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Statistical Modelling of Nutritional, Educational and Socio-Economic Status of School Going Children

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Abstract: Background: Malnutrition is associated with an increase risk of morbidity and mortality and may case an undesirable effect on the growth and development in children. Malnutrition, the condition resulting from faulty nutrition weakens the immune system as well as the nerve system. In our study we try to attempt to develop a model which correlates all the factors associated with the nutritional, educational as well as socio economic status of school going children and gives prevalence in Jammu Division.

Method: A cross sectional study in which we explored and nutritional status among the school going children in the age group (11-17) and analyzes the factors associated with malnutrition, education and socio economic status with the help of designed questionnaire and anthropometric measurement from April 2015-March 2016 in Urban and rural blocks of Jammu division and develop logistic regression model.

Result: out of 880 children screened, nearly (56) 6.4% students were severe, (98) 11.1% students were overweight and (46) 5.2% were obese. Highest severe incidence of malnutrition is found among male and female in the age group of (13-15) i.e. (22) 4.8% among male and (17) 4.1% among female. The logistic regression for school going children shows that the malnutrition is positively correlated to the nutritional, educational, and socio economic status of their parents.

Conclusion: Bearing in mind the burden of malnutrition among school children there is need for periodic screening, awareness at school and parent counselling.

Keywords: Nutritional, educational status, socio economic status, BMI, school children

I. INTRODUCTION

There are many statistical models and economical models were developed for studying the inter-relationship between nutritional status and the socioeconomic status. As we know that the malnutrition is associated with an increased risk of morbidity and mortality may cause an undesirable on the growth and development in children. School children's health status is related to future physical growth, intellectual capacity and income but malnutrition at early stage among children affects on physical growth and intellectual capacity [Kaur 2014[8]].

School age is the active growing phase of childhood primary school age is a dynamic period of physical growth as well as mental development of the child. Research indicates that health problem due to miserable nutritional status in primary age school children, are among the most common causes of low school enrolment, early dropout and unsatisfactory class performance. The best global indicator of children's well being is growth.

Poor growth is attributable to a range of factors closely linked to overall standard of living and ability of population to meet their basic needs such as access to food, housing and healthcare. Assessment of growth is the single measurement that best defines the nutritional and health status of the children's and provides an indirect measurement of the quality of life of the entire population. In the present study an attempt was made to find the prevalence of malnutrition among the school going children's in 11-17 yrs age groups in Jammu and samba districts of Jammu division.

This age group is a threshold of adolescence on whom the progress intelligence as well as welfare of the nation depends. The current study further explores the role of socio-economic characters of mother and father of the child. Nutrition influences growth and development before as well as after birth. Retardation of the growth rate is an indication of malnutrition measurement of weight and rate of gain in weight are the best single parameters for accessing the physical growth various maternal factors which influences nutritional status of children which includes level of education, economic status likes assets, per capita income of both the parents.

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II. METHODOLOGY

The study is school-based cross-sectional descriptive study. This study represent the middle school students of class (8^{th}) from urban and rural areas, belonging to both gender studying in the Govt and the Non-Govt schools of Jammu division from the Jammu and Samba district . In our study we apply multistage sampling technique and cluster sampling technique to select required number of sample. The schools with at least 10 students in class 8^{th} will be eligible for the study.

Eligible schools will be stratified into govt. and non govt categories from rural and urban areas of Jammu district and Samba district of Jammu division. Then, required number of schools will be selected on the basis of probability proportional to sample size (pps) i.e the schools with high number of students are more likely to be selected than school with low number of students.

The calculated sample size for our study is 480 students from non-govt school and Govt Schools of Jammu district and 400 students are selected from non-govt school and Govt Schools from Samba district. Finally, the required sample size for our study is approximately Eight hundred eighty (880).

The study was carried out in the randomly selected 11 blocks from rural area and urban local bodies of two districts (Jammu and Samba) of Jammu division. To represent the rural sample we was randomly selected 22 villages from 11 blocks of two districts and make list of schools. Then from the list of school we was randomly selected 4 schools including Govt. School and Non-Govt. School equal in numbers affiliated to Jammu Kashmir Board of Secondary Education (JKBOSE) from each Block of two district. Then from the each school 20 student including boys and girls will be selected from class 8^{th}. The same procedure will be followed for the selection of urban student from the Govt. schools and private schools by keeping the complete representation of whole area of selected 2 districts. This type of technique is very useful when the population compose of strata of different sizes so that representative sample must contain individual from each category stratum in accordance with size of sub group.

Child nutrition is a major public health issue in developing countries.BMI is a very useful indicator to calculate the nutritional status of school children. The accuracy of BMI varies substantially according to the individual child's degree of body fatness. BMI was calculated by dividing the weight (in Kg) by height squared (inm^2).

$$\text{BMI} = \frac{Weight(kg)}{Height^2\,(m)}$$

We used the percentile for respective reported by Centre for Disease control (CDC) for this purpose. Among obese children (or a BMI greater than or equal to the 95^{th} percentile), BMI is a good indicator of excess body fat. However, among overweight children (or a BMI between the 85^{th} and 95^{th} percentile), elevated BMI levels can be a result of increased levels of either fat or fat-free mass [CDC 2006[2]]. Similarly, among relatively thin children, differences in BMI are often due to differences in fat-free mass.

Percentile Ranking	Weight Status
Less than 5^{th} percentile	Underweight
5^{th} percentile to less than 85^{th} percentile	Healthy weight
Equal to or greater than the 85^{th} percentile	Overweight

After calculation all the data were compiled and analyzed and appropriate Statistical tests were applied. Statistical analysis was accomplished using SPSS v. 20.

Socioeconomic status (SES) is a measure of an individual's or family's economic and social position in relation to others, based on various variables responsible for that like income, education, occupation, family effluence, physical assets, social position, social participation, political influence, etc. SES classification namely Kuppuswami scale11 is widely used to measure the socio-economic status of an individual in urban communities. It is based on three variables namely education, occupation and income. Letter on modification of Kuppuswami scale were done, where the education and occupation of head of the family and income per capita per month was used. For the rural areas, Pareekh classification became popular based on nine characteristics namely caste, occupation of family head, education of family head, level of social participation of family head, landholding, housing, farm power, material possessions and type of family [Aggarwal, *et al* 2005[1]].

This scale consisted of 19 items. Suitable weight-age was given to each item and scoring for each item was based on a scale ranging from 0 to 7. The maximum aggregate score was 91. Based on the final score, the socio-economic states of the family is divided into Four socio-economic categories, namely Upper high (combined score of more than 68), High (52-67), Middle (38-51), Poor

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(combined score less than 37). In the present study, the instrument was used to assess the socio-economic status of all strata of the society.

Socio economic Scoring System

Socio economic Status	Total Score
Upper High	≥68
High	52-67
Middle	38-51
Poor	≤37

we used logistic regression model in order to examine the nutritional, educational and socio-economic factors behind the school going children. [Fox, *et al* 1984[4]] [5][9].

Modelling (Statistical Model)

We have developed the statistical model based on the incidence reporting by the school going children and their parents for malnutrition status in Jammu and samba district as follows.

$$TM_{SC} = (C_A) \quad (1)$$

Where TM_{SC} stands for total malnutrition among the school going children and C_A stands for children's of adolescence age group i.e. (11-17) years. Child malnutrition is related to the age of the children. The age of school children's is important because at lower age more incidence of malnutrition is observed.

$$TMC = (J, S) \quad (2)$$

Total malnutrition among school children's is observed in Jammu and samba district by considering 6 blocks of Jammu district and 5 from samba district.

$$CM = (PE) \quad (3)$$

The child malnutrition is related to education of parents.

$$PE = (M, F) \quad (4)$$

Education of mother and father is linked to the malnutrition among children.

$$E_{mf} = (I, M, HS, S, C) \quad (4a)$$

Education of mother and father is classified as illiterate, middle, high school, secondary, college.

$$SES = (P, M, H, UH) \quad (5)$$

Where socio economic status is classified in four categories according to Kuppuswami scale11 i.e. Poor, Middle, High, Upper High.

The Diet History (food eaten) by the children is classified as the vegetarian and non vegetarian food.

$$F = (Vg, Nonvg) \quad (7)$$

Child malnutrition is depending on income.

$$CM = (Y) \quad (8)$$

Such income is classified as the mother, father and other sources of income.

$$Y = (M, F, O) \quad (9)$$

Such income sources are differs from household to household.

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The incidence of malnutrition is observed in Jammu and samba district by considering 6 blocks of Jammu district and 5 from samba district among school going children.

Block	BMI(Weight Range)			Total
	Normal weight	overweight	severe	
Bhalwal	67(83.8%)	13(16.3%)	0(0.0%)	80
Bishnah	65(81.3%)	9(11.3%)	6(7.5%)	80
Gandhi nagar	56(70.0%)	24(30.0%)	0(0.0%)	80
Ghagwal	70(87.5%)	7(8.8%)	3(3.8%)	80
Jammu	58(72.5%)	22(27.5%)	0(0.0%)	80
Marh	72(90.0%)	8(10.0%)	0(0.0%)	80
Purmandal	65(81.3%)	11(13.8%)	4(5.0%)	80
Ramgarh	61(76.3%)	11(13.8%)	8(10.0%)	80
Samba	64(80.0%)	6(7.5%)	10(12.5%)	80
Satwari	67(83.8%)	12(15.0%)	1(1.3%)	80
Vijaypur	69(86.3%)	9(11.3%)	2(2.5%)	80

Child malnutrition is a major public health issue. So In our study we first try to analyze the nutritional status of school going children by using BMI indicator of Jammu and Samba district according to Block-wise data. As BMI is very useful indicator to calculate the nutrition status of school going children. In Jammu district we have 6 blocks namely Bhalwal, Bishnah, Gandhi nagar, Jammu, Satwari and Marh and in Samba district we have 5 blocks namely Purmandal, Ramgarh, Samba, Ghagwal and Vijaypur. In our analysis we see that in Bhalwal block 13(16.3%) were overweight, 67(80.0%) were having normal weight. In Bishnah 9(11.3%) were overweight, 65(81.3%) were having normal weight and 6(7.5%) were severely malnourished. In Gandhi nagar Block 24(30.0%) were overweight, 56(70.0%) were normal weight and and 0(0.0%) there were no severely malnourished. In Jammu Block 22(27.5%) were overweight, 58(72.5%) were normal weight, we didn't find any severely malnourished child. In Satwari Block 12(15.0%) were overweight, 67(83.8%) were normal weight, 1(1.3%) were severely malnourished. In Marh Block 8(10.0%) were overweight, 72(90.0%) were normal weight, nil severely malnourished children.

In Samba district we have 5 blocks, Purmandal block 11(13.8%) were overweight, 65(81.3%) were normal weight, 4(5.0%) were severely malnourished. In Ghagwal Block 7(8.8%) were overweight, 70(87.5%) were normal weight and 3(3.8%) were severely malnourished. In Ramgarh Block 11(13.8%) were overweight, 61(76.3%) were normal weight, 8(10.0%) were severely malnourished. In Samba Block 6(7.5%) were overweight, 64(80.0%) were normal weight, 10(12.5%) were severe. In Vijaypur Block 9(11.3%) were overweight, 69(86.3%) were normal weight, 2(2.5%) were severely malnourished.

		BMI(Weight Range)			Total
		Normal weight	overweight	severe	
Area	Rural	335(83.8%)	48(12.0%)	17(4.3%)	400

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	Urban	379(79.0%)	84(17.5%)	17(3.5%)	480

From Urban and Rural Area we found that total of 480 and 400, 17(3.5%) and 17(4.3%) were severely malnourished children, this proves that there is less severe children found from Urban Area as compare to Rural Area.

Mangeshkar (*et al* 2012[10]), studied the impact of SES on long term nutritional status among children keeping in view the hierarchical nature of data. The main findings were that across the states a disproportionate burden of stunting is obseverd among the children from Poor SES more so in Urban Areas.

A. Age wise malnutrition among school going children

Age group	BMI(Weight Range)			Total
	Normal weight	overweight	severe	
11-13	216(80.0%)	45(16.7%)	9(3.3%)	270
13-15	470(82.3%)	79(13.8%)	22(3.9%)	571
15-17	28(71.8%)	8(20.5%)	3(7.7%)	39

		BMI(Weight Range)			Total
		Normal weight	overweight	severe	
Gender	Male	399(86.2%)	52(11.2%)	12(2.6%)	463
	Female	315(75.5%)	80(19.2%)	22(5.3%)	417

In (11-13) age group, there were 45(16.7%) children are overweight, 216(80.0%) were normal weight children and children were 9(3.3%) severely malnourished. In (13-15) age group, there were 79(13.8%) children were overweight, and 470(82.3%) were normal weight children and 22(3.9%) children were severely malnourished. In (15-17) age group, there were 8(20.5%) children were overweight, and 28(71.8%) were normal weight children and 3(7.7%) children were severely malnourished. In our study overall we found that 8(20.5%) children in the age group of (15-17) years were Overweight. And Girls children 22(5.3%) were severely malnourished as compare to male children (12(2.6%). Also in our study, we found that 80(19.2%) females were overweight then 52(11.2%) male children.

Study conducted by Ghnonge (*et al* 2015[5]), Prevalence of both Obesity and Overweight was found to be maximum in 15 years age group both in Government schools and Private Schools

In our study we found that 22(5.3%) female children were suffering from severely malnourished as compared to 12(2.6%) male, which implicate that still there is a lot of negligence in the community regarding upbringing of female child.

Study by Katoch (*et al* 2016[7]) conducted that female children were at higher risk of undernutrition in terms of stunting(42.86 % of the Female children),whereas underweight (11.39% and wasting (2.53%) were prevalent only in Male children.

Study conducted by Sanghamitra Pati (*et al* 2014[12]), univariate analysis revealed that girls were almost five times at higher risk of being overweight/obese as compared to boys (OR:4.78 95%CI:1.35-16.93).[5]

B. Parental education and malnutrition among school children.

		BMI(Weight Range)			Total
		Normal weight	overweight	severe	
Education Status of father	illerate	88(80.0%)	9(8.2%)	13(11.8%)	110
	middle pass	266(81.3%)	51(15.6%)	10(3.1%)	327
	matric	235(84.2%)	36(12.9%)	8(2.9%)	279
	intermediate/12	74(75.5%)	22(22.4%)	2(2.0%)	98

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	graduate & above	51(77.3%)	14(21.2%)	1(1.5%)	66

		BMI(Weight Range)			Total
		Normal weight	overweight	severe	
Education Status of Mother	illerate	155(83.8%)	16(8.6%)	14(7.6%)	185
	middle pass	290(81.0%)	57(15.9%)	11(3.1%)	358
	matric	174(79.5%)	38(17.4%)	7(3.2%)	219
	intermediate/12	60(80.0%)	13(17.3%)	2(2.7%)	75
	graduate & above	35(81.4%)	8(18.6%)	0(0.0%)	43

The mother education is playing an important role in health status of children. Literate mother adopt many improved behaviours related to maternal and child healthcare, feeding, and eating practices which ultimately affect the nutritional status of child Joshi (*et al* 2011[6]). In our Present study among 185(21.02%) Illiterate mother 16(8.6%) were overweight, 155(83.8%) were normal weight and 14(7.6%) were severely malnourished children. Among 695(78.97%) Literate women 116(13.18%) were overweight, 559(80.43%) were normal weight and 20(2.877%) were severely malnourished children.

Among 110(12.15%) Illiterate father 9(8.2%) were overweight, 88(80.0%) normal weight and 13(11.8%) severely malnourished children. Among 770(87.5%) Literate men 123(13.97%) were overweight, 626(81.29%) were normal weight and 21(2.72%) severely malnourished children

A matriculate or intermediate qualified housewife mothers input in child feeding, decision making and assistants in upbringing of her child evident in her activities were also positively associated with optimum child nutrition.

Household assets play an important role in health status of adult and children. Household assets are considered as standard of living of family. The socio-economic status is calculated on the basis of assets in the house. At the same time the gradient of household socio-economic status remains as crucial determinant of level of nutritional achievement among children. We have asked various electronic and physical assets holding with different households in two district of Jammu division.

		BMI(Weight Range)			Total
		Normal weight	overweight	severe	
Socio economic Status	poor	130(86.1%)	16(10.6%)	5(3.3%)	151
	middle class	538(80.4%)	102(15.2%)	29(4.3%)	669
	high class	46(76.7%)	14(23.3%)	0(0.0%)	60

we found that 5(3.3%) and 29(4.3%) were severely malnourished children in the Poor class and the middle class. There were no severe children found in high class. And from overall we conclude that 14(23.3%) children were overweight in High class as compare to Poor and Middle class.

Study by Ghnonge *(et al* 2015[5]) found that children from Private Schools belonged to Upper Class whereas it was so only in 27.41% of Government School children who belonged maximally to Upper Middle class 378(67.5%). Overall Prevalence of

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Obesity and Overweight was 5.62% and 9.99%.

Study conducted by Masthi (*et al* 2013[11]), among the families surveyed at Rural and Urban setting it was observed that the majority 67% and 50% respectively belonged to High Class when Standard of living Index Scale was applied.

Now a day's most of the parents don't have time to observe children's activities. They play games and eat different kinds of food.

C. Malnutrition among children and Diet history of children.

		BMI(Weight Range)			Total
		Normal weight	Overweight	Severe	
Diet history	Veg	484(81.1%)	96(16.1%)	17(2.8%)	597
	nonveg	230(81.3%)	36(12.7%)	17(6.0%)	283

The nutritional status of the children affect due to the unhygienic food. Sometime parents provide money to the children. They buy gems and biscuits from shops. Finally, it also affects on their health status. There were 283(81.3%) children who eat non veg, 36(12.7%) were overweight, 17(6.0%) were severely malnourished. No doubt chicken provide good nutrition to children. But it is costly also therefore family cook chicken once or twice in a week. The 597(67.84%) eat vegetable, 96(16.1%) were overweight, 17(2.8%) were severely malnourished children. fresh vegetables are not costly like chicken and meat that is why every section can buy and consume it at reasonable rate.

Now we understand the relationship between per capita income of household and the malnutrition among children in the following table.

D. Per capita income and malnutrition among children.

		BMI(Weight Range)			Total
		Normal weight	Overweight	Severe	
Income	below 10000 to upto20000	321(81.5%)	58(14.7%)	15(3.8%)	394
	21000-30000	344(81.5%)	62(14.7%)	16(3.8%)	422
	31000-40000	49(76.6%)	12(18.8%)	3(4.7%)	64

Family income is the sole determinant of nutritional status of school children. At lower income group (below 10000 to up to 20000) we found out of 394(44.77%), the incidence of severe malnutrition were 15(3.8%), 58(14.7%) were overweight. In the middle income group (21000-30000), we found 422(47.95%), the incidence of severe malnutrition were 16(3.8%), 62(14.7%) were overweight. The upper income group (31000-40000) we found out of 64(7.27%), the incidence of severe malnutrition were 3(4.7%), 12(18.8%) were overweight. Now we see that the higher incidence of severely malnutrition were observed in the middle income group.

III. RESULT & CONCLUSION.

We used logit regression model in order to examine the nutritional status of school going children. Such model is used to (11-17) age group children in urban and rural areas. The children are classified as malnutrition if the BMI falls less than 5th percentile is underweight (Severe) and Equal to or greater than the 85th percentile is Overweight [Kleinbaum *et al* 1994[9]].

Logit model for school children is as follows

$$\text{Prob (a given school children is malnourished)} = \frac{Exp(\beta x)}{1+Exp(\beta x)}$$

The logistic regression can be understood simply as finding β parameters that best fit.

Interpreting the result

A. Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	118.668	51	.000
Deviance	95.008	51	.000

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In the goodness of fit table the first row labelled Pearson presents Pearson Chi-square Statistic p value .095 (<.05) indicates that the model fit the data well.

B. Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	194.789			
Final	187.051	7.738	5	.041

In the Model Fitting Information the p value is 0.41(<.05)
The Statistically significant chi-square Statistic (p=.041) indicate that the final model gives a significant association between the dependent and independent variables
Parameter Estimate

		Estimate	Std. Error	Wald	df	Sig.	95% confidence interval	
Threshold		1.164					Lower Bound	Upper Bound
	[BMI = 1.00]	1.164	.142	67.140	1	.000	.886	1.443
	[BMI = 2.00]	2.714	.190	203.622	1	.000	2.341	3.086
	SES=.00]	-.463	.257	3.263	1	.031	-.966	.039
	SES=1.00]	0[a]	.	.	0	.	.	.
	Edu of father=.00]	.038	.263	.021	1	.024	-.477	.553
	Edu of father=1.00	0[a]	.	.	0	.	.	.
	Edu ofmother=.00	-.227	.223	1.037	1	.030	-.663	.210
	Eduofmother=1.00	0[a]	.	.	0	.	.	.
	Age_group=.00	.008	.182	.002	1	.016	-.350	.365
	Age_group=1.00	0[a]	.	.	0	.	.	.
	Type of sch=.00	-.237	.172	1.893	1	.169	-.574	.100
	Type of sch=1.00	0[a]		.	0	.		

We use 880 observations in our data set for the analysis. In the Parameter estimate table we see that the p value in all cases less than 0.05 except the type of school, from this we conclude that nutritional status of school going children is associated with socio economic status, education status of father and mother, age group of children. The Household having lowest income are not able to buy different inputs required for health and so it is positively and statistically significant. Mothers education playing an important role in health of children so from our analysis part the p value 0.030 (<0.05) indicates significant association between them. From our analysis part we found that the children in the age group (11-13) were most likely affected by malnutrition. Srivasta (*et al* 2012[14]), conducted a cross-sectional study of nutritional Status in school age slum children and analysed the Prevalence of stunting and underweight was highest in the age group 11-13 years.
Thakre (*et al* 2011[16]), studied that the risk of Overweight/obesity was significantly (p=0.0120) higher among children who belonged to the upper SES and to the age group of ≥10 years.
In our study we found that 22(5.3%) female children were suffering from severely malnourished as compared to 12(2.6%) male, which implicate that still there is a lot of negligence in the community regarding upbringing of female child, study conducted by Stalin P,(*et al* 2013[15]) have shown prevalence of underweight was 52.9%. Around 7% of children were severely malnourished. In

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their study higher rate of malnutrition is observed in female (62.6%).

In our study we found that 5(3.3%) and 29(4.3%) were severely malnourished children in the Poor class and the middle class and Children belonging to higher socio economic status were no severely malnourished than poor and middle class. Study by Shreyaswmi (*et al* 2013[13]) have observed 63.16% malnourished children. Dhakal MM (*et al* 2005[3]) study, observed that the burden of malnourishment still haunts the poor with 82.75% children from low income group. [14-15]

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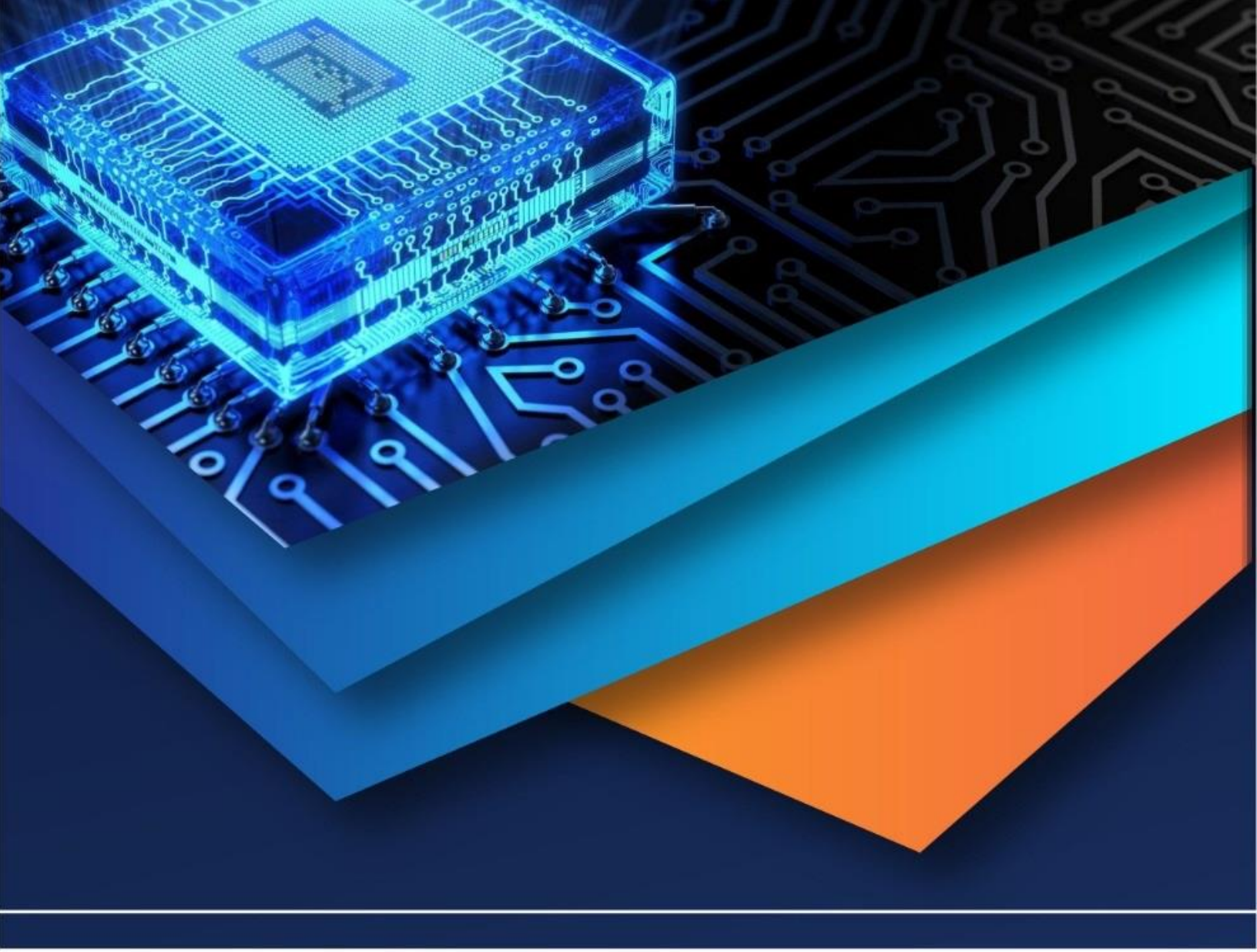

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