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Original Article

RELATIONSHIP OF ADENOSINE DEAMINASE AND SERUM FERRITIN LEVELS WITH BODY MASS INDEX IN CHILDREN. A CROSS-SECTIONAL STUDY.

Gautam Chand Sirvi[a], Mayank Nama[b], Abhinav Purohit[a], Shubhendu Kumar Suman[c]*

[a]Assistant Professor, Department of Physiology, Government Medical College, Pali, Rajasthan, India.
[b]MD, Department of Biochemistry, Government Medical College, Kota, Rajasthan, India.
[c]Tutor, Department of Biochemistry, Nalanda Medical College, Patna, Bihar, India.

Abstract

Objectives:

The study aims to establish the correlation between serum adenosine deaminase and ferritin levels with somatometric measurements in children aged 6 to 14. Additionally, it sought to assess the association of these biochemical parameters with components of dysmetabolic syndrome, including blood pressure and lipid profile.

Methods:

The multicentric study, conducted over a 2-year period from Jan 2021 to Dec 2022 at a tertiary care centre, focused on children aged 6 to 14 attending the outpatient department for eyesight irregularities or immunization. A total of 120 children meeting specific inclusion criteria underwent meticulous anthropometric measurements, BMI calculation, and comprehensive biochemical assessments to correlate serum adenosine deaminase (ADA) as well as ferritin levels with various parameters. The biochemistry tests were performed at the Department of Biochemistry, Nalanda Medical College & Hospital, Patna.

Results:

In the study of 120 children (6-14 years), the overweight/obese group (n=60) showed higher weight (52.309 kg) compared to the normal weight group (n=60, 27.945 kg). Anthropometric measures, excluding common parameters, were significantly elevated in the obese cohort. Robust positive correlations were noted amongst systolic blood pressure, adenosine deaminase, and serum ferritin with BMI, and significant associations were noted between anthropometric measures and ferritin levels, with ADA showing significance only in systolic blood pressure and waist-hip ratio.

Conclusion:

The current study revealed significant associations between anthropometric measures, serum adenosine deaminase (ADA), and ferritin levels in children aged 6-14. These findings emphasize the interplay between obesity, inflammatory markers, and cardiovascular health in this paediatric population.

Recommendation:

The study recommends further research with larger samples to validate findings and emphasizes the importance of longitudinal studies to elucidate dynamic relationships between anthropometric measures, inflammatory markers, and metabolic outcomes in paediatric populations.

***Keywords**: Paediatric Obesity, Anthropometric Measures, Serum Adenosine Deaminase, Ferritin Levels*
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***Corresponding Author**: Shubhendu Kumar Suman[a,*], Tutor, Department of Biochemistry, Nalanda Medical College, Patna, Bihar, India.*
Email: vassist.research@gmail.com

Introduction

Obesity is a major contributing factor for various non-communicable diseases (NCDs) [1]. The global incidence rates of overweight individuals have tripled over the past years, with juveniles aged 5-19 constituting a significant portion at 340 million [1]. The progression from childhood weight gain to adult obesity increases the susceptibility to NCDs in adulthood. Developing nations, like India, face a distinctive challenge of a "double burden," encompassing poverty and under-nutrition on one side and the emergence of obesity on the other [2, 3].

Adipocytes and immune cells release several inflammation-inducing agents, which are implicated in long-term systemic inflammation, impaired insulin sensitivity, and vascular diseases, contributing to NCDs like diabetes, cardiac diseases, malignancies, and breathing disorders [4]. In metabolic syndromes, adipose tissue generates anti-inflammatory adenosine in response to inflammation, but adenosine deaminase (ADA) activity may contribute to pathophysiology by converting adenosine into inosine [5]. Research on levels of ADA in serum as well as the genetic polymorphism of ADA in insulin-resistant and diabetic patients indicates elevated levels in those with obesity. Despite obesity presenting as a subdued inflammation, studies link body mass index (BMI) with the levels of inflammatory markers [6-8]. However, conflicting findings exist among adults regarding the association between BMI and ferritin content in the serum, hemoglobin, and iron content [9-12].

The present investigation was structured to establish connections between serum ADA and Ferritin concentrations and various anthropometric indicators in children. Furthermore, the biochemical aspects of

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dysmetabolic syndrome, such as blood pressure and lipid profile, corresponding to age, were assessed in conjunction with these parameters.

Materials and Methods

Study design

A cross-sectional study.

Study setting

The current research study was carried out at Nalanda Medical College, Patna, Bihar, India, over a 2-year duration from Jan 2021 to Dec 2022.

Participants

The study encompassed juveniles between 6 to 14 years visiting the outpatient department for evaluations related to eyesight irregularities or immunization.

Inclusion criteria

Inclusion criteria comprised healthy children attending for eyesight irregularities assessment or immunization, without known prolonged ailments.

Exclusion criteria

Exclusion criteria encompassed individuals with a history of various long-term health conditions, including wheezing during childhood, prolonged pulmonary disease, gluten-induced enteropathy, nephrosis, chronic renal insufficiency, hepatogenic jaundice, mental illness, haemoglobin disorders, coagulation disorders, tumours, seizures, diabetes mellitus, chronic drug usage, or use of haematinics. Exclusions were implemented to mitigate potential indirect influences on Ferritin and ADA serum levels.

Study size

The study included 120 children who met specific inclusion criteria.

Data collection and analysis

A proficient observer meticulously recorded height and weight using a height chart and a digital weighing scale, respectively, adhering to established guidelines. Subsequently, the quetelet index was computed and plotted in accordance with the BMI charts of the Indian Academy of Paediatrics [13]. The children were then categorized into two groups: those deemed obese with a BMI surpassing 27 (equivalent to adults) and those classified as normal, falling below 23 but above the 3rd percentile. This latter group served as the healthy control for the study.

Additionally, various anthropometric measurements, including thickness of the triceps skinfold, circumferences of the waist and hip, and the abdominal adiposity index, were diligently obtained as per the standard protocols [14-17]. Blood pressure was measured after a brief period of rest in a seated position. Furthermore, blood samples were drawn after a period of fasting for a comprehensive physicochemical analysis, encompassing total triglycerides, cholesterol, high-density and low-density lipoprotein cholesterol. Serum adenosine deaminase (ADA) concentrations were assessed by colorimetric method, and serum Ferritin levels were determined by Chemiluminescence Immunoassay technology on an automated analyzer, employing standardized reagents and calibrators. The biochemistry tests were performed at the Department of Biochemistry, Nalanda Medical College & Hospital, Patna.

Statistical Analysis

Quantitative variables were presented as average, and their analysis was conducted through an unpaired t-test. The coefficient of correlation (r) was computed to correlate BMI with the physicochemical parameters.

Ethical Consideration

The study protocol was approved from the institute ethical committee. Consent in writing was acquired from parents, and assent was secured from the children prior to study.

Results/Outcomes

Participants

Out of the initial 248 children screened, 128 were excluded, leaving a study cohort of 120 children, evenly divided into normal and overweight groups with 30 participants each. Predominantly, exclusions were due to unattained parental consent, notably in the normal segment. The overweight or obese cohort comprised more boys than girls. The average age was 10.124 yrs in the normal group and 10.267 yrs in the overweight cohort. Notably, the average weight was 27.945 kg in the normal cohort, significantly lower than the overweight cohort's 52.309 kg.

Statistically, all considered physique measurements, excluding weight, height and other common parameters were notably higher in the obese cohort. While SBP was prominently higher in obese children, DBP exhibited no substantial difference between the groups. Serum Ferritin levels were markedly higher in the obese group (43.826 ng per L) compared to the normal weight group (27.685 ng per L). ADA results echoed a similar pattern, with higher values in the overweight (24.397 U per L) vs non-obese (17.732 U per L), showing statistical significance. LDL cholesterol and total cholesterol were also drastically elevated in the overweight/obese group (101.486 mg per dl and 162.361 mg per dl, respectively) in contrast to the normal weight group (82.627 mg per dl and 126.589 mg per dl, respectively).

Serum triglyceride levels were slightly more in the overweight cohort (125.697 mg per dl) than the non-obese cohort (104.617 mg per dl), without statistical significance. HDL cholesterol, a cardiovascular risk factor in adults, showed no notable difference between the two groups. A robust positive correlation was observed between systolic blood pressure, Adenosine deaminase, and serum Ferritin with BMI (Table 1).

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Table 1: Association of BMI with Blood Pressure and Biochemical Parameters

Biochemical parameter	Correlation coefficient with BMI	
	(r)	(*P*)
Diastolic blood pressure	0.174	0.12
Systolic blood pressure	0.398	0.002
Serum Ferritin	0.339	0.006
Serum Adenosine deaminase	0.301	0.01
Total Cholesterol	0.261	0.071
Serum Low density lipoprotein	0.198	0.149
Serum High density lipoprotein	0.012	0.812
Serum Triglycerides	0.106	0.64

No significant variations were noted for the lipid profile components concerning body mass index. The correlation analysis of somatometric measures with Ferritin revealed a positive association with the lipid profile components. While blood pressure and somatometric measurements were also positively correlated, this did not reach statistical significance. All somatometric measures were positively correlated with ADA, but a significant variation was observed with WHR and SBP alone (Table 2).

Table 2: Association of Blood Pressure and Somatometric Measurements with Serum Ferritin and Adenosine Deaminase (ADA)

Physique measurements	Correlation coefficient with			
	Serum Ferritin		Serum Adenosine deaminase	
	(r)	(*P*)	(r)	(*P*)
Diastolic blood pressure (mm of Hg)	0.085	0.512	0.236	0.070
Systolic blood pressure (mm of Hg)	0.54	0.24	0.324	0.012
Waist circumference (cm)	0.375	0.003	0.229	0.079
Hip circumference (cm)	0.281	0.029	0.141	0.266
Waist/Hip ratio	0.396	0.002	0.301	0.019
Triceps Skin Fold Thickness (mm)	0.302	0.019	0.226	0.083

Discussion

The findings from the current study indicate that obese children exhibited significantly elevated levels of ADA, serum Ferritin, LDL cholesterol, and total cholesterol, compared to their normal counterparts. This aligns with previous findings, that recorded a substantial increase in serum ADA activity among obese subjects in contrast to standard cohort [18-22]. Another study in Bangladesh also demonstrated a robust association between lipid parameters, serum ADA levels, glucose, and BMI [23].

The study also identified a positive correlation between ferritin and other physicochemical parameters. Ferritin, a recognized acute phase reactant, is strongly linked to abdominal obesity and various markers indicating body fat distribution [8]. A comprehensive meta-analysis investigating the relationship between metabolic syndrome and ferritin showed a robust positive correlation between BMI and ferritin concentration in the serum [24].

While primarily derived from adult and animal studies, the study in children also highlighted significant differences in ferritin, LDL cholesterol and total cholesterol between obese and normal groups. The substantial variations in ADA and serum ferritin levels between overweight and normal weight children support these proposed explanations. Adipocytokines influence hepcidin secretion, regulating iron absorption and tissue secretion, potentially causing deficiency of iron [25]. Low-grade inflammation may falsely elevate ferritin levels in obesity associated with iron deficiency. Yet another perspective suggests that iron excess in obesity may result from insulin resistance impacting homeostasis of iron, leading to impairment of liver, elevated levels of insulin in blood, and abnormal lipid profile [26].

In the current study, a positive correlation emerged between ADA and all anthropometric values; however, statistical significance was specifically noted in relation to SBP and WHR. This underscores the importance of considering these specific anthropometric parameters in understanding the interplay between ADA and cardiovascular health in our study population.

Conclusion

The study highlights a significant association between anthropometric measurements and biochemical parameters, particularly the positive correlation of ADA with SBP and WHR. These findings underscore the potential impact of adiposity on systemic inflammation and cardiovascular health in the studied paediatric population. Additionally, the observed disparities in serum Ferritin levels between overweight and normal weight children suggest potential implications for iron homeostasis in relation to obesity. Further research is warranted to elucidate the intricate links between adiposity, inflammatory markers, and metabolic outcomes in paediatric populations.

Limitations

The current study is constrained by a relatively small sample size, limiting generalizability, and the cross-sectional design, which precludes establishing causation or assessing long-term trends.

Recommendations

The study recommends conducting further research with a larger and diverse sample to validate findings and enhance generalizability. Additionally, longitudinal studies are suggested to provide insights into the dynamic relationships between anthropometric measures, inflammatory markers, and metabolic outcomes in paediatric populations.

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List of Abbreviations

ADA – Adenosine Deaminase
NCDs - Non-Communicable Diseases
BMI - Body Mass Index
HDL – High Density Lipoprotein
LDL – Low Density Lipoprotein
WC - Waist Circumference
BP - Blood Pressure
WHR - Waist-Hip Ratio
TST - Triceps Skinfold Thickness
HC - Hip Circumference

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Conflict of interest

No conflict of interest.

References

1. World Health Organization. Obesity. 2020. Geneva: World Health Organization.
2. Bangalore TN, Joshi TK. India: Country report on children's environmental health. Rev Environ Health. 2020;35:27-39.
3. Ranjani H, Mehreen TS, Pradeepa R, Anjana RM, Garg R, Anand K, et al. Epidemiology of childhood overweight and obesity in India: A systematic review. Indian J Med Res. 2016;143:160-74.
4. Pîrsean C, Neguţ C, Stefan-van Staden RI, Dinu-Pirvu CE, Armean P, Udeanu DI. The salivary levels of leptin and interleukin-6 as potential inflammatory markers in children obesity. PLoS One. 2019;14:e0210288.
5. Takhshid MA, Zahediannejad Z, Aboualizadeh F, Moezzi L, Ranjbaran R. G22A polymorphism of adenosine deaminase and its association with biochemical characteristics of gestational diabetes mellitus in an Iranian population. Iran J Med Sci. 2015;40:170-4.
6. Wish JB. Assessing iron status: Beyond serum ferritin and transferrin saturation. Clin J Am Soc Nephrol. 2006;1(Suppl 1):S4-8.
7. Sharma AP, McKenna AM, Lepage N, Nieuwenhuys E, Filler G. Relationships among serum iron, inflammation, and body mass index in children. Adv Pediatr. 2009;56:135-44.
8. Lecube A, Hernández C, Pelegrí D, Simó R. Factors accounting for high ferritin levels in obesity. Int J Obes (Lond). 2008;32:1665-9.
9. Gartner A, Berger J, Bour A, El Ati J, Traissac P, Landais E, et al. Assessment of iron deficiency in the context of the obesity epidemic: Importance of correcting serum ferritin concentrations for inflammation. Am J Clin Nutr. 2013;98:821-6.
10. Gillum RF. Association of serum ferritin and indices of body fat distribution and obesity in Mexican American men--the third national health and nutrition examination survey. Int J Obes Relat Metab Disord. 2001;25:639-45.
11. Eftekhari M, Mozaffari-Khosravi H, Shidfar F. The relationship between BMI and iron status in iron-deficient adolescent Iranian girls. Public Health Nutr. 2009;12:2377-81.
12. Ghadiri-Anari A, Nazemian N, Vahedian-Ardakani HA. Association of body mass index with hemoglobin concentration and iron parameters in Iranian population. ISRN Hematol. 2014;2014:525312.
13. Indian Academy of Pediatrics Growth Charts Committee, Khadilkar V, Yadav S, Agrawal KK, Tamboli S, Banerjee M, et al. Revised IAP growth charts for height, weight and body mass index for 5-to 18-year-old Indian children. Indian Pediatr. 2015;52:47-55.
14. Rönnecke E, Vogel M, Bussler S, Grafe N, Jurkutat A, Schlingmann M, et al. Age-and sex-related percentiles of skinfold thickness, waist and hip

circumference, waist-to-hip ratio and waist-to-height ratio: Results from a population-based pediatric cohort in Germany (LIFE child) Obes Facts. 2019;12:25-39.
15. Sebati B, Monyeki K, Makgae P. An assessment of the relationship between anthropometric parameters and blood pressure among Polokwane private school children. Children (Basel). 2020;7:29.
16. Falkner B, Daniels SR. Summary of the fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents. Hypertension. 2004;44:387-8.
17. Browne RH. On the use of a pilot sample for sample-size determination. Stat Med. 1995;14:1933-40.
18. Shattnawi KK, Alomari MA, Al-Sheyab N, Bani Salameh A. The relationship between plasma ferritin levels and body mass index among adolescents. Sci Rep. 2019 Jan 24;9(1):692
19. Pompano LM, Correa-Burrows P, Burrows R, Blanco E, Lozoff B, Gahagan S. Adjusting Ferritin Concentrations for Nonclinical Inflammation in Adolescents with Overweight or Obesity. J Pediatr. 2022;244:125-132.e1.
20. He X, Wang W, Zhu Z, et al. Percent Body Fat-Related Disparities of Serum Ferritin on the Risk of Lipid Metabolism Abnormalities in Children and Adolescents. Int J Environ Res Public Health. 2022;19(23):16235. Published 2022 Dec 4.
21. Ryan BJ, Van Pelt DW, Guth LM, et al. Plasma ferritin concentration is positively associated with in vivo fatty acid mobilization and insulin resistance in obese women. Exp Physiol. 2018;103(11):1443-1447.
22. Ryan BJ, Van Pelt DW, Guth LM, et al. Plasma ferritin concentration is positively associated with in vivo fatty acid mobilization and insulin resistance in obese women. Exp Physiol. 2018;103(11):1443-1447.
23. Bhowmik B, Siddiquee T, Mujumder A, et al. Serum Lipid Profile and Its Association with Diabetes and Prediabetes in a Rural Bangladeshi Population. Int J Environ Res Public Health. 2018;15(9):1944.
24. Suárez-Ortegón MF, Ensaldo-Carrasco E, Shi T, McLachlan S, Fernández-Real JM, Wild SH. Ferritin, metabolic syndrome and its components: A systematic review and meta-analysis. Atherosclerosis. 2018;275:97-106.
25. Zhao L, Zhang X, Shen Y, Fang X, Wang Y, Wang F. Obesity and iron deficiency: A quantitative meta-analysis. Obes Rev. 2015;16:1081-93.
26. Zafon C, Lecube A, Simó R. Iron in obesity. An ancient micronutrient for a modern disease. Obes Rev. 2010;11:322-8.

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