

Role Of Dietary Macro-Nutrients And Micro-Nutrients In Scholastic Achievement Of Adolescents

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ABSTRACT

Background: - Diet and nutrition is the foremost pivotal component during childhood and adolescence stage, as deficiency of which may cause rudimentary physiological, motor, and cognitive development. Hence, a balanced diet (which comprised of all vital nutrients and minerals) is of prime importance during growth years so as to achieve optimum degree of cognitive and scholastic performance.

Objective:-The prime rationale of the present study is to analyze the inter-relationship between different dietary Macro-nutrients (Energy, Carbohydrate, protein, and Fats) and Micro-nutrients (Calcium, Phosphorus, and Iron) with Scholastic Achievement of adolescents.

Method: A sample of 164 Government school students from Class 11th and 12th has been selected from Delhi, India using random sampling procedure. Correlational research design has been used for this study.

Result: The obtained findings established that significant positive association occurs between dietary Macro-nutrients (Energy, Carbohydrate, protein, and Fats), Micro-nutrients (Calcium, Phosphorus, and Iron) and Scholastic achievement of students. Regression analysis also represented that dimension “Energy” of Macro-nutrient is act as notable predictor of Scholastic Achievement.

Conclusion: Dietary Macro-nutrients (Energy, Carbohydrate, protein, and Fats) and Micro-nutrients (Calcium, Phosphorus, and Iron) play significant role for the acquiring higher Scholastic performance among adolescents.

Keywords: *Macro-nutrients, Micro-nutrients, Scholastic achievement, Adolescence, Diet*

INTRODUCTION

Education – a systematic procedure for acquiring knowledge, cognizance and competencies, which empower individual's effective decision making during critical circumstances. Education is considered as the foundation for effective growth and development of each and every society because it passes their culture, traditions, values, knowledge and skills to their upcoming generations. Education provides window of possibilities to the students in order to transpire different dimensions of personality and identify their true caliber. The prime objective of formal education system is to inculcate appropriate aptitude among students hence they become effective member of the society.

Scholastic achievement is encapsulated as the performance outcome, which denotes the excellence attained by students in specific domains of academics particularly in school setting. It is evaluated on the basis of scores obtained by students on a test after providing specific set of instruction. Cambridge University Reporter (2003) explained scholastic achievement in terms of examination performance. Scholastic achievement is a standard procedure which analyzes the degree of knowledge and learning attained by students after a specific interval of directives. In this era of high competition, proficiency and expertise of an individual are considered as the key criteria of progress hence, Scholastic achievement uphold prime importance in education system.

Food and Nutrition is considered as the primary requisite for appropriate growth and maturation of adolescents. Food - any substance or item which is nutrient-rich eaten up by living beings in order to sustain life, maintain growth and nurturance, and support other bodily metabolic activities. Food comprised of vital Macro-nutrients (Carbohydrate, Protein, fats) and Micro-nutrients (Vitamins, minerals) which play crucial role for carrying-out different physiological, psychological, and biochemical processes. Adequate diet and nutrition (a Balanced diet) is foremost essential during adolescence stage of life because at this juncture children undergo several physical, hormonal, psychological, and cognitive transformations. Appropriate handling of psychological and cognitive transformation is accountable for better Scholastic performance of students. Bellisle (2004) indicated that healthy and nutritive dietary regime play pivotal role for optimum mental and cognitive functioning of children. Kim et al., (2016) suggested that intake of healthy diet which includes fruits, vegetables, and milk is accountable for better scholastic performance of students. Consumption of food substances with higher nutritive values is associated with advanced cognitive functioning of children and adolescents (Kim & Kang, 2017), whereas, nutritional deficiency is responsible for delayed learning and poor attention span among adolescents which leads to substandard Scholastic achievement (Demirezen & Cosansu, 2005).

MACRONUTRIENTS AND SCHOLASTIC ACHIEVEMENT

Macronutrients such as Carbohydrate, Protein, and Fats act as vital sources of energy which are required in considerable amount by the body to carry-out daily pursuits. Grantham- McGregor & Baker-Henningham (2005) indicated that malnourishment during childhood phase bring indelible maleficent alteration in behavior, cognition and motor domains. Persistent protein-energy malnutrition (stunting) at childhood phase put detrimental impact on the development of higher order cognitive functions (Kar, Rao, & Chandramouli, 2008). Insufficiency of nutrition is associated with substandard memory quotient, mental control, and digit span of children (Agarwal, Agarwal, & Upadhyay, 1995) which induces poor scholastic achievement. Patel & Issac (2019) denoted that insufficiency of Protein-energy among children is liable for deficit in motor development. Research studies have summarized that unbalanced consumption of food which contains high fat and sugar is responsible for alteration of brain regions which are associated with learning, memory and reward (Boitard et al., 2016; Gainey et al., 2016). This indicates that balanced consumption of Macro-nutrients during adolescence phase of life, act as critical parameter for attainment of higher order scholastic performance.

MICRONUTRIENTS AND SCHOLASTIC ACHIEVEMENT

Micronutrients such as Vitamins and Minerals are those nutritive components of our food which are needed by our body in short quantum. The prime functions of micro-nutrients include, maintain immunity, bone health, growth, fluid balance, and other vital bio-chemical processes. Study by Olson & Mello (2010) explained that insufficiency of Vitamin A nutrient may have irreversible impact on brain and cognitive functioning. Study by Plevin & Galletly (2020), summarized that Vitamin C (also known as ascorbic acid) - a pivotal micronutrient, deficiency of which is associated with detrimental mood and cognitive deficits. Nassar et al., (2012), indicated that Vitamin D, an important micronutrient which is closely linked with regulation of bone health, inadequacy of which results in cognitive deficits and poor scholastic achievement among students.

Minerals like Iron, Calcium, Phosphorus, etc. are required by the body in miniscule quantity but they uphold significant importance for keeping proper composition of body fluids and tissues, healing, and appropriate growth and nurturance. Study by Li (2009), explained that students with Iron deficiency anemia have poor scholastic performance as compare to the students with no Iron deficiency anemia. Study by Patil et al., (2018) elaborated that inappropriate calcium level among adolescence school girls is associated with higher psychological impairment. This clearly demonstrates that intake of micro nutrients in diet play distinguished role in the attainment of scholastic achievement among adolescents.

Objectives

1. To analyze the relationship of Macro-nutrients (Energy, Carbohydrate, Proteins, and Fats) intake with scholastic achievement of adolescents.
2. To analyze the relationship of Micro-nutrients (Calcium, Phosphorous, and Iron) intake with scholastic achievement of adolescents.
3. To analyze the role of gender difference on Macro-nutrients, Micro-nutrients and Scholastic Achievement of adolescents.

METHOD

The present study has used correlational research design. The sample was comprised of 164 students of 11th and 12th) standard from Government schools of Delhi by using random sampling method. Out of the 171 respondents, 164 respondents had appropriately shared their responses, hence only 164 respondents have been considered for further analysis. Informed consent has been taken from all students before data collection. Tools used for collection of data are mentioned below:-

Food Frequency Questionnaire (FFQ) by (Telles, Bhardwaj, & Gupta; 2016): The questionnaire was established to evaluate the dietary input of inhabitants of northern part of India. The FFQ is easy to administer over a group of 5 – 10 respondents at a time.

Scholastic achievement was evaluated on the basis of marks/grades secured by students in the 10th Standard Board exams.

RESULTS

Out of 164 answerers, 85 answerers (51.8%) are male and 79 answerers (48.2%) are female. The descriptive statistics with regard to each Dimension is given in Table 1.

	N	Mean	Std. Deviation	Skewness	Kurtosis
	Statistic	Statistic	Statistic	Statistic	Statistic
Energy	164	2647.6101	666.78186	-.134	-.877
Protein	164	99.1609	33.89841	-.151	-.809
Fats	164	37.2341	15.34807	-.067	-.030

Carbohydrate	164	471.0549	129.17750	.027	-.831
Calcium	164	1033.8313	470.40869	.132	-.481
Phosphorus	164	2054.3065	611.05681	.102	-.483
Iron	164	34.8874	10.50228	.197	-.606
Scholastic achievement	164	71.117	13.5441	.008	-1.058
Valid N (listwise)	164				

The derived values of correlation presented in **Table 2** depict that there exists a significant positive association between Dietary Macro-nutrients (Energy, Protein, Fats, and Carbohydrate), Dietary Micro-nutrients (Calcium, Phosphorus, and Iron) and Scholastic Achievement of adolescents which is significant at 0.01 level. Findings also illustrated that significant inter-correlation exist between different dimensions of Macro and Micro nutrients.

Table 2:- Correlations

		Energy	Protein	Fats	Carbohydrate	Calcium	Phosphorus	Iron	Scholastic achievement
Energy	Pearson Correlation	1	.897**	.656**	.944**	.755**	.903**	.894**	.880**
	Sig. (2-tailed)		.000	.000	.000	.000	.000	.000	.000
	N	164	164	164	164	164	164	164	164
Protein	Pearson Correlation	.897**	1	.505**	.858**	.802**	.929**	.855**	.799**
	Sig. (2-tailed)	.000		.000	.000	.000	.000	.000	.000
	N	164	164	164	164	164	164	164	164
Fats	Pearson Correlation	.656**	.505**	1	.483**	.561**	.555**	.523**	.626**
	Sig. (2-tailed)	.000	.000		.000	.000	.000	.000	.000
	N	164	164	164	164	164	164	164	164
Carbohydrate	Pearson	.944**	.858**	.483**	1	.697**	.857**	.897**	.816**

e	Correlation			*					
	Sig. (2-tailed)	.000	.000	.000		.000	.000	.000	.000
	N	164	164	164	164	164	164	164	164
Calcium	Pearson Correlation	.755**	.802**	.561*	.697**	1	.802**	.761**	.701**
	Sig. (2-tailed)	.000	.000	.000	.000		.000	.000	.000
	N	164	164	164	164	164	164	164	164
Phosphorus	Pearson Correlation	.903**	.929**	.555*	.857**	.802**	1	.904**	.799**
	Sig. (2-tailed)	.000	.000	.000	.000	.000		.000	.000
	N	164	164	164	164	164	164	164	164
Iron	Pearson Correlation	.894**	.855**	.523*	.897**	.761**	.904**	1	.796**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000		.000
	N	164	164	164	164	164	164	164	164
Scholastic achievement	Pearson Correlation	.880**	.799**	.626*	.816**	.701**	.799**	.796**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	
	N	164	164	164	164	164	164	164	164

** . Correlation is significant at the 0.01 level (2-tailed).

Table 3:- Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.885 ^a	.783	.773	6.4484

a. Predictors: (Constant), Iron, Fats, Calcium, Protein, Carbohydrate, Phosphorus, Energy

Table 4:- Coefficients^a

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
	(Constant)	25.199	2.274				11.083
Energy	.016	.004	.796	4.263	.000	.009	.024
Protein	.037	.047	.092	.777	.439	-.056	.130
Fats	.068	.055	.077	1.222	.224	-.042	.177
Carbohydrate	-.009	.015	-.085	-.584	.560	-.039	.021
Calcium	.002	.002	.054	.796	.427	-.002	.005
Phosphorus	-.002	.003	-.104	-.807	.421	-.008	.003
Iron	.122	.138	.094	.878	.381	-.152	.395

a. Dependent Variable: Scholastic achievement

The obtained values of linear regression from **Table 3**, explained that Dietary Macro-nutrients (Energy, Protein, Fats, and Carbohydrate) and Dietary Micro-nutrients (Calcium, Phosphorus, and Iron) are responsible for bringing 77.3% variance in Scholastic Achievement of adolescents.

The outcome of **Table 4** represents that dimension “Energy” of Macro-nutrients is the significant predictor of adolescents Scholastic Achievement.

The outcome of **Table 5** elaborated that no gender difference exists among adolescents with regard to Dietary Macro-nutrients (Energy, Protein, Fats, and Carbohydrate), Dietary Micro-nutrients (Calcium, Phosphorus, and Iron) and Scholastic Achievement.

Table 5: - Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means				
	F	Sig.	t	df	Sig.	Mean Difference	Std. Error Difference
					(2-tailed)		

Energy	Equal variances assumed	.062	.804	.376	162	.707	39.27353	104.47916
	Equal variances not assumed			.376	161.501	.707	39.27353	104.40952
Protein	Equal variances assumed	.012	.913	.082	162	.935	.43674	5.31380
	Equal variances not assumed			.082	160.857	.935	.43674	5.31589
Fats	Equal variances assumed	2.425	.121	-.416	162	.678	-.99969	2.40468
	Equal variances not assumed			-.418	161.309	.677	-.99969	2.39245
Carbohydrate	Equal variances assumed	.575	.449	.274	162	.785	5.53901	20.24519
	Equal variances not assumed			.274	161.996	.784	5.53901	20.19418
Calcium	Equal variances assumed	2.213	.139	-.405	162	.686	29.86617	73.70391
	Equal variances not assumed			-.403	156.222	.687	29.86617	74.02814
Phosphorus	Equal variances assumed	.007	.932	.060	162	.952	5.77982	95.78818
	Equal variances not assumed			.060	161.269	.952	5.77982	95.76577
Iron	Equal variances assumed	.083	.773	1.002	162	.318	1.64398	1.64126
	Equal variances not assumed			1.002	161.532	.318	1.64398	1.64006
Scholastic achievement	Equal variances assumed	1.502	.222	.402	162	.688	.8536	2.1221
	Equal variances not assumed			.404	161.965	.687	.8536	2.1152

DISCUSSION

The key rationale of this study is to evaluate the inter-relationship of Dietary Macro-Nutrients (Energy, Carbohydrate, Fats and Proteins), Dietary Micro-nutrients (Calcium, Phosphorus, and Iron) and Scholastic achievement of adolescents. The derived correlational values of Macro-nutrients and Micro-nutrients show significant positive association with Scholastic achievement which summarized that appropriate intake of nutrients play critical role for attainment of higher order academic performance among adolescents. Lack of proper nutrition specifically during adolescence phase of life is responsible for occurrence of developmental deficits which ultimately lead to poor academic attainment. The findings are in line with the research of (Benton & Jarvis, 2007) which summarized students who consume high calories meal pay more concentration as compare to students with low calories. The obtained results were in accordance with the findings of (Ingwersen, Defeyter, Kennedy, Wesnes, & Scholey, 2007) which indicated that intake of carbohydrate rich food during breakfast is associated with higher cognitive performance of students. The results follow the study of (Fischer, Colombani, Langhans, & Wenk, 2002) which concluded that high protein-rich diet is linked with better overall cognitive performance of students.

The secured results evidently concludes that consumption of appropriate diet which is comprised of varied Macro-nutrients as well as Micro-nutrients, play central role for Scholastic affluence of students. The outcomes of the present study are in line with the finding of (Lozoff, Jimenez, & Wolf, 1991; Grantham-McGregor, & Ani, 2001) which represented that insufficiency of iron is responsible for disintegrated memory, cognition, and learning of students. Hence, it can be encapsulated that Iron act as an essential nutrient for promoting scholastic performance of students. Results are also supported by the study of (Du, Hsiao, Ludy, & Tucker, 2022) which concluded that higher intake of calcium is linked with better psychological state which encourages superior scholastic attainment. Phosphorus is also positively associated with the scholastic achievement of adolescents. Findings yield on the basis of regression analysis also indicated that “Energy” is the significant predictor of adolescents’ Scholastic achievement. Hence, comprehensively we can conclude that consumption of Energy, Carbohydrate, Protein, Fats, Calcium, Phosphorus, and Iron has significant positive impact on the scholastic performance of adolescents. The current study also revealed that Gender has no impact on intake of nutrients and Scholastic achievement of adolescents.

CONCLUSION

Adolescence is a prolific and inventive phase of life which require ample amount of nutrition not only for optimal physiological growth and nurturance, but also for prominent performance in academic domain. Research studies have evidently illustrated that insubstantial intake of major and minor dietary nutrients throughout childhood and adolescence period is responsible for poor brain development, which lead to cognitive and academic deficits in future. The finding of this research study also indicated that different major and micro dietary components of food are significantly regulating the Scholastic accomplishment of adolescents. Insufficient ingestion of macro and micro nutrients will make adolescents feeble, frail, and vulnerable to diseases which increase the likelihood of absenteeism and school drop-out. This study clearly demonstrated that major and micro dietary nutrients have remarkable positive association with scholastic performance of student. This concludes that Nutrition play outstanding role in successful attainment of higher order scholastic performance among adolescents.

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