

Role of Calcium in Mental Development and Intelligence of School-Aged Children of District Hyderabad, Sindh

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ABSTRACT

Background: Calcium ions are essential regulators of a variety of neuronal activities that take place in the nervous system. “These neuronal activities include the formation and maturation of neural circuits, as well as long-term memory. However, Calcium ions are also important in the early stages of neurogenesis. **Objective:** The purpose of this study was to assess the impact that calcium on the mental development of school-aged children. **Study Design:** Cross-sectional study. **Settings:** The study was conducted in different government schools in Qasimabad, Hyderabad Pakistan. **Duration:** October 2021 to March 2022. **Methods:** Informed consent was obtained before the enrolment of participants, 121 children were recruited. A structured questionnaire was formed for the assessment, and a blood sample of five milliliters was drawn for the laboratory's investigation of serum calcium. Data analysis was performed using SPSS 26.0, and a *P*-value of less than 0.05 was set to be statistically significant. **Results:** In this study, the mean age of all participants was 11 ± 2.296 years, serum calcium was 9.12 ± 4.21mg/dl, and the FSIQ score was 91 ± 11.3. In this study, serum calcium was related to the development of IQ. **Conclusion:** This study concluded that an increase in serum calcium levels may lead to an increase in FSIQ levels and vice versa. As a result, one may conclude that the mental development of children is contingent on the quantities of calcium in their blood.

Keywords: Serum Calcium, FSIQ, Children.

INTRODUCTION

It is believed that dietary calcium deficiency is widespread throughout the world, research indicates that approximately half of the world's population lacks adequate access to dietary calcium. Dietary calcium deficiency is also known as calcium deficiency anemia. Low consumption of calcium has been linked to a variety of adverse health issues. Low calcium intakes are most prevalent in low- and middle-income countries (LMICs), but a significant number of people in high-income countries (HICs) do not reach recommended levels either.¹

The prevalence of mental health issues among college students in the United States (US) is on the rise, “but traditional treatments like medication and therapy have

their limitations. Despite this, the number of students in the US who experience mental health issues continues to rise. EA diet that is high in dairy and calcium is associated with improved mental health; however, research to date has focused on determining the specific associations that exist between milk and calcium intake and various mental health indicators. To determine whether or not an increase in milk consumption and calcium intake could be used as a mental health intervention, additional research on the associations between these factors is required.²

The calcium signaling pathway plays an important role in the regulation of neuronal excitability and neuronal breathing rhythms, both of which are essential for cognitive function. Dysregulation in vitamin D and

calcium signaling pathways has been linked to many neurological diseases, including dementia, Alzheimer's disease, Parkinson's disease, multiple sclerosis, epilepsy, bipolar disorder, and schizophrenia. The purpose of this review is to integrate clinically-based epidemiological research with potential calcium and vitamin D-linked physiological mechanisms in neuropsychiatric diseases 46." Our goal is to accomplish this goal. "Although calcium (Ca) and magnesium (Mg) are presumed to be associated with mental diseases like depression, very little research has been done to investigate the relationship between calcium and magnesium intake in the diet and depression in middle-aged female adults. There have been studies that demonstrate the effect that minerals such as calcium (Ca) and magnesium (Mg) have on those who suffer from depression. Ca dysregulation has a significant role in the pathophysiology of neurological conditions including dementia and depression. Changes in extracellular calcium concentration have the potential to stimulate neuromuscular connections, and hypocalcemia has been linked to irritability, mania, and agitation in patients. Ca intake is assumed to be associated with depression and mental disorders, even though only a few pieces of research have shown the relationship between Ca nutrition status and depression in middle-aged women who are pre-menopausal and post-menopausal. [Ca intake] is thought to be associated with depression and mental disorders".^{3,4}

METHODS

After approval from the Research Ethics Committee, vide letter no. LUMHS/REG/ACD/17391/93, DATED 28 OCTOBER 2021. This study was conducted in different government schools of Qasimabad district Hyderabad. A cross-sectional comparative study, aged between 6 to 18 years. The nonprobability convenience sampling technique was used from October-2021 to March-2022. Sample Size was calculated by using EPI INFO software. Inclusion Criteria, Students aged 6 -16 years, Students from government school Qasimabad / Hyderabad. Exclusion Criteria, Students below 6 years or above 16 years, Students with congenital and systemic disorders, handicapped students, Students with any unknown mental or physical abnormality, **and** Students with any unknown family history of mental or physical abnormality.

Informed consent was obtained before the enrolment of participants. A structured questionnaire was used to get sociodemographic status. A blood sample of 5ml was drawn for serum calcium level by using the micro lab. The IQ outcome measure consisted of standardized psychometric testing resulting in FSIQ scores using the Wechsler Preschool Scale of Intelligence Fifth Edition (WISC-V).⁵

RESULTS

Table 1, indicates the mean values along with *P* value participants.

Table 1: Description of population

Variables	Mean \pm SD
Age (n 121)	11 \pm 2.296
Male (51)	10.8 \pm 1.95
Female (70)	11.2 \pm 2.35
Calcium (mg/dl)	9.12 \pm 4.21
FSIQ Score	91 \pm 11.3

Table 2, indicates the significant association of serum calcium level with FSIQ score, as compared to hypocalcemia participants.

Table 2: Distribution of FSIQ Score in Population

Variable	Low IQ	Average IQ	High IQ
Total Population	19	87	15
Normocalcemia	6	35	13
Hypocalcemia	13	52	02

Table 3, indicates the statistically significant association of serum calcium with FSIQ level.

Table 3: FSIQ Score in Population

Variable	FSIQ Score	<i>P</i> - value
Total Population (n=121)	91 \pm 11.3	0.0431*
Normocalcemia (n=67)	96 \pm 6.9	
Hypocalcemia (n=54)	81 \pm 11.9	

Figure 1, shows the significant correlation of serum calcium with FSIQ Score.

Figure 1: Pearson Correlations between Serum Calcium Levels and FSIQ Score (n=121)

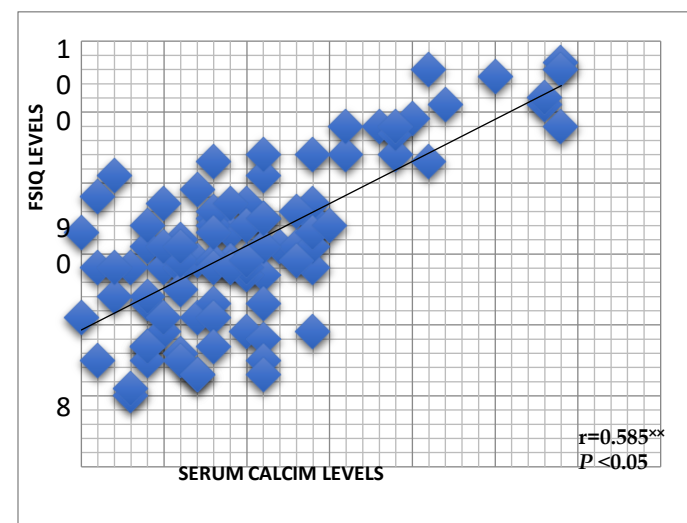


Figure 2, shows the significant correlation of serum calcium with academic performance in children.

Figure 2: Pearson Correlations between Serum Calcium Levels with Academic Performance (n=121)

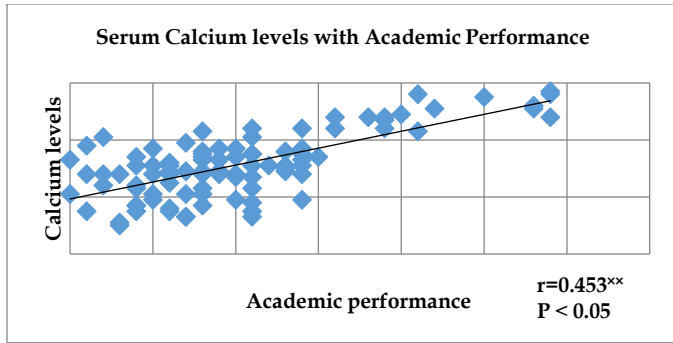


Figure 3, Group A has lower serum calcium levels have lesser IQ levels than Group B that have normal serum calcium levels.

Figure 3: FSIQ Scores Comparison between Hypocalcemia and Normocalcemic (n=121)

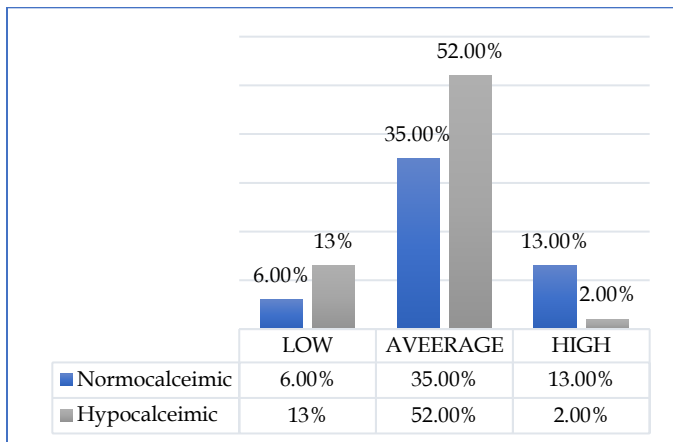


Table 4, Annova, test shows the significance of serum calcium with FSIQ, Academic performance, and BMI between groups for the variable

Table 4: ANOVA Test between Variables

		df	F	Sig.
Serum calcium Levels	Between Groups	23	4.199	.0031
	Within Groups	72		
	Total	95		
BMI	Between Groups	23	6.256	.0029
	Within Groups	72		
	Total	95		
FSIQ (Verbal)	Between Groups	23	35.628	.0041
	Within Groups	72		
	Total	95		
Academic performance	Between Groups	23	5.364	.0037
	Within Groups	72		
	Total	95		

DISCUSSION

Because hypocalcemia may have a detrimental effect not only on an individual's physical but also their mental

health. A healthier diet and increased consumption of calcium were found to be associated with lower levels of perceived stress and higher levels of positive mood ratings, as well as lower levels of anxiety, rumination, and higher levels of resilience. In addition to this, when the calcium intake level increased, the connection between experienced stress and anxiety, as well as perceived stress and mood, was shown to weaken.

According to the findings of a study that was carried out on 121 children between the ages of 6 and 16, "the average IQ of males is 79, while the average IQ of females is 76. These results, which can be seen in Table 02, indicate that there are no significant gender differences in IQ. In the meantime, the average IQ of people with normal calcium levels is 77, while those with hypocalcemia have an IQ of 67 (as shown in Table 03), which is a very significant difference with a P-value of 0.0197. In addition, the results of this study indicate that the Pearson correlation between serum calcium levels and FSIQ scores was found to be 585**, with a significance level of 0.0167. Consequently, this demonstrates that there is a moderately significant correlation between serum calcium levels and IQ levels. Furthermore, this demonstrates very clearly that decreasing serum calcium levels will cause a corresponding decrease in FSIQ levels

Calcium ions are responsible for this signal transfer. In neurons, calcium ions play an important part in regulating activity-dependent signaling and controlling the excitability of neurons. Calcium ions also play a role in controlling neuronal excitability.⁶ It has been suggested that because calcium influences neural development, there is a chance that dysregulation of calcium may play a role in lower IQ levels. This is because calcium has been shown to influence neurodevelopment.⁷ Interestingly, calcium signaling pathways have been shown to regulate neuronal functions. These pathways have also been implicated in other neural developmental disorders, including schizophrenia, bipolar disorder, and autism spectrum disorder, which further suggests that calcium levels in the diet could influence the neurodevelopmental phenotype.⁸

Gileeani et al⁹ Students found that the "Mean FSIQ of the real Pakistani children was found to be 84" in their research. The median and average scores on the FSIQ were 79 and 81.5, respectively, during the medieval period. The standard deviation of the FSIQ scores was 13 points, and the interquartile range was 17 points. The WISC-V was used to collect the data for this study, which is consistent with our data collection procedure. The fact that the mean FSIQ levels for males are 79 and the mean FSIQ levels for females are 76 indicates that there is no significant difference between the genders in terms of intelligence. Our results are also consistent with our previous research, although there are some slight

variations in the mean values. Ceatealano et al¹⁰ investigated the prevalence of hypocalcemia and hypercalcemia among all population groups that were studied. He states that hypocalcemia was present in 27.72% of the 12,334 people who participated in the study, whereas hypercalcemia was present in only 4.74% of them. In addition, he concluded that individuals between the ages of 0 and 18 years old had the greatest prevalence of hypoglycemia (44.95 percent). However, there was no difference in the prevalence of hypercalcemia between the sexes. Males were more likely to suffer from hypocalcemia (57.07%). The prevalence of hypoglycemia has steadily decreased since 2011, when it stood at 35.42 percent, and has now fallen to 21.93 percent. The findings of this study are consistent with our study, which shows that out of the 121 people who participated in the study, 47 (38.84%) had hypocalcemia and 74 (61.15%) had normal serum calcium levels. This study is consistent with our findings. In addition, we did not find any differences related to gender in our investigation of hypercalcemia.

In the evaluation of the 12 algorithms that were developed for the Canadian standardization sample, it was discovered that the algorithms that combined one subtest with demographics tended to account for less variance in actual FSIQ scores than the algorithms that combined two or four subtests. This was determined through the use of evaluation. The algorithm that only considered demographic information, known as C-DEMO, was the least predictive of FSIQ. The most variation in FSIQ was accounted for by an algorithm that combined four subtests with demographic variables (4ST). Moreover, based on our previous research predicting premorbid FSIQ scores,¹¹ we vigilance against assuming that the algorithm using four subtests (4ST) will perform well as an estimate of premorbid intellectual functioning. This is primarily because this algorithm has been shown to provide poor estimates of premorbid FSIQ in adult clinical studies.¹¹ Algorithms that combine one (or two) subtests with demographic variables may perform better as estimates of premorbid intellectual functioning. This may be the case if the subtests are selected carefully (e.g., Schoenberg et al., 2003). Variations in the function of smooth muscle in conjunction with decreased serum levels of calcium a possible cause of wheezing, dyspnea, dysphagia, and abdominal pain is irritability of the autonomic nervous system and bronchial tubes. Subscapular cataracts occur in chronic, longstanding hypocalcemia,⁷ and with treatment, especially when the calcium x phosphate product is chronically elevated. The presence of paravertebral ligamentous ossification has been documented in fifty percent of patients diagnosed with hypoparathyroidism, and gait may also be observed in these patients, and subnormal intelligence has been

observed in some cases of chronic hypoparathyroidism, psychoses, organic brain syndrome, and the like. The syndrome that includes hypoparathyroidism as one of its features may also be responsible for delayed development, below-average intelligence, and impaired cognitive function, among other symptoms.^{12,13} When evaluating young patients for the condition, this factor is of the utmost importance to take into account. The elderly population is more likely to exhibit symptoms of hypocalcemia, including disorientation and confusion."

CONCLUSION

This study has shown that there is a moderately significant correlation between serum calcium levels and IQ levels. "This demonstrates that decreasing serum calcium levels will cause a corresponding decrease in FSIQ levels, and vice versa. Additionally, this study has shown that increasing serum calcium levels will cause a decrease in FSIQ levels. As a result, one may conclude that the mental development of a kid is contingent on the quantities of calcium in their blood. This research indicates that there is not a significant gender difference, income difference, or BMI difference between the IQ scores of male and female participants who took part in the study. In addition, the findings of this study provide further evidence that serum calcium levels can have a significant physiological impact on IQ levels. As a result, ensuring that children have adequate serum calcium levels within the norms of physiological norms" can help improve the mental development of children as well as their IQ levels overall.

LIMITATIONS

A small or unrepresentative sample may not accurately reflect the broader population of school-aged children in Hyderabad.

SUGGESTIONS / RECOMMENDATIONS

To support the mental development and intelligence of school-aged children in District Hyderabad, it's crucial to promote the intake of calcium-rich foods through public health education and school-based programs. Regular nutritional assessments and cognitive evaluations should be conducted to monitor progress, and targeted interventions should be implemented for vulnerable groups.

CONFLICT OF INTEREST / DISCLOSURE

All authors declare no conflict of interest.

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