

Plasma b-type natriuretic peptide concentrations during the adolescent period

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ABSTRACT

Objective: Determine plasma NT-ProBNP concentrations during the adolescent period. **Object and methods of the study:** a prospective, cross-sectional study on 112 patients from 10-18 years old examined at the Department of Adolescent Health, Vietnam National Children's Hospital. Quantify plasma NT-ProBNP concentration and compare this index across juvenile stages, gender, and body mass index. **Results:** NT-ProBNP concentration in females was higher than in males with a statistically significant difference ($p < 0.05$). There was no statistically significant difference in NT-ProBNP concentrations between the early, middle, and late adolescence stages ($p > 0.05$). In girls, NT-ProBNP concentrations were higher during puberty than during pre-pubertal periods ($p < 0.05$), whereas in boys, NT-ProBNP concentrations during puberty were lower than during pre-pubertal ($p < 0.05$). NT-ProBNP concentration was highest in the underweight group, followed by the normal and overweight groups, and lowest in the obese group with a statistically significant difference ($p < 0.05$). **Conclusion:** There are differences in NT-ProBNP concentrations according to gender and no changes were observed in the adolescence stages. NT-ProBNP concentrations varied during puberty and according to body mass index ($p < 0.05$).

Keywords: NT-ProBNP, plasma, adolescent.

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INTRODUCTION

B-type Natriuretic Peptide (B-type Natriuretic Peptide) is a valuable biomarker in evaluating cardiovascular diseases in both adults and children, including biologically inactive NT-ProBNP and biologically active BNP. Currently, NT-ProBNP is more commonly used in clinical practice due to its longer half-life and greater stability than BNP [1]. In healthy children and adults, Natriuretic Peptide concentrations vary with age. In children, this index increases dramatically in the first days after birth, then gradually decreases and stabilizes after 4 years of age. In contrast, in adults, NT-ProBNP concentrations tend to increase with age [2].

Some studies suggest that B-type Natriuretic Peptide is associated with gender, sex hormone levels, and body mass index [3], [4], [5]. These variations play an important role in adolescent development, a phase marked by significant physical, psychological, and physiological changes. During this period, fluctuations in androgen and estrogen levels correlate with the onset of puberty with the degree of sexual maturity [5], [6]. Currently, data on the dynamics of B-type Natriuretic Peptide during adolescent development are still scarce in Viet Nam and globally. To address this issue, we conducted the study: "Plasma B-type Natriuretic peptide concentration during the adolescent period".

OBJECTS AND METHODS

Objects of the study

Criteria for selection

These are children who come for examination and health check at the Vietnam National Children's Hospital

Age ranges from 10 to 16 years old.

Criteria for exclusion

Excluded from the study if children had any of the following diseases: cardiovascular diseases, kidney failure, severe infection, pneumonia, or severe anemia.

Time and location of the study:

From February 2021 to October 2021 at the clinic of the Department of Adolescent Health – Vietnam National Children's Hospital.

Methods of the study

Design of the study: Cross-sectional descriptive study.

Sample selection method and sample size: The convenience sampling method was utilized. All patients who met the proposed selection criteria were included in the study. Specifically, 112 children met the criteria for selection of the study.

Steps to conduct the study: Children are asked for medical history, clinically examined, and evaluated with necessary paraclinical tests. NT-ProBNP concentrations were quantified using electrochemiluminescence immunoassay on Roche's Cobas e601 machine at the Department of Biochemistry at the Vietnam National Children's Hospital. Quantitative methods were carried out in accordance with the procedures (sample preservation,

sampling method, and quantitative method) of the Ministry of Health. The unit of plasma NT-ProBNP concentration is pg/ml.

The study's variables

Age:

- + 10 - 13 years old: early adolescence
- + 14-16 years old: middle adolescence.
- + 17-19 years old: late adolescence

Gender: male, female.

Puberty: puberty, prepubertal.

Body mass index (BMI): Calculated based on the following formula:

$$\text{BMI} = \text{Weight}/\text{height}^2$$

In which:

- + Weight, calculated in units of kg, height, calculated in units of m

Classification standards:

- + Normal: BMI: 18,50 - <25
- + Underweight: BMI <18,5
- + Overweight: BMI >25 - <30.
- + Obese: BMI \geq 30

Data processing and analysis

Data was processed using SPSS software version 22. Data were presented as median with 25th and 75th Interquartile range (IQR) for non-standard distribution. The Mann - Whiney test was used to compare the median of two independent samples for non-standard distribution.

Ethical considerations in the study

The child's family explained the study content and provided consent to participate. Patient information was guaranteed to be confidential. The study did not affect the patient's health.

RESULTS

We selected 112 patients who met the criteria for selection of the study. The study results are presented in the following tables and figures:

General characteristics

Table 1. General characteristics of study subjects

	Characteristics	Quantity	Percentage
Gender	Boys	59	52,7%
	Girls	53	47,3%
Adolescent stages	Early	64	57,1%
	Middle	45	40,2%
	Late	3	2,7%
Puberty	Puberty	43	38,4%
	Prepubertal	69	61,6%
BMI	Normal	69	61,6%
	Underweight	23	23,5%
	Overweight	15	13,4%
	Obese	5	4,5%

There is no significant difference in the proportion of boys and girls. Patients in the early adolescent stage account for the highest proportion (57.1%) and the lowest rate is in the late adolescent stage (2.7%). The rate of pubertal children is higher than that of pre-pubescent children. Most patients had a body mass index within normal limits (61.6%).

NT-ProBNP concentration during the adolescent period

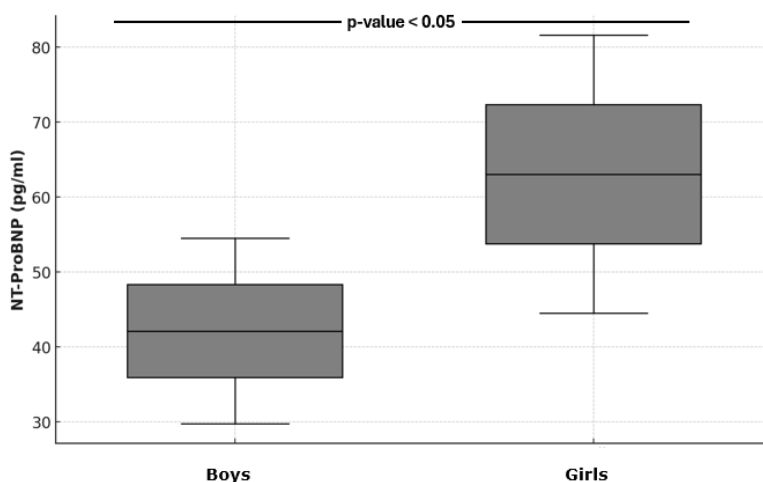


Figure 1. NT-ProBNP concentrations by gender

Plasma NT-ProBNP concentrations in girls were higher than in boys with a statistically significant difference ($p < 0.05$).

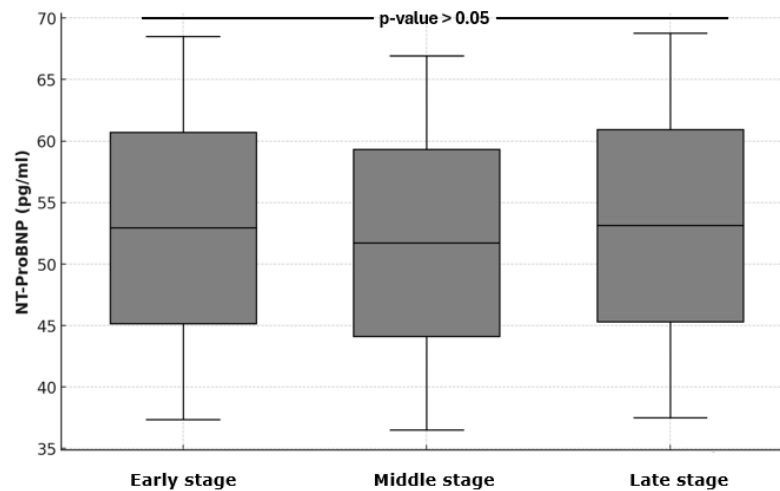


Figure 2. NT-ProBNP concentration according to the adolescent stage

There was no statistically significant difference in plasma NT-ProBNP concentrations between stages of adolescence (early, middle, and late) with ($p > 0.05$).

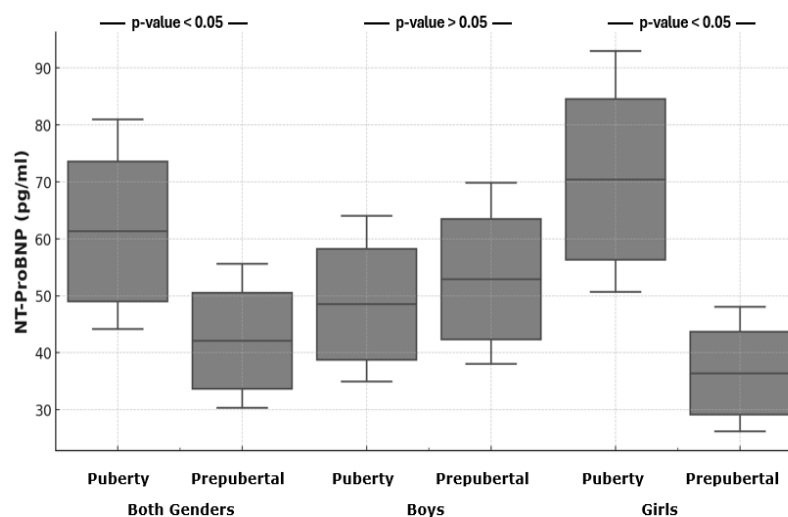


Figure 3. NT-ProBNP concentration in pubertal and prepubertal stages

Our study results show that, in both male and female groups, NT-ProBNP concentrations in the pubertal group are higher than in the pre-pubertal group. In the female group, NT-ProBNP concentrations in puberty were higher than in pre-pubertal periods with a statistically significant difference ($p < 0.05$). However, in the male group, NT-ProBNP concentrations during puberty were lower than those pre-puberty ($p < 0.05$).

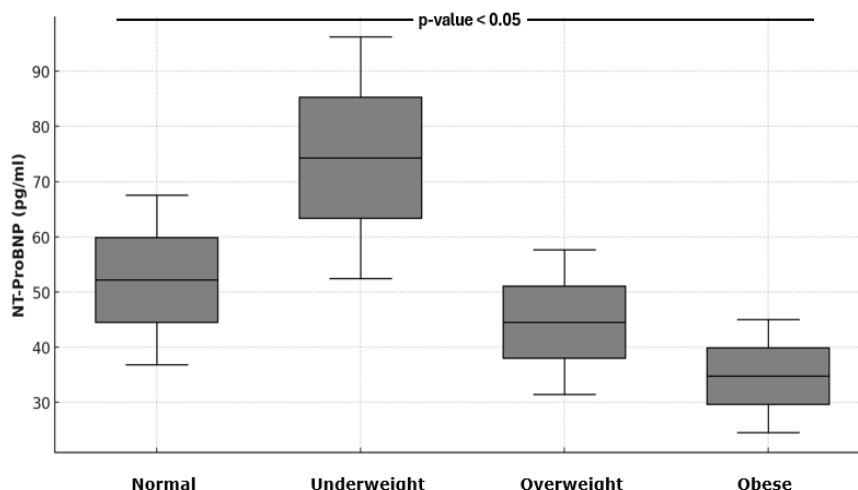


Figure 4. NT-ProBNP concentration according to body mass index

NT-ProBNP concentration was highest in the underweight group, followed by the normal and overweight groups and lowest in the obese group with the difference between groups being statistically significant ($p < 0.05$).

DISCUSSIONS

NT-ProBNP concentration by gender

In our study, NT-ProBNP concentrations differed by gender. Specifically, this index is higher in women than in men with a statistically significant difference ($p < 0.05$) (Figure 1). Other studies also show that, during the adolescent period, NT-proBNP concentrations in females are higher than in males [6], [7]. According to author Saenger AK, this index in girls is higher than in boys and may be related to the concentration of estrogen (activating the gene for synthesizing natriuretic peptide) and androgen (reducing the concentration of Natriuretic peptide) [5]. Gender differences in NT-ProBNP concentrations during adolescence compared to childhood. In children under 10 years old, studies show that NT-proBNP concentrations do not differ between the sex. [2], [6]. Meanwhile, in adults, NT-ProBNP concentrations are often higher in women than in men [6], [7].

NT-ProBNP concentration according to adolescence and puberty stages

Our study results show that plasma NT-ProBNP concentrations do not differ between stages of adolescence (Figure 2) which is different from findings in children and adults. According to Mu S et al., in children, NT-ProBNP concentrations increase after birth, then gradually decrease with age and stabilize in early adolescence. In adults, NT-ProBNP concentrations tend to increase with age, peaking in middle age [6]. Similarly, Lam E's study on 484 healthy children and adolescents under 19 years old showed that NT-proBNP concentrations were higher in children under 1 year old. Therefore, the author suggests that relying on changes in NT-ProBNP concentrations with age is necessary for a more accurate assessment of cardiovascular disease in children and adolescents [3].

Our study results show that in girls, NT-ProBNP concentrations during puberty are higher than in pre-puberty with statistical significance ($p < 0.05$). However, in boys, this index during puberty is lower than in pre-puberty ($p < 0.05$) (Figure 3). Similarly, in the study conducted by Goharian T.S. et al., results showed that NT-ProBNP concentrations in girls during puberty were

higher than those in pre-puberty and correlated with the Tanner stage ($r = 0.41$, $p = 0.001$). For boys, NT-ProBNP concentrations were lower in puberty than in pre-puberty and did not have a significant correlation with Tanner stages. Therefore, the author suggests that increased testosterone concentration (indicated by puberty in boys) may be a factor leading to reduced synthesis of NT-ProBNP concentration [8].

In Saenger AK's study, the results showed that there were differences in NT-ProBNP concentrations with gender (between men and women) and there was an independent negative correlation between NT-proBNP and testosterone but there was not a significant relationship with estradiol. This suggests that estrogen does not influence sex differences in NT-proBNP. Moreover, the importance of considering hormonal status and sexual maturity when assessing Natriuretic Peptide concentration in adolescents. Testosterone is directly involved in the regulation of Natriuretic Peptides in both men and women, suggesting that its influence has a greater impact than age or gender. The results show that the change in Natriuretic Peptide concentration according to gender during adolescence may be the result of the inhibitory effect of testosterone in men rather than the stimulatory response of estrogen in women. [5].

NT-ProBNP concentration according to the body mass index

In our study, the results showed that NT-ProBNP concentration was related to body mass index (BMI). Specifically, NT-ProBNP concentration was highest in the thin group and decreased progressively with increasing BMI, a statistically significant difference ($P < 0.05$) (Figure 4). Studies have also made similar observations and showed that NT-ProBNP concentrations in obese children are lower than those with normal weight [4], [7]. In the study conducted by Choi HI et al., a strong negative correlation between body mass index and NT-proBNP was observed in women, and this negative correlation was weaker in men, with a

significant difference between the two sexes [9]. Similarly, Chang A.Y and colleagues showed that NT-ProBNP concentrations in obese individuals were lower than in those with normal weight and independent of other factors such as diabetes, hypertension, and left ventricular end-diastolic pressure. This is explained by the fact that body composition affects the synthesis of natriuretic peptides, not because fat cells have many receptors that eliminate natriuretic peptides [10].

CONCLUSIONS

In research to determine plasma NT-ProBNP concentrations in 112 adolescents at the Vietnam National Children's Hospital, we found there are differences in NT-ProBNP concentrations according to gender and no changes were observed in the adolescence stages. NT-ProBNP concentrations varied during puberty and according to body mass index.

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