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Original Article

The effect of genetic on dental anxiety: Twin study

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Abstract

Aim: Genetic variations contribute differences in defensive behaviors among individuals. However, the exact role of heritability in the etiology of defensive behaviors like dental anxiety is not elucidated clearly. Twin studies provide an excellent source to investigate the relative contribution of genetics and environment in various phenotypic traits or disorders. Therefore, the aim of this study is to explore the relative contribution of genetics on dental anxiety on Turkish twins by using the classical twin method.

Material and Methods: Corah's Dental Anxiety Scale used for the anxiety measurement of 70 pairs of Turkish twins. Decayed, Missing, Filled-Teeth (DMF-T) index was calculated according to the number of decayed, missing and filled teeth after clinical and radiological examinations.

Results: No significant differences and correlations found within the dental anxiety scores of Monozygotic (MZ) and Dizygotic (DZ) twin-pairs. Significant positive correlation for DMF-T scores was found within the MZ and DZ twin-pairs.

Conclusion: Based on the data obtained from our study, it can be concluded that environmental factor appears to have a more dominant effect on dental anxiety and the high correlation regarding DMF-T among MZ twin pairs indirectly shows the genetic effect on dental caries.

Keywords: Dental anxiety; heritability; twin

INTRODUCTION

Different areas of the human brain regulate various behaviors with emotions triggered by different threat stimuli. An avoidable actual threat can activate the amygdala and result in reaction with fear. However, an avoidable potential threat can trigger the activity of the septo-hippocampal system and result in anxiety response (1). By using these trajectories more than 60 potential anxiety/fear-provoking dental materials and situations can reported to activate dental anxiety and fear response (2). Dental anxiety is defined as the state anxiety occurs as response to anticipation of encountering to a stressful dental stimulus (3,4). Fear, on the other hand, is a present-oriented, actual or activated response to an immediate dental threat (3,5,6). If the dental fear represents in a severe and unreasonable form, this is referred as dental phobia (2,6).

Dental anxiety, fear, and phobia are persisting problems with an increasing prevalence and continue to be the target of investigation in the scientific field (7-9). Avoidance of dental care associated with these conditions lead poor oral health, lower self-esteem, trigger medical compromises, and negatively affect the social relations (10-12). The detrimental effects of these conditions on oral/general health and the daily life of the people, force researchers to understand the exact etiology of these conditions (7,8,10). In the literature learning history, neuroticism, and environmental factors of dental fear and anxiety have been studied previously, however, a very small amount of information is known about the role of heritability in the etiology of these conditions (8,10).

The aim of this study is to determine the heritability of dental anxiety in a cohort of Turkish twins, and also to evaluate the relationship between the oral health and dental anxiety levels of these twins, by using classical twin model.

MATERIAL and METHODS

Patients

This study conducted on the twin pairs who were previously admitted to the Department of Oral and Maxillofacial Surgery of Ordu University for various treatment procedures. The contact information of the twin pairs or their parents has been reached from the archival records of the hospital and they contacted via telephone interviews. The twin pairs or their parents were informed about the study and the twin pairs who want to participate were invited to the clinic for detailed information. In clinical

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examination, healthy twin pairs who want to participate were included in the study. The twin pairs who have neurological or psychotic disorders were excluded. The study was approved by Ordu University Ethics Committee (No:2019-28) and informed consent was obtained from all participants or parents prior to participation. The study protocol was conducted in accordance with the ethical standards specified in the Helsinki Declaration of 1964 and its subsequent amendments. Zygosity was determined based on responses to a standard zygosity questionnaire (13). Based on data from a previous study(14), a sample size of 45 subjects was calculated using the G*Power software version 3.1. (Power 0.95, α = 0.05, β = 0.05). By considering the potential loss of power due to study dropouts more twins were included.

Measurement of anxiety and DMF-T

Corah's Dental Anxiety Scale (DAS)(15) which consists of 4 questions used for the anxiety measurement. For each question in the scale answer options from 1 (no anxious) to 5 (extremely anxious) are available. Total score ranges between 4 and 20, and the values of>13 indicate high dental anxiety.

DMF-T (Decayed, Missing, Filled-Teeth) index was calculated according to the number of decayed, missing, and filled teeth after clinical and radiological examinations. Extracted carious teeth are recorded as missing; the third molars and orthodontic extractions were excluded from the calculation.

Statistical analysis

To investigate whether dental anxiety significantly differs within MZ and DZ twin-pairs, paired t test or Wilcoxon test was used. Pearson or Spearman correlations performed as appropriate to explore the correlation in anxiety levels within twin pairs, and also to the anxiety levels and DMF-T scores. To estimate the heritability of dental anxiety, Falconer's formula of heritability was applied. Narrow-sense heritability-additive genetic (h^2), shared environmental (c^2) and non-shared environmental (e^2) variance calculated with the formulas as follows;

$h^2 = 2(rMZ - rDZ)$, $c^2 = 2rDZ-rMZ$, $e^2 = 1-rMZ$

RESULTS

This study consists of 70 pairs of Turkish twins. 18 of the twins were MZ while 52 of them DZ. MZ twins were aged between 9-54 years while DZ twins aged between 6-20 years. 7 of MZ twins were female (F-F), and 11 were male (M-M). Among DZ twins 15 were M-M, 20 were F-F and 17 were in opposite sex (OS), (Table 1).

Descriptive of the DAS and DMF-T were shown in Table 2. No statistically significant differences was found between the mean dental anxiety scores of MZ twin-pairs in general (p = 0.51), (Figure 1) or in terms of gender, for F-F twin-pairs (p = 0.67) and M-M twin-pairs (p = 0.46), (Figure 2A). Correlation for dental anxiety within MZ twin-pairs was r = 0.28 (p = 0.26). Regarding gender correlation for dental anxiety within MZ F-F twin-pairs was r = 0.01 (p = 0.97) and within MZ M-M twin-pairs was r = 0.49 (p = 0.12). In terms of DMF-T scores no statistically significant differences found among MZ twin-pairs in general (p = 0.15), (Figure 1) or in terms of gender, for F-F twin-pairs (p = 0.48) and M-M twin-pairs (p = 0.17), (Figure 2B). Correlation for DMF-T scores within MZ twin-pairs was r = 0.81 (p < 0.05), while correlation for DMF-T scores within MZ F-F twin-pairs was r = 0.82 (p = 0.22) and within MZ M-M twin-pairs was r = 0.83 (p < 0.05). Correlation between anxiety scores and DMF-T scores among MZ twins was not significant (r = 0.017), (p = 0.30).

Table 1. Demographic data of the twins

Zygosity	Sex	N	Age Mean±SD (Min-Max)
MZ	F-F	7	19.86±10.54 (12-40)
	M-M	11	20.27±15.58 (9-54)
DZ	F-F	20	12.25±3.81 (6-20)
	M-M	15	11i87±2.56 (8-17)
	OS	17	12±3.35 (6-16)

SD: Standard deviation

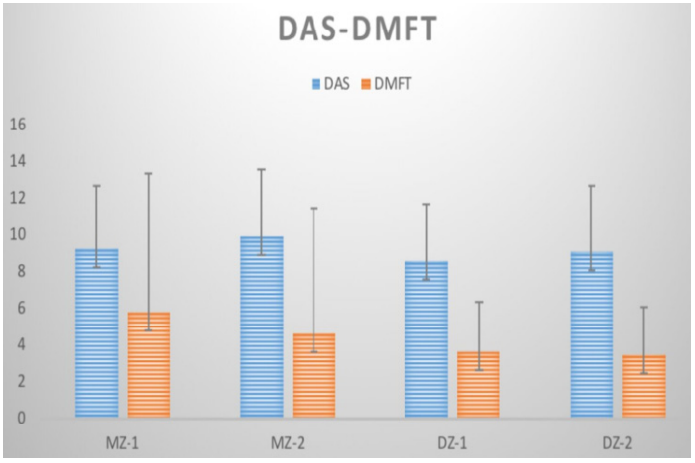

Figure 1. DAS and DMFT scores among MZ-DZ twin pairs

There was no statistically significant difference between the mean dental anxiety scores of DZ twin-pairs in general (p = 0.32), (Figure 1) or in terms of gender, for F-F twin-pairs (p = 0.87), M-M twin-pairs (p = 0.95) and OS twin-pairs (p = 0.12), (Figure 3A). Correlation for dental anxiety within DZ twin-pairs was r = 0.22 (p = 0.11). Correlation for dental anxiety within DZ F-F twin-pairs was r = 0.12 (p = 0.60), within DZ M-M twin-pairs was r = 0.25 (p = 0.36) and within DZ OS twin-pairs was r = 0.10 (p = 0.70). Regarding DMF-T scores no statistically significant differences found between DZ twin-pairs either in general (p = 0.61), (Figure 1) or in terms of gender, for F-F twin-pairs (p = 0.48), M-M twin-pairs (p = 0.47) and OS twin-pairs (p = 0.56), (Figure 3B). Correlation for DMF-T index scores within DZ twin-pairs was r = 0.47 (p < 0.05). Correlation for DMF-T index scores within DZ F-F twin-pairs was r = 0.33 (p = 0.14), within DZ M-M twin-pairs was r = 0.58 (p = 0.02) and DZ

Table 2. Descriptive of DAS and DMF-T among twins

DAS	Monozygotic (n=36)			Dizygotic (n=104)		
	Mean ± SD	Median (Min-Max)	p Value	Mean ± SD	Median (Min-Max)	p Value
Female 1	8.14 ± 2.61	8 (5-13)	0.67*	8.45 ± 2.74	8 (5-15)	0.87*
Female 2	11.29 ± 2.69	12 (7-14)		8.30 ± 3.35	8 (4-14)	
Male 1	9.91 ± 3.85	9 (4-17)	0.46*	9.13 ± 3.66	9 (4-15)	0.95*
Male 2	9 ± 4.05	8 (5-18)		9.20 ± 3.87	9 (4-16)	
Opposite Sex 1	-	-	-	8.29 ± 3.07	7 (5-17)	0.12†
Opposite Sex 2	-	-		9.88 ± 3.75	10 (5-17)	
DMF-T						
	Mean ± SD	Median (Min-Max)	p Value	Mean ± SD	Median (Min-Max)	p Value
Female 1	4.29 ± 3.49	3 (0-10)	0.48*	3.30 ± 2.27	3 (0-8)	0.48*
Female 2	3.57 ± 4.54	2 (0-12)		2.85 ± 2.60	2.5 (0-9)	
Male 1	6.73 ± 9.37	4 (0-29)	0.17†	4.27 ± 2.37	4 (0-9)	0.47*
Male 2	5.27 ± 8.17	3 (0-28)		3.80 ± 2.90	3 (0-11)	
Opposite Sex 1	-	-	-	3.53 ± 3.37	2 (0-12)	0.56†
Opposite Sex 2	-	-		3.88 ± 2.31	5 (0-7)	

*: Paired t test, †: Wilcoxon test

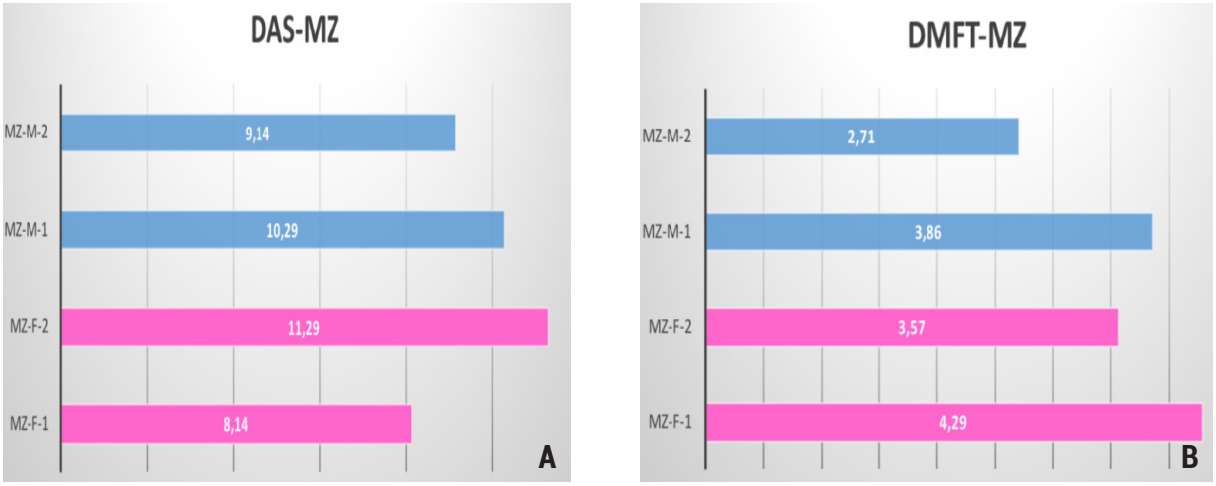

Figure 2 A, B. DAS and DMFT scores among MZ twin pairs regarding gender

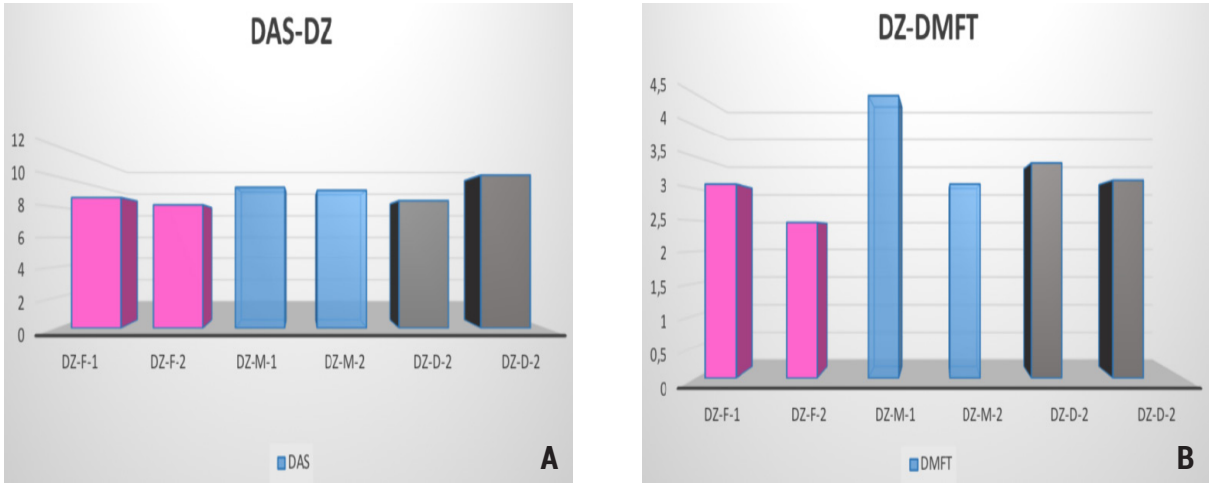

Figure 3 A, B. DAS and DMFT scores among DZ twin pairs regarding gender

OS twin-pairs was r = 0.52 (p = 0.29). Correlation between anxiety scores and DMF-T scores among DZ twins was not significant (r = 0.16), (p = 0.09). Heritability estimates for dental anxiety and DMFT were shown in Table 3.

Table 3. Heritability Estimates for Dental Anxiety and DMF-T

Phenotype	rMZ	rDZ	h^2	c^2	e^2
Dental anxiety	0.28	0.22	0.12	0.16	0.78
DMF-T	0.81	0.47	0.68	0.13	0.19

rMZ: within-pair correlations for MZ twins
rDZ: within-pair correlations for DZ twins

DISCUSSION

The exact nature of dental anxiety and fear is complex. Several underlying causal trajectories reported being involved (4,8). According to classical conditioning model objects and situations such as pain that resemble previous distressing experiences cause anxiety and fear. Nevertheless, it is suggested that 60–80 % of people who had at least one painful dental treatment experience did not have history of dental anxiety (2,8,12). Modelling on the other hand states that fear and anxiety are acquired through transmission of information and observational learning from relatives, close friends or the media (2,5,16). Genetic susceptibility, also considered another contributor in the development of anxiety, fear, and phobias. The diathesis-stress model of illness suggests that interaction between the genetic and the environment have an effect in the occurrence of these conditions (2,5,7). A meta-analysis study showed that genetic factors, shared environmental factors, and non-shared environmental factors constitute 48 %, 12 % and 40 % of variations in anxiety respectively (17,18).

First announced by Galton classical twin model compare the MZ and DZ twin pairs. Classical twin model is based on the assumption that MZ pairs share 100 percentage of their genes, while DZ twins share on average half (2). Genetic influence on a trait suggested if MZ twin pairs are more similar regarding a phenotype than DZ twin pairs. On the other hand, if the same proportion of similarity present, then shared environment possibly considered to pose a role. Non-shared environmental factors also explain the differences among the MZ twin pairs (1). These principles of classical twin method enable researchers to disentangle the effects of environmental and genetic factors on a phenotype (8).

The contribution of genetics on dental fear/anxiety is still a research area which is not elucidated clearly. Some researchers suggest that the anxiety is mediated via the inheritance of neuroticism that is about 50 % heritable (1,8,10). Binkley et al. (9) reported that variation in the melanocortin-1 receptor (MC1R) gene related with red hair, is cause increased dental anxiety. Smoller et al. (19) reported that a gene in mice that influences anxiety is related to human anxiety. Ray et al. (20) reported based on a twin study that the genetic vulnerability in the etiology of dental fear/anxiety is more important than what is commonly presumed. Vassend et al. (8) in their clinical study on 188 twins reported that majority of the variance in dental anxiety was related with genetic and environmental influences. In the present study, we found no significant correlation between the anxiety levels within MZ and DZ twin pairs in general and in terms of gender. According to our results, the dominant factor that influences the dental anxiety seems to be the non-shared environmental factor.

In general, the reported prevalence of fear/anxiety higher in women when compared to the men(2,21). However, the effect of gender differences on the genetic contribution to fears/anxiety and a specific phobia is not fully understood. Kendler et al. (22) who explore the changes in the animal, situational, and blood/injury fears in their longitudinal twin study reported similar effects of genetic and environmental factors on fears in males and females. Deryakulu and Caliskan (14) on the other hand, found that males seems to have higher computer anxiety than their female pairs. Regarding the effect of sex differences in dental anxiety very limited information present in the literature. Ray et al. (20) in their twin study found that the effect of heredity was different on the anxiety levels of boys and girls. They reported that the genetic factors almost do not affect boys while the genetic effect is more prominent in girls. In the current study, no significant difference found in the dental anxiety levels of male and female twin pairs.

Dental anxiety/fear can be very mild to severe and debilitating dental phobia which cause avoidance of dental care (4). It is reported that 3-7 % of the population have high levels of dental fear/anxiety, and in a vicious circle of avoidance of dental treatment-poor oral health (8). These lead impairment in oral/general health comparable to chronic disorders (7,9,12). However, in the studies of Akarslan et al.(23) and Yuzugullu et al. (24), it is reported that there was no correlation between DMF-T index and dental anxiety On contrary, in the study of Zinke et al. (11) conducted on 1549 patients, it is reported that patients with dental anxiety have more destroyed teeth than patients without dental anxiety. We found no correlation between dental anxiety and DMF-T scores in both MZ and DZ twins. However significant positive correlation in terms of DMF-T scores found within MZ and DZ twin pairs. The nearly two-fold higher correlation in terms of DMF-T scores among MZ twins may possibly suggests the genetic influence on tooth carious.

Several limitations are present regarding this manuscript. First the sample is small and the age of the sample is not homogenous. The scale used in the present study does not evaluate the dental anxiety sub-types. Also, because of the design of the present study, we did not explore the anxiety which reported to be developmentally dynamic, longitudinally.

CONCLUSION

As a conclusion; despite the limitations, the non-shared environmental factor seems to have a more dominant effect on dental anxiety. The higher correlation within MZ twin pairs in terms of DMF-T may indirectly suggest the genetic influence on tooth carious.

Competing interests: The authors declare that they have no competing interest.

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