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Original Research Article

Assessment of Haematological and Biochemical Parameters at Different Pubertal Stages among Boys from Khammam District

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Abstract

Background*:** Adolescence is the most critical phase of human growth that radically alters the physiology of the body and wherein any inconsistency can lead to serious health consequences in adulthood. In adolescents, the haematological and biochemical parameters change with age, necessitating a continuous age-related definition of the reference intervals. This prospective study aimed to examine the utility of new haematological and biochemical markers to assess nutritional status and possible health risks in children, adolescents and adult boys. ***Materials and Methods*:** We performed a cross-sectional study in a sizeable group of 90 male participants aged between 10–22 years to inspect the distribution of values of common haematological and biochemical parameters. Anthropometrical measurements were carried with standard protocols, and blood samples were collected from participants in a hospital setting. Haematological samples were measured using pathology laboratory protocols. Hepatic, renal, lipid and carbohydrate metabolism markers were determined by following standard biochemistry methods. ***Results*:** We observed some differences between haematological parameters, hepatic, renal, lipid and glycaemic profiles among children, adolescents and adults. Amongst lipid parameters, only HDL levels were significantly associated with gender following puberty ($p< 0.001$), the calculated BMI levels were in the lower normal range. ***Conclusions: This is the first study establishing haematological and biochemical parameters in this part of India. These findings provide a helpful guide for clinical researchers and care providers. Studies on a large scale and in different settings would also be desirable.

Keywords: Puberty, adolescents, BMI, haematological, biochemical.

INTRODUCTION

Age is a significant factor that contributes to variation in blood biochemistry. Ageing is a natural, continuous dynamic process that leads to psychological, behavioural and physiological changes resulting in cellular senescence or decline in function of organ systems, biological aberrations, metabolic dysfunction [1].

Amongst different stages of the human life span –infancy, childhood, adolescence, adulthood and old age, adolescence is the critical one. It mainly highlights the transition from childhood to adulthood and is characterised by rapid biological, social and emotional changes that severely impact future health. This transition is primarily governed by the gender of an individual that gives rise to the difference in physiological changes and hormonal levels among boys and girls at puberty [2].

Because of these multiple critical psychological, behavioural and physiological changes, haematological and biochemical parameters vary drastically. Considering the variability of these parameters during adolescence can lay off allied metabolic dysfunction in adulthood. Recently, many studies have examined variability in blood biochemistry in children in different populations; however, only a few have inspected adolescents [3].

The psychological, behavioural and physiological changes during adolescence always occur in a uniform and universal order. However, their pace and timing vary depending upon environmental influences (e.g., food habits, lifestyle, and cultural

systems) [4]. Today, several populations worldwide have encountered rapid urbanisation, swiftly changing the lifestyle of its people and hence pre-disposing them to several complex diseases. Together with the genetic makeup, these changes determine the population-specific normal range of values for common biochemical parameters. One such population that exhibits vast diversity on the grounds of both genetic and lifestyle ways is Indians.

Anthropometric measurements and blood tests are routinely prescribed in healthcare systems to analyse the physical and biochemical changes to evaluate a diseased or a healthy state. A typical haematological profile measures metabolic parameters–glycaemic, lipids, nitrogen metabolites and crucial enzymes [5]. These biochemical parameters vary considerably depending upon an individual's age, sex, ethnicity, dietary intake or physiological state of the body.

The early diagnosis of haematological and biochemical changes seemed to detect metabolic disorders in adolescents and adults. In this present study, we have evaluated the variations in haematological and biochemical parameters in more than 90 healthy male participants to examine the distributions of laboratory values.

MATERIALS AND METHODS

Subjects: A total number of 90 male participants were recruited for this study. They were divided randomly in three groups as pre-pubertal, mid-pubertal and post-pubertalgroup. Selection of participants were carried out from the outpatient department and wards of Department of Paediatrics, General Medicine and Obstetrics and Gynaecology of Mamata General and Super Speciality Hospital, Khammam, Telangana.

A detailed history and physical examination were carried out for every subject who entered in the study as per a pre-designed proforma. Examination comprised of a through physical examination assessment of vital parameters, anthropometry and systemic examination.

A total of 3 ml of blood sample (random) was collected. Serum is separated immediately by centrifuging for 10 minutes and analysed for hepatic, renal, lipid and glycaemic profiles. All the biochemical and haematological investigations were carried out by using the standard laboratory protocols.

Statistical analysis: Data analysis was done by using SPSS Package version. Simple proportions, mean, standard deviation and Chi-square test was used. Chi-square test was used to find out the association between two groups. P value of less than 0.05 is considered as statistically significant.

RESULTS

Results presented in Table 1 shows the descriptive characteristics of the 90 subjects enrolled in the study. There was statistically correlation between age, weight and BMI between thesethree groups.

Table 1: Baseline characteristics of the study participants from pre-pubertal, mid-pubertal and post-pubertal boys group

Variables	Pre-pubertal boys (n=30)	Mid-pubertal boys (n=30)	Post-pubertal boys (n=30)
Age (years)	11.9 ± 1.7	15.6 ± 1.9	19.4 ± 1.4*
Gender (boys/girls)	14/16	12/18	17/13
Height (cm)	148.6 ± 6.4	156.6 ± 6.1	167.8 ± 7.2**
Weight (kg)	53.1 ± 5.1	59.3 ± 4.6	64.3 ± 6.7*
Body mass index (kg/m^2)	19.9 ± 1.7	20.3 ± 2.8	22.6 ± 1.8*
Systolic blood pressure (mm Hg)	107.4 ± 11.9	114.8 ± 10.2	118.4 ± 12.4*
Diastolic blood pressure (mm Hg)	64.4 ± 9.2	69.3 ± 6.8	76.4 ± 5.4***

Mean ±**SD** *P Value <0.05, **P Value <0.01, ***P Value <0.001

Most of the measured haematological indices were significantly different between the three different groups. RBC count, Hb, and WBC count were significantly ($p<0.001$) lower in the exposed than in the pre-pubertal boys group.

Table 2: The estimation and distributions of haematological parameters among study participants from pre-pubertal, mid-pubertal and post-pubertal boys group

Variables	Pre-pubertal boys (n=30)	Mid-pubertal boys (n=30)	Post-pubertal boys (n=30)
RBC count (10^6 /µL)	4.1± 0.2	4.8± 0.6	5.4±1.2
Hemoglobin (g/dL)	12.4±1.2	13.3±1.0	14.6±1.6*
Leukocytes (10^3 /µL)	6.5 ± 0.3	7.4 ± 0.3	7.9±03
Platelets (10^3 /µL)	25.3 ± 4.7	26.5 ± 5.0	31.0±0.9**
Hematocrit (%)	45.6 ± 2.6	41.8 ± 2.5	40.8 ± 2.5
Total protein (g/L)	6.2±0.9	114.8 ± 10.2	118.4 ± 12.4*
Albumin (g/L)	3.5±0.4	69.3 ± 6.8	76.4 ± 5.4**
Globulin (g/L)	6.2±0.9	4.1 ± 0.5	4.4 ± 0.124
A/G ratio	1.6±0.4	2.5±0.9	2.2 ± 0.9*

Mean ±SD *P Value <0.05, **P Value <0.01,

The renal and hepatic functions indices such as, Blood urea nitrogen (BUN) as an indicator for the kidney function were also significantly higher in the than the pre-pubertal group (p<0.05). AST, ALT, and globulin levels were significantly higher in the pre-pubertal group compared to the control group (p<0.05).

Table 3: The estimation of renal and hepatic function indices among study participants from pre-pubertal, mid-pubertal and post-pubertal boys group

Variables	Pre-pubertal boys (n=30)	Mid-pubertal boys (n=30)	Post-pubertal boys (n=30)
Blood Urea Nitrogen (mg/dL)	27.8 ± 5.0	25.4 ±4.4	24.7 ± 3.2
Creatinine (mg/dL)	1.1±0.2	1.0±0.3	0.9±0.03
Uric acid (mg/ dL)	5.91 ± 1.07	4.64 ± 0.88	3.41 ± 0.61
AST (IU/L)	29.7±2.1	28.4±2.7	26.41 ± 4.76*
ALT (IU/L)	32.8±3.0	31.3±3.6	29.89 ±8.4*
ALP (IU/L)	170.0±58.0	154.7±57.0	131.99 ± 51.2***

Mean ±SD *P Value <0.05, **P Value <0.01, ***P Value <0.001

Modifications in lipid profiles were observed; in pre-puberty, HDL-C, triglycerides levels were significantly lower and LDL-C, total cholesterol levels were significantly higher. Fasting glucose and glycosylated haemoglobin were observed in normal range for all the participants.

Table 4: Variations of lipid profiles and glycaemic parameters among study participants from pre-pubertal, mid-pubertal and post-pubertal boys group

Variables	Pre-pubertal boys (n=30)	Mid-pubertal boys (n=30)	Post-pubertal boys (n=30)
Total cholesterol (mg/dL)	156.1 ± 32.1	167.1 ± 27.7	172.8 ± 38.9*
LDL-cholesterol (mg/dL)	88.9 ± 20.6	104.1 ± 22.3	104.9 ± 33.5**
HDL-cholesterol (mg/dL)	51.8 ± 10.9	47.8 ± 10.6	39.4 ± 9.7**
Triglycerides (mg/dL)	69.6 ± 40.2	78.6 ± 21.0	139.5 ± 71.8***
Fasting plasma glucose (mg/dL)	93.1 ± 7.7	94.6 ± 4.1	98.5 ± 6.7*
Glycosylated haemoglobin HbA_{1c} (%)	5.16 ± 1.41	5.08 ± 0.78	5.24 ± 1.27

Mean ±SD *P Value <0.05, **P Value <0.01, ***P Value <0.001

The present study asserts that age, sex and BMI are the essential contributors to variability in haematological and biochemical parameters during adolescence. These parameters vary considerably depending upon an individual's age, sex, ethnicity, dietary intake or physiological state of the body.

DISCUSSION

Our present study has achieved its objectives of establishing a comprehensive relationship among biochemical and hematologic parameters and puberty stages. These reference values would be likely to serve as standards for interpreting laboratory results for children in routine healthcare practice and screening/ follow-up during clinical trials. The rapid and significant growth and development during childhood may result in drastic alterations of normal circulating levels of various biochemical markers. Abnormal levels of such markers are classical indications that can signal an underlying paediatric disease or early signs of an adult's onset disease. These levels are strongly influenced by their growth rate, organ maturity, hormone responsiveness, nutrition and metabolism [6, 7]. Additionally, children are immunologically naive and respond differently to infections; therefore, adult

normative values of various biochemical markers are not applicable in a paediatric setting.

Haematological and biochemical parameters in adolescents are essential for the early identification of preventable risk factors for and diagnosis of various diseases. For example, an abnormal complete blood count often is the first sign of anaemia and hematologic malignancies [8]. Estimated serum creatinine is commonly used to assess renal function and detect chronic kidney disease [10]. Serum uric acid is sometimes helpful to reveal hidden asymptomatic conditions, including drug side effects, hereditary diseases and malignant disorders [9]. The elevated HDLC and LDLC in adolescents are frequently the first indicators of genetic dyslipidaemias[10].

Our study observed the statistical correlation between age, weight and BMI between these three different groups. Most of the measured haematological indices were significantly different between the three different groups. RBC count, Hb, and WBC count were significantly ($p<0.001$) lower in the exposed than in the pre-pubertal boy's group.

The BMI is generally used to evaluate obese subjects, and it is considered a reliable indicator of adiposity. However, this index alone has some limitations in children because the relationship between the fat and fat-free mass varies at different ages [11].

Our present study shows that the renal and hepatic functions indices such as blood urea nitrogen (BUN) as an indicator for kidney function were significantly higher than the pre-pubertal group. AST, ALT, and globulin levels were significantly higher in the pre-pubertal group compared to the control group.

Besides drastic variation in blood biochemistry due to multiple physiological events, a higher BMI further reinforces this variability during adolescence [12]. We observed that all biochemical parameters vary considerably among these participants. The underlying rationale behind the consistency of serum urea levels with obesity is though unknown. However, urea levels have previously been reported to remain unaltered with weight loss.

The male participants of 11-15 years of age experienced few haematological and biochemical parameters changes compared to females of the same age [13]. In our study, we found 7 out of 18 parameters that varied through the periods. As we have observed, haematological and biochemical parameters and hepatic and renal functions decreased significantly between the three groups.

We consider that other studies on hematologic and biochemical parameters that include more parameters and diverse participants from different regions will reinforce evidence. In the meantime, these findings remain helpful in the scarcity of data. Hence, we recommend its use by clinical laboratories.

CONCLUSIONS

Our study demonstrates changes in haematological and biochemical parameters affected by puberty, gender, and possibly nutritional status. Our findings will benefit medical practitioners assessing paediatric and adolescent health in piloting a timely intervention for chronic conditions and has the potential to contribute to the early identification and prevention of lifestyle-related diseases and merits future research remains to be proven in longitudinal studies.

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