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An Efficient Anthropometric Model to Measure BMI Values of Adolescent Girls in Karnataka Rural Areas and Recommend Food Nutrition to Predict from Anemia Problems

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Abstract:- Adolescent girls were easily enter into anemia due to skipping of food like breakfast, lunch, dinner, and not consuming proper nutritional foods. It is one of the dangerous issues facing by world and in future definitely it may be call health emergency. Nearly around twenty percentage of adolescent are exist in overall population of India as per statistics. Death rate in girls and women's are more due to anemia disease. The main objective of these research paper is to reduce the count of girls adolescent affected with anemia, reduce the anemia effects on pregnant women's, minimize risk of giving birth to babies with underweight, protect from risk of giving birth to babies with overweight, and also encourage women to feed babies at least six months. We proposed anthropometric model to measure BMI values. In this research paper we conducted detailed survey on 11000 adolescent girls and we observed 540 members are affected with anemia. We compared our results with IAP model and WHO model. We observed adolescent girls height and weight growth by taking various age groups. At the end we recommend nutrition and food items consumption per day to predict from anemia problems.

Keywords:- *Home Science, IAP Model, WHO Model, Nutrition Supplements, Anemia, BMI, Anthropometric Model.*

I. INTRODUCTION

Anemia disease affected to approximately two billion persons of total population of the world. Mostly children's under adolescent are more affected with anemia problem. Death rate in girls and women's are more due to anemia disease [1]. Anemia patient risk factor in pregnant ladies is high when compared with non-pregnant ladies. In the world South Africa is more affected area with anemia health problem [4]. Eighteen out of twenty anemia affected people are living developing countries, more percentage of people are suffering with deficiency of iron, six hundred million people from Asia are anemia patients due to deficiency of iron, mostly affected to adolescent and ladies with reproductive age [2].

Nearly around twenty percentage of adolescent are exist in overall population of India as per statistics and in Thailand more than 25% of girls are affected with anemia [5], and based on the various reports in all countries on girl adolescent show that severity of between 20% to 80%. From the data in India anemia disease severity is moderate [3]. From World Health Organization (WHO) data twenty out of forty countries, at most 33% of girls aged between 14 and 19 are suffering with anemia [6]. As per UNICEF report anemia is a one of the severe anemic in fifteen countries, more number of cases are identified in India and in India 50% of girls age 14-19 were suffering with anemia [10]. As per WHO 2018 endorsement report proper plan to be implemented on nutrition supplement to adolescent girls on nutrition's and they are planning to reduce the count of girls adolescent affected with anemia [15].

To minimize anemia effects on reproductive ladies age by 2030 has need to minimize 8% every year [19]. Identification of severity of anemia requires discovery of different methods, hybrid approaches, multiple factor approaches, multiple sector approaches to be needed to reach these research objectives [7]. As per WHO reports protecting adolescent girls from anemia is more complex task and risk factor varied from 40% to 80%. As per medical survey in India 90% of girls age (14-19) years are effected with anemia, the families coming under low income category merely 85% girls are having less than 12% of hemoglobin levels, urban area that to slum areas in Karnataka has 70% of anemia effected adolescent girls, from another research report Gulbarga of Karnataka has 80% of anemia effected girls aged (15-18) years, and rural areas of Andhra Pradesh effected rate is 70%.Almost all 60% of urban girls aged from14 to 19 years with economically below poverty category are affected with anemia [9]. When compared with other age group girls aged between 14 to 19 years are affected with health issue and these problems should be considered as health emergency problem [8].

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II. RELATED WORK

In India 95% of girls underage (14-19 years) is affected with anemia, nineteen percentages affected with light anemia, fifty one percentages are affected with average anemia symptoms, and twenty five percentages are affected with high anemia symptoms [11]. Ninety percentages of adolescent girls of Chhattisgarh are affected with anemia symptoms. Next highest effected state is Haryana with 84 percentages, followed by other states like Andhra Pradesh (82.2%), Delhi (80.56%), Rajasthan (79.02%), Uttar Pradesh (77.05%), Nagaland (75.06%), Tamilnadu (74.08%), and Telangana (72.04%). In Karnataka anemia cases are in between 50.00% to 75.00%, and remaining states of India are less than 50 percentages [18]. In India 170 out of 806 districts are categorized under lightly effected adolescent girls with anemia disease, 285 districts were affected with average symptoms of anemia and 351 districts were affected with highly with anemia symptoms. Kerala, Haryana, Punjab are economically strong states and as well as agriculturally strong states shows less affected anemia adolescent girls are exist in these states [16].

Hybrid model of research study were conducted by many researchers and their research findings are on anemia diseases under urban areas, rural areas, and slum areas data on adolescent girls are taken for analysis, total of 600 girls data under age 14 to 19 years were taken for analysis from various districts of Karnataka (160adolescent girls from rural areas, 149 adolescent girls from slum areas, and 291 adolescent girls from urban), total 80% of girls under age 14 to 19 years were suffering with anemia, that to in slum areas 100% of adolescent girls are effected with anemia, and 91% of girls from rural arrears are suffering with anemia [12]. The average consumption of iron by girls under these areas is 19.7 mg per day. The average hemoglobin value of adolescent girls may vary from 8.95 g/dl to 11.77 g/dl. From research findings iron deficiency of rural and urban residing adolescent girls are abnormal that leads to medical emergency in Karnataka state. Adolescent girls from urban and rural may consume very bad quality of food that to they take same kind of food long period of time due to this they are entering into anemia problem at early stage [14].

Authors in [13] calculated deficiency of iron in adolescent girls underage 12-18 years in Tamilnadu districts, total 500 school girls underage (11-17 years) data is taken for analysis, approximately 399 girls (79.99%) were effected with anemia, from which 39.99% are highly effected, 25.01% are effected with average symptoms, 14.99% are effected with severe anemia problems. From the analysis girls who are studying in government schools affected more (44.61%) then girls studying in private schools (34.02%). Authors in [17] have conducted research study on Bihar state districts girls under age 14 to 19 years, total 900 girls data is collected for analysis, from this data almost 42.23% adolescent girls were suffering with anemia with severe symptoms, 38.89% girls are affected with light anemia symptoms, 8.3% of girls with average anemia symptoms. The anemia effected adolescent girls Bihar is mostly coming under below poverty or low income category families.

Authors in [18] measure the security and prediction of disease anemia over girls underage 11-19 years in Andhra Pradesh, total girls effected with anemia is 74.87%, around 39.12% were lightly effected with anemia, 27.23% were moderately effected with anemia, and 8.52% were severely affected. In Andhra Pradesh districts economically weaker adolescent girls are more affected with anemia problem. Authors in [8] conducted a research study on 200 college studying girls in Haryana. Approximately 64.23% are affected with anemia, 128 out of 200 are affected with anemia health issue, 35.05% girls were not affected with anemia, 37.25% are lightly affected with anemia, 25.62 are affected with medium level symptoms, and 4.36% are affected with severe anemia symptoms.

III. ANTHROPOMETRIC MODEL

In this research paper we focus on adolescent girl's nutrition supplements, awareness on nutrition, nutrition status in order to predict from anemia at early stage. We conducted detailed survey from March 2023 to May 2024, economic situations of urban, rural, slum were studied, adolescent girls knowledge over nutrition supplements are calculated, also motivated adolescent girls to take proper nutrition supplements to balance their health conditions, and provide complete knowledge about nutrition supplements. A complete survey is conducted on Gulbarga in Karnataka state and approximately 11000 adolescent girl's data is taken for analysis, by conducting various test blood samples of these adolescent girls we come to know that 540 people are affected with anemia, and their background data is gathered with different features and the features are listed in Table 1.

Table 1 540/11000 Anemia Affected Adolescent Girls with Different Features

S. No.	Features	Sub Features	Count	Percentage
1	Age	10-12 Years	184	34.07%
		13-15 Years	220	40.74%
		16-19 Years	136	25.18%
2	Occupation of Father	Labor	148	27.41%
		Skilled Worker	62	11.48%
		Business	63	11.67%
		Private Sector	65	12.04%
		Former	142	26.30%
		Public Sector	60	11.11%

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3	Father Education	Illiterate	106	19.63%
		Able to read or write	88	16.30%
		SSC	127	23.52%
		Intermediate	96	17.78%
		UG	68	12.59%
		PG	49	9.07%
4	Mather Education	Illiterate	267	49.44%
		Able to read or write	113	20.93%
		SSC	68	12.59%
		Intermediate	47	8.70%
		UG	30	5.56%
		PG	15	2.78%
5	Girls Education Level	Illiterate	270	50.00%
		Studying	193	35.74%
		Dropout	77	14.25%
6	Family Type	Small Size (4)	113	20.92%
		Medium Size (8)	272	50.37%
		Large Size (15)	155	28.70%
7	Food Habit	Veg	363	67.22%
		Non Veg	177	32.77%
8	Financial Status	Upper	24	4.44%
		Upper Middle	37	6.85%
		Middle	92	17.04%
		Lower Middle	252	46.67%
		Lower	135	25.00%

Changes in adolescent girl features (dimensions) may lead to change in health condition. Anthropometry is one of the measuring technique to measure physical positions (or size) and shape of the body. This tool is not an expensive and popularly used tool to calculate nutritional values of a person or group of persons. In this paper, the collected dataset is evaluated with the help of anthropometric method and the main objective is to protect adolescent girls from anemia health problem. In this research paper to evaluate nutrition position we use metrics like BMI, height of the girl and weight of the girl.

Table 2 BMI values of Dataset

	Age 10-12 (182)	**Age 13-15 (234)**	**Age 16-19 (124)**	**Total (540)**
BMI Mean	10.74 to 10.98	11.43 to 22.27	13.54 to 22.3	10.1 to 23.56
BME SE	0.37	0.39	0.46	0.33
BME CI	14.58 to 15.98	16.02 to 17.58	17.29 to 18.77	16.09 to 17.39
Weight-Mean	21.81 to 39.85	32.03 to 48.51	36.78 to 52.42	30.22 to 48.04
Weight-SE	0.72	0.59	0.78	0.41
Weight-CI	28.97 to 31.89	38.87 to 40.96	42.91 to 45.79	37.12 to 38.99
Height-Mean	130.9 to 144.56	139.98 to 155.86	146.94 to 159.8	139.85 to 154.21
Height-SE	0.54	0.59	0.64	0.36
Height-CI	135.89 to 137.92	146.82 to 148.99	151.91 to 154.56	146.29 to 147.54

The value of each parameter is listed in Table 2. From the Table 2, we came to know that adolescent girls have low average height and average weight and have low BMI in adolescent girls in Karnataka rural areas.

IV. HEIGHT AND WEIGHT GROWTH

We are expecting the height of adolescent girls should be increased when their age is increased, the average height of adolescent girls under age 10-12years were increased in between 130.9 to 144.5, at the age between 13-15years, average height were increased in between 139.98 to 155.86, and at the age between 16-19years, average height is between 146.94 to 159.8. Average height of adolescent girls at different age measured, a graph is plotted between age and height of the adolescent girls, and it is depicted in figure 1.

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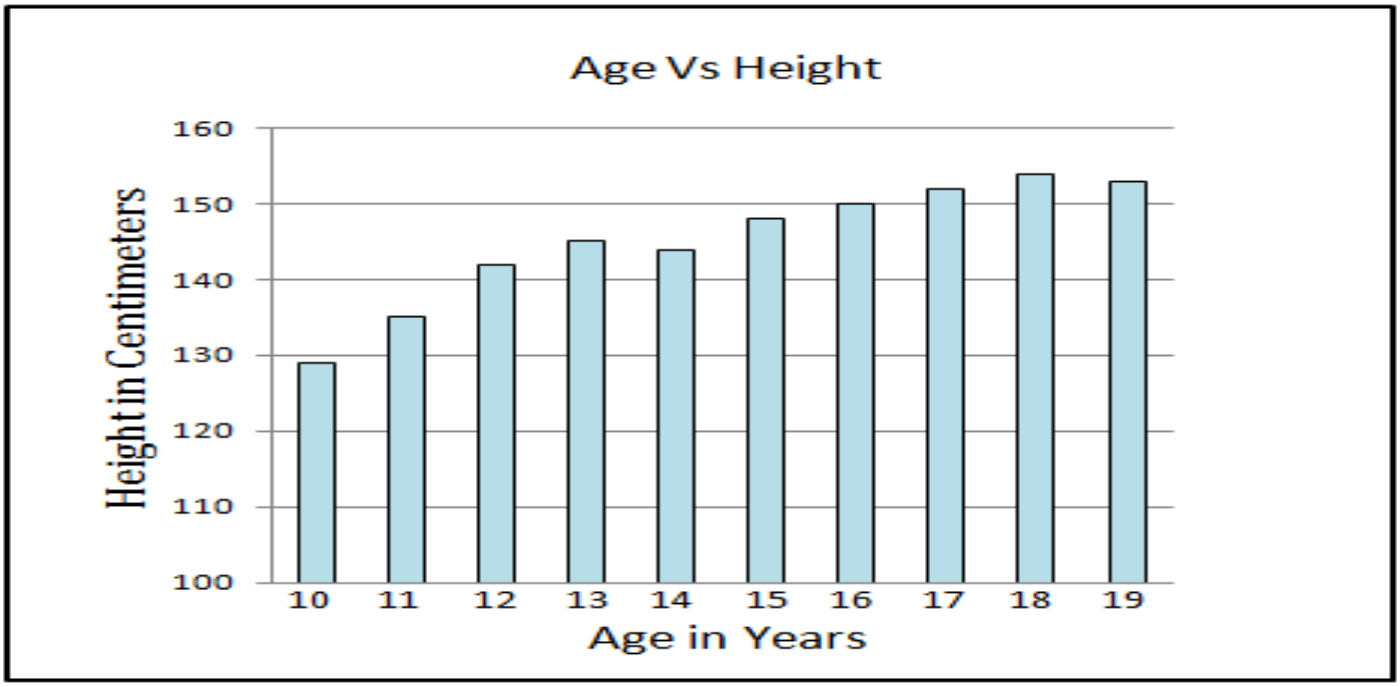

Fig 1 Height values of Adolescent Girls

Average weight of adolescent girls at different age measured, a graph is plotted between age and weight of the adolescent girls, and it is depicted in figure 2.

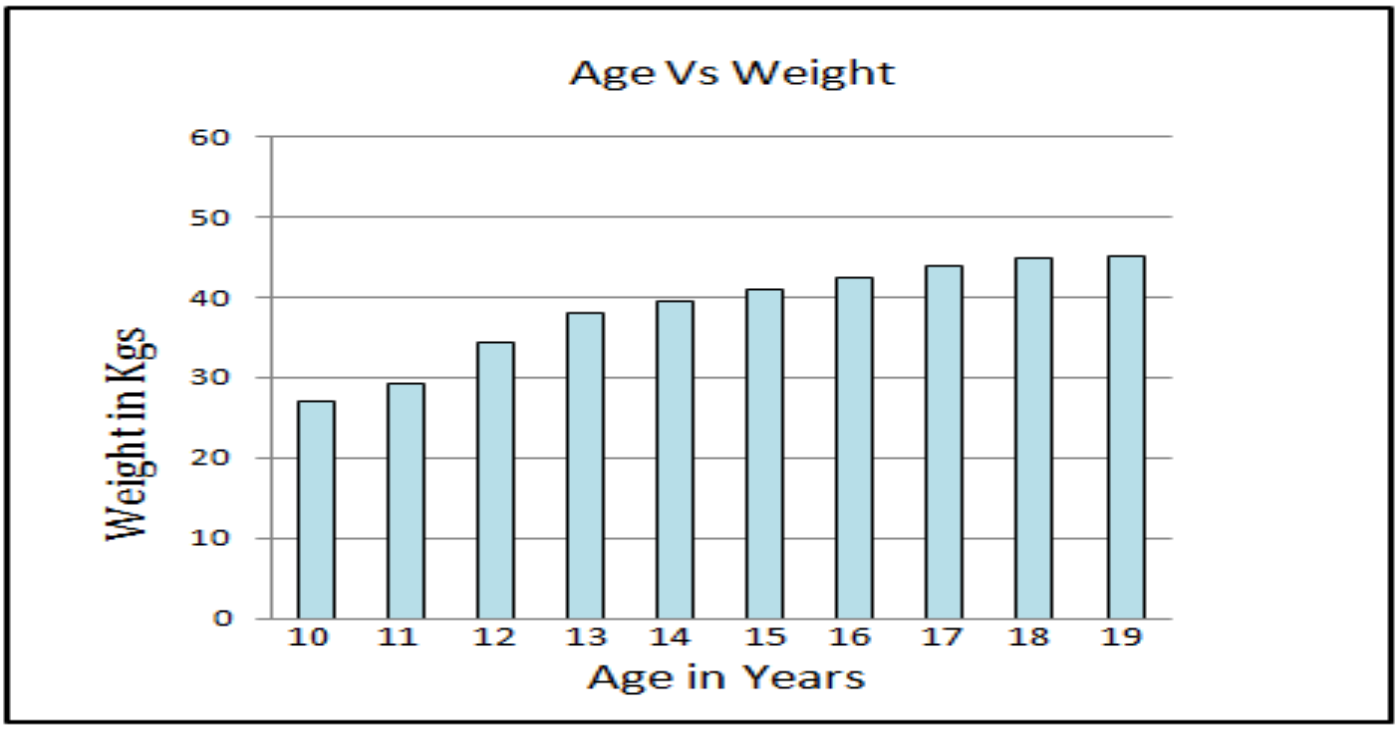

Fig 2 Weight values of Adolescent Girls

V. PERFORMANCE EVALUATION

Proposed Anthropometric model (M1) is compared with other models like WHO model (M2), IAP model (M3), and average height of adolescent girls at different ages are measured using three different methods (M1, M2, M3). From our results we observed that there is a sufficient growth in height of centimeters under the age between twelve to thirteen years, height growth of adolescent girls are common but it varies person to person based on their intensity and nutrition supplements, and that to mostly adolescent girls are attaining menarche at the age from twelve to thirteen years therefore there is a chance to increase height in this age. The results of findings are shown in figure 3.

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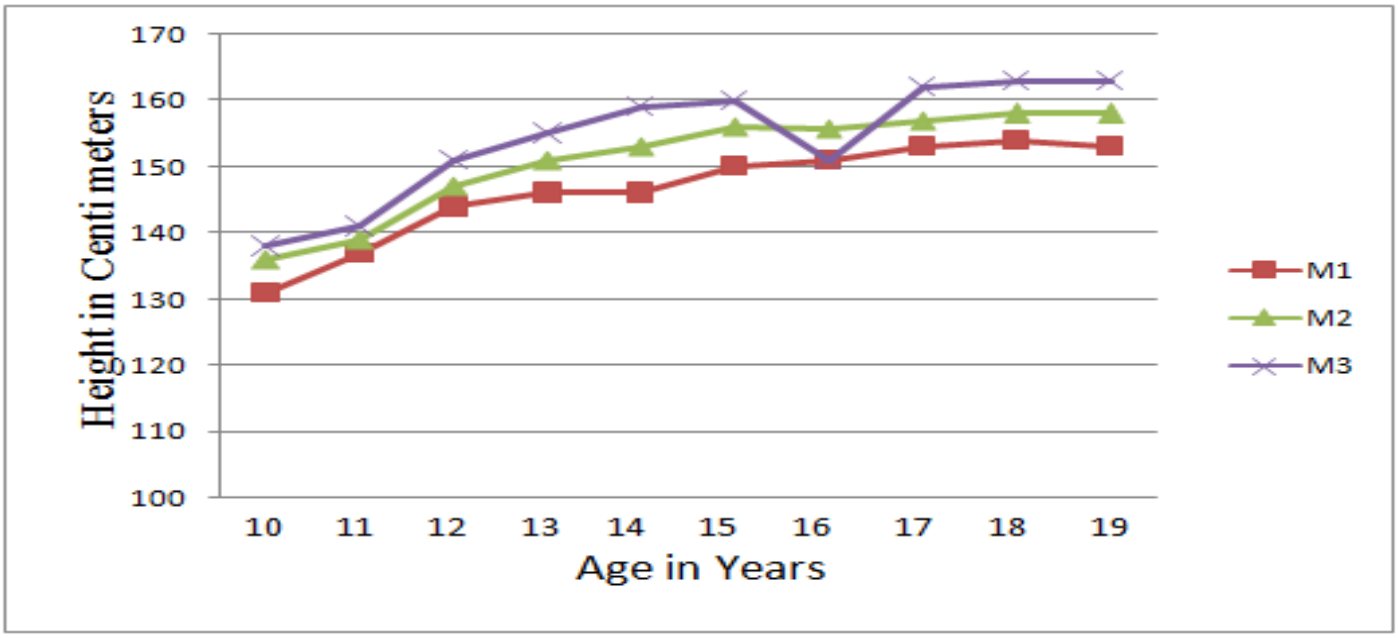

Fig 3 Height values of M1, M2, and M3 Models

Average weight of adolescent girls are measured using M1, M2, and M3 models, proposed Anthropometric model (M1) is compared with other models like WHO model (M2), IAP model (M3), from the results we come to know that weight of adolescent girls are low than standard growth, these results shows that adolescent girl has to consume more food in the stages, and average weight values of three methods are shown in figure 4. From our results we observed that there is a sufficient growth in weight of centimeters under the age between twelve to thirteen years, weight growth of adolescent girls are common but it varies person to person based on their intensity and nutrition supplements, and that to mostly adolescent girls are attaining menarche at the age from twelve to thirteen years therefore there is a chance to increase weight in this age.

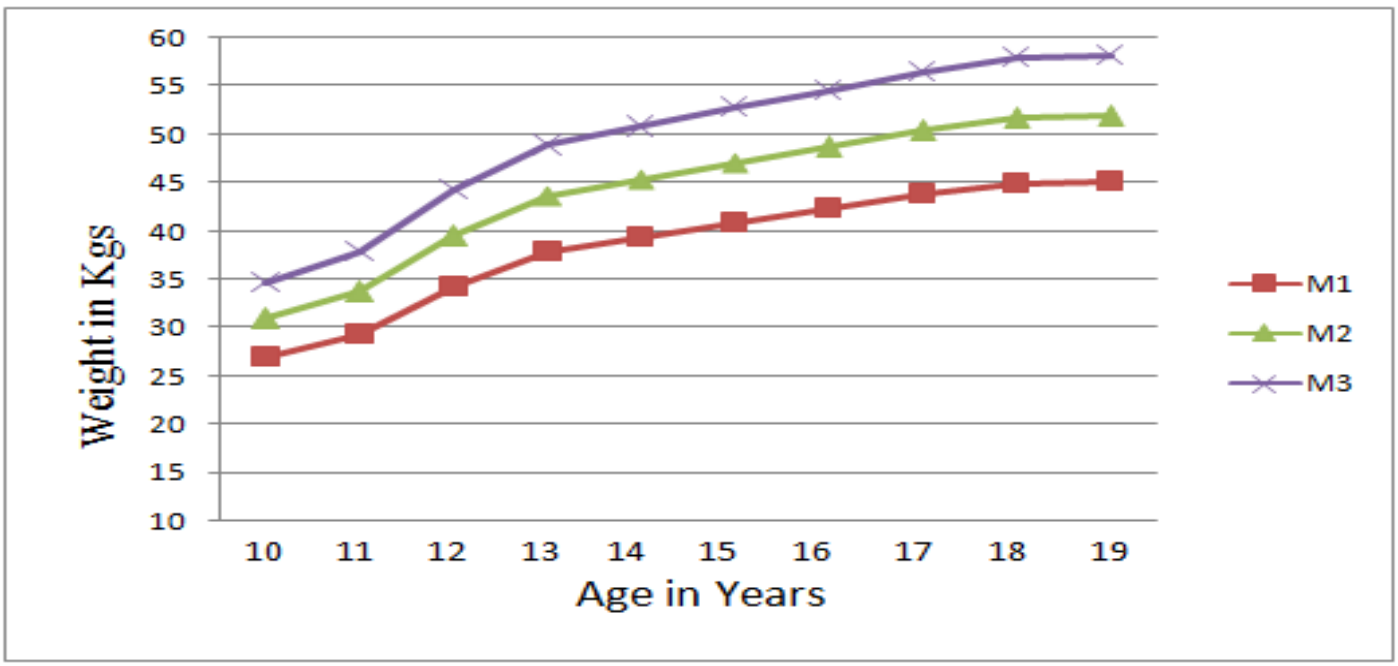

Fig 4 Weight values of M1, M2, and M3 Models

In the proposed model BMI value is low for adolescent girls than other two standard methods (M2, M3), and values of BMI of all these three methods are shown in figure 5. From our findings weight and height values of adolescent girls are increased when age is increased, from the results there is a regular growth in weight and height based on age, average height of adolescent girls were increased to 2.7 centimeters, average weight of adolescent girls were increased to 2.4 kgs, the weight value difference in two continues years were approximately 3.9 kgs, and the height value difference in two continues years were approximately 4.89 centimeters.

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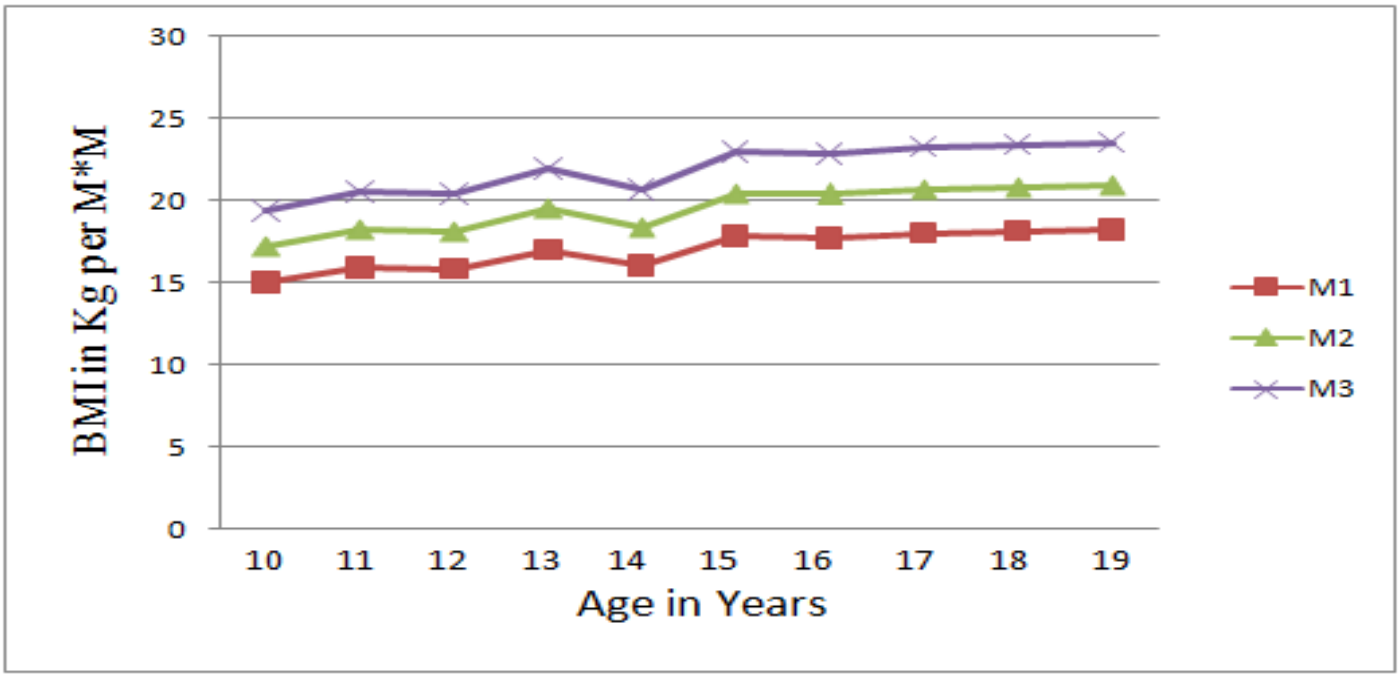

Fig 5 BMI values of M1, M2, and M3 Models

Values of BMI are measured to all 540 peoples, based on BMI values data is categorized into five categories, BMI values is less than 17 are treated as Thinness (T), BMI value less than 18.5 and greater than 17 are treated as underweight (UW), BMI values between 18.5 to 24.9 are treated as normal weight (NW), BMI values between 25 to 30 are treated as over weight (OW), BMI values greater than 30 are treated as obesity (O), and list of measured values of 540 peoples are tabulated in table 3.

Table 3 Classification of Dataset based on BMI values

Age (years)	T		UW		NW		OW		O	
	Count	%	Count	%	Count	%	Count	%	Count	%
10-12	61	11.30	64	11.85	36	6.67	18	3.33	11	2.04
13-15	58	10.74	63	11.67	39	7.22	17	3.15	14	2.59
16-19	50	9.26	55	10.19	25	4.63	14	2.59	05	0.93
10-19	169	31.30	182	33.70	100	18.52	49	9.07	40	7.41

VI. PREDICTING FROM WRONG NUTRITION SUPPLEMENTS

Consumption of balanced nutrition in adolescent ages are predict from many diseases, intake of over food nutrition and also consuming very less nutritional food leads to health issues. Cereals like wheat, maize, rice are mostly available foods must be included in the diet, pulses like various grams (black, red, green, Bengal) are also suggested to add, leafy vegetables like menthe, cabbage, spinach are advised to add, roots like onion and potato, other vegetables like guards, brinjal, cauliflower, lady finger, cucumber, and so on are need to be add, fruits are rich in vitamin C and fruits like apple, papaya, grapes, banana are mostly available fruits in India must be part of food, milk products like butter, ghee, curd are also advised to add to their daily food intake. From our research we recommend list of various food nutrition to different age group of adolescent girls and are tabulated in Table 4.

Table 4 Food Items Quantities Recommended to Adolescent Girls

S. No	Food	Age Group in years (nutrition suggested per day)		
		10-12	13-15	16-19
1.	Pulses	26.54g to 26.89g	15.67g to 28.12g	20.34g to 37.99g
2.	Cereals	100.89g to 151.78g	97.86g to 167.77g	111.87g to 165.37g
3.	Leafy Vegetables	17.69g to 29.12g	16.54g to 28.14g	11.18g to 30.95g
4.	Roots	25.12g to 68.27g	35.68g to 65.08g	53.91g to 96.12g
5.	Other Vegetables	16.54g to 68.71g	14.82g to 82.69g	19.31g to 85.11g
6.	Fruits	11.24g to 19.88g	12.42g to 22.47g	11.75g to 20.51g
7.	Milk products	11.59mg to 204.58mg	161.2mg to 227.62mg	111.28mg to 224.26mg

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From foods adolescent girls must require adequate energy levels, that to they need energy based on their body size, mostly adolescent girls are facing energy problems due to ignorance of taking breakfast regularly, proteins are also one of the nutrition that is used to build body components like muscles and blood, consumption of adequate protein is more important, and advised to consume eggs, meat, chicken, fish, milk, and milk items frequently. Fatty foods are also useful to increase body metabolism levels. Calcium foods like milk, vegetables, and millets are useful to improve bone strength. List of food nutrition recommended to adolescent girls at different age groups are listed in Table 5.

Table 5 Nutrition Recommended to Adolescent Girls

S. No	Food nutrition	Age Group in years (nutrition suggested per day)		
		10-12	13-15	16-19
1.	Energy	235.45 kcal to 1204.10 kcal	243.20 kcal to 1345.4 kcal	384.54 kcal to 1432.6 kcal
2.	Fat	16.11g to 19.42g	18.13g to 21.3g	18.4g to 20.98g
3.	Protein	19.8g to 40.5g	17.8g to 52.2g	16.2g to 55.12g
4.	Calcium	297.11mg to 385.12mg	248.13mg to 393.31mg	152.14mg to 403.21mg
5.	Beta Carotene	>=951.14 μg	>=984.51 μg	>=1030.17 μg
6.	Iron	10.4mg to 12.5mg	11.4mg to 12.4 mg	9.1mg to 11.4mg
7.	Carbohydrate	53.87g to 302.4g	53.12g to 350.41g	53.8g to 367.33g

VII. CONCLUSION

In this research paper we conducted detailed survey on 11000 adolescent girls and we observed 540 members are affected with anemia. These age group girls were easily enter into anemia due to skipping of food like breakfast, lunch, dinner, and not consuming proper nutritional foods. Niacin deficiency occurred on these group girls due to not consuming non vegetarian foods and cereals. Anthropometric model is used in this research to measure BMI values and we compared our results with IAP model and WHO model. We observed adolescent girls height and weight growth by taking various age groups. We did classification (T: 31.30%, UW: 33.70%, NW: 18.52%, OW: 9.07%, and O: 7.41%) based on BMI values and mostly adolescent girls are facing thinness and underweight problems. At the end we recommend nutrition and food items consumption per day to predict from anemia problems.

REFERENCES

[1]. Baker P, Machado P, Santos T, Sievert K, Backholer K, Hadjikakou M, Russell C, Huse O, Bell C, Scrinis G, Worsley A, Friel S, Lawrence M. Ultra-processed foods and the nutrition transition: Global, regional and national trends, food systems transformations and political economy drivers. Obes Rev. 2020 Dec;21(12):e13126.

[2]. Elizabeth K. Dunford, Donna R. Miles, Barry Popkin, Food Additives in Ultra-Processed Packaged Foods: An Examination of US Household Grocery Store Purchases, Journal of the Academy of Nutrition and Dietetics, vol. 123, no. 6, 2023.

[3]. LE, Gurzo K, Paolicelli C, Whaley SE, Weinfield NS, Ritchie LD. Diet Quality of US Infants and Toddlers 7-24 Months Old in the WIC Infant and Toddler Feeding Practices Study-2. J Nutr. 2018 Nov 1;148(11):1786-1793. doi: 10.1093/jn/nxy192. Erratum in: J Nutr. 2020 Apr 1;150(4):971.

[4]. Kay MC, Duffy EW, Sun B, Borger C. Comparing Diet Quality Indices for Low-Income 24-Month-Old Toddlers: Exploring Changes Driven by 2020-2025 Dietary Guidelines for Americans. J Nutr. 2023 Jan, vol. 153, no. 1, pp. 215-224.

[5]. Guthrie JF, Anater AS, Hampton JC, Catellier DJ, Eldridge AL, Johnson WL, Quann EE. The Special Supplemental Nutrition Program for Women, Infants, and Children is Associated with Several Changes in Nutrient Intakes and Food Consumption Patterns of Participating Infants and Young Children, 2008 Compared with 2016. J Nutr. 2020 Nov 19, vol. 150, no. 11, pp. 2985-2993.

[6]. Ahluwalia N. Nutrition Monitoring of Children Aged Birth to 24 Mo (B-24): Data Collection and Findings from the NHANES. Adv Nutr. 2020 Jan 1, vol. 11, no. 1, pp. 113-127.

[7]. Au LE, Arnold CD, Ritchie LD, Frongillo EA. The Infant Diet Quality Index Predicts Dietary and Adiposity Outcomes in US Children 2 to 4 years old. J Nutr. 2023 Mar, vol. 153, no. 3, pp. 741-748.

[8]. Lioret S, Betoko A, Forhan A, Charles MA, Heude B, de Lauzon-Guillain B; EDEN Mother–Child Cohort Study Group. Dietary patterns track from infancy to preschool age: cross-sectional and longitudinal perspectives. J Nutr. 2015 Apr;145(4):775-82.

[9]. Sirkka O, Fleischmann M, Abrahamse-Berkeveld M, Halberstadt J, Olthof MR, Seidell JC, Corpeleijn E. Dietary Patterns in Early Childhood and the Risk of Childhood Overweight: The GECKO Drenthe Birth Cohort. Nutrients. 2021 Jun 15;13(6):2046.

[10]. Northstone K, Smith ADAC, Newby PK, Emmett PM. Longitudinal comparisons of dietary patterns derived by cluster analysis in 7- to 13-year-old children. British Journal of Nutrition. 2013;109(11):2050-2058.

[11]. Capriati T, Pediatric short bowel syndrome: predicting four-year outcome after massive neonatal resection. Eur J Pediatr Surg 28:455–463, 2018.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24SEP1182

[12]. Brubaker PL, Glukagon-like peptide -2 and the regulation of intestinal growth and function. Compr Physiol 8:1185–1210, 2018.
[13]. Dai Y.J., Comparison of formulas based on lipisd emulsions of olive oil, soybean oil, or several oils for parenteral nutrition: A systematic review and meta-analysis. Adv Nutr 15, 2016, pp. 279–286.
[14]. Han SM, Long-term outcomes and disease burden of neonatal short bowel syndrome. J Pediatr Surg 55:164–168, 2020.
[15]. Hargrove DM, Pharmacological characterization of Apraglutide, a novel ling-acting peptidic glucagon-lke peptide-2 agonist, for treatment of short bowel syndrome. J Pharmacol Exp Ther 373:193–203, 2020.
[16]. Teo, P.S., van, Dam, R.M., Whitton, C., Tan, L.W.L., Forde, C.G., “Consumption of foods with higher energy intake rates is associated with greater energy intake, adiposity, and cardiovascular risk factors in adults”, The Journal of Nutrition, vol. 151, no. 2, pp. 370–8, 2021.
[17]. Wong prawmas, R., Mora, C., Pellegrini, N., Guine, R.P.F., Carini, E., Sogari, G., "Food choice determinants and perceptions of a healthy diet among Italian consumers”, Foods Basel Switz, vol. 10, no. 2, 318, 2021.
[18]. McKay, N., Przybysz, J., Cavanaugh, A., Horvatits, E., Giorgianni, N., Czajka, K., “The effect of unhealthy food and liking on stress reactivity”, Physiology & Behavior, vol. 229, pp. 113-216, 2021.
[19]. Esfandiari, M., Papapanagiotou, V., Diou, C., Zandian, M., Nolstam, J., Sodersten, P., “Control of eating behavior using a novel feedback system”, Journal of Visualized Experiments, vol. 8, no. 135, 57432, 2018.
[20]. Stott, N., Fox, J.R.E., Williams, M.O., “Attentional bias in eating disorders: a meta-review”, International Journal of Eating Disorders, vol. 54, no. 8, pp. 1377–1399, 2021.
[21]. Valenzuela, P.L., Morales, J.S., Emanuele, E., Pareja-Galeano, H., Lucia, A., “Supplements with purported effects on muscle mass and strength”, European Journal of Nutrition, vol. 58, no. 8, pp. 2983–3008, 2019.