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Optimization Approach on Planning Balance Nutrient Intake for Secondary School Students Aged 16 to 18

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Abstract

This study presents optimization approach to plan a balanced nutrient intake for Malaysian secondary school students aged sixteen to eighteen. The aim of this study is to minimize cost of daily food intakes and to provide a practical tool for schools and institutions responsible for planning menus for students. In this study, linear programming, integer programming, and binary programming are applied to solve the diet problem of Malaysian students aged 16 to 18 using a mathematical model. The objective function of the meal planning model is to minimize the cost of food while meeting the recommended nutrient. The results revealed that the optimal solution achieved used integer programming shows a minimum cost of RM9.80 per day for a nutritious diet suitable for secondary students who are moderately active and RM 9.90 for students who are active in sports. Furthermore, the study contributes to the theoretical foundation by addressing the challenge of repetition in meal plans, emphasizing the importance of diverse food choices for promoting healthier eating practices among students.

1. Introduction

In recent years, there has been a growing concern about the dietary habits of adolescents and whether they are getting the right balance of nutrients [1]. A healthy diet is important for everyone, especially during adolescence, it is very important for healthier growth. This is because the body processes are developing during this age. To ensure that they meet their energy and nutritional needs, it is very important for adolescents to consume a healthy and balanced diet [2]. This issue is particularly pressing for secondary school students who are very active in sports and have higher nutritional needs due to their increased level of physical activity.

Malaysia is currently facing a growing concern about the inadequate nutrient intake of adolescents [3]. There is research that highlights the impact of physical activity on adolescents' energy requirements [4]. Insufficient nutrients not only affect physical health but also impact mood and emotional well-being [5]. The first objective of this study is to determine the daily nutrient requirement for secondary school students aged sixteen to eighteen. Next, second objective to identify the minimum cost of menu planning that meet nutritional requirement for secondary school students aged sixteen to eighteen using Linear Programming (LP) and Integer Programming (IP) while the third objective is to prepare a seven-day meal plan with variety types of food for secondary school students aged sixteen to eighteen using Delete-Reshuffle Algorithm and Binary Programming (BP).

There has been an increasing interest in utilizing optimization approaches to plan balanced nutrient intake in recent years. Diet problem, which is an optimization problem, is a mathematical method for choosing foods that meet nutritional needs has been widely used. According to an article review, one of the early research projects about diet problem has been done by Jerry Cornfield during the second world war in 1941 to 1945 for the soldiers

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with the objective to find a low-cost diet that could fulfill the nutritional requirements of soldiers [6]. The optimization approach has been widely used in preparing balanced nutritional menus [7].

A study has used the linear programming method in optimizing diets simultaneously for nutrient content, affordability, cultural acceptability, and sustainability [8]. The goal is to minimize the overall relative deviation from the baseline diet through the objective function. There is another study used integer programming to determine the optimal meals that maximize nutritional content while adhering to the Recommended Dietary Allowances (RDA) set by the Indian Council of Medical Research [9]. The data was analysed by using LPSolve programming software.

Other than that, there is a study that used integer programming to address the diet optimization problem for McDonald's menu that would meet the daily calorie while minimizing costs. The problem was solved by linear integer programming model, with the overall cost of the proposed set menu as the objective function and solved by using MS Excel Solver [10]. Diet problem is also used in the healthcare industry such as a study conducted on diabetic patients using the integer programming method. The study found that the possible menu repetition and determined that the most suitable menu combination for a diabetic patient and the optimized solution for the two-day menu plan effectively met the nutritional requirements for individuals with diabetes [11].

In this study, LP, IP, and BP have been applied to illustrate the menu planning model for secondary school students aged sixteen to eighteen. Case 1 was focused on boys' students who are moderately active in school while case 2 focused on boys' students who are very active and need different levels of nutrient intake. Hence, this approach can also help minimize the cost of the daily budget, ensuring that it is utilized as efficiently as possible. The meal plans can also help to establish healthy eating habits that can be carried through into adulthood.

2. Materials and Methods

The aim of the study is to develop a menu planning model aimed at minimizing the cost while maximizing the diversity of food options. There are six daily meals, including breakfast, morning tea, lunch, evening tea, dinner, and supper. The optimization methods were utilized to create a healthy diet menu plan for secondary school students aged 16 to 18, with the LP and IP chosen as the technique to formulate the mathematical model for this study. Next, the use of Delete-Reshuffle Algorithm as well as BP will create a seven-day meal plan with a variety of types of food.

2.1 Data Description

The data for this study are obtained from Recommended Nutrient Intake (RNI) 2017 National Coordinating Committee on Food and Nutrition (NCCFN) Ministry of Health Malaysia (2017), and Nutrient Composition of Malaysia Food book database. RNI 2017 provides recommended dietary intake guidelines for different age groups and populations in Malaysia [12]. It comprises the upper and lower bound values of each nutrient needed by adolescents aged between 16 and 18 years old. Next, Nutrient Composition of Malaysia Food book details the nutrient content of commonly consumed Malaysian foods [13]. Malaysian Food Composition Database (MyFCD), website that offers updated data from the Nutrient Composition book and Price Catcher Malaysia from Kementerian Perdagangan Dalam Negeri & Hal Ehwal Pengguna the application provides updated food price data in Malaysia [14].

2.2 Mathematical Modelling

This study utilizes mathematical optimization to create cost-effective meal plans that satisfy both nutritional needs and budget limitations by LP and IP. The study dataset comprises 404 variables with variety of foods, categorized into groups like beverages, cereals, meat dishes, vegetables, and fruits. Table 1 shows the food requirement per day that consists of types of food group with the available range from the dataset of food.

Table 1 Food requirement per day

Types of food	No. of requirement per day
Beverage (x_1-x_{37})	6 * including 2 plain waters
Cereal Flour Based (x_{38}-x_{85})	1
Rice Flour Based (x_{86}-x_{113})	1
Cereal Based Meal (x_{114}-x_{126})	2 * including 1 cooked rice
Meat Dishes (x_{127}-x_{158})	1
Vegetable (x_{159}-x_{212})	2
Fruits (x_{213}-x_{261})	2
Wheat Flour Based (x_{262}-x_{286})	1
Seafood (x_{287}-x_{316})	1
Miscellaneous (x_{317}-x_{404})	1

Total dishes per day	18

There are 18 food that served per day. LP and IP are used to find a menu for a day. Next, the BP is used to prepare a seven-day meal plan. The use of BP is to avoid the repetition of the various food in a day. 11 nutrients are considered, including energy, carbohydrates, protein, fat, vitamin A, vitamin B1, vitamin B2, vitamin B3, iron, and calcium. Table 2 shows the upper and lower daily intake bounds for these nutrients. Each nutrient has specific upper and lower bounds, except for protein, vitamin B1, and vitamin B2, which only have a lower bound.

Table 2 Lower bound (LB) and upper bound (UB) of Nutrients in Case 1 and Case 2

Nutrients	Case 1 (Moderately Active)		Case 2 (Very Active)	
	LB	UB	LB	UB
Energy (*kcal*)	2340	2840	2640	2930
Fat (*g*)	53	91	85	120
Carbohydrate (*g*)	180	330	200	520
Protein (*g*)	51	-	52.8	-
Calcium (*mg*)	1300	3000	1300	3000
Vitamin A (μg)	600	2800	600	2800
Vitamin B1 (*mg*)	1.2	-	1.2	-
Vitamin B2 (*mg*)	1.3	-	1.3	-
Vitamin C (*mg*)	65	1800	65	1800
Niacin (*mg*)	16	30	16	30
Iron (*mg*)	15	45	15	45

The study focuses on nutrient needs for sixteen to eighteen-year-old school students based on the RNI 2017. It includes two case studies for menu planning, with the first case involves moderately active secondary school students, while the second focuses on very active students engaged in sports where both studies are boys' students. The nutrient bound for both cases have been consulted and verified with a dietitian.

2.3 Objective Function

The objective function is to minimize the daily food cost [15]:

$$Minimize\ the\ cost\ function = \sum_{i=1}^{404} c_i x_i \tag{1}$$

where c_i refer to cost for each food items *i*, and x_i refer to food items. There are 404 types of food that are from 10 of the food group.

2.4 Constraints

The nutrient daily constraint is [15];

$$LB \le \sum_{i=1}^{404} w_i x_i \le UB \tag{2}$$

where LB refer to lower boundary and UB is upper boundary for daily recommended nutrients needed on secondary school students aged 16 to 18 while w_i is the weight of the food nutrient. Next, the daily constraint of food group is [12];

$$\sum_{i=1}^{404} Type\ of\ foods, x_i = n \tag{3}$$

where *n* refers to the number of food requirements per day based on the food group on Table 1 to provide 18 total dishes per day. Then, the combination of food with six different meals will appear with the decision variable written as below for LP [15]:

$$0 \le x_i \le 2 \tag{4}$$

The outcome for the LP model is used for the pilot study to ensure the validity of the result. For the decision variable for IP model is written as below [15]:

$$x_i = \begin{cases} 1\ or\ 2, & \text{if menu } i \text{ appear in the menu list} \\ 0, & \text{otherwise} \end{cases} \quad (5)$$

For LP method, the decision variables are in range 0 and 2 and for IP method, the decision variables are being serve once or twice, otherwise it will be zero. LP models are being used for pilot studies to validate the model's constraints and objective function. However, the outcome may not be directly applicable to real-world scenarios due to the possibility of fractional servings. IP models are more suitable for scenarios where the diet plan needs to be implemented for meal planning.

For the BP method, all variables are in binary values, except plain water, allowing each menu item to be served once a day to avoid repetition, as plain water is not treated as a binary decision and is served twice daily. The LPSolve IDE is used to solve the developed model and produce optimal results.

3. Results and Discussion

By applying the LP and IP model for the dataset, Table 3 and 4 shows the results of meals for a day for case 1 and case 2 respectively. The meal comprises six beverages, one cereal flour-based, one rice flour-based, two cereal meal-based, one meat item, one seafood item, two vegetables, two fruits, one wheat flour-based, and one miscellaneous item.

Both programming approaches have fulfilled the range of requirements nutrients that have been suggested. LP model expressed in decimal values that cannot be practically served while IP is more practical for meal plan because it provides food quantities in whole units that can be served.

Table 3 *Linear and Integer Programming Method for Case 1 (Moderately Active)*

Meal	Linear Programming	Integer Programming
Breakfast	Tea (1) Biscuit, coconut (1)	Milo (1) Biscuit, coconut (1)
Morning Tea	Milo (0.760) Kuih kasui (1)	Tea (1) Kuih peneram (1)
Lunch	Plain water (1) Rice, cooked (1) Celery (1.712) Banana, common varieties (1) Quail egg, whole (1)	Plain water (1) Rice, cooked (1) Celery (1) Date, dried (1) Fish curry (1)
Evening Tea	Tea (1) Cake, swiss role (0.534) Curry puff twisted (0.989)	Tea (1) Kesari (1)
Dinner	Syrup rose (1.239) Rice, fried (1) Mengkudu (0.288) Banana, common varieties (1) Fish curry (1)	Syrup rose (1) Rice, fried (1) Mengkudu (1) Water Apple (1) Quail egg, whole (1)
Supper	Plain water (1) Kuih Bangkit only (1)	Plain water (1) Kuih Bangkit only (1)
Total Food Cost	RM 9.70	RM 9.80

Based on the Table 3, the price cost for both method is slightly different because of the difference in the portion produced by the two methods. The value in bracket shows about the amount serve for each food.

Table 4 Linear and Integer Programming Method for Case 2 (Very Active)

Meal	Linear Programming	Integer Programming
Breakfast	Milo (0.919) Biscuit, coconut (1)	Milo (1) Biscuit, coconut (1)
Morning Tea	Plain water Kuih kasui (0.896)	Tea (1) Kuih kasui (1)
Lunch	Syrup rose (1.081) Rice, cooked (1) Mengkudu (0.918) Date, dried (1) Fish curry (1)	Syrup rose (1) Rice, cooked (1) Celery (1) Date, dried (1) Fish curry (1)

Evening Tea	Tea (1) Kesari (1)	Tea (1) Yau-car-kue (1)
Dinner	Plain water (1) Rice, fried (1) Celery (1.184) Date, dried Quail egg, whole (1)	Plain water (1) Rice, briyani (rice only) (1) Mengkudu (1) Date, dried (1) Quail egg, whole (1)
Supper	Tea (1) Kuih Bangkit only (1)	Plain water (1) Kuih Bangkit only (1)
Total Food Cost	RM 9.80	RM 9.90

Based on the comparison from Table 3 and 4, the price cost is almost the same, however, different meals have been suggested in the menu plan. However, IP are used considering LP is expressed in decimal values that cannot be served practically. The difference between both cases is due to the different level of bound on each case. The recommended food options are considered suitable for both cases, as indicated by the findings of a prior study on the benefits of the food [16][17][18][19].

Further analysis has been done by using BP along with Delete-Reshuffle Algorithm to prepare a seven-day meal plan. The seven-day meal plan for both cases is shown in Table 5 and Table 6. Based on both seven-day meal plans, there is no repetition of food in the daily menu, ensuring it stays varied.

Table 5 Menu Plan for Seven-day using BP for Case 1 (Moderately Active)

Meal	Breakfast	Morning Tea	Lunch	Evening Tea	Dinner	Supper	Price (RM)
Day 1	• Coffee mixture, powder • Biscuit, coconut	• Milo • Kuih kasui	• Plain water • Rice, cooked • Carrot • Banana, common varieties • Fish curry	• Tea • Cake, swiss role	• Syrup rose • Rice, fried • Mengkudu • Date, dried • Quail egg, whole	• Plain water • Kuih Bangkit only	10.00
Day 2	• Malted milk drink, packet • Oats, processed, tinned	• Plain water • Kuih lompang	• Plain water • Rice, cooked • Carrot • Banana • Sardine	• Coffee powder, instant • Cake, plain	• Sirap Bandung • Rice, "dagang" • Soya bean sprout • Water Apple • Hen egg, whole	• Milk, UHT, low-fat • Laddu	11.60
Day 3	• Milk, UHT, chocolate flavoured • Bread, white	• Coffee & Sugar • Kuih peneram	• Plain water • Rice, "oily" • Fern shoots • Nangka • Chicken frankfurter	• Milk, cow, fresh • Kesari	• Plain water • Rice, cooked • Pegaga gajah • Pineapple only • Indian mackerel, curry	• Milk, UHT, full cream, recombin • Mysore pak	13.50
Day 4	• Orange flavoured drink • Bread coconut	• Milk, UHT, chocolate flavoured • Kuih buah Melaka	• Sarsi • Rice, cooked • Mung bean •Banana • Chicken curry	• Plain water • Yau-car-kue	• Plain water • Rice, chicken • Mustard leaves, chinese • Banana • Anchovy, dried, fried in chilli	• Milk powder, skim • Putu kacang	13.90
Day 5	• Milk, sterilised • Biscuit soda/plain	• Milk based diet supplement, powder • Kuih koci pulut hitam	• Plain water • Rice, briyani (rice only) • Kesom •Kismis • Chicken Satay	• tea&milk • Kuih kapit	• Plain water • Rice, cooked • Tapioca shoots • Binjai • Shrimp, small, cooked in chilli	• Yogurt Strawbery •Seaweed, agar	15.70

Day 6	• Yoghurt oren • Cookies, peanut	• Malted milk powder • Kuih lapis	• Plain water • Rice, cooked • Cekur manis • Guava • Catfish eel, fried	• Soya bean milk, unsweete ned • Kuih keria	• Plain water • Rice porridge, fish, instant • Yam stalks • Cempedak • Beef_Satay	• Yogurt banana • Baked bean, canned	17.40
Day 7	• Soya bean milk, packet • Bread, wholemeal	• Plain water • Tapai pulut	•Lengkong • Rice, cooked • Spinach • Pineapple • Chicken, fried	•Plain water •Cake swiss roll chocolate flavour	• Sugar cane juice • Rice, coconut • Papaya shoots • Rambutan • Crab, blue, boil	• Yoghurt, apricot flavour • Pizza with chicken	21.10

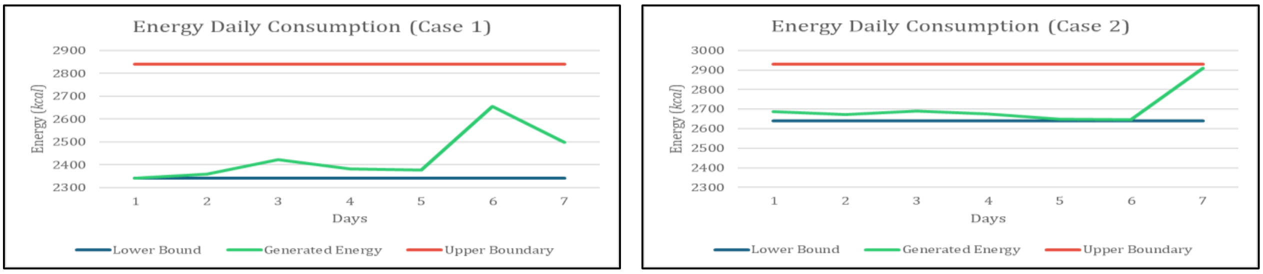
Table 6 Menu Plan for Seven-day using BP for Case 2 (Very Active)

Meal	Breakfast	Morning Tea	Lunch	Evening Tea	Dinner	Supper	Price (RM)
Day 1	• Milo • Biscuit, coconut	•Plain water •Kuih kasui	•Sarsi •Rice, cooked •Celery •Date, dried • Fish curry	•Tea •Kesari	•Sirap rose •Rice, fried •Mengkudu •Water Apple •Quail egg, whole	•Plain water •Laddu	10.80
Day 2	• Milk, UHT, full cream, recombin •Biscuit, finger cream	•Plain water •Kuih lompang	•Sirap bandung •Rice, cooked • Kesom • Banana, common varieties •Sardine	•Coffee& sugar •Curry puff twisted	•Plain water •Rice, "dagang" •Soyabean sprot •Buah pala • Beef frankfurter	• Milk, UHT, low-fat •Kuih Bangkit only	11.70
Day 3	•Milk, UHT, chocolate flavoured • Oats, processed, tinned	• Coffee mixture, powder • Kuih lopes pulut	•Plain water •Rice, cooked •Fern shoots •Nangka • Anchovy, dried, fried in chilli	•Malted milk , packet, instant • Yau-car-kue	•Plain water •Rice, "oily" •Carrot •Banana (pisang nangka) •Chicken frankfurter	• Yogurt strwberi • Putu kacang	13.40
Day 4	• Yogurt Banana • Bread coconut	• Coffee powder, instant •Kuih lapis	•Plain water •Rice, cooked •Mung bean •Pineapple • Threadfin bream, fried in chilli	•Milk, cow, fresh •Kuih kapit	•Plain water •Rice, chicken •Garlic, plant • Banana (pisang Brangan) • Hen egg, whole	•Yogurt Oren •Mysore pak	14.90
Day 5	•Milk powder, skim • Bread, white	• Orange flavoured drink, powder •Kuih koci pulut hitam	•Plain water • Rice, briyani •Yam stalks • Banana (pisang mas) • Chicken curry, canned	•Soya bean milk, unsweetene d •Kuih ketayap	•Plain water •Rice, cooked •Pegaga gajah •Binjai • Spanish mackerel, fried in chilli	•Yogurt apricot flavour • Cucur badak	15.60
Day 6	•Milk based diet supplemnt, powder • Egg Banjo	•Soya bean milk, packet •Kuih koci pulut putih	•Plain water •Rice, cooked • Spinach •Cempedak • Indian mackerel, fried chilli	• tea& milk •Doghnut	•Plain water •Rice,coconut milk •Mustard leaves, chinese •Kismis • Duck egg	• Milk, sterilisd • Baked bean, canned	18.10

Day 7	• Milk, instant, full cream • kuih-teow, bandung style	•Plain water •Tapai pulut	•Sugar cane juice • Rice, cooked •Spinach •Durian belanda •Chicken, fried	•Coconut water • Cucur udang	•Plain water • Rice porridge, fish, instant • Peas salted, fried • Buah zaitun •Crab, blue, boil	•Malted milk powder •Pizza with chicken	25.40

The cost for the second day's menu and the day after is higher than the day before due to the removal of the most cost-effective options from the day before. The developed menu plan has met the daily recommended nutrient intake for secondary school students aged sixteen to eighteen. The findings of a previous study article on the benefits of each food indicate that the suggested food options are appropriate for both cases [20][21][22].

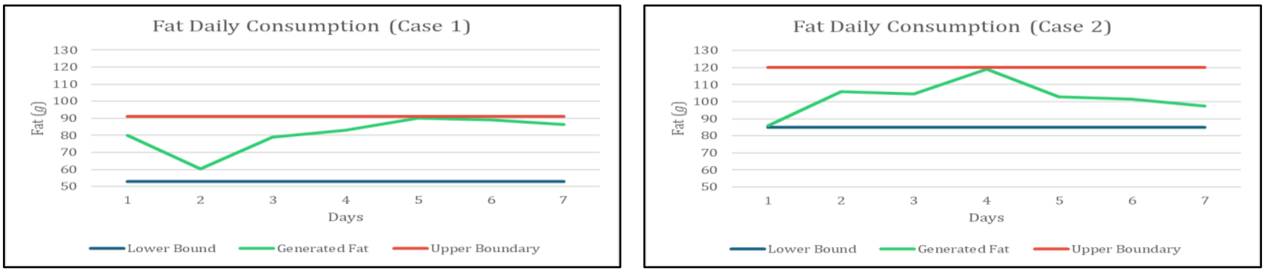
The analysis also shows that all the generates food nutrients are within the upper and lower bound of the nutrients needed as shown from Fig. 1 until Fig. 11. The nutrient consumption is varied among moderate students and the student who are actively involve in sports. It is important for student-athletes to ensure that they have adequate nutrients to avoid undesirable outcomes due to insufficient nutrient intake.



(a) **(b)**

Fig. 1 Energy daily intake within a week (a) Case 1; (b) Case 2

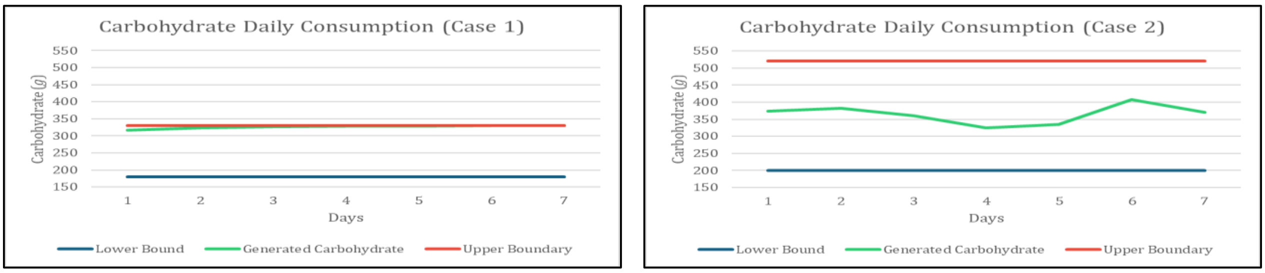
Based on the Fig. 1, it shows that the generated energy consumption everyday fulfils the benchmark which case 1 is between 2340 to 2840 *kcal* while case 2 is between 2640 to 2930 *kcal*.



(a) **(b)**

Fig. 2 Fat daily intake within a week (a) Case 1; (b) Case 2

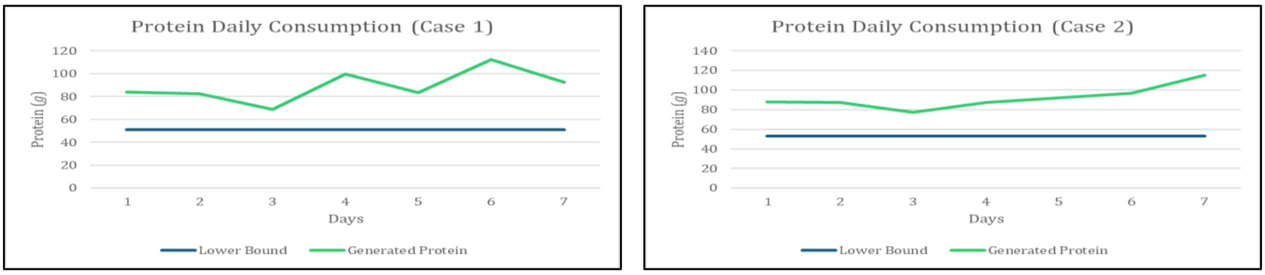
Fig. 2 shows that all the generated fat intakes are between upper and lower boundaries.



(a) **(b)**

Fig. 3 Carbohydrate daily intake within a week (a) Case 1 (b) Case 2

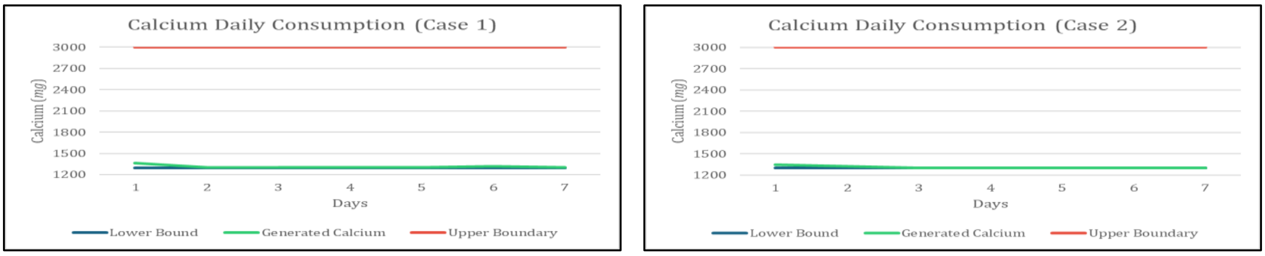
Fig. 3 shows that the carbohydrate intake level for a week and it fulfilled the constraints as it lies between lower and upper boundaries. Carbohydrates are a primary energy source for adolescents, providing fuel for physical activities and cognitive function.



(a) **(b)**

Fig. 4 Protein daily intake within a week (a) Case 1; (b) Case 2

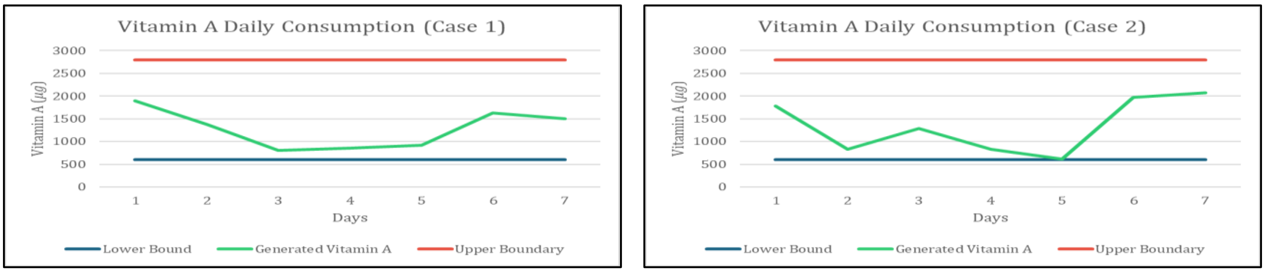
Fig. 4 shows that all the generated protein intakes fulfilled the constraints which are above 51 for case 1 and above 52.8 for case 2.



(a) **(b)**

Fig. 5 Calcium daily intake within a week (a) Case 1; (b) Case 2

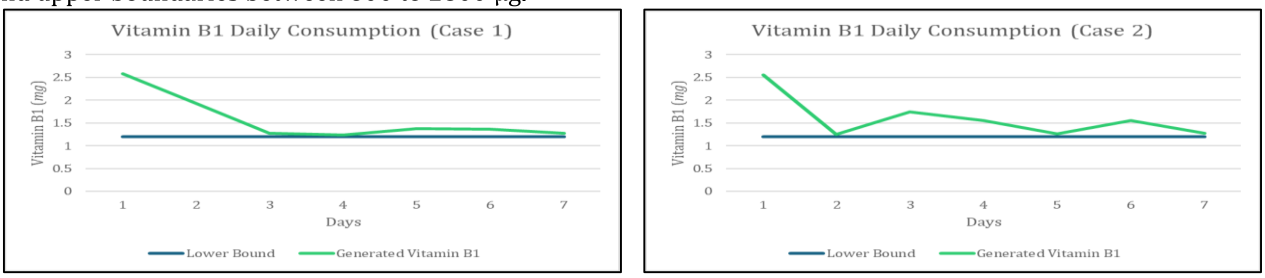
Fig. 5 shows that the calcium intake level for a week and it fulfilled the constraints as it lies between lower and upper boundaries between 1300 to 3000 mg.



(a) **(b)**

Fig. 6 Vitamin A daily intake within a week (a) Case 1; (b) Case 2

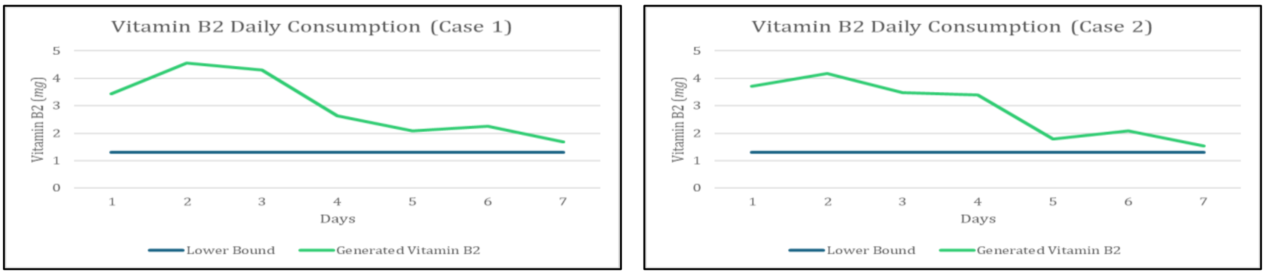
Fig. 6 shows that the vitamin A intake level for a week and it fulfilled the constraints as it lies between lower and upper boundaries between 600 to 2800 μg.



(a) **(b)**

Fig. 7 Vitamin B1 daily intake within a week (a) Case 1; (b) Case 2

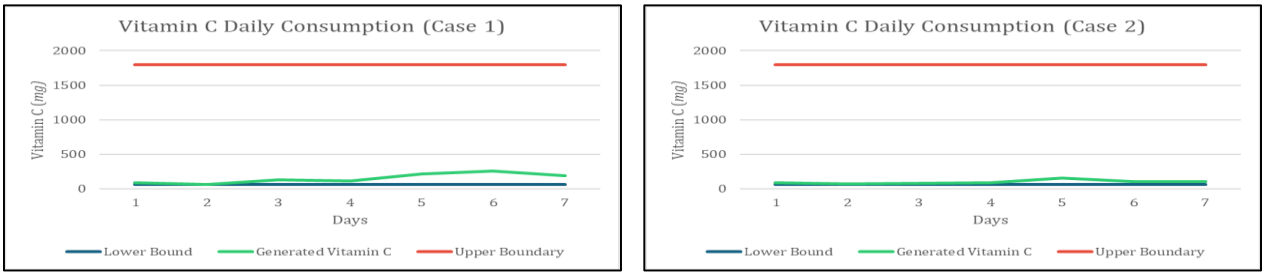
Based on the Fig. 7, it shows that the generated vitamin B1 consumption everyday fulfils the benchmark as it lies above the lower bound of the nutrients needed which is 1.2 mg.



(a) **(b)**

Fig. 8 Vitamin B2 daily intake within a week (a) Case 1; (b) Case 2

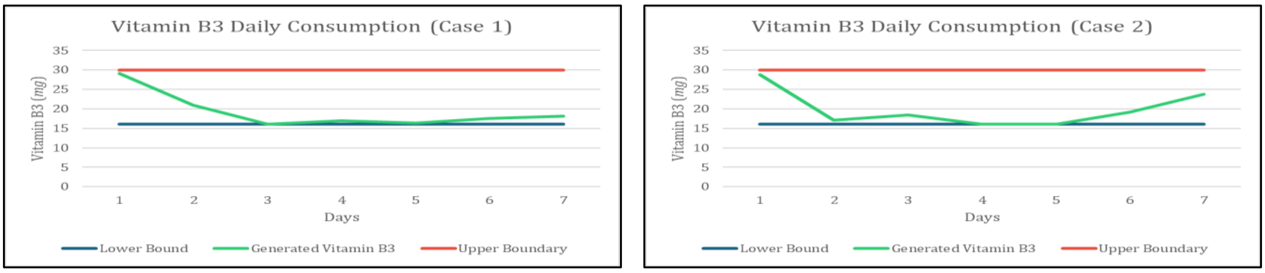
Fig. 8 shows that all the generated vitamin B2 intakes fulfilled the constraints as it lies above the lower bound of the nutrients needed which is 1.3 mg.



(a) **(b)**

Fig. 9 Vitamin C daily intake within a week (a) Case 1; (b) Case 2

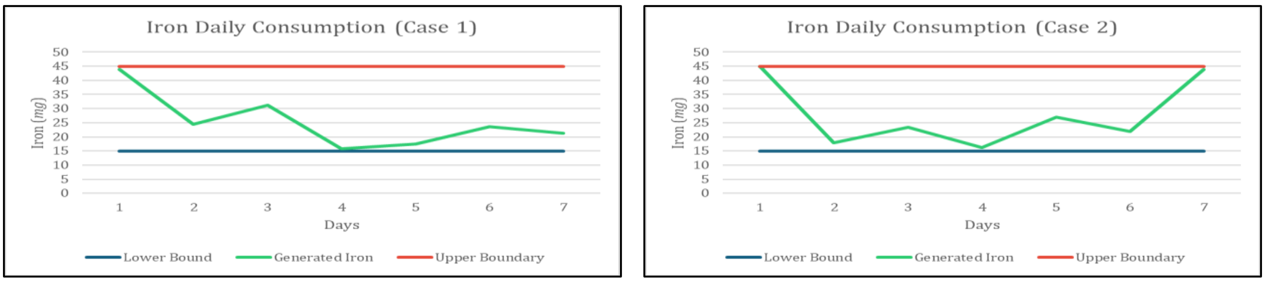
Fig. 9 shows that the vitamin C intake level for a week and it fulfilled the constraints as it lies between lower and upper boundaries between 65 to 1800 mg.



(a) **(b)**

Fig. 10 Vitamin B3 daily intake within a week (a) Case 1; (b) Case 2

Based on the Fig. 10, it shows that the generated vitamin B3 consumption everyday fulfils the benchmark as it lies within the upper and lower bound of the nutrients needed which is between 16 mg to 30 mg. According to RNI 2017, vitamin B3 can be beneficial to avoid fatigue, lost appetite, headache, and diarrhoea.



(a) **(b)**

Fig. 11 Iron daily intake within a week (a) Case 1; (b) Case 2

Fig. 11 shows that the iron intake level for a week and it fulfilled the constraints as it lies between lower and upper boundaries from 15 mg to 45 mg.

In this diet problem of secondary school students aged sixteen to eighteen, the application of linear programming, integer programming and binary programming have been discussed. The programming approaches have determined the optimal solution that meets the requirements nutrients and minimize the cost. The seven-day meal plan suggested by using binary programming method is well-suited for consumption by secondary school students aged sixteen to eighteen as well as the students who are very active in sports.

4. Conclusion

This study successfully determined daily nutrient requirements for secondary school students aged 16 to 18 using RNI 2017 data, validated by a dietitian. Mathematical modeling minimized menu planning costs through linear and integer programming, ensuring practical food quantities. The developed model achieved the objective of consuming a well-balanced diet at minimal cost. The optimization approach, including the Delete-Reshuffle algorithm, produced a diverse seven-day meal plan, enhancing student satisfaction and fostering healthier eating practices by avoiding food repetition.

This study makes a significant contribution to nutritional science and mathematical modeling theory on diet problem for balanced nutrient intake in secondary school students. The developed mathematical model, including LP and IP, and the Delete-Reshuffle algorithm, provides a theoretical framework for creating cost-effective and diverse meal plans. The integration of BP enhances understanding, addressing the challenge of repetition in meal plans and promoting healthier eating practices among students. This research has practical implications in nutrition planning, offering a valuable tool for schools and institutions, ultimately contributing to broader initiatives promoting the nutritional well-being of adolescents.

While successfully meeting its objectives, this study acknowledges limitations. Findings may lack generalizability beyond the studied age group and activity levels. The assumption of uniform tastes and nutritional needs overlooks individual variations. Economic uncertainties and government policies may impact food prices, affecting the proposed optimization approach's feasibility. Future research could involve sports nutritionists for comprehensive athlete-specific nutrient recommendations and consider incorporating individualized dietary preferences, ensuring continual monitoring of food prices for real-world applicability.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: ***study conception and design:*** *Mohamad Azam Mohd Nazri, Suliadi Firdaus Sufahani;* ***data collection:*** *Mohamad Azam Mohd Nazri, Suliadi Firdaus Sufahani;* ***analysis and interpretation of results:*** *Mohamad Azam Mohd Nazri, Suliadi Firdaus Sufahani;* ***draft manuscript preparation:*** *Mohamad Azam Mohd Nazri, Suliadi Firdaus Sufahani. All authors reviewed the results and approved the final version of the manuscript.*

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