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Investigation of the relationship of cardiac troponin I and cortisol hormone levels with some variables in children: Relational screening model

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Abstract

This study aimed to determine salivary cardiac troponin I and cortisol hormone levels in primary school students to evaluate the cardiac response depending on age and gender variables. The sample of the study consisted of a total of 180 children, including boys and girls aged 8, 9, and 10 years old. The ELISA technique determined cTnI and cortisol hormone levels in saliva samples taken from the children included in the study. There was a significant difference between the salivary cTnI levels and the age levels of the children in the groups ($p<0.001$). A significant difference was found between the mean level of salivary cortisol hormone and the gender and age variables of the child ($p<0.001$). As a result of the study, a positive, weak, and statistically significant correlation was found between salivary cTnI and cortisol hormone levels ($p<0.05$). In the model created for the dependent variable of saliva cTnI, it was found that 7.5% of the variance was explained by the independent variables (R^2 adjusted=.075), and the age variable was a statistically significant positive predictor ($p<0.001$). In the model created for the dependent variable of cortisol hormone, it was found that 48.4% of the variance was explained by the independent variables (R^2 adjusted=.484), and age and gender were positive statistically significant predictors ($p<0.001$). Within the scope of the data obtained in our current study, it was determined that cortisol hormone levels were also high in children with high salivary cardiac troponin I levels. It is thought that examining and monitoring cardiac troponin I and cortisol hormone levels may be useful parameters in the nursing care and practice of children with heart disease risk and disease.

Keywords: Cardiac troponin I, cardiovascular disease, child, cortisol, nursing

Introduction

Cardiovascular diseases are one of the leading causes of death worldwide, causing a decrease in the quality of life of the individual.Although it is seen intensively in adults, it is one of the diseases of concern in the pediatric field because its prevalence is gradually increasing due to neglect in children. It is estimated that 1.3 million children are born with heart disease in the world, and the rate of heart disease in children is gradually increasing [1]. Various reasons that prevent the myocardium from working efficiently in childhood, starting in the fetal period, lead to heart failure. In infants with heart disease, frequent breathing, bruising, inability to gain weight, and fatigue symptoms are observed. In children's heart diseases, there are blue color around the lips, pallor and bruising in the skin color, chest pain, dizziness, fainting, palpitations, shortness of breath, rapid fatigue symptoms [2]. In addition, children with cardiovascular disease are at increased risk of developing cognitive and behavioral dysfunction [3].

Cardiac troponin I (cTnI) is an indicator of stress-induced heart arrhythmia, myocardial damage, and a cardiac marker with high cardiospecificity in the evaluation of myocardial diseases. There is a lot of literature reporting the auxiliary and prognostic importance of salivary cTnI level in the screening of heart diseases in both children and adults [4-6]. Saliva is a non-invasive biofluid for diagnosis and evaluation containing some of the serum components [5]. Measurement of cTnI concentration in saliva is more traditional and common, and sampling is simple,

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non-invasive, and stress-free [7].

Cortisol is known as a stress hormone involved in the response to physical and/or emotional stress [8]. Saliva cortisol is used as a biomarker of stress and intensely psychological stress [9-11]. Measurement of salivary cortisol hormone level provides a simple, non-invasive and stress-free measurement [11-14].

Cardiology and pediatric nurses work to ensure that heart health is improved at an optimum level through practices that include counseling, screening and stress tests, as well as disease prevention and management strategies [15]. It also has important duties in the processes of revealing cardiovascular risk factors, monitoring them and determining the treatment plan. Pediatric nurses are an important actor in the daily life of children that is informing and educating the child about possible complications of the disease [16]. Screenings studies are of critical importance in terms of screening children in terms of heart health without waiting for them to become ill, paying attention to their ideal weight, protecting them from infection, and preventing possible negative situations. In this context, in this study, it was aimed to determine salivary cardiac troponin I and cortisol hormone levels in order to evaluate the cardiac response of primary school students depending on age and gender variables.

Material and Methods

Ethical Considerations

Ethics committee approval (2023-41/5) was obtained before the study. Before the data were collected by the researchers, parents were informed about the study in accordance with the Declaration of Helsinki and their written/verbal consent was obtained. Children who had parental permission and volunteered to participate in the study were briefly informed and included in the study.

Study Design and Population

This study was conducted in relational screening model with primary school students of different ages and gender in a city located in the Eastern Black Sea Region of Türkiye. Sample selection, 6 schools were determined randomly and simple random selections were made from each class list. The sample of the study consisted of 180 children, including 8-year-old male (n=30) and female (n=30) children, 9-year-old male (n=30) and female (n=30) children, and 10-year-old male (n=30) and female (n=30) children. This age group was preferred considering that this age group may be at risk in terms of cardiac health. In addition, this age group is important for early diagnosis through health screenings. Children with cardiovascular disease or a chronic disease, who are taking medication for any reason, and who have communication disabilities were excluded from the scope of the study. In addition, people who have psychological disorders, show excessive emotional reactions during the study, are timid, introverted, etc. Students who could not express their emotions and were excited were excluded from the scope of the study. Factors that could cause stress in students were identified and necessary precautions were taken during the data collection phase. For this purpose, an information and introduction meeting about the study was held before the start of the study.

Procedure

The data were obtained by ELISA technique and cTnI and cortisol levels in the saliva samples taken from the children included in the study and the form containing the age and gender information of the children.

Part 1. Collection of saliva samples

The saliva samples were collected by the researcher, who is experienced in the field of child health and disease nursing. Saliva samples were collected at a time period of 08:00 to 09:00 in the morning using the passive salivation method in Salivette tubes (Sarstedt, GERMANY) at 5 ml. After the saliva sample was collected, it was centrifuged at 3800 g for 10 minutes, and the saliva samples were stored at -80°C until the analyzes for cTnI and cortisol hormone levels were performed.

Part 2. Measurement of cTnI and cortisol hormone levels in salivary

The minimum detectable concentration used to measure salivary cTnI and cortisol hormone level in salivary obtained from the research was 0.5-200 ng/ml. An ELISA kit type-specific for human cTnI ELISA kit (BT LAB, Cat. No E 1 003Hu, CHINA) and human cortisol ELISA kit (BT LAB, Cat. No EA0010Ge, CHINA) from 31.25–2000.00 pg/mL, an intra-assay coefficient 8.0%, and an inter-assay coefficient of 10.0% was utilised in accordance with the manufacturer's protocol. The results were evaluated by reading absorption values at 450 nm in accordance with the procedure reported in the kit.

Statistical Analysis

The SPSS (Windows 26.0) software was used for data analysis. Number, percentage, mean±standard deviation values for continuous variables were used for descriptive statistics. The Independent Samples Test, One-Way ANOVA test and Tukey HSD posthoc analysis were used to compare the descriptive characteristics of the children with their salivary cTnI and cortisol hormone levels. Whether there was a relationship between the variables was evaluated with Pearson correlation analysis and Multiple Linear Regression analysis.

Results

In the study, the mean salivary cTnI level of children was determined as .018±.009 ng/mL. While the mean salivary cTnI level was found to be .019±.009 ng/mL in female children, it was determined as .017±.008 ng/mL in male children. According to the age of the children, mean salivary cTnI levels were determined as .015±.007 ng/mL, .018±.009 ng/mL and .021±.009 ng/mL for 8, 9 and 10-year-old children, respectively. There was a significant difference between the salivary cTnI levels and the age levels of the children in the groups ($p<0.001$). As a result of the posthoc analysis, it was determined that the salivary cTnI level was higher

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in those aged 10 years than in those aged 8 years (Table 1).

In the study, the average level of salivary cortisol hormone was found to be 2.608±.466 ng/ml. The mean salivary cortisol hormone level was found to be 2.734±.461 ng/ml in female children; It was determined as 2.482±.438 ng/ml in male children. According to the age of the children, mean levels of salivary cortisol hormone were determined as 2.280±.268 ng/ml, 2.530±.336 ng/ml and 3.015±.436 ng/ml for 8, 9 and 10 year old children, respectively. A significant difference was found between the mean level of salivary cortisol hormone and the gender and age variables of the child ($p<0.001$).It has been determined that female children have higher cortisol hormone levels than male children. As a result of the posthoc analysis performed in terms of age variable, it was found that the level of salivary cortisol hormone was higher in those aged 10 than in those aged 8 and 9, and in those aged 9 than in those aged 8 (Table 1).

As a result of the correlation analysis, a positive, weak and statistically significant correlation was determined between salivary cTnI and mean cortisol hormone levels ($p<0.05$) (Table 2).

Table 1. Comparison of age and gender characteristics of children with salivary cardiac troponin I and cortisol hormone levels (n=180)

Variables	n (%)	Cardiac troponin I	Cortisol hormone
Gender			
Girl	90 (50)	.019±.009	2.734±.461
Boy	90 (50)	.017±.008	2.482±.438
		t=1.378	**t=3.758**
		p=.170	**p=.000***
Age			
8[1]	60 (33.3)	.015±.007	2.280±.268
9[2]	60 (33.3)	.018±.009	2.530±.336
10[3]	60 (33.3)	.021±.009	3.015±.436
		F=7.180[a]	**F=66.874[b]**
		p=.001**	**p=.000****

*Independent T test, **One-Way ANOVA, a: Tukey HSD=3>1, b: Tukey HSD=2>1, 3>1, 3>2

Table 2. The relationship between salivary cardiyac troponin I and cortisol hormone levels (n=180)

Variables		Cardiyac troponin I levels	Cortisol hormone levels
Cardiyac troponin I levels	**r**	1	
	p		
Cortisol hormone levels	**r**	.162*	1
	p	.029	

*Correlation is significant at the 0.05 level (2-tailed)

In the analysis of children's variables, it was observed that there was a significant model in the evaluation of goodness of model fit (F/p) regression coefficients (R/R^2) ($p<0.001$). In the model created for the dependent variable of saliva cTnI, it was found that 7.5% of the variance was explained by the independent variables (R^2 adjusted=.075), and the age variable was a statistically significant positive predictor ($p<0.001$). In the second model created for the dependent variable of cortisol hormone, it was found that 48.4% of the variance was explained by the independent variables (R^2 adjusted=.484), and age and gender were a positive statistically significant predictor ($p<0.001$) (Table 3).

Table 3. Multiple linear regression analysis model of the predictive factors of salivary cardiac troponin I and cortisol hormone levels according to children's age and gender characteristics (n=180)

Dependent variables	Independent variables						95.0 Cl		
		B	SE	β	t	p	Lower	Upper	Model fit
Cardiac troponin I	**(Constant)**	-.006	.008	-	-.818	.415	-.021	.009	**R=.293**
	Age	.003	.001	.274	3.811	**.000**	.001	.005	**Adj. R^2=.075**
	Gender	-.002	.001	-.103	-1.430	.155	-.004	.001	**F=8.283**
Ccortisol hormone	**(Constant)**	-.321	.286	-	-1.120	.264	-.886	.244	**R=.700**
	Age	.368	.031	.645	12.016	**.000**	.307	.428	**Adj. R^2=.484**
	Gender	-.252	.050	-.271	-5.050	**.000**	-.351	-.154	**F=84.943**

Adj.R^2: adjusted R square; B: partial regression coefficient; β: standard partial regression coefficient; 95% CI: 95% confidence interval

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Discussion

The normal reference value of cTnI, which is a very sensitive test parameter in determining myocardial infarction and cardiac disorders, is between 0 and 0.04 ng/mL, but it can cause an increase in troponin levels in case of heart damage and discomfort. According to the European Society of Cardiology, cTnI levels were below normal, normal and high values were <0.01 ng/ml; ≥0.01 ng/ml and <0.04 ng/ml; it is reported as ≥0.04 ng/ml [17,18].

It was determined that there was correlation between the ages of the children in our study and their salivary cTnI levels ($p<0.001$). The results of our study are within the reference values reported in the literature and salivary cTnI levels are consistent with the reported research results [18,19]. Therefore, it was concluded that there was no significant cardiac stress or damage due to the slight increase in cTnI concentrations due to age, due to exercise and being in the range of reference values presented in the literature. When the result in cTnI level observed depending on age was examined, it was determined that the increase was within the range of values observed in clinically healthy individuals, but did not constitute a pathological increase. We think that the reason for this situation is that it is shaped due to physiological and emotional factors. In addition, it has been concluded that studying changes in the level of salivary cTnI may be a useful and useful parameter for monitoring the state of cardiovascular disease in children.

In the study, it was determined that salivary cortisol hormone levels were higher in female children than male children. The results of our study are within the reference values reported in the literature and salivary cortisol hormone levels are consistent with the results of the studies reported [20,21]. However, it also differs from the results of studies examining salivary cortisol levels [22]. Therefore, it is thought that the increase in cortisol concentrations with age is due to the differences in the study method for cortisol hormone level measurement reported in the literature. It has been concluded that there is no significant stress because the results are in the range of reference values presented in the literature.

In our study, a positive, weak and statistically significant relationship was found between salivary cTnI levels and cortisol hormone levels ($p<0.05$). Because cortisol is a corticosteroid hormone associated with the body's response to stress, elevated cortisol hormone associated with prolonged stress may be an important risk factor for heart disease.

Study Limitations

A couple of limitations of this study should be mentioned. Participants of the study were limited to children aged 8-10 years. In addition, evaluating only age and gender variables is another limitation of the study. For these reasons, the results obtained from the study can only be generalized for children in the same age group. The application of the research with different variables in different age groups will contribute to the literature. Despite these limitations, the study also had its strengths. This study is valuable because it is the first study to examine the salivary cardiac troponin I and cortisol hormone levels of children in terms of cardiovascular system health.

Conclusion

In our current study, it was determined that cortisol hormone levels were also high in children with high salivary cTnI levels. Cardiac troponin I and the stress cortisol hormone, which are reported as biomarkers with high cardio specificity in cardiovascular diseases, may be important biomarkers in heart health screenings for the determination of cardiovascular diseases that can be neglected in children and can also be asymptomatic. Necessary information and guidance should be provided to parents of children at risk. In addition, it is thought that these may be useful parameters in the nursing care and practices of children with heart disease risk and disease in the fields of school health, pediatrics and cardiology nursing.

Conflict of Interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that they have received no financial support for the study.

Ethical Approval
The Bayburt University Research Ethics Committee approved the research. Ethics committee approval dated 2023 and numbered 41/5 was obtained.

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