated to be 35 mg per m2 of body surface area, urinary losses are around 40 mg in children, increasing to 80 mg before puberty, and then tapering down to 40 mg in adulthood. About 20–50% of the calcium in the food is absorbed, and vitamin D plays a significant role in this process. For skeletal development throughout growth and to produce calcium in breast milk during lactation, more calcium is needed. [2]

Functions of Calcium:

With crucial roles in the skeletal, cardiovascular, endocrine, and neurological systems, calcium is a vital mineral.

The majority (99%) of the body's calcium is found in the bones, where it serves as a calcium storage and gives the skeletal system rigidity and shape.

The remaining portion takes part in metabolic activities like

- enzyme activation,
- transmembrane transport,
- nervous system transmission,
- vascular and
- muscular contraction, and
- hormonal activity. [3]

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Sources of Calcium:

Below, foods containing calcium are categorized as good calcium sources (both requirements are met), potential calcium sources (only one criterion is met), and bad calcium sources. Most milk products, most tofu varieties, several vegetables from the dark-green cabbage family, turnip greens, and canned fish with bones like salmon and sardines are all excellent sources. Ice cream and nearly all green leafy vegetables are good sources of calcium. Cottage cheese, all beans, some varieties of tofu, almonds, and sesame seeds are examples of foods that are poor suppliers of calcium. By using this method to identify calcium-rich food sources, nutrient information is not altered as it would be if foods were simply listed by their calcium amount. [4]

For adolescents from higher socioeconomic groups, dairy products were the predominant source of calcium, but for those from lower socioeconomic groups, it was dark-green leafy vegetables. For both boys and girls, the median calcium consumption was significantly lower in lower socioeconomic groups than in higher socioeconomic groups. Compared to boys, girls from both groups had reduced access to dairy foods. It is necessary to take action to address the gender disparity in the distribution of dairy products in India as well as the low calcium consumption of teenagers from lower socioeconomic groups. [5]

Calcium Requirements:

Given the aforementioned information, the current committee considered bone accretion rates for healthy populations and a factorial approach to establish EAR and RDA for every age group,

with RDA ranging from 550 mg for children 4 to 6 years old to 1050 mg for adolescents 16 to 18 years old.[2]
The IOM/NAM upper intake levels for children and adolescents range from 1000 mg per day (from birth to six months) to 3000 mg per day (9–18 years). [6]

Dietary factors affecting calcium requirements:
It is acknowledged that various nutrients have an impact on how much calcium is required. The minerals and antinutrients found in plants, the soil's characteristics (pH, water content, and microbial activity), vitamin D intake, and the presence of phytic and oxalic acids are all factors that affect how much calcium a person may absorb through diet.
Phytates and oxalates bind calcium to form ions that the body cannot absorb, preventing it from being absorbed. [7]
Previously, it was thought that eating a lot of protein elevated calcium output from the urine.[8]

Calcium Deficiency:
Lack of calcium can weaken bones and cause osteoporosis, which is marked by frail bones and a higher risk of falling. Although vitamin D insufficiency is more frequently the cause of these problems, calcium shortage can still result in rickets in children and other bone disorders in adults. The growth cartilage does not mineralize normally in rickets patients, which might result in permanent alterations to the skeletal structure. Osteomalacia, or poor bone mineralization and bone softening, is another consequence of chronic calcium shortage that can affect both adults and children. [9]

Hypocalcemia, defined as a serum calcium level of less than 8.5 mg/dL (2.12 mmol/L) or an ionised calcium level of less than 4.61 mg/dL (1.15 mmol/L), is frequently brought on by a lack of vitamin D or magnesium, impaired parathyroid hormone (PTH) production resulting in hypoparathyroidism, impaired calcium absorption from the bones, a serious illness, or the use of specific medications (e.g., bisphosphonates, cisplatin, or proton pump inhibitors)[10]

Renal calcification or damage, brain calcification, neurologic symptoms (such as depression and bipolar disorder), cataracts, congestive heart failure, paresthesia, seizures, and, in rare instances, coma are examples of more severe indications and symptoms.[11]

MATERIALS & METHODOLOGY

Sample Size:

A total of 4 schools under The Telangana Social Welfare Residential Educational Institutions Society (TSWREIS) were selected based on the assumed prevalence and availability of Calcium Deficiency cases. The selected schools were all girl schools: Bantwaram , Mominpet , Shankarpalli , Maheshwaram , which are all located within the outskirts of the twin-cities of Hyderabad and Secunderabad. Cluster sampling was employed to select adolescent subjects aged 14-18 years from the above-mentioned schools. Four different target groups were chosen to fulfil the sample size of 140 students in total. Classification was done based on Serum Calcium levels availed from the school health-data records of all the subjects. The Arsenazo III method was used to draw out blood samples from the subjects and determine their Serum Calcium levels.
Inclusion Criteria: Adolescent Girl Students 14-18 years and receiving formal education.
Exclusion Criteria: Students below 13 years of age with no formal education. Sample collection via Serum Calcium

Test:The sample data of the Serum Calcium Levels of the adolescent girls was collected through a Serum Calcium Test using the Arsenazo III Method

Dietary Recall for a Week:The dietary recall for a week was taken through the Standard Weekly Menu provided to all Adolescent Girl Students residing in Residential Schools of Telangana State.

Data Collection Process:The data was collected in the form of Serum Calcium Blood Tests and the reports were obtained via school healthcare records. The data was also calculated in the form of a Dietary Recall of a Week in the form of the Standard Weekly Menu of the Adolescent Girl Students residing in Residential Schools of Telangana State. This Standard Weekly Menu was obtained via the school healthcare records. The Standard Weekly Menu was calculated in the form of Nutritive Value Calculations to obtain the daily Energy, Protein, Fat, Carbohydrate and Calcium Intake. This was done to check whether the diet provided to the students is adequate in Calcium intake or not. Prior consent was taken from every subject and data collection was done over a period of one month.

Statistical Methods Used:

The collected data was compiled, organized, tabulated, and statistically analysed using MS Excel and SPSS software (statistical package for the social sciences). For quantitative data like age and Serum Calcium level, the range, mean, and standard deviation where Karl Pearson's coefficient of was obtained between Age and Calcium Levels to show any linear correlation. Chi-square test (Attached in Annexure II) was performed to test whether the stated hypothesis was true or false and the statistical significance was found to be 0.114.

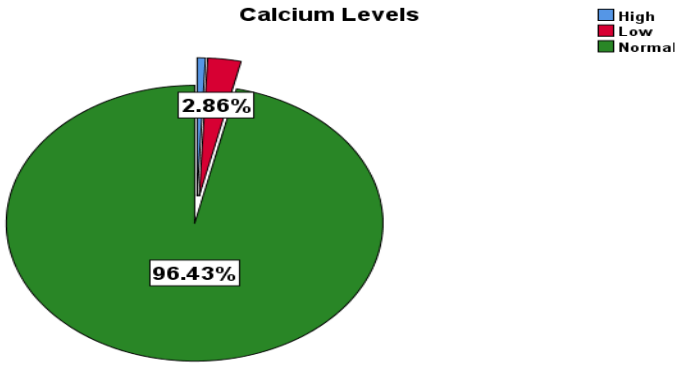
RESULTS AND DISCUSSIONS

Frequencies & Percentage
Overall

Table 1 Calcium Levels of Total Number of Subjects

Calcium Levels N (%) Total Number of Subjects: 140		
Low	Normal	High
4 (2.9)	135 (96.4)	1 (0.7)

Fig. 1 of Overall Calcium Levels



Out of 140 Subjects, 135 (96.4%) had Normal Serum Calcium Levels, 4 (2.9%) had Low Serum Calcium Levels and 1(0.7%) had High Serum Calcium Level.

Majority of the subjects had their Serum Calcium Levels within the Normal Range (8.8-10.6)

Age wise Calcium Levels of Adolescent Girl Students

Table 2 Age wise Calcium Levels of Adolescent Girl Students

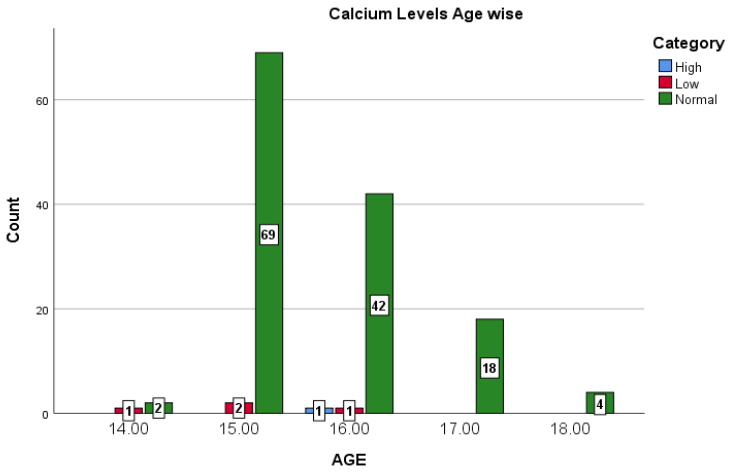
Age (years)	Calcium Levels N (%)		
	Low	Normal	High
14	1 (33.3)	2 (66.7)	0 (0.0)
15	2 (2.8)	69 (97.2)	0 (0.0)
16	1 (2.3)	42 (95.5)	1 (2.3)
17	0 (0.0)	18 (100)	0 (0.0)
18	0 (0.0)	4 (100)	0 (0.0)

Out of 140 Subjects, ranging from 14-18 years of Age,

- in the Age of Group of 14-year-olds there was found to be 1 (33.3%) Subject having Serum Calcium Deficiency and 2 (66.7%) having Normal Serum Calcium Range.

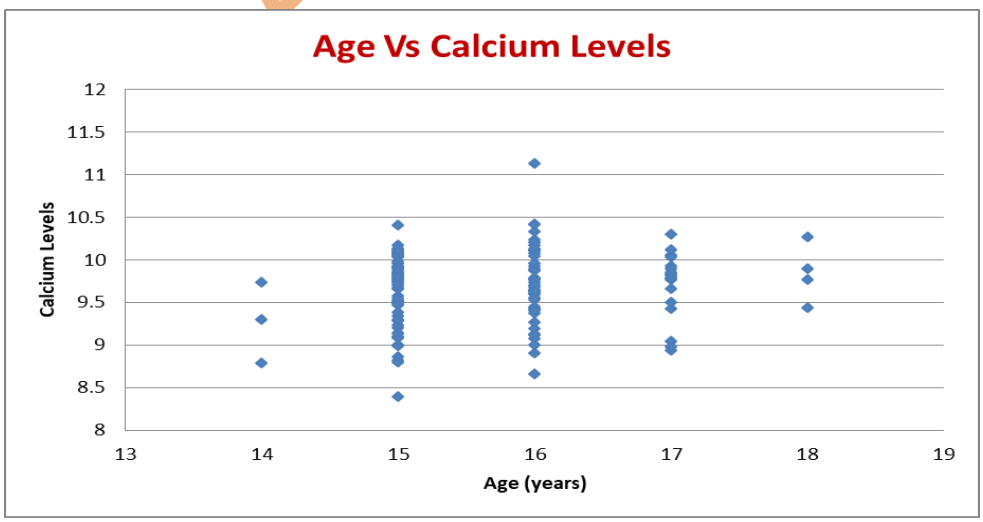
- in the Age of Group of 15-year-olds there was found to be 2 (2.8%) Subject having Serum Calcium Deficiency and 69 (97.2%) having Normal Serum Calcium Range.
- in the Age of Group of 16-year-olds there was found to be 1 (2.3%) Subject having Serum Calcium Deficiency and 42 (95.5%) having Normal Serum Calcium Range and 1(2.3%) having High Serum Calcium Range.
- in the Age of Group of 17-year-olds there was found to be 18 (100%) Subjects having Normal Serum Calcium Range.
- in the Age of Group of 18-year-olds there was found to be 4 (100%) Subjects having Normal Serum Calcium Range.

Fig.2 Calcium Levels Age Wise



The Bar Chart depicting Low, Normal and High Levels of Calcium Age Wise showing that majority of the subjects have Normal Serum Calcium Levels, and they belong to the all the Age Groups.

Fig. 3 Scatter Plot of Age vs Calcium Levels



The scatter plot shows that there is no correlation between age and calcium levels.

Correlation between Age and Calcium Levels:
Karl Pearson's coefficient of correlation has been obtained between Age and Calcium Levels and obtained as 0.14, not showing a significant linear correlation.

Association between Age and Calcium Levels
Chi-square test has been used to find the association between age and calcium levels. The P-value of the Chi-square test is 0.114. This P-value is < 0.12. This indicates that there was found to be no association between age (years) and calcium levels at 12%, though not very significant, as the commonly used levels of significance are 0.01, 0.05 and 0.1.

RDA of Adolescent Girl Students 2020

Table 3 RDA of Adolescent Girl Students 2020

Age Group	Energy (in kcal)	Protein (gm/d)	Fat(gm/d)	Carbohydrate(gm/d)	Calcium (mg/d)
Girls (13-15 years)	2060	43.2	35	130	1000
Girls (16-18 years)	2500	55.4	35	130	1050

Source -Nutrient Requirements for Indians, Recommended Dietary Allowances, Estimated Average Requirements, A Report of the Expert Group 2020, ICMR- NIN.)

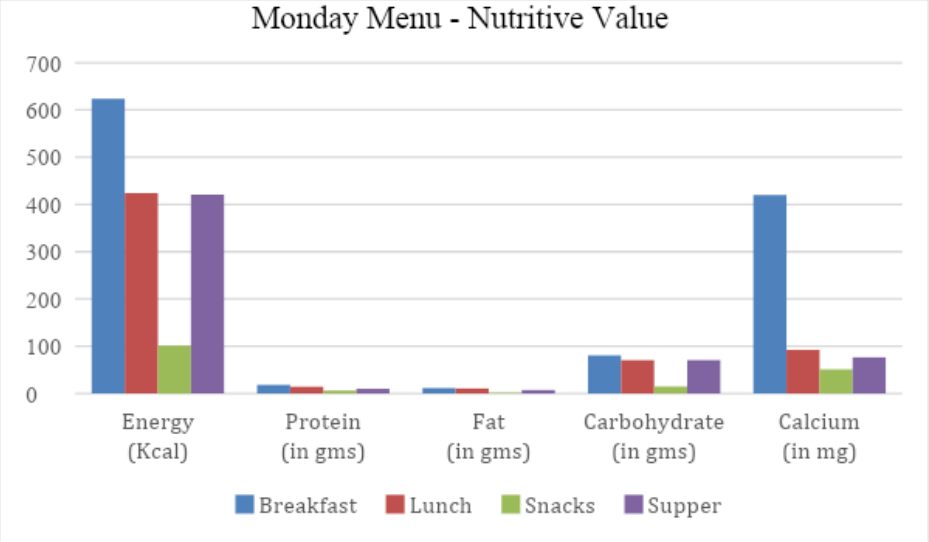
Standard Weekly Menu Plan of Adolescent Girl StudentsBelow is the table depicting the Standard Weekly Menu Plan of Adolescent Girl Students residing in Government Residential Schools of Telangana State.

MENU TTWR SAINIK SCHOOL, ASHOKNAGAR FOR 2022-23				
Day	Break Fast	Lunch	Snacks	Supper
Monday	Pulihora with Chutney or Rasam Milk with Boost/Ragi Malt Boiled Egg	Rice Veg Curry Dal with Leaf Curd Ghee	Boiled Senagalu	Rice Veg Curry Rasam Butter Milk Seasonal Fruit
Tuesday	Bonda with Chutney Milk with Boost/Ragi Malt, Fruit	Rice Veg Curry Tomato Dal Rasam Curd Ghee	Sompapidi/ Biscuit/ Boiled Dal	Rice Veg Curry Sambar Buttermilk

Wednesday	Khichdi with Rasam Milk with Boost/Ragi Malt	Rice Chicken Curry Dal with Leaf Rasam Curd Ghee	Biscuit/ Boiled Bobbarlu	Rice Veg Curry Sambar Buttermilk
Thursday	Popu Rice with Chutney Milk with Boost/Ragi Malt Boiled Egg	Rice Veg Curry Tomato Rasam Curd Ghee	Boiled Groundnuts/ Biscuits	Rice Veg Curry Sambar Buttermilk Fruit
Friday	Idly with Chutney or Sambar, Milk with Boost/Ragi Malt Fruit	Rice Veg Curry Sambar Curd Ghee	Palli Chikki / Sompapidi	Rice Veg Curry Sambar Buttermilk
Saturday	Pongal Semiya / Ragi Malt Boiled Egg	Rice Veg Curry Sambar Curd Ghee	Biscuits/ Sompapidi/ Palli patti	Rice Veg Curry Sambar Buttermilk Fruit
Sunday	Chapati with Veg Curry / Dal Milk with Boost/Ragi Malt	Bagara Rice Sambar Chicken (2^{nd} & 4^{th} Week) Mutton (1^{st} & 3^{rd} Week). Curd	Boiled Bobbarlu/ Senagalu	Rice Veg Curry Sambar Buttermilk Fruit

Table 4 Standard Weekly Menu Plan of Adolescent Girl Students

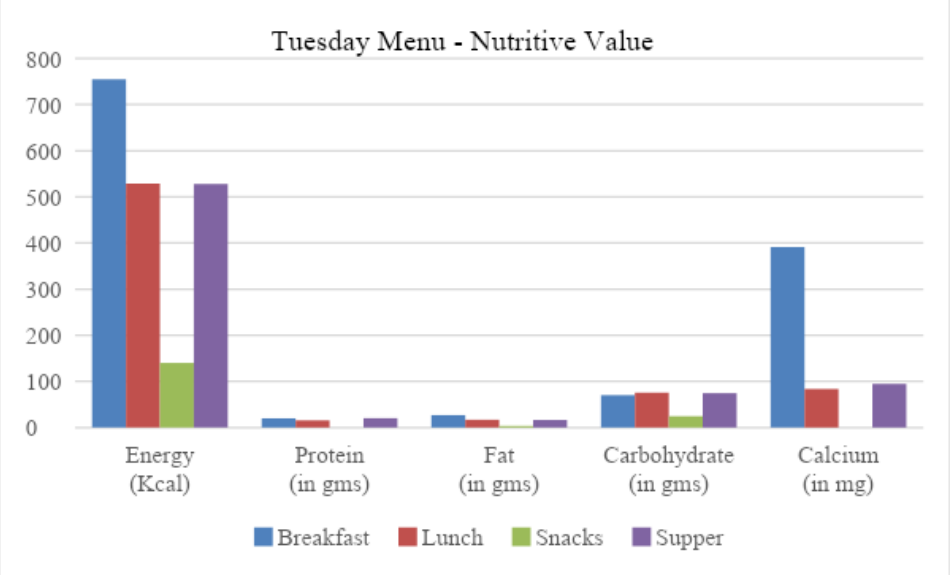
Figure 4 Nutritive Value of Monday Menu of the Standard Weekly Menu



As per the Nutritive Value Calculations of Monday's Menu Plan, it is observed that the Total Energy is 1571.08 kcal, Total Protein is 32.53 gm, Total Fat is 30.82 gm, Total Carbohydrate is 236.08 gm, and the Total Calcium is 644.95 mg.

This is not meeting the Revised RDA (2020) Requirements for Adolescent Girls, and there should be increase in the Energy, Protein, Fat and Calcium content for the day and there should be a decrease in the Carbohydrate content for the day.

Figure 5 Nutritive Value of Tuesday Menu of the Standard Weekly Menu

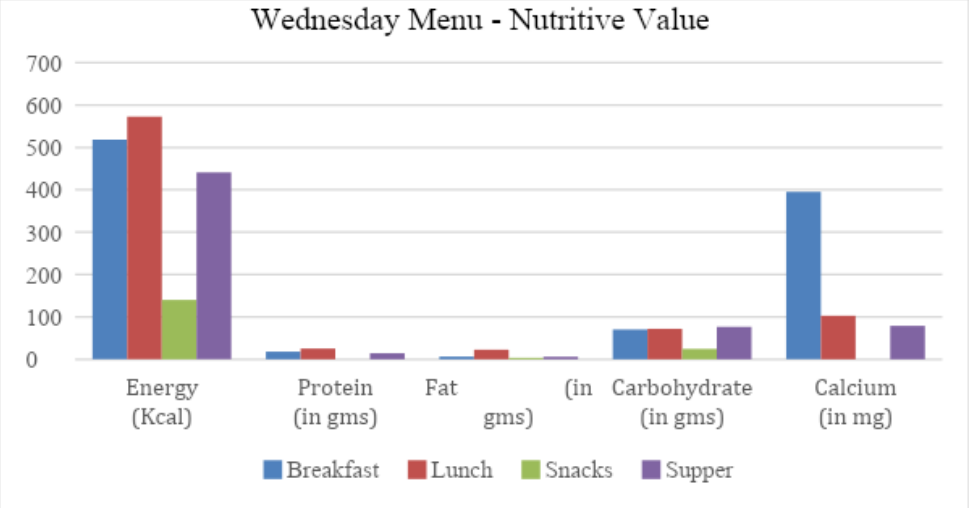


As per the Nutritive Value Calculations of Tuesday's Menu Plan, it is observed that the Total Energy is 1951.56 kcal, Total Protein is 55.9 gm, Total Fat is 63.54 gm, Total Carbohydrate is 244.63 gm, and the Total Calcium is 575.74 mg.

This is not meeting the Revised RDA (2020) Requirements for Adolescent Girls, and there should be increase in the Energy, Calcium content for the day. There should be a reduction in the amount of Fat and Carbohydrate content for the day. The Protein Value

is within range for Adolescent Girls between (13-15 years) of age and (16-18) years of age.

Figure 6 Nutritive Value of Wednesday Menu of the Standard Weekly Menu

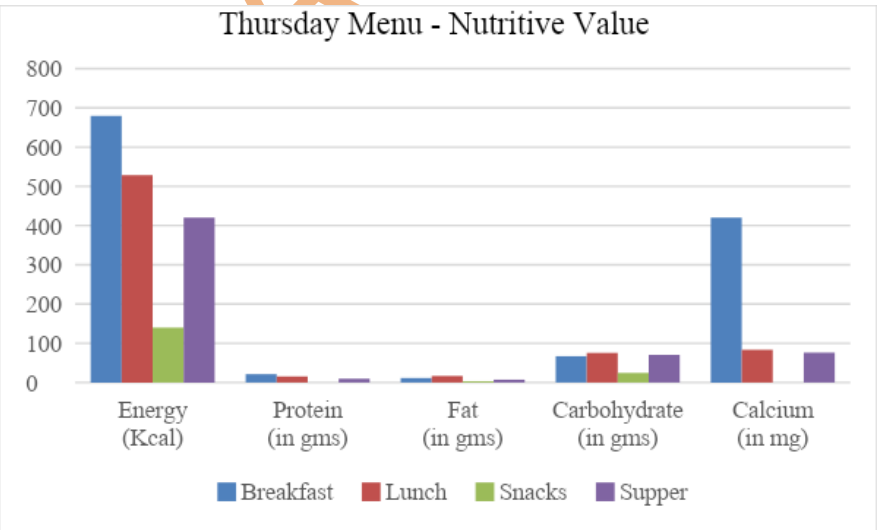


As per the Nutritive Value Calculations of Wednesday's Menu Plan, it is observed that the Total Energy is 1671.58 kcal, Total Protein is 57.59 gm, Total Fat is 38.43 gm, Total Carbohydrate is 243.35 gm, and the Total Calcium is 577.14 mg.

This is not meeting the Revised RDA (2020) Requirements for Adolescent Girls, and there should be increase in the Energy, Calcium content for the day. There should be a reduction in the amount of Fat and Carbohydrate content for the day.

The Protein Value is within range for Adolescent Girls between (13-15 years) of age and (16-18) years of age.

Figure 7 Nutritive Value of Thursday Menu of the Standard Weekly Menu

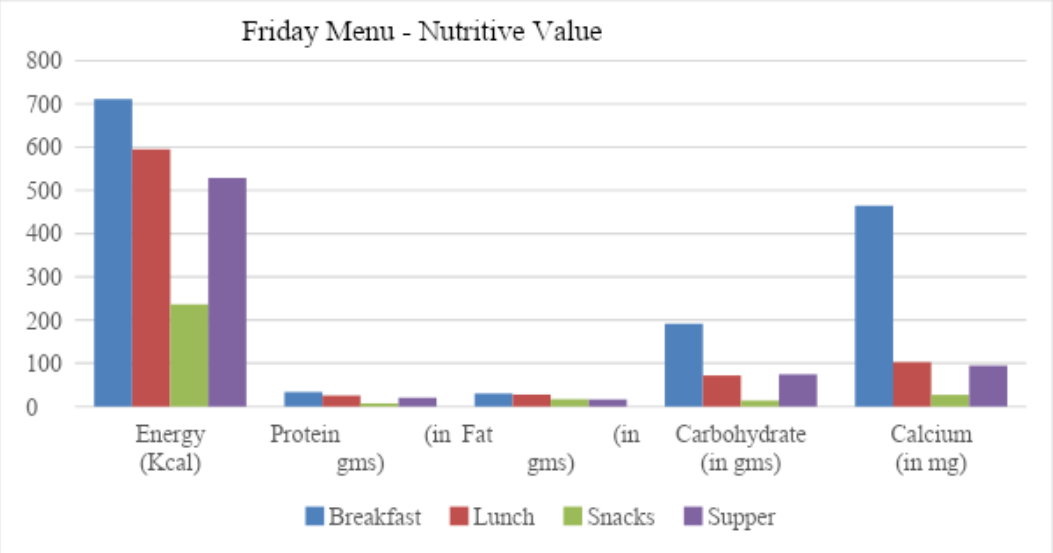


As per the Nutritive Value Calculations of Thursday's Menu Plan, it is observed that the Total Energy is 1768.67 kcal, Total Protein is 46.68 gm, Total Fat is 39.18 gm, Total Carbohydrate is 237.69 gm, and the Total Calcium is 580.24 mg.

This is not meeting the Revised RDA (2020) Requirements for Adolescent Girls, and there should be increase in the Energy, Protein & Calcium content for the day. There should be a reduction in the amount of Fat and Carbohydrate content for the day.

The Protein Value is within range for Adolescent Girls between (13-15 years) of age but is lower for Adolescent Girls between (16-18 years) of age.

Figure 8 Nutritive Value of Friday Menu of the Standard Weekly Menu

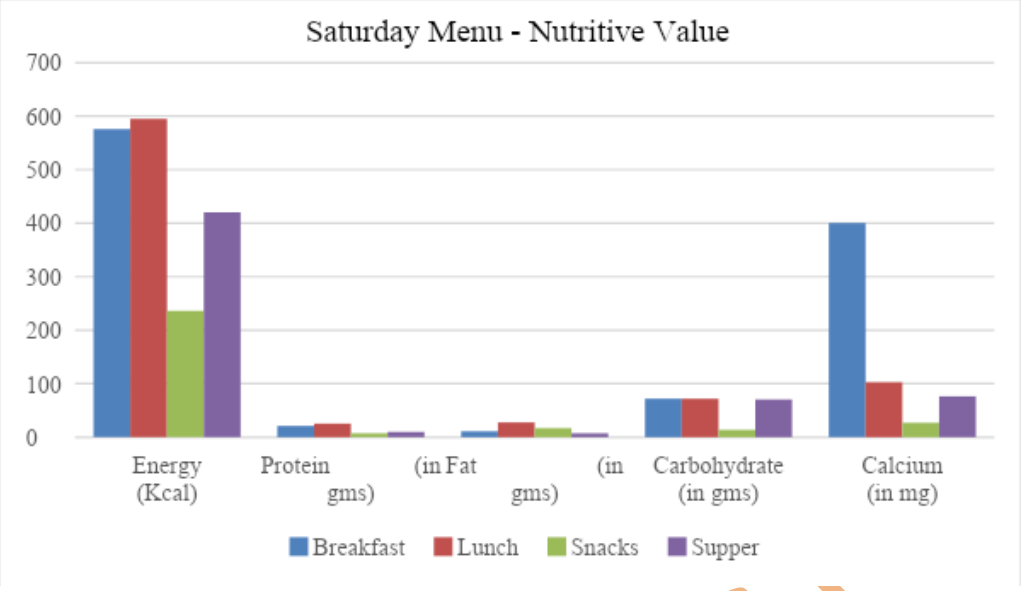


As per the Nutritive Value Calculations of Friday's Menu Plan, it is observed that the Total Energy is 2070.86 kcal, Total Protein is 86.47 gm, Total Fat is 90.97 gm, Total Carbohydrate is 351.2 gm, and the Total Calcium is 689.28 mg.

This is not meeting the Revised RDA (2020) Requirements for Adolescent Girls, and there should be an increase in Calcium content for the day. There should be a reduction in the amount of Protein, Fat and Carbohydrate content for the day.

The Energy is within the range for Adolescent girls (aged 13-15 years), but there should be an increase in Energy content for Adolescent girls (aged 16-18 years), to meet the daily RDA.

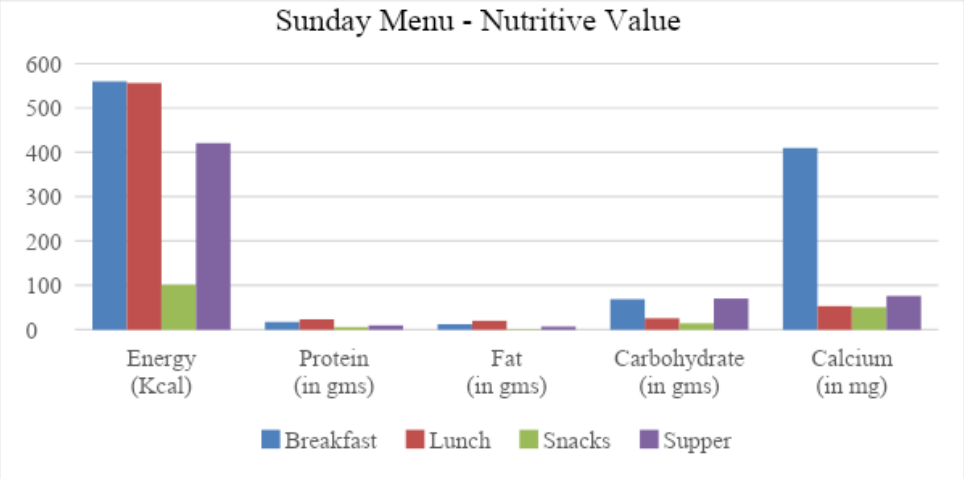
Figure 9 Nutritive Value of Saturday Menu of the Standard Weekly Menu



As per the Nutritive Value Calculations of Friday's Menu Plan, it is observed that the Total Energy is 1838.19 kcal, Total Protein is 63.43 gm, Total Fat is 62.76 gm, Total Carbohydrate is 228.05 gm, and the Total Calcium is 606.17 mg.

This is not meeting the Revised RDA (2020) Requirements for Adolescent Girls, and there should be an increase in Energy & Calcium content for the day. There should be a reduction in the amount of Protein, Fat and Carbohydrate content for the day.

Figure 10 Nutritive Value of Sunday Menu of the Standard Weekly Menu



As per the Nutritive Value Calculations of Friday's Menu Plan, it is observed that the Total Energy is 1638.9 kcal, Total Protein is 57.28 gm, Total Fat is 41.74 gm, Total Carbohydrate is 180.1 gm, and the Total Calcium is 590.86 mg.

This is not meeting the Revised RDA (2020) Requirements for Adolescent Girls, and there should be an increase in Energy & Calcium content for the day. There should be a reduction in the amount of Fat content for the day.

The Protein Value is within range for Adolescent Girls between (16-18years) of age but is higher for Adolescent Girls between (13-15 years) of age.

DISCUSSION

The three main population groups that are most at risk for a calcium deficit in the diet are as follows: Women (amenorrhoeic, the female athlete triad, postmenopausal), people with milk allergies or lactose intolerance, and people in at-risk categories for dietary deficient consumption are among them (adolescents and the elderly).

Female adolescents are especially at risk during this critical time for bone growth and formation. Women remain most at risk later in life, and this risk is increased if early baseline bone strength is not sufficient during adolescence. Institute of Medicine Standing Committee on the Scientific Evaluation of Dietary Reference Intakes (US). Dietary reference intakes for calcium, phosphorus, magnesium, vitamin D, and fluoride. Washington, D.C.: National Academies Press;1997.; Bonjour JP et al 2013.

Through the results obtained on Serum Calcium Tests done on Adolescent Girl Students (aged 14-18 years) residing in Government Residential Schools of Telangana State, it is observed that, out of 140 subjects, 135 (96.4%) had Normal Serum Calcium Levels, 4 (2.9%) had Low Serum Calcium Levels and 1(0.7%) had High Serum Calcium Level.

It has also been observed that there is no association and significant linear correlation between the Age and Calcium levels of the subjects.After examining the students' weekly dietary patterns, it was discovered that their diets fell short of the recommended daily allowances for energy, protein, and calcium.

These needs to be corrected to avoid predisposition to Calcium deficiency in the future and other problems that are caused by Calcium deficiency such as Rickets, Osteoporosis, Increased Susceptibility to fractures.

A shortage of calcium during growth can hinder the formation of the skeletal mass that is genetically programmed, while a lack of calcium later in life can exacerbate involutional loss. Calcium deficiency can also result in low bone mass. Heaney, R. P. (1992)

The Standard Weekly Menu is deficient in daily requirements of Energy, Protein and Calcium and high in Carbohydrate content as per the latest RDA. The Standard Weekly Menu should be revised to include foods that are Energy dense, rich in Protein and Calcium.

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