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Hybrid Anthropometric Dietary Assessment Approach to Continuously Monitor Adolescent and Prevent from Nutritional Deficiencies

Aruna[1], Dr.Sandhya Srivastava[2]

[1]Research scholar, Department of Home Science, Bhagwant University, Ajmer, aruna.dietician@gmail.com
[2]Professor, Sarvoday Kisan PG college, Kauriram, Gorakhpur, drsandhyasrivastav@gmail.com

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Abstract - Age of adolescent is very sensitive span, all organs are biologically grown in this age, monitoring and giving additional nutritional supplements to protect their future problems. In this research we determined nutrition values of adolescents with help of detailed assessment approach by combining living life style parameters, anthropometric features, and intake of dietary calculation method. Data samples are gathered by using circumference of upper arm, BMI value, score of dietary type, and frequency of dietary intake per day. Nutrition values are measured for gender specific adolescents, behaviour in dietary intake, parameters related to growth, and result of nutritional values in adolescents. Performance proposed Hybrid Anthropometric Dietary Assessment Approach (HADAA) is evaluated and results of HADAA compared with NARM, DDSM, AAM, and DRM Approaches. From the results we observed that HADAA exhibits greater RDA value, shows high adequacy Value, exhibits higher CCI Value, shows high Reliability Score, exhibits greater Detection Rate, shows high Specificity, exhibits higher Sensitivity, shows high accuracy, field of applicability of HADAA is high, resource efficiency of HADAA is also high, mean energy intake of HADAA is 2124 ± 284 value, and intake in terms of grams per day is 55.6 ± 7.4 value.

Key Words: Behaviour patterns, BMI value, anthropometric features, dietary habits, dietary intake frequency, mean average intake.

1. Introduction

As per UNICEF reports many of the adolescent people lazy or neglected in consuming quality dietary foods that is shown major impact and infringement their cycle of intergeneration with underfeeding [1]. UNICEF highlighting that many of them has required energy but their nutritional levels are poor that may lead to deficiencies on micro nutrition in future [2]. UNICEF pointed out the requirement of important parameters to assess adolescent who are crossed their normal weights and supplements are required for less nutritional adolescents to manage their weight [3].

In this research reviewed how nutritional levels of adolescents is predisposed by their lifestyle parameters, values of anthropometric method, adequate micro nutrition supplements, and quality of food items consumed inside or outside of their living environment [4]. The baseline research methods shows that classification in assessment methods, only few are focused on adolescents, only few of them working with both anthropometric parameters and dietary food items [5], and there is a necessity of development of combined approach to address all the assessment parameters to identify anemia affected adolescents at early stages to increase their life span by providing required food supplements [6].

Authors in [7] conducted a detailed survey on nutritional absences on adolescent and focused towards problems faced due to shortage of iron, the effect of body weight due to consequence of iron deficiencies, and sometimes anthropometry model fail to identify such a problem [8]. Authors in [9] discussed parameters of behavioral and social are used to calculate nutrition levels in adolescent, identified that intake of appropriate dietary food shows major impact on health conditions [10], in addition to these parameters they also taken environmental features to study adolescent health, and they highlighted how these parameters influence the nutritional levels in adolescent people [11]. Authors in [12] conducted a detailed survey on food habits of adolescents like over intake of snacks and heavy sugar sweets during school time, they identified correlation analysis over nutritional changes and quality of diet consumed, they highlighted monitoring and educating will give better results [13].

2. Related Work

Authors in [14] evaluated the relationship between food consumption and nutritional level in school aged adolescents, they identified many of them are having inadequate power due to consuming of less intake or low quality food items, they studied many students from urban and as well as rural background to calculate nutritional levels, and suggest assessment must be done frequently to predict adolescents nutritional levels. Authors in [15] done complete analysis on interventions of nutrition, they highlighted how some of the adolescents missing an opportunity by consuming low-quality food items, they identified intake of appropriate quality food items may help to maintain nutrition levels of adolescents, and they suggested that continuous monitoring is required on border level adolescents and educating them to take good diet may improve their nutrition levels. Authors in [16] determine nutritional levels on early married adolescent girls, they studied how their nutritional growth changing at the time of pregnancy, and studied constraints on socio parameters will lead to malnutrition.

Authors in [17] conducted detail survey at worldwide on adolescent nutritional program, they noticed that a greater number of researches are missed basics of nutrition assessment, their descried that without preliminary information on food consumption the baseline research methods shows inconsistent outcomes. Authors in [18] conducted a research on requirement of micro nutrition on adolescent and then identified that many of them are shortage with vitamin A, calcium deficiency, and low iron levels and these factors will moderate growth in adolescents. Authors in [19] determined transition of nutrition at the age of adolescent and prepared evidence how transition food diet converted into heavy sugar processed items, the mainly focused how transition may further lead to obesity problem or under nutritional problems, and their work is fail to identify complexity and suggest combined approach to assess risk factors at adolescent age.

Authors in [20] described technical guidance on adolescent food intake assessment, highlighted the limitations of depending on only one dietary assessment approach on adolescent, observed the growth rate when consuming irregular food items, it may lead to consumption of heavy nutrition or poor intake of nutrition, authors introduced hybrid assessment tool for analyses dietary nutrition. Authors in [21] analyzed nutritional level in school age adolescent peoples, observed the BMI values and consumption of micro nutrition under different category of people with different economy income people, they proved that their model identified high risky people due to irregular intake of food items with low quality or poor nutrition foods, and their model really useful to identify list of adolescents who is effected with nutrition imbalance. Authors in [22] identified new trends on health predicting health of adolescents from nutrition deficiency problems, they described that only limited research is conducted on adolescents then children, intergeneration growth of any adolescent is completely depends on food intake at that period, and authors recommended hybrid methods to assess nutrition with different health strategies.

Authors in [23] conducted a survey on adolescent health condition, notice that over intake of proceeded food items or junk food items may lead to raise health problems at early stages, from their observation changes in urbanization may in turn motivated adolescents towards junk food or low quality proceeded foods, authors studied both behavior and as well as available food items for intake. Authors in [24] studied different methods on nutritional assessment, identified mixed results due to inappropriate assessment tools to determine nutrition, and observed that most of the methods fail to take age wise assessment tool. Authors in [25] calculated future impact of adolescent low nutrition food consumption, described the severity of disease in reproduction age and its risk of life threat, elaborated how nutrition deficiencies may impact on growth of both weight and height, and they feel that taking strength nutrition foods may automatically increase lifespan of adolescent.

Author in [26] determined adolescent concern in health perspective and listed different health problems associated with less consumption of nutrition at the age of adolescent. Authors in [27] highlighted that food consuming habits during adolescent age are shown very big impact on future and may lead to enter into critical diseases. Authors in [28] described that baseline methods are inadequate to focus towards to identify requirement of balanced nutrition food items by considering lifestyle parameters, growth parameters, and as well as quality of dietary items.

Authors in [29] studied behavior of adolescent and make a note or warning to make intake high nutrition foods and they observe lifestyle of adolescent, living environment, list of food items consumed, and eating junk food items. Authors in [30] elaborated a new method to estimate energy consumption does not depends on nutrition requirement and emphasize the requirement of different

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kinds of food items with nutrition to assess adolescent nutritional level. Authors in [31] focused towards nutrition assessment in school going adolescent, highlighted behavior parameters and dietary habits shows major impact on adolescent with balanced nutrition.

After literature identified list of research gaps are many researchers on nutritional effects on adolescent are done based on BMI values but not consider intake of food items, only limited research is conducted on types of dietary foods and classification of food items, these parameters are missing means fail to decide nutrition level whether it is insufficient or sufficient, many of the conventional methods fail to distinguish nutrition requirement and growth based on gender, limited research on preparing dietary food nutrition planning to school students based on their living environment, few researchers only consider behavior and physical exercise patterns while performing the assessment, there is no automatic tool to combine lifestyle parameters, anthropometric values, and dietary consumption to assess adolescent nutrition.

3. HADAA Nutrition Assessment Approach

In this research we determined nutrition values of adolescents with help of detailed assessment approach by combining living life style parameters, anthropometric features, and intake of dietary calculation method. Data samples are gathered by using circumference of upper arm, BMI value, score of dietary type, and frequency of dietary intake per day. Nutrition values are measured for gender specific adolescents, behaviour in dietary intake, parameters related to growth, result of nutritional values in adolescents, and workflow of proposed HADAA approach is visualized in figure 1.

Step 1: Research Problem: we demonstrated the problem depends on inadequate food items, imbalanced nutrition, malnutrition parameters, and that are calculated from targeted adolescent. As well as identified list of gaps in the traditional similar kind of approaches.
Step 2: Research Objectives: list of objectives is framed to evaluate food consumption, adequate nutrition, and level of nutrition in the adolescent. The mean dietary nutrition intake is calculated as $\mu_W = \frac{1}{k}\sum_{j=1}^{k} w_j$, w_j represents nutrition consumed by jth adolescent, and k represents count of population.

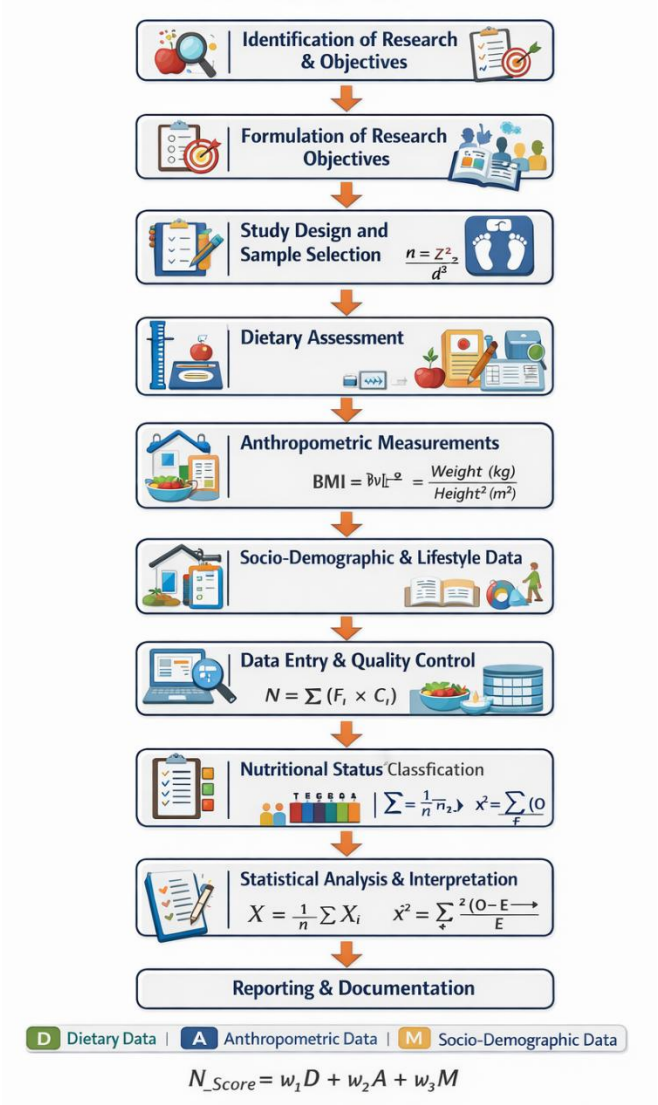

Fig. 1. Proposed nutrition assessment methodology

Step 3: Research Design: opted cross design based on population community, measure parameters at a time. The probability of observed inadequate nutrition is defined as: $Q(Z) = \frac{O_c}{k}$, O_c represents observed count, and k represents population count.
Step 4: Population identification: the list of eligible population who are satisfied predefined conditions and mean of population for anthropometric parameters is defined as: $\overline{P} = \frac{\sum P_j}{k}$.
Step 5: Inclusion conditions: including or excluding samples based on predefined conditions to optimize variations by improving accuracy in data selection.
Step 6: Sample size estimation: population sample size is measured as $k = \frac{R^2 * a * b}{e^2}$, R represents standard deviation, a represents measured prevalence, $b = 1 - a$, e represents acceptable error value.

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Step 7: Sampling: a multiple sampling method is applied to maintain randomness and the selection at each step probability is defined as $P(k) = P_1 * P_2 * P_3$.

Step 8: Approval from consent: ethical values and confidentiality is maintained about adolescent information. Probability each participant is calculated as $P(C) = \frac{k_c}{k}$, and k_c represents the count of participants.

Step 9: Data collection: data is collected by asking questions and that can be defined as: $R_c = \frac{q}{q-1}(1 - \frac{\sum \sigma_j^2}{\sigma_S^2})$, R_c represents coefficient value of reliability, and q represents number of questions.

Step 10: Assessment of dietary: mean daily consumption of food item is measured as $\bar{D} = \frac{1}{k}\sum_{j=1}^{k} D_j$.

Step 11: Food consumption is converted into nutrition with help of composition tables. $N_j = \sum C_j * F_j$, C_j represents nutrition values per each unit of food item, and F_j represents quantity of food intake.

Step 12: Nutrition Evaluation: NAR(Nutrition Adequate Ratio) is defined as $NAR = \frac{N_j}{RDA_j}$ and MAR (Mean Adequate Ratio) is defined as $MAR = \frac{1}{n}\sum_{i=1}^{n} NAR_i$.

Step 13: Assessment of Anthropometric: BMI is measured as $BMI = \frac{Weight}{height^2}$.

4. Performance Evaluation

Proposed Hybrid Anthropometric Dietary Assessment Approach (HADAA) is evaluated and results of HADAA compared with NARM (NAR or MAR method), DDSM (Dietary Diversity score method), AAM (Assessment of Anthropometric method), and DRM (Dietary recall method). Accuracy Hybrid Anthropometric Dietary Assessment Approach (HADAA) is evaluated and results of HADAA compared with NARM, DDSM, AAM, and DRM Approaches. From the results we observed that DRM method exhibits 68.4% of accuracy, AAM approach shows 72,9% of accuracy, DDSM technique exhibits 70.1% of accuracy, NARM method shows 76.3% of accuracy, proposed HADAA exhibits greater accuracy (89.6%), and results are visualized in figure 2.

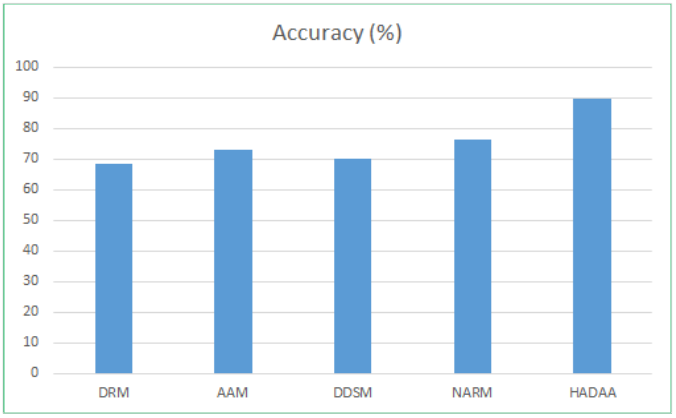

Fig. 2. Accuracy values of different Models

Sensitivity Hybrid Anthropometric Dietary Assessment Approach (HADAA) is evaluated and results of HADAA compared with NARM, DDSM, AAM, and DRM Approaches. From the results we observed that DRM method exhibits 65.2% of Sensitivity, AAM approach shows 71.8% of Sensitivity, DDSM technique exhibits 69.4% of Sensitivity, NARM method shows 75.9% of Sensitivity, proposed HADAA exhibits greater Sensitivity (88.3%), and results are visualized in figure 3.

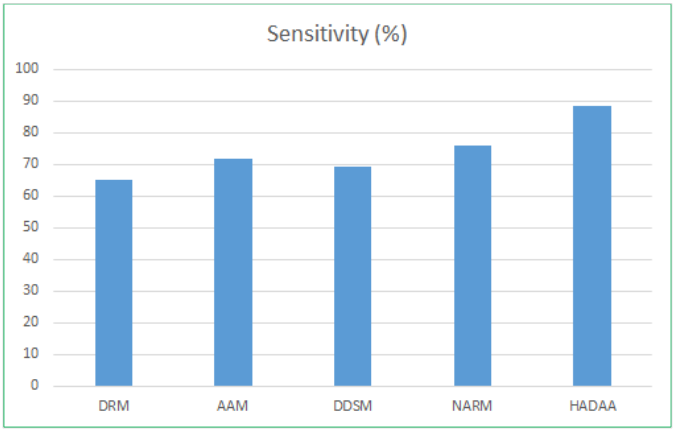

Fig. 3. Sensitivity values of different Models

Specificity Hybrid Anthropometric Dietary Assessment Approach (HADAA) is evaluated and results of HADAA compared with NARM, DDSM, AAM, and DRM Approaches. From the results we observed that DRM method exhibits 70.1% of Specificity, AAM approach shows 74.3% of Specificity, DDSM technique exhibits 72.6% of Specificity, NARM method shows 78.2% of Specificity, proposed HADAA exhibits greater Specificity (90.1%), and results are visualized in figure 4.

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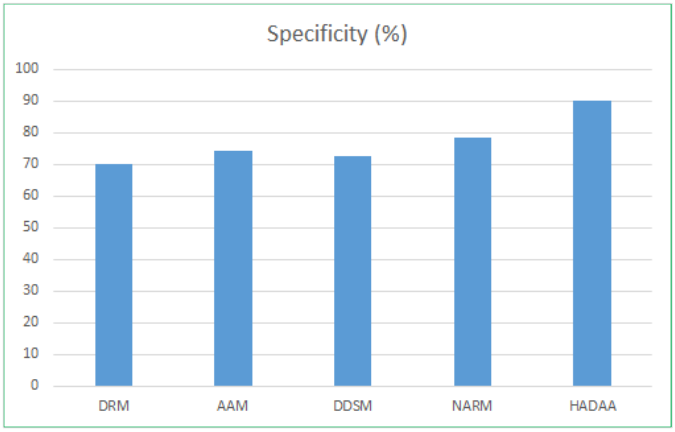

Fig. 4. Specificity values of different Models

Detection Rate Hybrid Anthropometric Dietary Assessment Approach (HADAA) is evaluated and results of HADAA compared with NARM, DDSM, AAM, and DRM Approaches. From the results we observed that DRM method exhibits 60.8% of Detection Rate, AAM approach shows 55.6% of Detection Rate, DDSM technique exhibits 63.2% of Detection Rate, NARM method shows 79.4% of Detection Rate, proposed HADAA exhibits greater Detection Rate (91.2%), and results are visualized in figure 5.

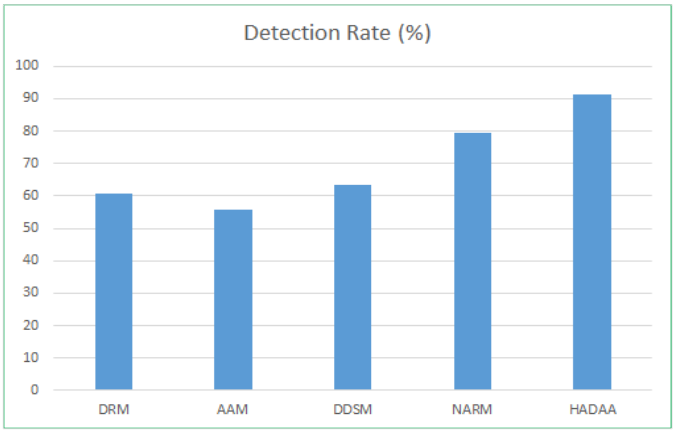

Fig. 5. Detection rate values of different Models

Reliability Score Hybrid Anthropometric Dietary Assessment Approach (HADAA) is evaluated and results of HADAA compared with NARM, DDSM, AAM, and DRM Approaches. From the results we observed that DRM method exhibits 0.71 of Reliability Score, AAM approach shows 0.76 of Reliability Score, DDSM technique exhibits 0.73 of Reliability Score, NARM method shows 0.82 of Reliability Score, proposed HADAA exhibits greater Reliability Score (0.91), and results are visualized in figure 6.

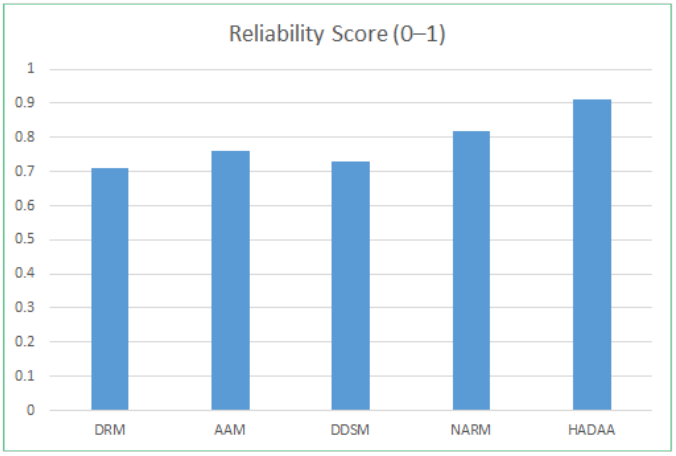

Fig. 6. Reliability values of different Models

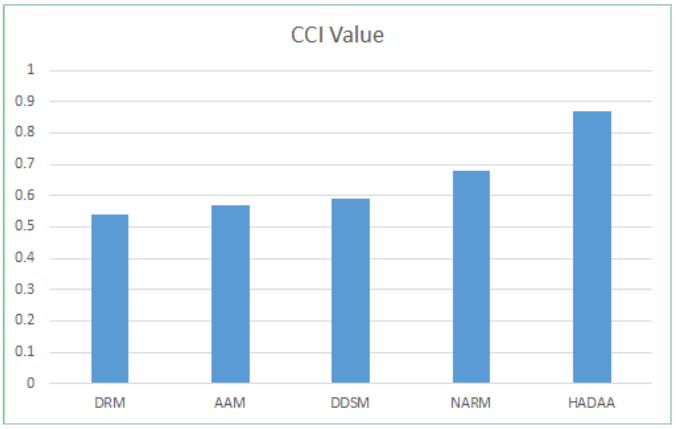

Fig. 7. CCI values of different Models

CCI Value Hybrid Anthropometric Dietary Assessment Approach (HADAA) is evaluated and results of HADAA compared with NARM, DDSM, AAM, and DRM Approaches. From the results we observed that DRM method exhibits 0.54 of CCI Value, AAM approach shows 0.57 of CCI Value, DDSM technique exhibits 0.59 of CCI Value, NARM method shows 0.68 of CCI Value, proposed HADAA exhibits greater CCI Value (0.87), and results are visualized in figure 7. Adequacy Value Hybrid Anthropometric Dietary Assessment Approach (HADAA) is evaluated and results of HADAA compared with NARM, DDSM, AAM, and DRM Approaches. From the results we observed that DRM method exhibits 79.9% of adequacy Value, AAM approach shows 92.6% of adequacy Value, DDSM technique exhibits 96.3 of adequacy Value, NARM method shows 89.5% of adequacy Value, proposed HADAA exhibits greater adequacy Value (99.9%), and results are visualized in figure 8.

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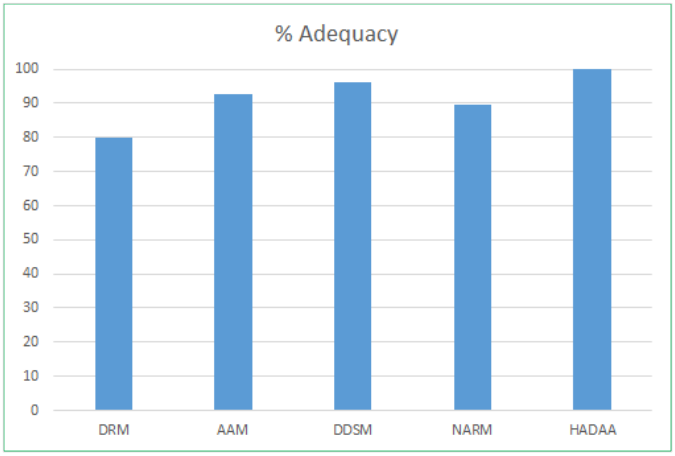

Fig. 8. Adequacy values of different Models

RDA Value Hybrid Anthropometric Dietary Assessment Approach (HADAA) is evaluated and results of HADAA compared with NARM, DDSM, AAM, and DRM Approaches. From the results we observed that DRM method exhibits 78.7% of RDA Value, AAM approach shows 83.6% of RDA Value, DDSM technique exhibits 88.4% of RDA Value, NARM method shows 90.5% of RDA Value, proposed HADAA exhibits greater RDA Value (99.2%), and results are visualized in figure 9.

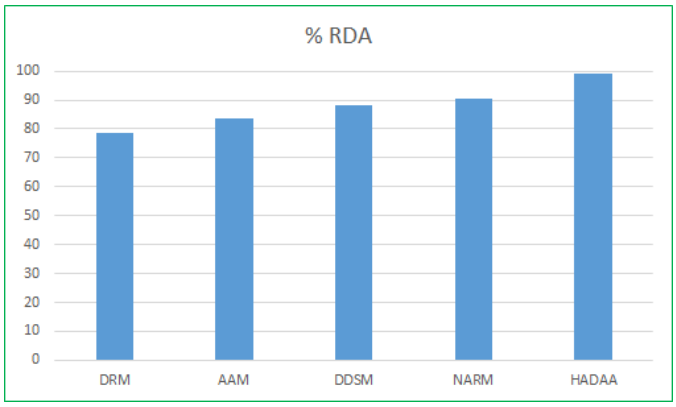

Fig. 9. RDA values of different Models

Performance proposed Hybrid Anthropometric Dietary Assessment Approach (HADAA) is evaluated and results of HADAA compared with NARM, DDSM, AAM, and DRM Approaches. From the results we observed that field of applicability of HADAA is high, resource efficiency of HADAA is also high, mean energy intake of HADAA is 2124 ± 284 value, and intake in terms of grams per day is 55.6 ± 7.4 value.

Method	Field Applicability	Resource Efficiency	Mean Energy Intake	Intake (g/day)
DRM	High	High	1897 ±119	40 ± 5.6
AAM	High	Moderate	1964 ± 312	46.2 ± 8.5
DDSM	Moderate	High	2041 ± 298	48.9 ± 7.9
NARM	Moderate	Moderate	1898 ± 327	50.1 ± 8.2
HADAA	High	High	2124 ± 284	55.6 ± 7.4

Table 1. Comparative analysis

5. CONCLUSIONS

In this research we determined nutrition values of adolescents with help of detailed assessment approach by combining living life style parameters, anthropometric features, and intake of dietary calculation method. Data samples are gathered by using circumference of upper arm, BMI value, score of dietary type, and frequency of dietary intake per day. Nutrition values are measured for gender specific adolescents, behavior in dietary intake, parameters related to growth, and result of nutritional values in adolescents. Performance proposed Hybrid Anthropometric Dietary Assessment Approach (HADAA) is evaluated and results of HADAA compared with NARM, DDSM, AAM, and DRM Approaches. From the results we observed that HADAA exhibits greater RDA Value (99.2%), shows high adequacy Value (99.9%), exhibits greater CCI Value (0.87), shows high Reliability Score (0.91), exhibits greater Detection Rate (91.2%), shows high Specificity (90.1%), exhibits greater Sensitivity (88.3%), shows high accuracy (89.6%), field of applicability of HADAA is high, resource efficiency of HADAA is also high, mean energy intake of HADAA is 2124 ± 284 value, and intake in terms of grams per day is 55.6 ± 7.4 value.

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