SHORT ARTICLE

Assessment of relationship between Hemoglobin and BMI levels in female college students and influence of diet and physical activity on these parameters

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Citation

Article Cycle

Abstract

Anaemia and nutritional status through Body Mass Index (BMI) are two key indicators in National Family Health Survey of India. The objective of the study is to determine the correlation between Hemoglobin (Hb) and BMI values and to understand the effect of diet and physical activity on these two parameters amongst college girl students. A questionnaire covering food habits and physical activity of 200 female students (18-22 years age) was used for data analysis along with Hb and BMI values of the same subjects. No significant association was found between Hb and BMI values, but a significant association was found between physical activity and BMI. Diet consumption which included leafy and other vegetarian diet, eggs and meat has shown significant contribution for high Hb levels. The present study strongly provides evidence based conclusion for the relationship between diet, nutrition and Hb levels as well physical activity and BMI. A multiple regression model was developed to estimate Hb levels based on their food habits.

Keywords

College Girls; Anaemia; BMI; Chi-Square Test; Multiple Regression

Introduction

Nutritional anaemia due to iron deficiency is the result of increased iron demand during phases of growth, decreased dietary iron intake and low/inadequate absorption of iron and high demands during reproductive age and pregnancy (1). According to the latest available data considering nationwide, the percentage of anaemia in women of reproductive age (15-49 years) was 53.1% (2), much higher compared to worldwide of same age (32.5%)(3). Studies indicate that anaemic people are more prone to respiratory infections and recent studies are even indicating that anaemia seems to be associated with increased risk of severe COVID-19 infection and the state of anaemia shall be regarded as an important factor in future risk stratification models for COVID-19 (4). Rate of overweight and obesity is growing continuously in India amongst adults and children. Women who are under reproductive age and overweight or obese (BMI ≥ 25.0 kg/m2) are 20.6% in 2015-16 (latest available data nation-wide) in comparison to 12.6% in 2005-06, indicates an alarming state (2). Raised BMI is a major risk factor for non-communicable diseases such as cardiovascular diseases, diabetes, musculoskeletal disorders and some cancers (5).

Aim & Objectives

1. To understand the association between Anaemia (Hb levels) and BMI values in the tested population.
2. To test the association between physical activity and BMI.

3. To Test the effect of diet on Hb levels and types of food which affect Hb levels.
4. To construct multiple regression model to predict Hb levels, based on food habits of college girls.

Material & Methods

Study Plan: Filled questionnaires, which were collected from 200 girl students of age between 18-22 years of a particular college were used for the present study. The data of participants covering their food consumption, physical activity along with their Hb and BMI values was used for present study. Consent from each participant to use data for further research analysis was taken into consideration.

Statistical methods used: Chi-square test for independent of two attributes and multiple regression analysis using python.

Results

The collected data was analysed by various statistical methods and the results were presented for the above mentioned objectives. From the data, it was found that anaemia (Hb values) and BMI values were independent to each other [Table.1] and in turn signifies no relationship between Hb and BMI values. On the other hand, physical activity and BMI are dependent to each other with significant p value of 0.0317 [Table.1]. Though majority of girl students have stated that they are carrying out exercise on regular basis ranging from 15 minutes to one hour, the percentage of girl students who were falling under overweight and obese category is slightly higher (27.5%) than average overweight or obese percentage of Indian population under similar group (20.6%)(BMI ≥ 25.0 kg/m2), indicating an alarming state. Though recent data was released from NFHS-5 (2019-20), only state-wise data is available but not overall Indian scenario (6), therefore the NFHS-4 data was used for the study.

Using multiple regression method it was used and found leafy and other vegetarian diet, eggs and meat have more significant effect on hemoglobin levels whereas fruits did not show much effect [Table.2].

A multiple regression model is suggested to predict the levels of Hb based on food consumption.

Hemoglobin (Hb) levels = 11.2001 + 0.6608 x Eggs + 0.0799 x Fruits - 0.4847 x Meat+ 0.8644 x Veg-Diet

The mean absolute percentage error= 9.701149 which is < 10, hence, can be concluded that the suggested model is highly accurate for forecasting Hb levels.

Discussion

The present study shows no significant association exists between Hb and BMI levels and a similar study was reported amongst male and female medical students (7). On the other hand, a strong relationship was observed between BMI and Hb levels in other adolescent populations (8, 9). Statistical testing of the association between Physical activity and BMI has clearly indicated a strong positive correlation in our study and it was shown that changes in activity levels of at ages 18 - 19 years significantly affected changes in BMI and adiposity (10). In general, a higher proportion of vegetarians, compared to non-vegetarians, had iron deficiency anemia (11). But on the other hand, studies also shows that there is no difference in iron intake and anemia prevalence between vegetarians and non-vegetarians (12). The results of the present study clearly indicated that non-vegetarian group has maintained non-anemic state better compared to vegetarian group (data not shown).

Conclusion

Hb and BMI values are independent to each other, diet and physical activity influences these two parameters respectively. By using the proposed multiple regression model to calculate Hb levels, one can educate the student population to opt for better food sources to maintain adequate levels of Hb and prevent possible occurrence of anemia. Regular exercise with balanced diet is essential for maintenance of healthy weight and to escape from obesity associated diseased conditions.

Recommendation

Coordinated efforts like institutional health awareness programs and government initiatives are necessary to bring awareness on importance of diet, nutrition and physical activity amongst young generation, especially girls to prepare them for future maternal and professional responsibilities. Frequent screening for the prevalence of anaemia and obesity should be done among the target group. The students should be motivated and educated to take balanced diet rich in green leafy vegetables and fruits combined with regular physical activity.

Limitation of the study

Sample size is limited to one particular college under study and to urban population. More number of student participants amongst urban as well rural population strengthens the study on broader perspective and provides large data for government to plan for future programmes.

Relevance of the study

Bringing awareness about anaemia, Hb levels and BMI is necessary for maintenance of one's good health, especially of young girls, due to their menstrual cycles and consumption of junk food with peer group. The present study focused on these points and showed evidence based results about effect of diet and physical activity on the above said parameters.

Authors Contribution

SPA: Played key contribution for data acquisition, manuscript preparation, RD: Data acquisition and segregation, CBN: Statistical analysis.

Acknowledgement

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Tables

TABLE 1 ASSOCIATION BETWEEN ANAEMIA (HB IN G/DL) AND BMI VALUES & PHYSICAL ACTIVITY AND BMI AMONGST COLLEGE GIRL STUDENTS.

Levels of Anemia	BMI-levels				
(Hb in g/dL)	Under Weight	Normal Weight	Over Weight	Obese	Total
Severe (< 8)	0	3	0	0	3
Moderate (8-10.9)	6	23	7	1	37
Mild (11-11.9)	5	25	4	7	41
Non-anemia (>12)	23	60	24	12	119
Total	34	111	35	20	200
Association between Hb and BMI values.	p- value= **0.3206476**		p value>0.05,Independent(H0 holds true)		
Physical activity	Body BMI - levels				
	Under Weight	Normal Weight	Over Weight	Obese	Total
Daily 15 min Exercise	2	4	0	0	6
Daily 30 min Exercise	16	74	17	9	116
Daily 45 min Exercise	0	0	1	1	2
Daily 60 min Exercise	10	25	16	7	58
No Exercise	6	8	1	3	18
Grand Total	34	111	35	20	200
	p- value = **0.031717**		< 0.05, Reject H0, Dependent (reject H0)		

TABLE 2 EFFECT OF LEAFY AND OTHER VEGETARIAN DIET, EGGS, MEAT AND FRUITS ON HB LEVELS

Dependent Variable: Hemoglobin (Hb); level Method: Least Squares; Date: 10/30/20; Time: 10:58				
Sample (adjusted): 1 200; Included observations: 200 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	11.2002	0.21832	51.3017	0
Eggs	0.66088	0.2697	2.4504	**0.0152**
Fruits	0.07994	0.32475	0.24618	0.8058
Meat&fish	-0.4847	0.25109	-1.9306	**0.055**
Leafy and other vegetarian diet	0.86448	0.2378	3.63537	**0.0004**
R-squared	0.1514	Mean dependent var		12.058
Adjusted R-squared	0.134	S.D. dependent var		1.50107
S.E. of regression	1.39688	Akaike info criterion		3.53105
Sum squared resid	380.5	Schwarz criterion		3.61351
Log likelihood	-348.1	Hannan-Quinn criter.		3.56442
F-statistic	8.6977	Durbin-Watson stat		1.96588
Prob (F-statistic)	**0.000002**			