



Original Article

## Prevalence of barodontalgia in Brazilian aviation pilots and flight attendants

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### ABSTRACT

**Introduction:** Barodontalgia is an unusual toothache associated with a change in atmospheric pressure. Many cases of barodontalgia occur in teeth that already have some clinical alteration: deep caries lesions, previous restorative treatment, pulp necrosis, pulpitis, inflammatory periapical lesions, and failed dental restoration. The occurrence of barodontalgia is more common in climbers, divers, and aviation professionals. The objective of this research was to investigate the prevalence and characteristics of barodontalgia in Brazilian pilots, copilots, and flight attendants.

**Material and Methods:** An electronic questionnaire with ten questions about barodontalgia was applied to a group of aviation professionals.

**Results:** One hundred and forty captains, 23 copilots, and 95 flight attendants (174 men and 84 women) answered the questionnaire. The prevalence of barodontalgia in this sample was 21.7%. There was a low correlation between barodontalgia and age (CI = -0.233) and length of service in the profession (CI = -0.272). Barodontalgia was more frequent during the cruise (57.1%) and landing phases (25%). Mandibular molars were the teeth most affected by barodontalgia (48.2%). Most aviation professionals who manifested barodontalgia used to visit the dentist more than once a year.

**Conclusion:** The prevalence of barodontalgia in Brazilian crew members was high and mainly affects male flight attendants.

**Keywords:** Atmospheric pressure, Aviation, Barotrauma, Pain, Toothache

### INTRODUCTION

In recent years, there has been an increase in the number of people traveling by air.<sup>[1]</sup> In this way, both passengers and flight crew were more likely to suffer from barodontalgia. This condition is defined as an intense painful sensation in the teeth related to a change in atmospheric pressure.<sup>[2]</sup> However, barodontalgia can also occur in other activities, such as divers, workers in pressure chambers, and climbers.<sup>[3,4]</sup>

In addition to pain, there are reports in the literature of patients who have suffered fractures of teeth with defective restorations or with deep carious lesions due to changes in atmospheric pressure.<sup>[5]</sup> In general, barodontalgia appears in teeth that already have some involvement in the pulp tissue or tooth structure (deep caries lesions, previous restorative treatment, pulp necrosis, pulpitis, inflammatory periapical lesions, and failed dental restoration). In other patients, oral pain may be related to the barotrauma.<sup>[6]</sup> In addition, one-tenth of cases of pain in the oral cavity can be caused by barosinusitis.<sup>[7]</sup>

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The onset and/or exacerbation of severe pain in the face or mouth may be associated with changes in atmospheric pressure. This discomfort can lead patients to seek emergency dental care.<sup>[8]</sup> The frequency of barodontalgia is much higher on board aircraft. However, the literature has revealed that the prevalence of barodontalgia during a flight is variable.<sup>[9]</sup>

At the moment, there are no records of the prevalence of barodontalgia among Brazilian aviation professionals. Thus, the aim of this study was to investigate the prevalence and characteristics of barodontalgia in Brazilian pilots, copilots, and flight attendants.

## MATERIAL AND METHODS

The protocol for this research was approved by the Research Ethics Committee of the Health Sciences Sector of the Federal University of Paraná (Number: 4,422,006). All individuals who participated in the research previously signed an informed consent form.

The sample of this cross-sectional study consisted of adult aviation professionals of both sexes. The inclusion criterion used was that the participant should be a pilot, copilot, or flight attendant of Brazilian aviation companies or a military pilot. Repeated questionnaires or those that were not filled out were excluded from the study.

An electronic questionnaire based on the study by Gunepin *et al.*<sup>[10]</sup> and containing ten objective questions was prepared in Google Forms.

The questionnaire contained questions about the following variables: (1) Personal and job data, (2) respondent's oral health, and (3) clinical characteristics of barodontalgia. The survey and access to the questionnaire were disseminated by E-mail by the Brazilian Air Force to military pilots and also in groups related to commercial aviation on the social network Facebook and WhatsApp groups.

A Microsoft Excel spreadsheet was generated that allowed statistical analysis of the data with the help of the IBM® SPSS Statistics software version 20 (IBM Corporation, NY, USA). Data were submitted to descriptive statistical analysis, Pearson's correlation test, and a binary logistic regression analysis.

## RESULTS

Two hundred and fifty-eight individuals were part of this study. Of this total, the majority was composed of 173 men (67%). The mean age was 34.7 years, ranging from 18 to 67 years, and 92% of respondents were under 50 years of age.

The distribution of respondents revealed that the sample was composed of 139 (53.8%) pilots, 96 (37.2%) flight attendants, and 23 (8.9%) copilots. The average length of service of the

participants was 12.7 years, ranging from 1 to 45 years. Of the 162 pilots and copilots, 34 were military pilots.

The distribution of demographic data of the professionals interviewed is shown in Table 1. Pearson's correlation test was applied to continuous variables (age and length of service in years) to analyze whether there is a linear relationship between them and barodontalgia. This test showed that there was a low correlation between barodontalgia and age (CI = -0.233) and length of service in the profession (CI = -0.272).

Table 2 presents the distribution of captains, copilots, and flight attendants concerning barodontalgia. The prevalence of barodontalgia in this sample was 21.7%. Most of these individuals were male (51.7%) and with a measure of 39.1 years of age. There was only one (0.3%) record of barodontalgia among military pilots. Flight attendants (52%) reported experiencing more barodontalgia than pilots (41%) and copilots (7%). Thirty (57%) respondents said they had suffered from a single episode of barodontalgia. Pain episodes occurred mainly in the cruise phase (55.3%), and during landing (25%).

When asked about the sensation of pain, respondents described discomfort similar to strong pressure (48.2%), throbbing pain (33.3%), and sharp pain (21.4%).

Most cases of barodontalgia were attributed to a tooth in the jaw region (48.2%). However, some participants reported pain in both the maxilla and the mandible [Table 2].

Seeing the dentist does not seem to be related to the episodes of pain in this sample, as most professionals who manifested barodontalgia visited the dentist more than once a year, 15 once a year and seven less than once a year [Table 3].

Table 3 shows that 80% of the sample reported having already felt pain in other anatomical regions, mostly in the ear (58%), followed by pain in the sinus region (37%).

A binary logistic regression analysis was performed taking into account the following variables: sex, profession, age, and length of service. The results of this analysis revealed that the chance of experiencing barodontalgia is greater in the male group (OR 1.6), that is, men are 64% more likely to have this type of pain. Flight attendants are 14% more likely to have barodontalgia than copilots. On the other hand, flight attendants are less likely to have barodontalgia than pilots. On the other hand, pilots are more likely to suffer from barodontalgia than copilots.

## DISCUSSION

Barodontalgia is a toothache that occurs due to changes in atmospheric pressure.<sup>[2]</sup> Therefore, some activities or certain professions favor its occurrence, such as divers, pilots, and climbers.<sup>[3,4]</sup> The present study investigated the prevalence

**Table 1:** Sociodemographic variables of aviation professionals.

Variables	Barodontalgia in airplane pilots and copilots			Barodontalgia in flight attendants		
	Yes n(%)	No n (%)	Total	Yes n (%)	No (%)	Total
Gender						
Male	26 (10)	132 (51)	158	3 (1.1)	12 ( 4.6)	15
Female	1 (0.3)	3 (1.1)	4	26 (10.0)	55 ( 21.3)	81
Age group						
<29 years	10 (3.8)	58 (22.3)	65	4 (1.5)	22 (8.5)	26
30–39 years	3 (1.1)	47 (18.1)	50	8 (3.1)	20 (7.7)	28
>40 years	14 (5.3)	30 (11.4)	44	17 (6.5)	25 (9.6)	42
Time in occupation						
<9 years	10 (3.8)	65 (26.2)	75	5 (1.9)	33 (12.7)	38
10–19 years	5 (1.8)	44 (17)	49	8 (3.1)	11 (4.2)	19
>20 years	12 (4.6)	26 (10)	38	16 (6.2)	23 (8.9)	39

**Table 2:** Clinical characteristics of barodontalgia.

	Barodontalgia in airplane pilots and copilots n (%)	Barodontalgia in flight attendants n (%)	Total
Frequency of episodes			
Only once	19 (32.3)	13 (22.1)	32
More than once	8 (13.6)	16 (27.2)	24
Flight stage			
Take-off	1 (1.7)	1 (1.7)	2
Cruise	19 (32.3)	12 (20.4)	31
Landing	5 (8.5)	9 (15.3)	14
During all phases	2 (3.4)	7 (11.9)	9
Type of pain			
Feeling of pressure	10 (17)	16 (27.2)	26
Pulsatile	7 (11.9)	8 (13.6)	15
Acute	6 (10.25)	5 (8.5)	11
Localization			
Mandibule	13 (22.1)	1 (22.1)	14
Maxilla	8 (13.6)	9 (15.3)	17
Both	2 (3.4)	7 (11.9)	9

of barodontalgia in a sample of airplane pilots, copilots, and flight attendants from the Brazilian population.

The prevalence of barodontalgia is variable, probably due to population differences (0.3–49.6%).<sup>[9–15]</sup> Our results revealed that the prevalence of barodontalgia in the Brazilian population was high (21.7%). It is similar to what has already been recorded in pilots from India,<sup>[11]</sup> but even higher than in other countries.<sup>[12–14]</sup> The record of barodontalgia prevalence was <10% in pilots from the following countries: Turkey, Spain, France, Israel, and Jordan.<sup>[9–15]</sup>

Most cases of barodontalgia occurred in flight attendants (51.7%) when compared to pilots and copilots. Although the exact cause of barodontalgia was not investigated in our study, this finding can be attributed to the fact that

flight attendants theoretically only seek treatment in dental offices every 2 years. According to McNeely *et al.*,<sup>[16]</sup> flight attendants are an understudied occupational cohort despite experiencing a wide and unique range of work-related adverse exposures.

According to the Brazilian Civil Aviation Regulation, all professionals involved with civil aviation must obtain and periodically renew an Aeronautical Medical Certificate (CMA). After expert health examinations are carried out on candidates, this certificate is a document issued by National Civil Aviation Agency, attesting to their psychophysical aptitudes, under the Regulation in force, to allow the exercise of functions related to aircraft. To obtain or revalidate the CMA, the candidate undergoes several evaluations and laboratory tests that include a dental examination. Flight attendants are required to undergo medical and dental examinations every 2 years. The same is not true for pilots and copilots. Before the age of 40, the revalidation of the CMA of pilots and copilots is annual and becomes biannual when they reach 40 years of age. Therefore, one can imagine that the chance of deep caries lesions, pulpitis, and periapical diseases being detected early is greater in pilots and copilots.

Clinically, inflammation of the pulp, deep caries, and fractured or leaking restorations are associated with cases of barodontalgia.<sup>[5]</sup> A limitation of our study was the impossibility of identifying the cause of barodontalgia in the participants through the questionnaire. Although the experience of severe pain is often remarkable for many patients, the most ideal situation is to have had contact with the dentists who treated these individuals at the time of the episode of barodontalgia. This was impossible to accomplish, as each respondent was treated by different dentists.

According to our results, barodontalgia was more frequent in men. This result may reflect the profile of professionals who normally act as airplane pilots, copilots, and flight attendants, most of whom are men. However, according to Franciscatto

**Table 3:** Frequency of visits to the dentist and pain in the head region during the flight.

	Barodontalgia in airplane pilots and copilots			Barodontalgia in flight attendants		
	Yes n (%)	No n (%)	Total	Yes n (%)	No n (%)	Total
Frequency of visit to the dentist						
Once a year	11 (4.2)	69 (26.2)	80	11 (4.2)	40 (15.5)	51
More than once a year	16 (6.2)	14 (5.3)	30	18 (6.9)	27 (10.4)	45
Pain in other anatomical regions						
Ear	11 (4.2)	63 (23.8)	74	15 (5.7)	31 (11.7)	46
Sinuses	4 (1.5)	29 (11)	33	13 (4.9)	23 (8.7)	36
Eyes	-	3 (1.1)	3	1 (0.3)	3 (1.1)	4
Nose	-	3 (1.1)	3	-	-	0
Mouth	1 (0.3)	-	1	-	-	0
None	4 (1.5)	37 (14)	41	-	10 (3.8)	10

*et al.*,<sup>[17]</sup> male gender, advanced age, decayed teeth, and pulp diseases are considered as risk factors involving episodes of pain that lead patients to seek care in dental emergency services.

It is important to note that 48.2% of cases of barodontalgia were observed in women and that the vast majority worked as flight attendants (96.2%). This finding may be associated with a large number of women in our sample. However, in the literature, there is still a lack of studies on barodontalgia involving women. Although the literature demonstrates that women are more careful about their oral health, a systematic review showed a higher rate of dental caries in Brazilian women.<sup>[18]</sup>

A curious fact observed in our study is that most cases of barodontalgia occurred in pilots and flight attendants who consulted the dentist more than twice a year (60.7%). Patients who have the behavior of seeking dental care more often generally have better oral health. This will affect your overall health and well-being.<sup>[19]</sup> Therefore, those patients who seek dental care more than twice in a year are less likely to have pain-related dental care.

After erupting into the mouth, teeth are continuously exposed to the action of different chemical and physical agents. They can cause the wear and tear of hard dental tissues, gum recession and other subsequent problems. This wear of tooth surfaces associated with aging reduces the thickness or generates loss of tooth enamel. This process can expose deeper layers of enamel (which have different physical and chemical properties than surface enamel) or dentin.<sup>[20]</sup> These changes may explain the fact that barodontalgia was more prevalent in the age group over 40 years of age, both in captains/pilots and in-flight attendants in our sample.

Despite the data indicating that the number of episodes of barodontalgia was higher in both airplane pilots, copilots, and flight attendants with more service time or hours flown, Pearson's correlation test revealed that the correlation between these variables was low. Most pilots and copilots

who had barodontalgia had a single episode (70.3%). On the other hand, 62% of flight attendants report having had barodontalgia more than once.

The discomfort of barodontalgia occurred more during the cruise phase and at the landing of the aircraft. This finding is due to the effect of changes in atmospheric pressure levels on the inflamed pulp or pulp cavity of a necrotic tooth. According to Hamilton-Farrel and Bhattacharyya,<sup>[21]</sup> when a body space filled with gas (without communication with the environment) is impossible to equalize the pressure or restore the volume in response to a change in atmospheric pressure, it can generate pain. Thus, teeth with dental abscesses or necrotic pulp can also contain gases inside. These gases can change in volume in response to barometric changes as the plane climbs to cruising level and descends to land on the ground. Gases can be trapped in tissue spaces by two mechanisms: (1) If there is a gap between the tooth and restoration, it may be forced in during an increase in local pressure; and (2) a dissolved gas can diffuse from tissues into neighboring spaces as atmospheric pressure decreases. This movement can stimulate the nociceptors that cause the sensation of pain in the area. These theories could explain the higher frequency of cases of barodontalgia during cruise (55%) and landing (25%) phases. However, these findings differed from the study developed by Santiago *et al.*<sup>[9]</sup> and Al-Hajri and Al-Madi.<sup>[22]</sup> These authors observed more episodes of barodontalgia during takeoff and in the cruise phase.

Pain is an unpleasant experience mediated by nociceptors that are stimulated in response to tissue damage.<sup>[23]</sup> As pain is a subjective sensation, it can be difficult for the patient to clinically describe. According to Edens *et al.*,<sup>[24]</sup> pain resulting from irreversible pulpitis, abscesses, and pulp necrosis can be variable. In general, patients complain of continuous, dull, aching pain and episodes of pulsing, throbbing, and sharp pain. In our study, most respondents with barodontalgia described the pain as a feeling of pressure (46.6%). In the study carried out by Santiago *et al.*,<sup>[9]</sup> the majority of patients



(76.9%) who suffered from barodontalgia reported having suffered from severe acute pain.

In our study, the mandibular teeth were the most involved with barodontalgia and corroborate the findings of Santiago *et al.*<sup>[9]</sup> According to the literature, mandibular molars are considered the teeth most likely to be indicated for endodontic treatment due to pulp involvement.<sup>[25]</sup>

The ear and sinuses are the anatomical regions most vulnerable to the effects of trauma caused by atmospheric pressure. Some authors call barotrauma which is a condition experienced by the tissues. Barotrauma can be caused by a difference in pressure between a gas space within the body and the surrounding fluid. It involves different anatomical structures, such as barotrauma in the outer ear, barotitis media, barotrauma-related headaches, barosinusitis, and barodontalgia itself.<sup>[2]</sup> In our sample, some pilots and flight attendants responded that they had already felt pain associated with other anatomical regions of the head and neck region, especially in the ear and sinuses. However, in those individuals with barodontalgia, 46.4% and 42.8% reported having suffered from ear and sinus pain, respectively.

Finally, the results of this study showed that the prevalence of barodontalgia in this sample of Brazilian aeronauts was high and affects, especially, men who act as flight attendants. Thus, performing periodic dental examinations is essential for professionals who perform duties related to aircraft, especially pilots and flight attendants.

## CONCLUSION

Despite the limitations of this study, it is possible to conclude that the prevalence of barodontalgia was high in the Brazilian crew, especially in flight attendants

## Declaration of patient consent

Patient's consent not required as patients identity is not disclosed or compromised.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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