

# The Relationship between Periodontal Diseases and Plasma Level of Copper and Magnesium

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## Abstract

Periodontitis is an immuno-inflammatory condition initiated by the dental plaque biofilm. Balanced levels of trace minerals like iron are essential to prevent progression of chronic conditions such as periodontitis. Their excess as well as deficiency is detrimental to periodontal health. The aim of the current study was to find out any possible relationship between copper and magnesium levels in the plasma and periodontal diseases.

The sample of the study included 29 patients seeking periodontal treatment. Full record of every patient was completed and the periodontal situation was determined clinically. Blood samples were collected from the patients and transferred to a medical laboratory for blood testing. The records of copper (Cu) and magnesium (Mg) in plasma were collected. T-test was used to compare the obtained values with the normal ones, and to compare the values obtained in paired samples. The differences were considered significant when  $P < 0.05$ .

The mean levels of copper in plasma were 148.88 mg/dl and 148.56 mg/dl for patients suffering acute gingivitis and chronic gingivitis respectively.

The results of T-test showed no significant differences between the records in both patients' groups. The mean scores of magnesium were 1.85 mg/dl and 2.03 mg/dl for patients suffering acute gingivitis and chronic gingivitis respectively and T-test showed a significant difference between the records. The mean scores of copper were 166.33 mg/dl and 164.83 mg/dl for patients suffering chronic periodontitis and aggressive periodontitis respectively with no statistically significant difference between the records. The mean records of magnesium in plasma were 2.25 mg/dl and 2.48 mg/dl for patients suffering chronic periodontitis and aggressive periodontitis respectively and T-tests showed a significant difference between those records. The records of magnesium and the copper were significantly increased in all patients more than the normal values.

The results of the current study showed a remarkable increase of copper and magnesium plasma scores in patients suffering different types of periodontal diseases. More studies to explore the mechanism of magnesium increase in plasma due to periodontal disease are needed. Representing the records of magnesium and copper in plasma as indicators for the severity of periodontal disease might come under future research focus

**Keywords:** Periodontitis; Dental; Plaque; Minerals

## Introduction

Periodontitis is an infection disease that affects the hard and soft tissues surrounding the teeth, and it is demonstrated as destruction in alveolar bone and connective tissue. It is a multifactorial disease in which many factors could contribute to its severity including diabetes mellitus, smoking, the host response, and the nutrition conditions [1].

Although periodontal diseases are highly connected to special kinds of pathogenic bacteria, most of gingival tissues could be damaged when host response is not sufficiently resistant against microorganisms, as well as due to the lack of balance between nutrition conditions and destructive factors [2].

Nutrition has a big effect on the inflammatory responses in the human body as well as on the cellular immunity. It also plays an important role in wound healing, and periodontitis is such a kind of wounds in which good circumstances of nutrition is necessary to complete their healing process.

The daily nutrition of human contains macronutrients and micronutrients. The need for micronutrients is measured by microgram or milligram, it contains, for example, vitamins and minerals. The daily need for some micronutrients like copper, iron, and zinc is about 100 microgram. Those elements have different functions and metabolic features, which considered necessary for the general health. They are also necessary for some enzymatic systems in the body like DNA, RNA, and alkaline phosphatase [3]. However, the critical mechanism

in which micronutrients contribute to periodontal destruction is still unknown and hardly represented in clinical studies.

The aim of the current study was to find out any possible relationship between copper and magnesium scores in the plasma and periodontal diseases.

## Materials and Methods

The sample of the study included 29 systemically-healthy patients (12 males and 17 females) who visited the dental clinics of the Faculty of Dentistry in the Syrian Private University in Damascus, and were seeking periodontal treatment due to several reasons. Oral consents were received from all patients to get their approval for being incorporated in the study. The aim of the study was explained to all patients and full record of every patient was completed including general information, and the periodontal situation was determined clinically through intra-

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oral examination and by means of x-ray panoramic records. Acute gingivitis was considered available when patients suffered spontaneous gingival bleeding with swelled and light reddish appearance of the gingiva, while chronic gingivitis was considered available when the patients showed gingival bleeding on probing with swelled and dark reddish appearance of the gingiva. The diagnosis of periodontitis was done in the light of the age of patient, the familial history, the amount of dental plaque persisted, the amount of bone destruction, and the depth of periodontal pockets. The classification of the American Academy of Periodontology in 1999 [4] was appointed in order to distinguish both types of periodontitis assuming that chronic periodontitis was usually seen in adult patients with a considerable amount of dental plaque and probably with some local factors like smoking, irritating prosthetics, bad fillings, and bad oral hygiene. Aggressive periodontitis was usually related to younger patients with less amount of dental plaque, and, in many cases, was related to past familial history.

Blood samples (2 cm<sup>3</sup> / Patient) were collected from the patients (left or right arm with no preferences) and preserved in special tubes. Blood samples were transferred as soon as possible to a specialized medical laboratory for blood testing. The laboratory staffs were asked to measure the records of copper (Cu) and magnesium (Mg) in plasma. The blood samples were analysed by means of spectrometer device and the results for every patient were recorded on a special registration card that was, later on, attached to the clinical intraoral sheet of the patient. Statistical analysis software (SPSS IBM 21) was used to analyse the obtained data. T-test was used to compare the obtained values with the normal ones, and to compare the values obtained in paired samples. The differences were considered significant when P<0.05

## Results

The sample of the study included 29 patients who were suffering different kinds of periodontal diseases distributed as follows: Eight patients with acute gingivitis, 9 patients with chronic gingivitis, 6 patients with chronic periodontitis, 6 patients with aggressive periodontitis (Table 1).

When comparing the scores of copper and magnesium in plasma with the normal values, the following results were shown: First of all, it has to be mentioned that the normal values of magnesium in plasma range between 1.3 mg/dl and 2.1 mg/dl, and the normal values of copper in males range between 70 mg/dl and 140 mg/dl, and between 80 mg/dl and 155 mg/dl in females (10). Therefore, and in order to facilitate the statistical analysis, we took the mean value of the normal range of magnesium which was 1.7 mg/dl and also the mean value of the normal range of copper in plasma for both male and female which was about 111.2 mg/dl. We compared the scores of copper and magnesium obtained in the study with the normal values mentioned above.

Regarding the records of magnesium (2.12 mg/dl), the statistical analysis showed that those records were significantly increased in all patients more than the normal values (P<0.05) (Table 2).

Regarding the records of copper in plasma (155.8 mg/dl), the statistical analysis showed that those records were significantly increased in all patients more than the normal values (P<0.05) (Table 3).

It was shown that the scores of copper in plasma for all patients ranged from 144 mg/dl to 172 mg/dl with a mean of 155.8 ± 9.07 (SD). The scores of magnesium in plasma for all patients ranged from 1.7 mg/dl to 2.6 mg/dl with a mean of 2.12 ± 0.23 (SD). Table 4 demonstrates the scores of copper and magnesium as recorded for the patients.

The mean scores of copper in plasma were 148.88 mg/dl and 148.56 mg/dl for patients suffering acute gingivitis and chronic gingivitis respectively. The results of T-test showed no statistically significant differences between the records in both patients' groups (i.e. between acute and chronic gingivitis) (P>0.05).

Regarding the scores of magnesium between both groups of patients who were suffering acute gingivitis and chronic gingivitis, it was shown that the mean scores of magnesium were 1.85 mg/dl and 2.03 mg/dl for patients suffering acute gingivitis and chronic gingivitis respectively. T-test showed a statistically significant difference between the records (P<0.05) (Tables 5 and 6).

Regarding the scores of magnesium between both groups of patients who were suffering chronic periodontitis and aggressive periodontitis, it was shown that the mean scores of copper were 166.33 mg/dl and 164.83 mg/dl for patients suffering chronic periodontitis and aggressive periodontitis respectively. However, the results of T-test did not show any statistically significant difference between the records (P>0.05).

The mean records of magnesium in plasma were 2.25 mg/dl and

Category of Periodontal Disease			
		Frequency	Percent
Valid	Acute Gingivitis	8	27.5
	Chronic Gingivitis	9	31
	Chronic Periodontitis	6	20.6
	Aggressive Periodontitis	6	20.6
	Total	29	100.0

Table 1: Distribution of patients according to the categories of periodontal diseases.

	N	Mean	Std. Deviation
Mg Values (mg/dl)	29	2.120	0.2384
	Test Value = 1.7 (Normal Value)		
	Sig. (2-tailed)		Significance
	0.000		S

Table 2: Results of T-test comparing the scores of magnesium extracted in the study with the normal value (S: significant).

	N	Mean	Std. Deviation
Cu Values (mg/dl)	29	155.83	9.079
	Test Value = 111.2 (Normal Value)		
	Sig. (2-tailed)		Significance
	0.000		S

Table 3: Results of T-test comparing the scores of copper extracted in the study with the normal value (S: significant).

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Cu Values (mg/dl)	29	144	172	155.83	9.079
Mg Values (mg/dl)	29	1.7	2.6	2.12	0.2384

Table 4: Scores of copper and magnesium for all patients.

	Category of Periodontal Disease	N	Mean	Std. Deviation
Cu Values (mg/dl)	Acute Gingivitis	8	148.88	2.357
	Chronic Gingivitis	9	148.56	2.651
Mg Values (mg/dl)	Acute Gingivitis	8	1.85	0.0756
	Chronic Gingivitis	9	2.03	0.0500

Table 5: Scores of copper and magnesium for patients suffering acute and chronic gingivitis.

	Sig. (2-tailed) (P Value)	Mean Difference (chronic periodontitis - aggressive periodontitis)	Significance
Cu Values (mg/dl)	0.798	0.319	NS
Mg Values (mg/dl)	0.000	-0.1833	S

**Table 6:** Results of T-test comparing the scores of copper and magnesium for patients suffering acute and chronic gingivitis (S: significant, NS: not significant).

	Category of Periodontal Disease	N	Mean	Std. Deviation
Cu Values (mg/dl)	Chronic Periodontitis	6	166.33	4.320
	Aggressive Periodontitis	6	164.83	5.879
Mg Values (mg/dl)	Chronic Periodontitis	6	2.25	0.0548
	Aggressive Periodontitis	6	2.48	0.0753

**Table 7:** Scores of copper and magnesium for patients suffering aggressive and chronic periodontitis.

	Sig. (2-tailed) (P Value)	Mean Difference (chronic periodontitis - aggressive periodontitis)	Significance
Cu Values (mg/dl)	0.625	1.50	NS
Mg Values (mg/dl)	0.000	-0.23	S

**Table 8:** Results of T-test comparing the scores of copper and magnesium for patients suffering aggressive and chronic periodontitis (S: significant, NS: not significant).

2.48 mg/dl for patients suffering chronic periodontitis and aggressive periodontitis respectively. T-tests showed a statistically significant difference between those records ( $P < 0.05$ ), confirming that the records of magnesium were significantly higher in patients with aggressive periodontitis than those with chronic periodontitis (Tables 7 and 8).

## Discussion

The results of the current study showed a remarkable increase in the scores of copper in plasma in the patients who were affected by periodontal diseases in general, and especially for those who were suffering aggressive periodontitis. These results were compatible with those previously published by Freeland et al. 1976, who found higher records of copper in plasma in patients affected by periodontal diseases.

Turnlund, et al. (1998) showed that the increase in copper scores in plasma could change the immunological function and the conditions of antioxidants [5].

Other studies showed that the higher records of copper in plasma could change the collagen metabolism, and it could also prepare a good environment for an inflammation to take place in the periodontal tissues [6].

On the other side, the process of inflammation in general could make an increase in the records of copper in plasma. For instance, Pekarek, et al. (1972) showed that copper in blood, which exists in the form of "Ceruplasmin", could be released as a feedback signal initiated by some immunological mediators related to the white blood cells. However considering higher records of copper in plasma as a risk factor for periodontal disease is still a debate and needs more comprehensive studies [7]

Two different theories could be stated regarding the copper values in plasma. The first theory states that the higher copper values could be a direct result of periodontal disease, while the second theory states that the increase of those records affects the intensity of periodontitis.

However, due to the fact that the nutrition consumption of copper is not related to the values of copper in plasma, it could be stated that to higher increase of copper values in plasma in our study is a direct cause of periodontitis [8].

It has to be mentioned that some changes in collagen metabolism are also related to the increase of copper records in plasma in general, and, therefore, the activity of collagenase enzyme is closely related to the level of gingival inflammation due to the fact that collagenase plays an important role in the metabolic process in the periodontal tissues and it is probably related to the big loss of connective tissue occurs in periodontitis.

Similarly, it was previously shown that elevated levels of Iron (Fe) n plasma showed a negative impact on periodontal health [8,9].

More recently, Sundaram, et al. [10] conducted a study To find out the effect of nonsurgical periodontal therapy on serum zinc, magnesium, and copper concentration and glycemic status in type 2 diabetes with chronic periodontitis. They found that after nonsurgical periodontal management, there is an increase in the zinc and magnesium content and decrease in the copper content.

To our knowledge there is no studies in the literature which examined the increase or decrease of magnesium records in plasma in patients suffering periodontitis.

However the results of the current study regarding the mean values of magnesium were similar to those related to copper. The magnesium scores in patients suffering chronic periodontitis were less than those in patients suffering aggressive periodontitis, and this difference was statistically significant. The scores of magnesium were higher in all patients than the normal values in plasma for those who were suffering periodontal diseases in general. The mechanism of magnesium increase in plasma in patients with periodontal disease still needs more immunological, histological and biochemical studies.

The clinical importance of the current study comes through the idea of representing the records of magnesium and copper in plasma as indicators for the intensity of periodontal disease.

## Conclusion

The results of the current study showed a remarkable increase of copper and magnesium plasma scores in patients suffering chronic and aggressive periodontitis and also in patients suffering chronic and acute gingivitis. We suggest the performance of more comprehensive studies to explore the exact mechanism of magnesium increase in plasma due to periodontal disease and also to find the relationship between periodontal diseases and the scores of copper in plasma.

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