

## Association Between Dietary Intake, Physical Health, And Academic Achievements Of Pre-Primary Level Students

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### ABSTRACT

*Quality of diet and physical fitness of students relate to their learning outcomes at pre-primary level. So, in current study data was collected by survey analysis by circulating questionnaires in educational institutes of adjacent cities and peripheries of Rawalpindi and Islamabad. Learning potency, agility, patience, stamina, modes of self-expression, and IQ level have been correlated with quality and quantity of diet, along with balanced and imbalanced nutritional impacts of diet. Statistically analyzed results proved that academically best students have BMI of 14 Kg/m<sup>2</sup>, head circumference of 19-20 inches and least health issues while unhealthy toddlers can grasp more knowledge by consuming vitamin and protein enriched meals. Moreover, maximum lipids and minerals in diet enhance academic achievements and students who feel glad and confident to attend lectures, performed better academically as compared to timid one. Lipid enriched food, followed by vitamin comprising meal on alternate days can yield better academic performance. Proteinaceous food gives better results while vitamin and mineral enriched food can lead to best academic performance. Maximum lipid intake in breakfast and lunch while minimum at dinner can enhance academic and non-academic achievements. Current work has significant impact for designing a diet plan for a pre-primary level toddlers to strengthen, nurture and nourish their learning skills both academically and non-academically, which ultimately engrave a foundation stone for bright future.*

**Keywords:** Diet, pre-primary level, BMI, IQ level, Academics.

### INTRODUCTION

Many factors effect cognitive development, together with nutrition. There is a huge literature that proposes a link between better nutrition and best brain utility. Nutrients make building blocks that are crucial in cell proliferation, DNA synthesis, neurotransmitter and hormone metabolism, main components of enzyme systems in the brain (Walker et al., 2021; Rawal et al., 2023; Ruiz-Roso et al., 2020; Carayanniet al., 2021, Keshanti al., 2019). Development of brain is quicker in early life as compared to the latter, which makes body more prone to nutrition deficiency.

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Glucose metabolism in the brains of students rises from birth till four years of age and becomes double till the adult's metabolic rates and this remains elevated in students till 9–10 years of age, then drop to the mature level by late adolescence (Abdeyazdanet al., 2017). That's why for more glucose supply to brain and more metabolic rate, regular diets and uninterrupted glucose supply is compulsory in students than in adults (Keshaniet al., 2019). Similarly, students are more susceptible to the antagonistic outcomes of overnight fasting, so breakfast is a very essential to provide fuel for brain in the morning. A systematic review concluded that taking breakfast is useful item for cognitive function and development, particularly in malnourished students. Lack of studies performed into the ideal breakfast including type, composition and portion size but carbohydrate rich, hypoglycemic food for breakfast which gives a incessant supply of glucose is known to ease well cognitive functions (Rawal et al., 2022; Arora et al., 2022; Boukrim et al., 2021). Objectives of current study were to find out the differential impact of diet (quality, quantity, and plan) with physical health, learning capacity and learning achievement (as a product) of students.

## **MATERIALS AND METHODS**

It was a Co relational study on the population of students (3 to 11 years of age and up to Grade 1 of local Schools at Rawalpindi/Islamabad. Students were selected by using random sampling technique by using data of three system of education. Each data was collected in triplicate while sample size in each age group was 35. Diet details have included quality, quantity, balance and imbalance diet, while learning capacity was monitored by performing IQ Test. Learning achievements was calculated by using test marks of whole academic year and physical health test.

### **Pilot Study**

In this study, the data of Grade Play Group to one of the academic session 2016 – 2017 was collected to get the information about the physical health, learning capacity, learning achievement (as product) to check the impact of diet. Initially toddlers from various institutions were selected randomly with total population size of 60. The parents of these 60 students were also involved in this study. Experts Studies and their opinion have also been included in it (Sahota et al. , 2019).

### **Validity and Reliability**

To ensure the validity of questionnaire, a team of expert were involved to review questionnaire. The questionnaire was refined in the light of their suggestions and comments. Reliability of instrument was checked by applying Cronbach Alpha through IBM SPSS Statistics version 2015 (Ruiz-Roso et al. , 2020).

### **Data Collection**

The self-explanatory questionnaire was administered to the students for data collection. In order to collect data from respondents through final instrument; the researcher had visited the sample schools and administered the questionnaire personally to find out the role of diet and physical health of students on their learning capacity and achievements at Pre-Primary level in present and previous classes (Sahota et al. , 2019).

### **Statistical Analysis**

Data collected through questionnaire was decoded, tabulated, analyzed, and interpreted based by using GraphPad Prism 8.0 for chi-square analysis and two-way ANOVA. Results have been expressed as mean±SD (Ruiz-Roso et al., 2020).

## **RESULTS AND DISCUSSION**

### **Physical Health and Learning Achievements of Students**

Maximum good results in academics of students had been achieved when they have BMI of 14 Kg/m<sup>2</sup> while percentage of academic results and positions of students were lowered when BMI was equal to or exceeds to 16 Kg/m<sup>2</sup>. Similarly, those toddlers whose head's circumference ranged between 19 to 20 inches performed best in academics while those whose head circumference was higher or lower than this, had performed least in academics (Figure 1, 2, 3, 7).

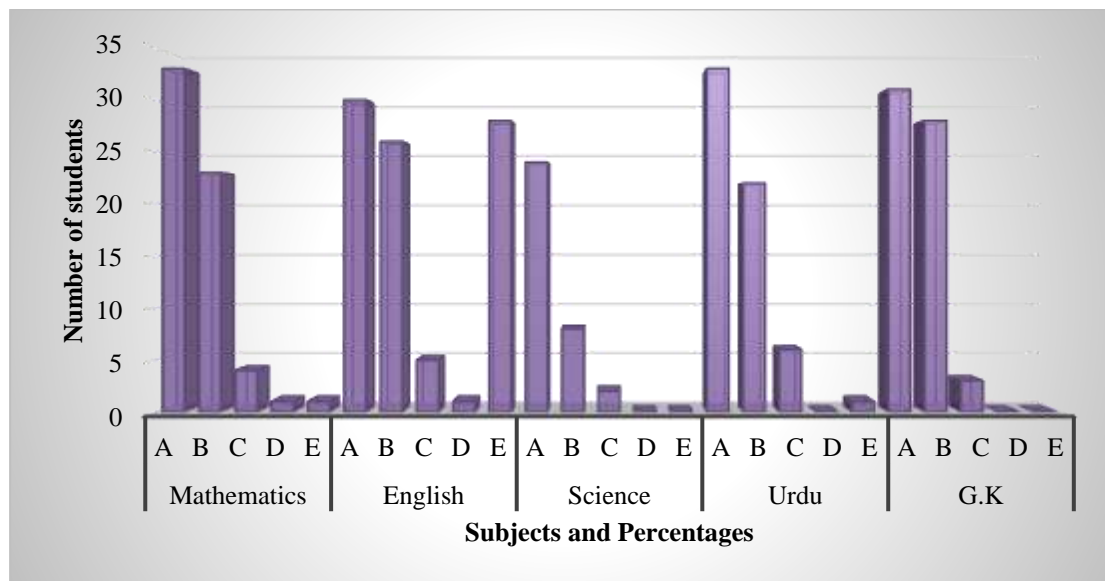
The health of a child is a very important factor for good performance in academic and non-academic achievements. Healthy students have performed and produced much better results than diseased ones. Moreover, a student who has more than one health issue given poor results than one who has only one health problem (Figure 4, 5). It was also observed that an ill student with good dietary habits produced good results. More protein and vitamin containing foods have increased the work efficiency of an ill toddler while more lipids and mineral containing food increased the academic achievements of students even much more (Figure 6, 8, 9). Along with balanced diet plan, least participation in game/ extracurricular activities and least outdoor games also improved the learning achievements and learning capacity of toddlers (Figure 1, 7, 9). These results are like a previous study which shows that cognitive development in pre-schoolers was extrapolative of later school attainment (Chaudhary et al., 2020; Micha et al., 2018 and Engle, 2010). As Lytle et al., (2003) stated that education shapes human wealth, assistances, aptitudes, and belongings, which eventually figures health and well-being. Certainly, extra education has related to superior occupations, more earnings, upper socio-economic position, improved health care admittance and accommodation, improved life pattern, nourishment and physical activity which are all well-known health determinants (Rippin et al., 2019). Schooling upsurges sense of personal control and self-esteem of an individual, which also affects improved health conduct (Gallotta et al., 2016; Vereecken et al., 2010).

### **Diet and Learning Achievements of Students**

Statistical analysis of the results showed that maximum toddlers have utilized more carbohydrate and mineral containing foods and least lipid containing foods and subsequently more students have best results than those who have reverse, which is evident that toddler's body need more energy to do work which are fulfilled by maximum carbohydrate intake. Moreover, as students have more physical activity and learning efforts had less deposition of carbohydrates in the form of cholesterol while excess lipids/ fats are stored in the body and make them fatty which reduces their work efficiency as well (Figure 1, 6, 7). One day food of toddlers have maximum those food items which have high Lipid, followed by the protein along with vitamins while least amount of lipids/ Fats were present in daily food items of students which also shows that students can give much better results when they take more Proteinous foods than fatty one while even their academic results can become best with more mineral and vitamin intake proteinoids foods. Least amount of lipids in dinner and highest in lunch and breakfast can help to raise the academic and non-academic achievements of toddlers (Figure 8, 9).

Some researchers have investigated the influences of overall diet on neurocognitive development during childhood. Hollar et al. (2010) considered dietary patterns in infancy in relation to cognitive development and found higher full-scale IQ (measured on the Wechsler Preschool and Primary Scale of Intelligence test) at 4 years of age in students who consumed

higher amounts of fruit, vegetables and food prepared at home during infancy (i.e., between 6 and 12 months). The association remained significant after adjusting for a wide range of factors, including socioeconomic status, maternal IQ and education. A cross-sectional study reported by El Harake et al. (2018) examined the association between (i) the intake of specific food groups in 3½ years old students and in the same students again at 7 years of age and (ii) their cognitive development measuring on the Stanford–Binet Intelligence Scale (at 3 years) and on the WISC-III (at 7 years). These researchers found that a higher level of consumption of fish at 7 years of age and bread and cereals at 3½ years of age was associated with higher IQ scores, whereas those students at the age of 3½ who consumed margarine every day scored significantly lower on IQ. Adab et al. (2018) reported that higher scores on the “health conscious” dietary pattern (which included more salad, rice, pasta, and fruits) at 3 years of age were associated with higher IQ score on the WISC-III when these same students were tested aged 8½ years, compared to those students on the “processed” dietary pattern (with high fat and sugar content), after adjusting for a wide variety of potential confounders. In the same study, Hermans et al. (2018) examined six different dietary patterns and found negative associations between (i) the “discretionary pattern” (which contains biscuits, sweets, soft drinks, and snacks) at 6, 15, and 24 months of age, and ready-prepared baby foods at 6 and 15 months of age and (ii) IQ scores at 8 years of age (measured on the WISC). Jones et al. (2017) also reported positive associations between students's IQ at age 8 years and “breastfeeding pattern” (measured at 6 months), “home-made contemporary” (legumes, fruits, fruit juices, cheese, egg) at 15 and 24 months, “home-made traditional” (vegetables, meat, sauces) at 6 months (but not at 15 and 24 months), and “ready-to-eat” food pattern (biscuits, breads, cereals, yoghurt) at 24 months.



**Figure 1 Learning Capacity of Students**

**Note:**A= 90-100%, B= 80- 90 %, C= 70-80 %, D= 60-70 %, E= 50- 60 %, G.K.= General Knowledge

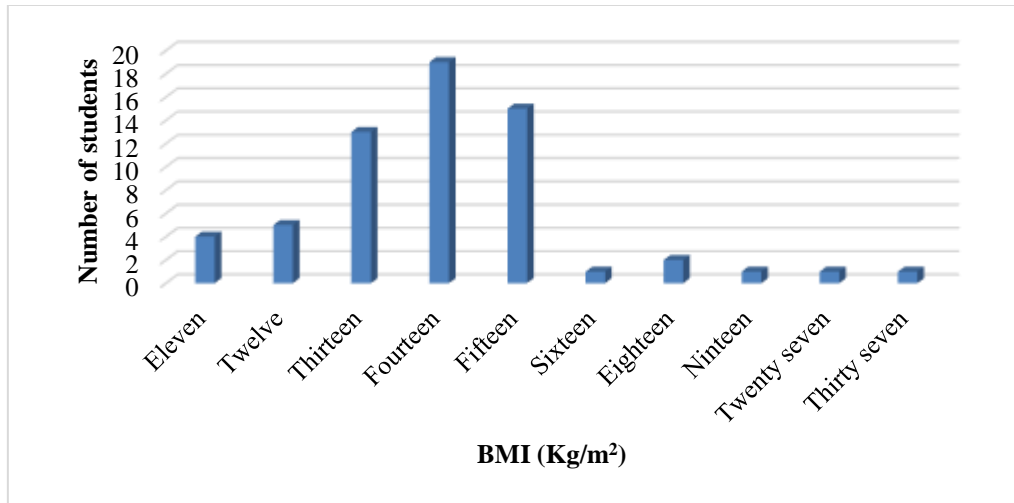


Figure 2 BMI (Kg/m<sup>2</sup>) of toddlers

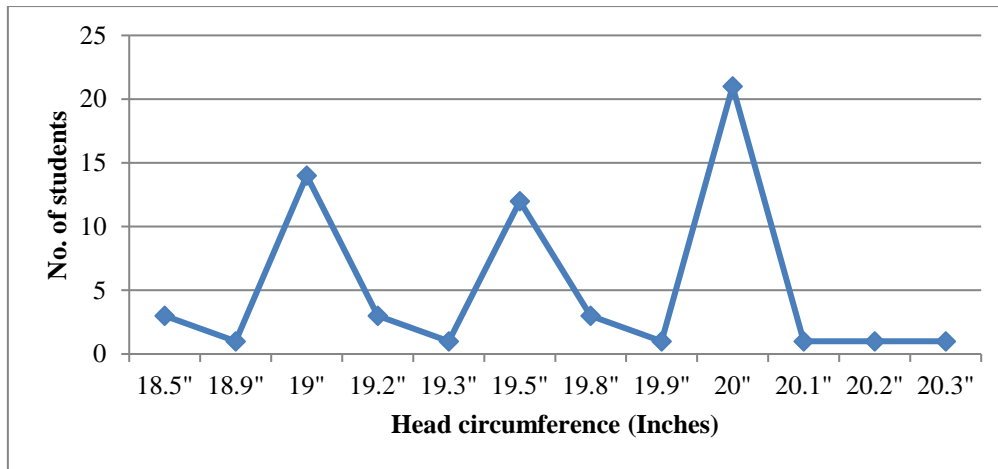


Figure 3 Head Circumferences of toddlers

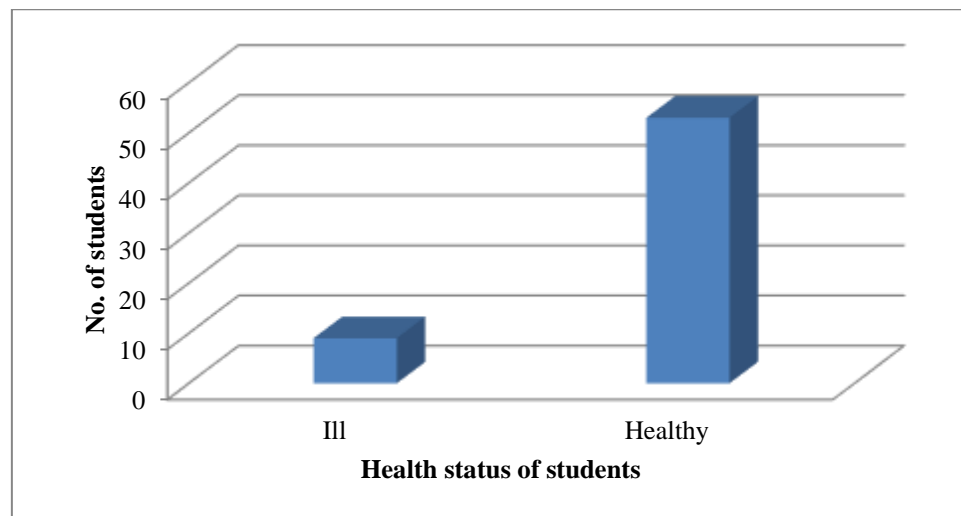


Figure 4 Comparison of healthy and ill students

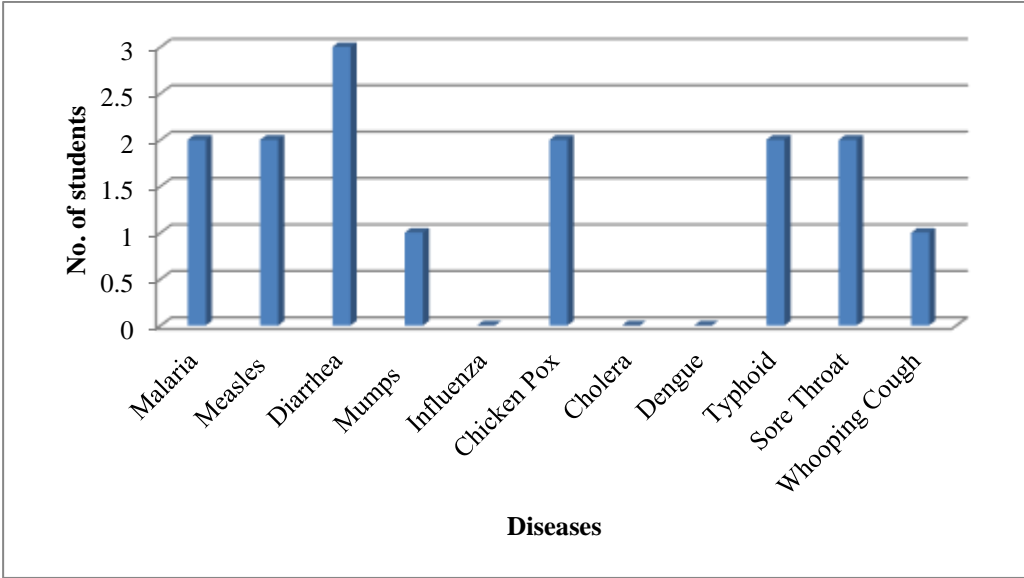


Figure 5 Comparison of students suffering from different diseases

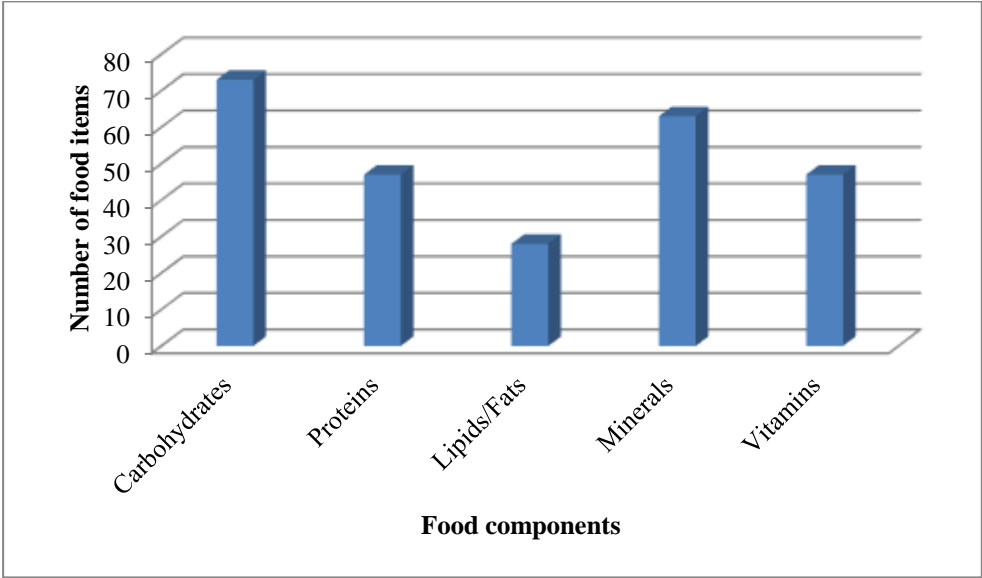


Figure 6 Food components and food items for toddler's diet

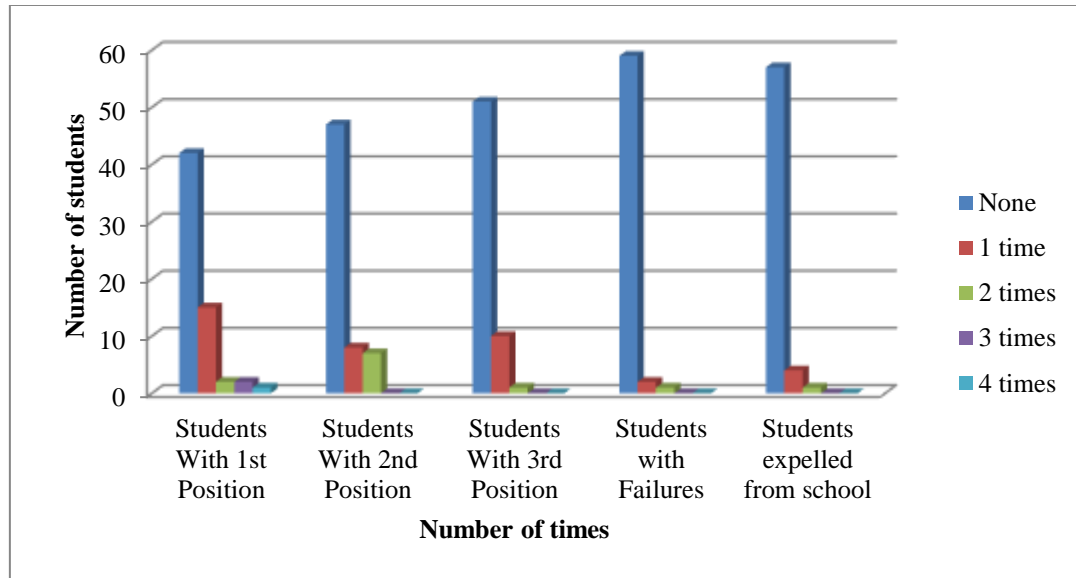


Figure 7 Number of positions in class during academic career

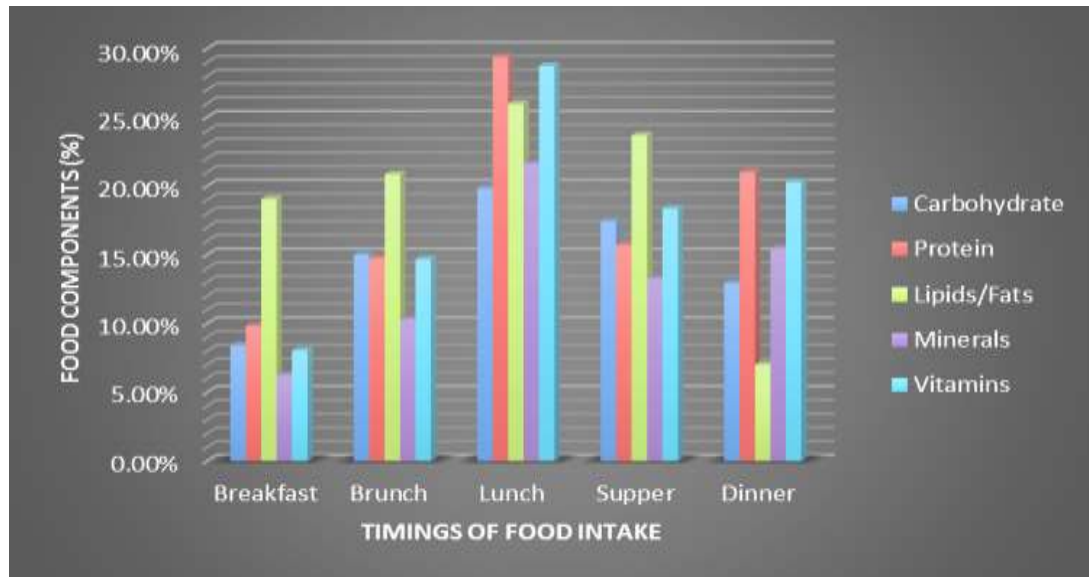
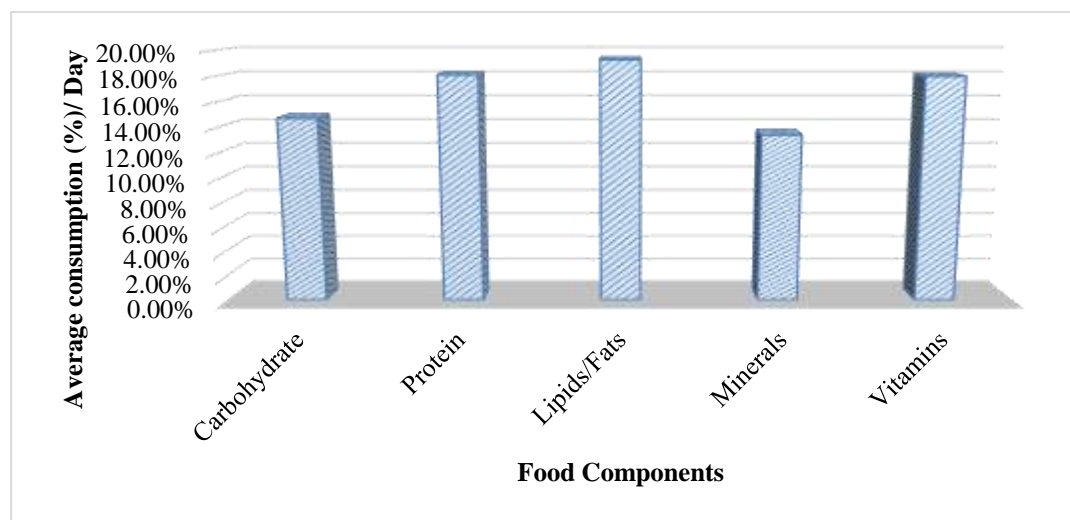


Figure 8 Food components of toddlers in whole day



**Figure 9 Average consumption of food components in one day**

## CONCLUSION

Maximum good results in academics of students can be achieved. If students have BMI of 14 Kg/m<sup>2</sup>, head's circumference between 19 to 20 inches and have least health issues. More protein and vitamin containing foods can increase the work efficiency of a diseased toddler while more lipids and mineral containing food increases the academic achievements of students even much more. Moreover, when students feel happy at the time of departure to school, they produce better results. Students who feel any kind of fear can produce least good results. Maximum toddlers have utilized more carbohydrate and mineral containing foods and least lipid containing foods, so more students gave best results. One day food of toddlers has maximum number of food items with high Lipid and then protein amount along with vitamins. So, students can give much better results when they take more proteinous foods than fatty ones and results can even become best when there is more mineral and vitamin intake. The amount of least lipids in dinner and highest in lunch and breakfast can help to raise the academic and non- academic achievements of toddlers.

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## REFERENCES

- Abdeyazdan Z., Moshgdar H., Golshiri P. Evaluating the effect of lifestyle education based on health belief model for mothers of obese and overweight school-age children on obesity-related behaviors. *Iran J Nurs Midwifery Res.* 2017;22(3):248.
- Adab P., Pallan M.J., Lancashire E.R., Hemming K., Frew E., Barrett T., Bhopal R., Cade J.E., Canaway A., Clarke J.L., et al. Effectiveness of a childhood obesity prevention programme delivered through schools, targeting 6- and 7-year-olds: Cluster randomised controlled trial (WAVES study) *BMJ.* 2018;360: k211. doi: 10.1136/bmj. k211.
- Arora M., Mathur C., Rawal T., Bassi S., Lakshmy R., Nazar G., et al. Socioeconomic differences in prevalence of biochemical, physiological, and metabolic risk factors for non-communicable diseases among urban youth in Delhi. *India Prevent Med Rep.* 2018;12:33–39.



- Boukrim M., Obtel M., Kasouati J., Achbani A., Razine R. Covid-19 and confinement: effect on weight load, physical activity and eating behavior of higher education students in Southern Morocco. *Ann Glob Health*. 2021;87(1):7.
- Carayanni V., Vlachopapadopoulou E., Koutsouki D., Bogdanis G.C., Psaltopoulou T., Manios Y., et al. Effects of nutrition, and physical activity habits and perceptions on body mass index (BMI) in children aged 12-15 years: A cross-sectional study comparing boys and girls. *Children (Basel)* 2021;8(4).
- Chaudhary, A., Sudzina, F., & Mikkelsen, B. E. (2020). Promoting Healthy Eating among Young People-A Review of the Evidence of the Impact of School-Based Interventions. *Nutrients*, 12(9), 2894. <https://doi.org/10.3390/nu12092894>.
- El Harake M.D., Kharroubi S., Hamadeh S.K., Jomaa L. Impact of a Pilot School-Based Nutrition Intervention on Dietary Knowledge, Attitudes, Behavior and Nutritional Status of Syrian Refugee Children in the Bekaa, Lebanon. *Nutrients*. 2018;10:913. doi: 10.3390/nu10070913.
- Gallotta M.C., Iazzoni S., Emerenziani G.P., Meucci M., Migliaccio S., Guidetti L., Baldari C. Effects of combined physical education and nutritional programs on schoolchildren's healthy habits. *PeerJ*. 2016;4:e1880. doi: 10.7717/peerj.1880.
- Hermans R.C., van den Broek N., Nederkoorn C., Otten R., Ruiters E.L., Johnson-Glenberg M.C. Feed the Alien! The Effects of a Nutrition Instruction Game on Children's Nutritional Knowledge and Food Intake. *Games Health J*. 2018;7:164–174. doi: 10.1089/g4h.2017.0055.
- Hollar D., Messiah S.E., Lopez-Mitnik G., Hollar T.L., Almon M., Agatston A.S. Effect of a Two-Year Obesity Prevention Intervention on Percentile Changes in Body Mass Index and Academic Performance in Low-Income Elementary School Children. *Am. J. Public Health*. 2010;100:646–653. doi: 10.2105/AJPH.2009.165746.
- Jones M., Pitt H., Oxford L., Bray I., Kimberlee R., Orme J. Association between Food for Life, a Whole Setting Healthy and Sustainable Food Programme, and Primary School Children's Consumption of Fruit and Vegetables: A Cross-Sectional Study in England. *Int. J. Environ. Res. Public Health*. 2017;14:639. doi: 10.3390/ijerph14060639.
- Keshani P., Hossein Kaveh M., Faghih S., Salehi M. Improving diet quality among adolescents, using health belief model in a collaborative learning context: a randomized field trial study. *Health Educ Res*. 2019;34(3):279–288.
- Keshani P., Hossein Kaveh M., Faghih S., Salehi M. Improving diet quality among adolescents, using health belief model in a collaborative learning context: a randomized field trial study. *Health Educ Res*. 2019;34(3):279–288.
- Lytle L.A., Kubik M.Y. Nutritional issues for adolescents. *Best Pract. Res. Clin. Endocrinol. Metab*. 2003;17:177–189. doi: 10.1016/S1521-690X(03)00017-4.
- Micha R., Karageorgou D., Bakogianni I., Trichia E., Whitsel L.P., Story M., Penalvo J.L., Mozaffarian D. Effectiveness of school food environment policies on children's dietary behaviors: A systematic review and meta-analysis. *PLoS ONE*. 2018;13:e0194555. doi: 10.1371/journal.pone.0194555.
- Rawal T., van Schayck O.C., Willeboordse M., Arora M., Bhaumik S., Bhagra A., et al. How to promote a healthy lifestyle among schoolchildren: Development of an intervention module (i-PROMISE) *Public Health Pract*. 2022 Jun 1;3.
- Rawal, T., Muris, J. W. M., Mishra, V. K., Arora, M., Tandon, N., & van Schayck, O. C. P. (2023). Effect of an educational intervention on diet and physical activity among school-aged adolescents in Delhi -The i-PROMISE (PROMoting health literacy in Schools) Plus Study. *Dialogues in health*, 2, 100123. <https://doi.org/10.1016/j.dialog.2023.100123>.
- Rippin H.L., Hutchinson J., Jewell J., Breda J.J., Cade J.E. Child and adolescent nutrient intakes from current national dietary surveys of European populations. *Nutr. Res. Rev*. 2019;32:38–69. doi: 10.1017/S0954422418000161.
- Ruiz-Roso M.B., de Carvalho Padilha P., Mantilla-Escalante D.C., Ulloa N., Brun P., Acevedo-Correa D., et al. Covid-19 confinement and changes of adolescent's dietary trends in Italy, Spain, Chile, Colombia and Brazil. *Nutrients*. 2020;12(6):1807.
- Ruíz-Roso M.B., de Carvalho Padilha P., Matilla-Escalante D.C., Brun P., Ulloa N., Acevedo-Correa D., et al. Changes of physical activity and ultra-processed food consumption in adolescents from different countries during Covid-19 pandemic: An observational study. *Nutrients*. 2020;12(8):2289.

*702 Association Between Dietary Intake, Physical Health, And Academic Achievements Of Pre-Primary Level Students*

- Sahota P., Christian M., Day R., Cocks K. The feasibility and acceptability of a primary school-based programme targeting diet and physical activity: the PhunkyFoodsProgramme. *Pilot Feasibil Stud.* 2019;5(1):1–15.
- Vereecken C., Haerens L., De Bourdeaudhuij I., Maes L. The relationship between children’s home food environment and dietary patterns in childhood and adolescence. *Public Health Nutr.* 2010;13:1729–1735. doi: 10.1017/S1368980010002296.
- Walker, T. J., Craig, D. W., Pavlovic, A., Thiele, S., Natale, B., Szeszulski, J., DeFina, L. F., & Kohl, H. W., 3rd (2021). Physical Activity and Healthy Eating Programming in Schools to Support Student's Health-Related Fitness: An Observational Study. *International journal of environmental research and public health*, 18(21), 11069. <https://doi.org/10.3390/ijerph182111069>.