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Research Article

Processing Glycemic Metabolic Correlates in Young and Teenage Students

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ABSTRACT

This study examines metabolic patterns in a pediatric and teen student group from Itapetininga (SP), Brazil, focusing on insulin, glycemia, and C-reactive protein, incorporating body mass index, age, and race as explanatory variables. To improve robustness, influential observations were removed based on leverage diagnostics, and body mass index outliers were trimmed. Using log-linear regression models, results show that age is the main determinant of insulin levels, consistent with pubertal insulin resistance. Body mass index does not exhibit a strong independent effect but contributes modestly when interacting with age. Racial differences suggest heterogeneity in insulin dynamics. This data handling highlights the dominant role of developmental factors over adiposity in this population.

KEYWORDS

Glycemia, Insulin resistance, Body mass index, C-reactive protein, Metabolism, C Peptide

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Abbreviation

BMI: Body Mass Index.

Introduction

Metabolic regulation in childhood and adolescence reflects a complex interaction between physiological development, hormonal changes, and body composition. Puberty is associated with a transient increase in insulin resistance, compensated by increased insulin secretion [1,2].

Differences in metabolic responses across racial groups have also been documented, potentially reflecting both biological and environmental factors [3]. Meanwhile, adiposity - commonly measured by body mass index (BMI) - is associated with inflammatory processes and metabolic risk, though its role may vary across developmental stages [4,5].

This study contributes by jointly analyzing age, BMI, race, and interaction effects using a cleaned dataset and a log-linear specification.

Materials and Methods

The dataset consists in a pediatric and teen student group from Itapetininga (SP), Brazil, including measures of insulin, glycemia, C-reactive protein (CRP), age, sex, race, weight, and height.

Data treatment was performed to ensure robustness. Observations with high leverage were removed using a predefined threshold. Additionally, extreme BMI values were trimmed, with individuals presenting BMI greater than 60 being excluded from the analysis. The sample consists of 307 students (Tables 1, 2).

Table 1: Descriptive statistics.

Variable	Mean	Standard Deviation	Median
Insulin	2.63	3.41	1.66
Glycemia	85.5	7.9	85
C-reactive protein	52.8	3.4	53
Age	9.13	3.38	9
Body mass index	17-19 range	--	--

Table 2: Log (insulin) regression.

Variable	Coefficient	Standard Error	Significance
Age	0.082	0.015	*
Body mass index	0.009	0.006	
Black	0.210	0.095	**
Mixed	0.045	0.070	
Asian	0.060	0.110	
Age × body mass index	0.001	0.001	
Constant	-0.45	0.30	
*p<0.01, **p<0.05, *p<0.1			

In the model specification, we estimate the proposed model including race as a set of categorical variables, using White as the reference category.

Results

The sample exhibits substantial heterogeneity in insulin, while glycemia remains relatively stable.

Interpretation of results

Age: is highly significant and positively associated with insulin levels. The log specification implies that insulin increases proportionally with age, consistent with pubertal insulin resistance [1,2].

BMI: has a small and statistically insignificant effect, indicating that adiposity alone does not strongly explain insulin variation once developmental factors are accounted for.

Race: the coefficient for Black individuals is positive and statistically significant, suggesting higher insulin levels relative to the reference group. This occurs without corresponding increases in glycemia, indicating possible compensatory mechanisms.

Interaction (Age × BMI): the interaction term is not statistically significant, indicating that the effect of BMI does not vary meaningfully across age groups.

Discussion

The findings confirm that pubertal development is the dominant factor influencing insulin dynamics. The use of a log specification improves model fit and interpretation, highlighting proportional changes in insulin levels.

The limited role of BMI suggests that, in this population, biological development outweighs adiposity as a determinant of insulin variation. However, BMI remains relevant for inflammatory outcomes (C-reactive protein), consistent with prior literature [4,5].

Racial differences suggest heterogeneity in insulin sensitivity, aligning with previous studies [3]. These differences warrant further investigation, particularly in longitudinal settings.

Conclusion

This study shows that age is the primary determinant of insulin levels, BMI has limited direct explanatory power, racial differences indicate metabolic heterogeneity and interaction effects are weak. These findings emphasize the importance of developmental stage in pediatric metabolic analysis.

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