



Evaluation of the Gingival Health Status in Children Suffering from Some Renal Disorders



Sirma Todorova Angelova*

Department of Pediatric Dentistry, Faculty of Dental Medicine, Medical University-Varna, Varna, Bulgaria

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*Corresponding author: Sirma Todorova Angelova, Department of Pediatric Dentistry, Faculty of Dental Medicine, Medical University-Varna, Varna, Bulgaria

Abstract

Salivary secretory Ig A is characterized as a considerable indicator for assessment of the risk of pathological processes affecting periodontal tissues and structures. The initiation and progression of the excretory system disorders of pyelonephritis and nephrotic syndrome correlate to the necessity of frequent hospitalizations of patients in child's age. The aim of the study is to be evaluated the gingival health status in children suffering from pyelonephritis and nephrotic syndrome. In the study are applied clinical, laboratory and statistical methods. Among the children with diagnosed nephrotic syndrome is registered moderate negative correlation between salivary sIg A and PLI, as well as moderate negative correlation between salivary sIg A and GI. The healthy representatives of the study are characterized with significant negative correlation between the indicators of salivary sIg A and PLI, as well as significant negative correlation between salivary sIg A and GI. The participants with nephrotic syndrome are characterized with moderate negative correlation between the clinical indicator of PLI and salivary pH level. In the group of children with pyelonephritis is recorded significant negative correlation between PLI and salivary pH. Among the healthy representatives is registered extremely great negative correlation between both of the indicators of PLI and salivary pH. Great negative correlation between the clinical indicator of GI and salivary pH value is ascertained among the representatives of the three groups included in the study. The lowest level of secretory sIg A is registered among the participants suffering from nephrotic syndrome. The increased concentration of salivary secretory Ig A correlates to the lower levels of the PLI and GI. The reduced level of sIg A in saliva predisposes to initiation and progression of inflammatory reactions of the gingival tissue.

Keywords: Gingival health; Children; Pyelonephritis; Nephrotic syndrome; Salivary Ig A

Introduction

In saliva of healthy people can be determined insignificant quantities of organic substrates, namely: bilirubin, creatinine, triglycerides, cholesterol [1,2]. Salivary concentrations of urea and uric acid are similar to these in plasm and can vary as a consequence of metabolic disturbances such as kidney disorders [3], gout [4] or metabolic syndrome [5]. Other essential organic molecules- ascorbic acid and vitamin E, ensure the functionality of salivary antioxidant protective system [6,7]. Salivary DNA is routinely applied in many clinical laboratories for the purposes of assessment of individual's genetic predisposition towards some diseases. Saliva-based assays are efficiently implemented for identification of HIV infection [8], monitoring of the course of renal disorders [3], prevention of cardio-metabolic risk [9], detection and quantitative evaluation of viral nucleic acids [10], forensic medicine investigations [11], oral health-related researches [12,13], as well as in condition of monitoring of medicines' abuse [14]. Ig A is detected in mucosa secretion, precisely as an ingredient of saliva, tears, sweat, milk, and secretion of respiratory, urinary, and gastro-intestinal tract. Ig A is produced by plasmocytes of the

mucosa-associated lymphoid tissue. Secreted Ig A is connected to glandular epithelial cells which are supplied with corresponding receptors on their basal surface [15]. The main function of Ig A is to connect to the microorganisms trying to colonize mucosa and to prevent their adhesion upon epithelial cells [16]. As a marker of human immune response, secretory Ig A fluctuates in conditions of local or common status-related bacterial and viral infections. Based on profounf investigations, A. Ivanova, A. Krasteva-Panova, Z. Krastev, established that the referent values of secretory Ig A in mixed saliva of children vary in the interval between 30-130 mg/L [17]. The synergetic and additive interaction of secretory Ig A with other antibacterial compounds in saliva such as lysozyme, lactoferine, peroxidase and mucines have the potential to protect oral mucosa from penetration of various antigens [18]. Some researchers accentuate on the interrelation between low levels of salivary Ig A and enhanced susceptibility of the organism to periodontal disorders [19-26].

Salivary secretory Ig A is characterized as a considerable indicator for assessment of the risk of initiation and progression of

pathological processes affecting periodontal tissues and structures [27,28]. Simultaneously, an investigation among patients suffering from differentiated forms of primary glomerulonephritis, respectively: Ig A-related mesangial nephritis, idiopathic nephrotic syndrome, idiopathic membranous nephropathia, accentuates on the establishment of significantly increased concentration of immunoglobulins, and especially Ig A, in saliva [29]. Urinary tract infections are characterized as inflammatory processes which affect the topographic zone between the urethra and renal parenchyme, clinically manifested with the compulsory symptom of bacteriuria. These excretory system disorders are diagnosed in different periods of childhood, including the breast-feeding period and early childhood. In condition of status febrilis and anaemia with non-identified etiology in the age between one and three years the diagnosis of pyelonephritis has to be taken into consideration. In child's age bacterial infections of the urinary tract are ranged as second in distribution, following the infections of the upper segment of the respiratory tract [30,31].

High degree of proteinuria (>3-3,5 g/day), hypoproteinaemia, hypoalbuminaemia (decrease of serum albumin under the level of 2,5 g/dl), hyperlipoproteinaemia with increase of the level of cholesterol and triglycerides, are associated to the excretory system disorder of nephrotic syndrome [32]. Children with diagnosed nephrotic syndrome have to keep to a specific dietary regime with limitation of proteins' intake and consumption of salty foods. This is related especially to the periods of relapses and acceptance of high dosage of corticosteroids. The child and its family have to be aware of the fact that nephrotic syndrome is

a prolonged disease, with risks for complications, related to the disorder itself or its treatment [33]. The initiation and progression of the excretory system disorders of pyelonephritis and nephrotic syndrome correlate to the necessity of frequent hospitalization of patients in child's age. Physicians, respectively nephrologists and pediatric specialists, parents and children do the utmost of their capacity and concentrate their efforts for overcoming the renal disease. Dietary habits' modifications and restrictions, as well as wide-spectrum therapy can have the effect of stress-provokers, which additionally deteriorate child's common health status. As a consequence, there can be neglected the significance of preventive measures addressed to oral health maintenance, resulting in its explicit disturbance [34-36].

Aim

The aim of the study is to be evaluated the gingival health status in children suffering from some renal disorders, namely pyelonephritis and nephrotic syndrome.

Study Design

Subject of the study: A total number of thirty-six (36) participants are included in our study. All of them belong to the age interval of childhood, respectively up to the age of 18. These children are divided into three groups according to their common health status. The number of participants with diagnosed excretory system disorders equals to twenty-six (26). A control group of ten (10) healthy children also takes part in that investigation. A declaration of informative consent has been signed by a parent or guardian of each of the participants into the study (Figure 1).

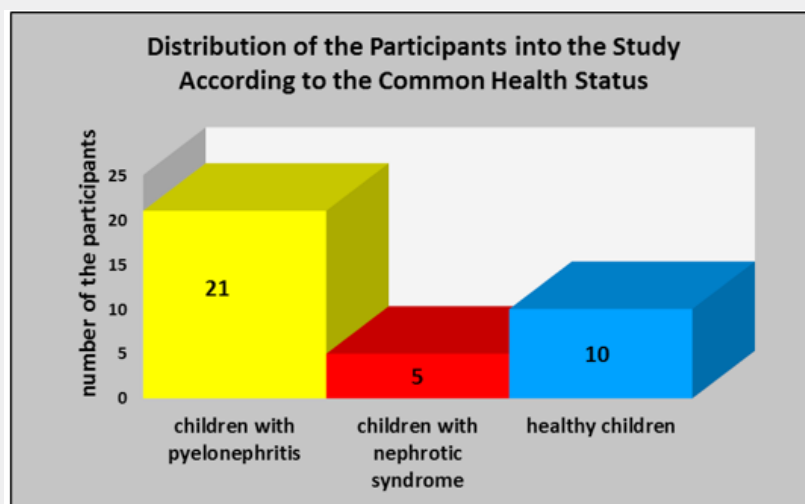


Figure 1: Distribution of the participants into the study according to the common health status.

Methods

In the context of that study are applied clinical methods, laboratory methods and statistical methods.

Clinical Methods

The gingival status of the examined participants is assessed by the clinical indices of Plaque index by Silness-Löe (PLI) and Gingival

index by Løe-Silness (GI). By application of the plaque index PLI Silness-Løe is evaluated the level of accumulated dental plaque on teeth surfaces as an essential factor for initiation and progression not only of carious lesions, but also of gingival inflammation. The representative teeth which are included are. The level of dental plaque is assessed with figures in the interval from 0 to 3, with record of the medial, distal, vestibular and oral surfaces of all the applied ramfjord teeth. The sum of figures illustrating the plaque on ramfjord teeth surfaces of each participant in the study is divided to the total number of teeth surfaces, respectively 24, which results in the average individual value of the plaque index PLI Silness-Løe. B the means of the gingival index GI Løe-Silness is ascertained the status of gingival inflammation. With the figures from 1 to 3 is registered the degree of gingivitis of the same teeth, respectively teeth surface as in the indicator of PLI Silness-Løe. The figure of 0 corresponds to healthy gingiva, without symptoms of edematization or bleeding. The figure of 1 associate to slight degree of gingival inflammation, clinically manifested by slight degree of edematization, without bleeding. The figure of 2 is equal to moderate degree of gingivitis. The last is characterized with edematized marginal gingiva and interdental papillae, combined with the symptom of provoked bleeding (bleeding on probing). The figure of 3 is related to severe degree of gingival inflammation, which correlates to pathological morphological substrate, interstitial edema in the zone of marginal gingiva and interdental papillas and spontaneous bleeding. The sum of all the recorded figures is divided to the total number of examined teeth surfaces, respectively 24. As a result, is obtained average individual value of the gingival index GI Løe-Silness for each of the participants included into the study.

Laboratory Method

The level of salivary secretory Ig A is evaluated by implementation of the method of radial immune diffusion. The individually collected samples of non-stimulated mixed saliva are collected in small containers with volume of 5 ml. The containers are stored at $t = -80^{\circ}\text{C}$. The salivary samples are being centrifuged for 15 minutes with 14000 revolutions per minute in condition of $t = 4^{\circ}\text{C}$. According to the protocol, on a special plate supplied with outlined wells are deposited the centrifuged individual samples of non-stimulated mixed saliva. The plate with the samples is stored in its original package for providing proper level of humidity and hermetization for the period of incubation of the samples for 72 hours in room temperature ($t = 22^{\circ}\text{C}$). After the fixed interval of 72 hours is made a record of the diameter of the circle around each well, measured in mm. Based on a monogram by the manufacturer of the product, each value of all of the registered diameters corresponds to a definite concentration of sIg A evaluated in mg/L.

Statistical Methods

Descriptive Analysis: The average value of n figures is determined when the total sum of all figures is divided in their whole number of n . The average value is the most widely applied parameter of central tendency. The median is the value which

is in the middle position of the order of explored variables, or that is the value which separates the cases aligned according to the criterion of differentiation into two equal parts. Similar to the average value, the median is a definite characteristic of each statistical order and is unique for each sequence of data. The standard error is the quantitative expression of the uncertainty of the evaluation of the average value. Taking into consideration the variable of standard error and the rate of probability, the actual level of average value for the whole population is calculated in the range of average value plus/minus the standard error in terms of the fixed rate of probability. That is related to the variable of the interval of confidentiality. In the context of our investigation the interval of confidentiality equals to 95%.

Correlation Analysis: One of the main tasks of statistical analysis in the scope of medicine science is related to determination and establishment of interrelations between various events and phenomena, figured out at definite levels. The interrelation between the factorial characteristic and several or a great number of variations of the results-associated characteristic is defined as an interrelation of correlation. The coefficient of correlation by Pearson evaluates the significance of the linear interrelation between two variables. There is a five degree-related scale of evaluation of correlation between two parameters based on definite intervals of variations of the coefficient of correlation by Pearson. In the interval between 0,00 and 0,25 is registered slight correlation. In the interval between 0,26 and 0,49 is evaluated moderate correlation. The interval of values of the coefficient by Pearson between 0,50 and 0,69 corresponds to significant correlation. The interval of values of the coefficient of correlation by Pearson between 0,70 and 0,89 regards to the condition of great correlation, and in the interval between 0,90 and 1,00 is established extremely great correlation. The positive interrelation of correlation is characterized with simultaneous increase or decrease of both of the investigated variables. The negative interrelation of correlation is marked out with elevation of the values of one of the explored parameters and reduction of the values of the other one (Figure 2).

Results

The lowest average value of the indicator of secretory salivary Ig A, namely 33,5920 mg/l, is established among the examined children with diagnosed nephrotic syndrome. Among the participants suffering from pyelonephritis and healthy children are registered similar values of this parameter of sIg A, respectively 58,7143 mg/l and 56,8800 mg/l. The lowest value of the median of secretory Ig A is recorded among the patients with nephrotic syndrome, namely 40,0000 mg/l. The healthy participants and children with established pyelonephritis are characterized with similar levels of that indicator, respectively 52,2000 mg/l and 52,1000 mg/l. The lowest minimal value of sIg A amounts to 4,06 mg/l and is recorded among the examined patients with nephrotic syndrome. Greater minimal value of secretory Ig A, equal to 12,80 mg/l, is registered for the healthy controls. The highest level of

that indicator is related to the representatives of the study with the diagnosis of pyelonephritis, respectively 14,70 mg/l. The lowest maximal value of the variable of salivary sIg A, namely 57,2000 mg/l, characterizes the participants in the study with diagnosed nephrotic syndrome. Among the participants without common health disorders the maximal value of sIg A amounts to 123,0000 mg/l. In the group of patients suffering from pyelonephritis is ascertained the maximal value of sIg A equal to 130,0000 mg/l.

With the highest average value of the Plaque Index by Silness-Löe (PLI), respectively 1,8640, and the highest average value of the Gingival Index Löe-Silness (GI), respectively 1,6020, are characterized the children suffering from nephrotic syndrome. Among the patients with diagnosed pyelonephritis and healthy controls are recorded similar levels of the average value of PLI equal to 1,3957 and 1,3010, respectively. The average values of GI

among the participants with pyelonephritis and children without common health disorders amount namely to 1,0390 and 1,0150 (Tables 1-3). Based on the calculated coefficient by Pearson there have been established definite interrelations. Among the patients suffering from pyelonephritis has been recorded slight negative correlation between salivary sIg A and the Plaque index PLI, as well as between salivary sIg A and the Gingival index GI. Among the children with diagnosed nephrotic syndrome has been registered moderate negative correlation between salivary sIg A and PLI, as well as moderate negative correlation between salivary sIg A and GI. The healthy representatives of the study have been characterized with significant negative correlation between the indicators of salivary sIg A and PLI Silness-Löe, as well as with significant negative correlation between salivary sIg A and GI Löe-Silness (Graph 1).

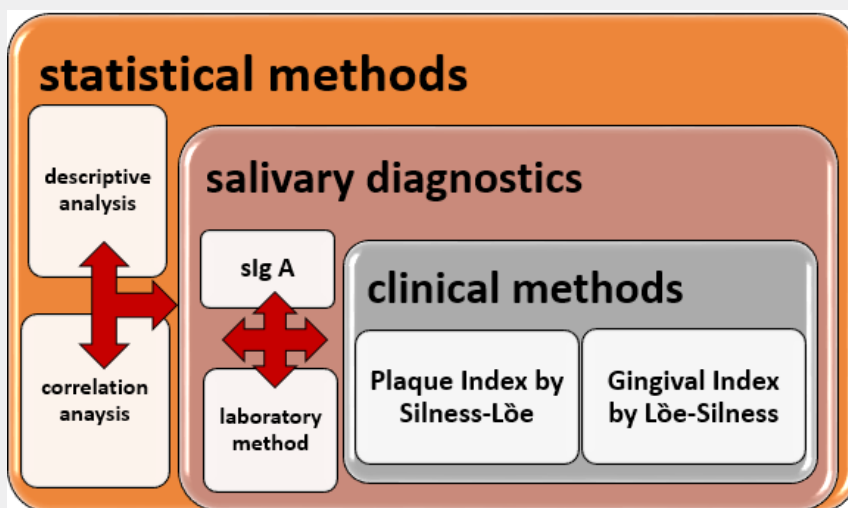
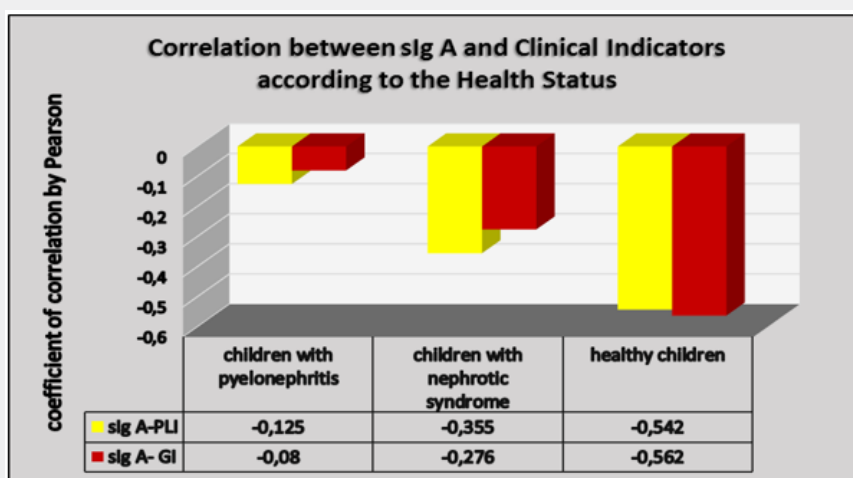


Figure 2: Application of methods into the study.



Graph 1: Correlation between sIg A and clinical indicators according to the health status.

Table 1: Descriptive data of the indicators of salivary sIg A, PLI, GI and pH in children with pyelonephritis.

Indicator	Average value	Standard error of the average value	Median	Minimal value	Maximal value
sIg A	587,143	543,424	521,000	14,70	130,0
PLI	13,957	0,09723	14,500	0,73	2,18
GI	10,390	0,13409	12,300	0,00	1,82
pH	63,333	0,11616	60,000	5,50	7,50

Table 2: Descriptive data of the indicators of salivary sIg A, PLI, GI and pH in children with nephrotic syndrome.

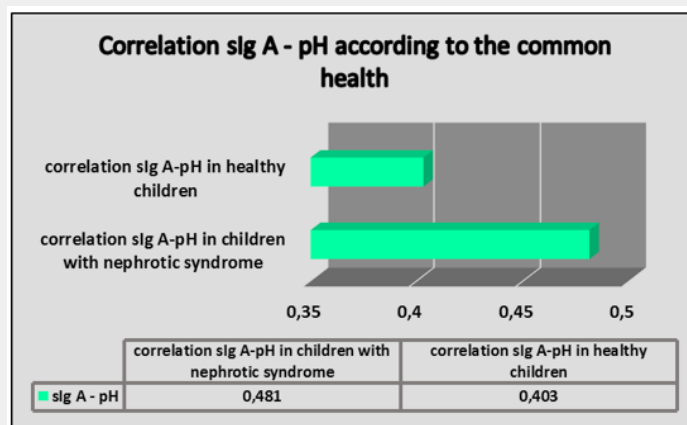
Indicator	Average value	Standard error of the average value	Median	Minimal value	Maximal value
sIg A	335,920	882,922	400,000	4,06	57,20
PLI	18,640	0,13121	18,200	1,50	2,18
GI	16,020	0,12085	16,400	1,14	1,82
pH	62,000	0,25495	6,00	5,50	7,00

Table 3: Descriptive data of the indicators of salivary sIg A, PLI, GI and pH in healthy children.

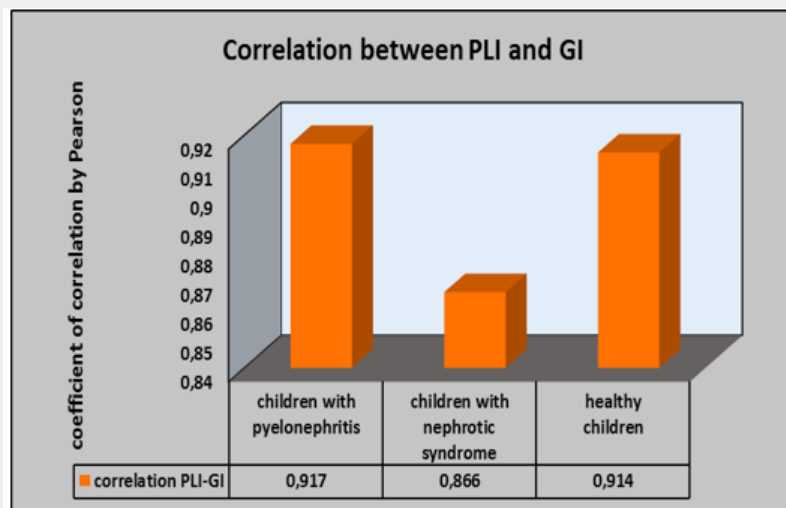
Indicator	Average value	Standard error of the average value	Median	Minimal value	Maximal value
sIg A	568,800	1,005,779	522,000	12,80	123,0
PLI	13,010	0,17612	13,150	0,14	2,00
GI	10,150	0,16753	11,800	0,00	1,68
pH	65,000	0,21082	65,000	5,50	8,00

Among the participants with the diagnosis of nephrotic syndrome has been ascertained moderate positive correlation between the indicator of salivary sIg A and salivary pH. Children without common health disorders included in the investigation confirm similar level of moderate positive correlation between both of these variables of salivary pH and sIg A (Graph 2). Among the patients suffering from nephrotic syndrome there has been recorded great positive correlation between the clinical parameters of the Plaque Index PLI Silness-Løe and Gingival Index GI Løe-Silness. The children with diagnosed pyelonephritis and healthy controls in the study have been characterized with extremely great positive correlation between the indices of PLI and GI (Graph 3). The participants with the diagnosis of nephrotic syndrome have been characterized with moderate negative

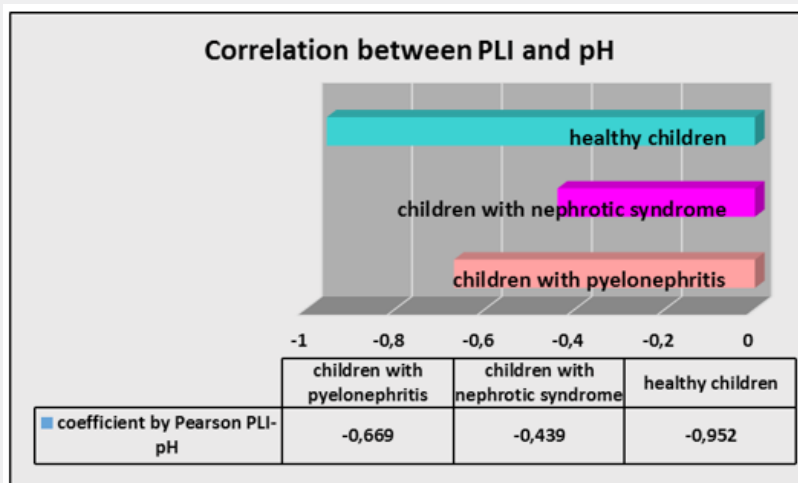
correlation between the clinical indicator of PLI Silness-Løe and salivary pH level. In the group of children with established excretory system disorder of pyelonephritis has been recorded significant negative correlation between the Plaque Index PLI and the para-clinical parameter of salivary pH. Among the healthy representatives in the investigation has been registered extremely great negative correlation between both of the indicators of PLI and salivary pH (Graph 4). Great negative correlation between the clinical indicator of GI Løe-Silness and salivary pH value has been ascertained among the representatives of the three groups included in the study, namely in the group of patients with pyelonephritis, in the group of participants with nephrotic syndrome and among the healthy controls (Graph 5).



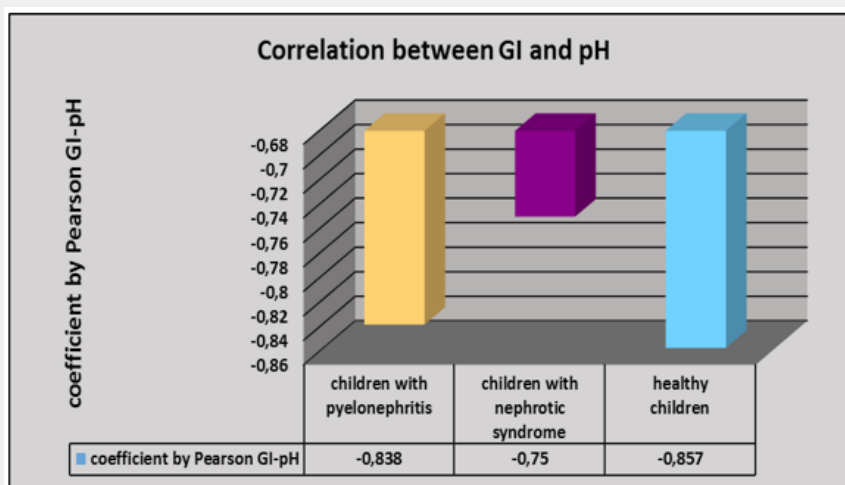
Graph 2: Correlation sIg A–pH according to the common health status.



Graph 3: Correlation between PLI and GI.



Graph 4: Correlation between PLI and pH.



Graph 5: Correlation between GI and pH.

Discussion

The results obtained in the context of our study are based on the explicitly manifested interrelations between the local immunity factor of salivary secretory Ig A and the specifics of common health status on individual and group level. There are definite, considerable correlations between local immunity into oral cavity and basic clinical parameters of the state of gingival tissue complex. A scientific investigation accentuates upon the interrelations between the salivary secretory Ig A in its role for physiological, functional and clinical manifestation of local acquired immunity in oral cavity, from one side, and effectors on systemic and local level, on the other side [37]. The secretory Ig A is characterized as a fundamental indicator for proper assessment of the level of risk of alteration of hard teeth tissues and periodontal structures in condition of pathological processes [27,28]. Among some of the participants in our study with the diagnosis of nephrotic syndrome is verified moderate negative correlation between sIg A and the Plaque Index PLI. Simultaneously, there is negative moderate correlation between the parameters of sIg A and the Gingival Index GI. Immune-suppressive activities of corticosteroids perform inhibiting effect upon the protective mechanisms of local immunity in oral cavity. This is related to suppression of the synthesis and secretion of salivary immunoglobulins, including immunoglobulin A (Ig A) [17,18,33]. In parallel, the common health disorder of renal failure is associated with a definite increase of blood and salivary urea level with risk of establishment of the pathological state of uremic stomatitis. The elevated rate of urea in blood and saliva is related to considerably lower distribution of non-cavitated and cavitated carious lesions, but to enhanced risk of gingival and periodontal disease [38-42]. We confirm the key role of secretory Ig A in non-stimulated mixed saliva as a plaque-inhibiting indicator, with suppressive activity against progression of the gingival inflammatory process.

In the context of a study performed by Rashkova et al. [26] a number of thirty (30) children without common health disorders and with clinically healthy gingiva are compared with thirty (30) children also without somatic deviations, but with clinically manifested plaque-induced gingivitis. In the group of 30 children with diagnosed gingivitis the average value of salivary sIg A amounts to $sIgA = 41,07 \pm 32,14 \mu g/ml$. The group of 30 healthy participants at child's age with no symptoms of gingival inflammation are characterized with higher average value equal to $sIgA = 48,3 \pm 32,41 \mu g/ml$. There has been established a statistically significant correlation between sIgA and the plaque index PLI Silness & Løe ($p < 0,05$). There has been ascertained no correlation between salivary sIg A and the degree of bleeding on probing (BoP). The parameter of sIgA is evaluated as a variable with considerable significance of assessment of the risk of pathological processes with impact upon oral cavity tissues. Secretory Ig A in the medium of non-stimulated mixed saliva performs plaque-inhibiting activity with key control function against advancing of the gingival inflammatory process [27]. In our study the children

suffering from nephrotic syndrome are treated by application of corticosteroids [34-36]. In the specific therapy-related conditions of that excretory system disorder salivary sIg A is characterized with caries-protective activity against initial carious lesions and indirect impact upon the levels of plaque and gingival indices.

Based on the principles determined into the researches by Kiselova [17] and Dencheva et al. concerning the behavioral patterns of dental medicine doctors towards patients suffering from urinary tract infections, we accentuate on the explicit necessity of regular visits at dentist's office on each three months. The purpose of these appointments is associated to the performance of professional complex oral-hygiene procedures in combination with programs for motivation and re-motivation of patients [17]. The infections affecting hard teeth structures and periodontal tissues have to be adequately and radically treated [43-48].

The specifics of clinical manifestation and therapeutic protocols of the excretory system disease of pyelonephritis correlate to numerous factors with negative influence on the processes of formation of enamel, respectively on its qualitative and quantitative traits. There have been investigated the adverse effects of wide spectrum antibiotics [49-52], limitation of proteins' consumption in condition of modified dietary regime, with prevailing frequency of intake of cariogenic foods [53], recurrent episodes of sub-febrile and febrile body temperature [54]. These variables combined with the need of application of steroid anti-inflammatory drugs concern the disease of nephrotic syndrome. All of these factors serve as definite prerequisites for impingement of oral-dental health and disturbance of the periodontal status of the patients with excretory system disorders of pyelonephritis and nephrotic syndrome [55].

In the context of profound, thorough investigations of the salivary marker of pH is ascertained its essential role of a considerable factor for initiation and progression of the carious process [56-58]. In our study we accentuate on the interrelations between dynamics of salivary pH levels and gingival health status in children with diagnosed nephrotic syndrome and pyelonephritis. In parallel, the researchers A. Ivanova, A. Krusteva and Z. Krustev evaluate the average value of pH in mixed saliva equal to 7,2 [17]. The limited consumption of foods rich in proteins, with respect to protection of the renal system from functional overload, is compensated with considerable amounts and high frequency of intake of sugar-containing products among the participants with established nephrotic syndrome and pyelonephritis. As a consequence of performance of this explicitly modified dietary regime there is a considerable number of episodes of reduction of salivary pH level, facilitating the inflammatory process of the gingival tissue [56,59].

Conclusion

1. The lowest level of secretory Ig A in saliva is registered among the participants suffering from nephrotic syndrome.

2. The increased concentration of salivary secretory Ig A correlates to the lower levels of the Plaque Index PLI and the Gingival Index GI.

3. The reduced level of secretory Ig A in saliva predisposes to initiation and progression of inflammatory reactions of the gingival tissue.

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