



## A comparative evaluation of periodontal parameters and oral health in the twins of Khorasan Province, Iran

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### Original Article

#### Abstract

**BACKGROUND AND AIM:** Several risk factors contribute to periodontal diseases. Studying twins has helped increase our knowledge on the roles of genetic and environmental factors in periodontal diseases. The objective of this study was the evaluation of periodontal parameters in the twins of Khorasan Province, Iran.

**METHODS:** This study was carried out on 30 pairs of twins between 12-35 years old including 12 pairs of monozygotic (MZ) twins and 18 pairs of dizygotic (DZ) twins with the average age of 18 years old. Periodontal parameters studied consisted of: probing pocket depth (PPD), clinical attachment level (CAL), and bleeding on probing (BOP). Analyses were conducted through SPSS software. T-test was used to examine the differences between MZ and DZ twins also between first twin and second twin. Significance level was set at 0.05.

**RESULTS:** The amounts of PPD ( $P = 0.045$ ) and CAL ( $P = 0.003$ ) were significantly different between MZ and DZ twins, while no significant difference in BOP ( $P = 0.474$ ) was observed between the two groups. Studying heritability showed that BOP could be affected by environmental factors ( $h^2 = 0.41$ ), while CAL and PPD were affected by genetic factors ( $h^2 = -0.70$  and  $h^2 = -0.61$ , respectively).

**CONCLUSION:** Our study confirms previous studies which had focused on the role of genetic factors in periodontal diseases. It indicates that in twins, PPD and CAL are mostly affected by genetic factors, while BOP is mainly affected by environmental factors.

**KEYWORDS:** Bleeding on Probing; Periodontal Disease; Twins

**Citation:** Fatemi K, Chavoshi A, Banihashemrad SA, Ghodsi K, Rezaee ME, Javan-Rashidi A, et al. A comparative evaluation of periodontal parameters and oral health in the twins of Khorasan Province, Iran. *J Oral Health Oral Epidemiol* 2019; 8(4): 167-72.

People who are biologically similar share common genes and environment with each other. The environment plays a major role in the similarity of those who are not genetically similar but live in the same place like partners. Studying different groups of twins can help us investigate the role of genetic and environmental factors in appearance of

different characters.<sup>1</sup>

There are two types of twins: monozygotic (MZ) and dizygotic (DZ) twins. MZ twins are the same in genotype, sex, and all the genetic characters. DZ twins are like common siblings and share half of their genes with each other. If both of twins share the same character, they are called concordant and if MZ twins are discordant for a character, we can say that the

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environment is playing a substantial role in appearance of that character.<sup>2</sup>

Furthermore, if MZ and DZ twins are concordant for a character, environmental factors are playing a major role.<sup>3</sup>

In an attempt to separate the role of genes from the environment in multifactorial characters, the heritability has been invented. It tells us how much genetic factors are involved in a given phenotype.<sup>4</sup>

One of the ways to estimate the heritability is to compare the concordance of MZ and DZ twins in a given character with its prevalence in the whole population. Heritability shows us the diversity caused by genetic differences in a population.

Periodontal diseases are referred to common disorders such as gingivitis and periodontitis caused by subgingival biofilm.<sup>5</sup>

Although bacterial plaque has been accepted as the primary etiologic cause, there is little information about the effects of host genetic factors in the severity of the disease.<sup>6</sup> An investigation on Indonesian young siblings who had not shown severe chronic periodontitis in spite of not getting regular dental care may propose that genetic factors are responsible for milder manifestations of periodontal disease. Family studies may give us useful information, but it cannot differentiate between genetic and environmental factors just as the environmental factors may alter the gene expression.<sup>7</sup>

Schenkein and Van Dyke declared that genetic factors were responsible for prepubertal periodontitis as much as other types of early-onset periodontitis (now called aggressive periodontitis).<sup>8</sup>

Watanabe suggested that there were differences in the prevalence of prepubertal periodontitis based on genetic diversities in the studied populations.<sup>9</sup>

Shapira et al. investigated prepubertal periodontitis in a big family and found that MZ twins were similarly afflicted. They suggested a strong genetic factor for this disease.<sup>10</sup>

In a study of Virginia and Minnesota twins in United States, Newman et al.

concluded that there was an important genetic part in adult periodontitis (now called chronic periodontitis).<sup>11</sup>

In two separate studies, Michalowicz et al. investigated the role of genetic and environmental factors in clinical parameters of periodontal disease. They concluded that there was an important genetic part for periodontal disease parameters.<sup>12</sup> In the second study, they investigated 117 twins and showed the role of genetics in development of adult (chronic) periodontitis. They said that almost half of periodontal diseases were caused by genetic factors.<sup>13</sup>

In an investigation done by Moore et al. on genetic and environmental effects on subgingival flora content, it was concluded that the amount and concentration of some bacteria was affected by host genetic factors.<sup>14</sup>

Although there is a lot of information about the effect of systemic and local factors in development of periodontal disease, there is little data about the role of genetic factors. In addition, the exact share of genetic and environmental factors in clinical periodontal parameters has not been identified.<sup>15</sup>

In this study, we aim to investigate three clinical periodontal parameters including probing pocket depth (PPD), clinical attachment level (CAL), and bleeding on probing (BOP) in some of the MZ and DZ twins living in Khorasan Province, Iran, and then determine the share of genetic and environmental factors in these three parameters.

## Methods

This cross-sectional study was carried out on 30 pairs of twins between 12-35 years old including 12 pairs of MZ twins and 18 pairs of DZ twins. We used non-probability snowball sampling. We asked the twins who came to dental school in Mashhad, Iran, to recommend us twins with the age range of 12-35 years if they knew any. We determined 30 twin pairs because when sample size exceeds 30, Z values, the area under the normal curve, would not change considerably and it would

approach normal distribution.

For collecting the data, a questionnaire consisting of two major parts was prepared.

In the first part of the questionnaire, the participants were asked to provide information about demographic variables, such as sex and age. They were also asked about their clinical genetic history and the history of any special disease or surgery. One of the students gathered the questionnaires.

The second part consisted of a number of tables for writing down their clinical periodontal parameters such as PPD, CAL, and BOP.

We asked a geneticist to complete the clinical genetic history part of the questionnaire. He investigated whether they were MZ or DZ twins and then examined their history for any probable genetic disorder.

Informed consent was obtained from all the participants. Inclusion criteria included being twins and absence of any special disorder or disease.

Exclusion criteria included drug, alcohol, and tobacco addiction, genetic disease or anomaly, and the history of surgery.

In the second part of the questionnaire, we measured 3 periodontal parameters for each individual as follows:

**PPD:** We recorded the distance between the gingival margin and the pocket depth in 6 areas of tooth consisting of mesiobuccal, midbuccal, distobuccal, mesiolingual (palatal), midlingual (palatal), and distolingual (palatal) using a periodontal probe.<sup>11</sup>

**CAL:** We recorded the distance between the pocket depth and a constant point on the crown such as cemento-enamel junction (CEJ). Changes in CAL may be due to an attachment loss. Therefore, measuring CAL is a useful way for diagnosis of periodontal diseases.<sup>11</sup>

**Measuring CAL:** When the gingival margin is on the anatomical crown, CAL is calculated by subtracting the distance between the gingival margin and CEJ from the pocket depth. If they are equal, then CAL will be zero. When the gingival margin is at the same level with CEJ, CAL equals to the

pocket depth. When the gingival margin is more apical to CEJ, CAL is larger than the pocket depth. So we should add the distance between CEJ and the gingival margin to the pocket. In this study, we measured CAL in 4 points [mesial, distal, lateral buccal, and lingual (palatal)].<sup>11</sup>

**BOP:** If there is a swollen or atrophic gingiva and we enter a periodontal probe to the pocket depth, bleeding will be initiated. Non-inflamed areas rarely have bleeding. Most of the times, bleeding occurs during probing.

In order to investigate bleeding, we should enter a probe to the pocket depth carefully and then move it laterally through the length of the pocket depth. Sometimes bleeding occurs immediately after pulling out the probe and sometimes we may see bleeding with a few seconds delay. Thus, we should recheck the probed areas after 30 to 60 seconds. Depending on the degree of inflammation, we may see bleeding in different forms. It may be a red line in the gingival sulcus or a severe bleeding.

We measured BOP in 4 points of the tooth by probing and checking after 10 seconds using the mentioned method.

After collecting the data, we used descriptive and inferential statistics to analyze the data. In descriptive part, we used frequency tables for introducing the population we studied.

In inferential part, we used the mean and the standard deviation (SD) of the data to compare periodontal parameters of the twins. Analyses were conducted through SPSS software (version 22, IBM Corporation, Armonk, NY, USA). T-test was used to examine the differences between MZ and DZ twins also between first twin and second twin. Significance level was set at 0.05.

## Results

As we see in table 1, CAL and PPD were significantly different between MZ and DZ twins ( $P = 0.003$  and  $P = 0.045$ , respectively), but BOP did not differ significantly between MZ and DZ twins ( $P = 0.474$ ).

**Table 1.** Comparing mean and standard deviation (SD) of periodontal parameters in monozygotic (MZ) and dizygotic (DZ) twins

Twin type	n (%)	BOP (mean ± SD)	CAL (mean ± SD)	PPD (mean ± SD)
MZ	24 (40)	48.70 ± 23.32	2.60 ± 0.49	2.41 ± 0.41
DZ	36 (60)	96.63 ± 13.37	2.24 ± 0.29	2.21 ± 0.29
T-test results		t = 0.70, P = 0.474	t = 3.27, P = 0.003	t = 2.10, P = 0.045

MZ: Monozygotic; DZ: Dizygotic; BOP: Bleeding on probing; CAL: Clinical attachment level; PPD: Probing pocket depth; SD: Standard deviation

We can see in tables 2 and 3 that there was also no statistically significant difference for PPD, BOP, and CAL in each of the two independent groups using t-test. We used Kolmogorov-Smirnov test (K-S test) in order to be reassured of t-test results.

We used the data in table 4 to calculate the heritability for each of the three periodontal parameters.

Considering the heritability formula, if the fraction is near 0, it shows the effect of environmental factors rather than genetic factors. If it is near +1 or -1, it means that the character is mostly controlled by genetic factors.

$$h^2 = \frac{\text{variance in DZ twins} - \text{variance in MZ twins}}{\text{variance in DZ twins}}$$

As can be seen in table 5, CAL and PPD were mostly controlled by genetic factors but BOP was mostly affected by the environment.

## Discussion

Periodontal diseases are the result of a complicated interaction between the microbial invasion and the host response. Both of them are controlled by the environmental factors.<sup>16</sup> In addition to external factors, there is evidence that genetic factors may play an important role in determination of host response quality. The

relative influence of genetic and environmental factors on complex diseases can be estimated using twin data. However, efforts for determining the risk factors of periodontal disease have primarily focused on immunological and bacteriological parameters; few studies have investigated the role of genetic factors in periodontal disease.<sup>17</sup>

One of the researchers (Gunsolley) states that when we count periodontal disease as a multifactorial disease, we mean that it spreads by genetic and environmental factors and the important question is which part of the risk for periodontal disease is due to genetics and which part is due to the environment.<sup>13</sup> In the classic twin study, reared-together MZ and DZ twins are compared to estimate the effects of shared genes.

Studying MZ and DZ twins is a great way to understand the role of genetics and the environment in periodontal disease.<sup>18</sup>

MZ twins originate from a single zygote and consequently have the same sex. They are always genetically the same. DZ twins originate from two separate zygotes and have half of their genes in common; the same as in common siblings. Differences between DZ twins may be the result of different genetics or environment.<sup>19</sup>

**Table 2.** Comparing mean and standard deviation (SD) of probing pocket depth (PPD) between monozygotic (MZ) and dizygotic (DZ) twins, separated by gender

Twin type	Gender	N	First twin (mean ± SD)	Second twin (mean ± SD)	Paired t-test
MZ	Male	6	2.27 ± 0.71	2.36 ± 0.18	t = 0.300, P = 0.818
	Female	6	2.42 ± 0.30	2.58 ± 0.31	t = 0.910, P = 0.387
DZ	Male	3	2.49 ± 0.11	2.52 ± 0.57	t = 0.810, P = 0.867
	Female	10	2.07 ± 0.20	2.05 ± 0.27	t = 1.350, P = 0.311
	Male & female	5	2.23 ± 0.29	2.26 ± 0.02	t = 0.860, P = 0.442

SD: Standard deviation; MZ: Monozygotic; DZ: Dizygotic

**Table 3.** Comparing mean and standard deviation (SD) of bleeding on probing (BOP) and clinical attachment level (CAL) between monozygotic (MZ) and dizygotic (DZ) twins, separated by gender

Periodontal parameter	Type of twin	Gender	N	First twin (mean ± SD)	Second twin (mean ± SD)	Paired t-test
BOP	MZ	Male	6	72.47 ± 37.43	73.06 ± 17.78	t = 0.035, P = 0.999
		Female	6	68.51 ± 40.21	67.86 ± 37.66	t = 0.029, P = 0.999
	DZ	Male	3	69.34 ± 26.85	72.33 ± 47.94	t = 0.094, P = 0.998
		Female	10	47.60 ± 37.45	64.99 ± 42.26	t = 0.974, P = 0.748
		Male & female	5	80.71 ± 33.63	69.65 ± 33.35	t = 0.552, P = 0.983
CAL	MZ	Male	6	2.63 ± 0.67	2.54 ± 3.55	t = 0.250, P = 0.984
		Female	6	2.54 ± 0.45	2.67 ± 0.60	t = 0.552, P = 0.326
	DZ	Male	3	2.49 ± 0.11	2.52 ± 0.57	t = 0.081, P = 0.867
		Female	10	2.07 ± 0.20	2.05 ± 0.27	t = 1.350, P = 0.311
		Male & female	5	2.23 ± 0.29	2.26 ± 5.02	t = 0.180, P = 0.442

MZ: Monozygotic; DZ: Dizygotic; BOP: Bleeding on probing; CAL: Clinical attachment level; SD: Standard deviation

Therefore, the difference between MZ and DZ twins in the amount of periodontal disease may show the effect of similar genes in MZ twins provided that the environmental factors are the same. In studies in which twins have grown up together, we can suppose that there is a similar environmental factor influencing MZ and DZ twins. If susceptibility to a disease is mainly controlled by host genes but also the environment is partly involved, the similarities between MZ twins will be more than DZ twins. In addition, studying MZ twins which have been separated from each other since birth is another way to determine the phenotypic relations of common genes. So, any similarity in these twins will be exclusively the result of common genes, although these twins are rare and this limits the usage of them in medical researchers.<sup>20</sup>

Regardless of the method of estimation, heritability pertains to populations and not individuals.

We did this research to investigate the periodontal parameters in twins. After analyzing the data, now we discuss about

the results.

Our investigations show a statistically significant difference for PPD and CAL in MZ and DZ twins. But BOP is not statistically significant in the twins. Regarding that when MZ and DZ twins are nearly concordant for a character, environment is playing a substantial role, a possible explanation for these results is that BOP is mainly influenced by environmental factors, but PPD and CAL are mostly influenced by genetic factors. This can be seen in table 5 in which heritability is calculated for each parameter.

Furthermore, such estimates describe the impact of genes on specific populations exposed to a particular range of environments. Finally, twin studies alone cannot be used to determine the mode of inheritance of a disorder or the number of location or disease alleles.

### Conclusion

Our study produced results which corroborate those results suggesting that genetic is playing a substantial role in periodontal diseases.

**Table 4.** Means and variances of periodontal parameters in monozygotic (MZ) and dizygotic (DZ) twins

Type of twin	Periodontal parameter	N	Mean	Between-pair variance	within-pair variance	Population variance
MZ	BOP	24	70.49	0.004	1086.074	1087.078
	CAL	24	2.60	0.003	0.251	0.254
	PPD	24	2.41	0.093	0.175	0.268
DZ	BOP	36	63.96	451.832	1406.246	1858.078
	CAL	36	2.24	0.077	0.080	0.157
	PPD	36	2.24	0.077	0.080	0.157

MZ: Monozygotic; DZ: Dizygotic; BOP: Bleeding on probing; CAL: Clinical attachment level; PPD: Probing pocket depth

**Table 5.** Calculating heritability for periodontal parameters

Periodontal parameter	Variance in DZ twins	Variance in MZ twins	Heritability (h <sup>2</sup> )
BOP	1858.078	1086.078	0.41
CAL	0.157	0.254	-0.61
PPD	0.157	0.268	-0.70

MZ: Monozygotic; DZ: Dizygotic; BOP: Bleeding on probing; CAL: Clinical attachment level; PPD: Probing pocket depth

In this research, we aimed to investigate the twins who live in Khorasan Province of Iran in terms of periodontal parameters. The present study is limited in having a small number of participants (n = 30). More research with larger number of participants is needed to elucidate the exact share of genetic factors in periodontal parameters.

### Conflict of Interests

Authors have no conflict of interest.

### Acknowledgments

We appreciate the School of Dentistry of Mashhad University of Medical Sciences for funding this study.

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