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Analysis of selected indicators for tonsillectomy

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Oświadczenie opiekuna pracy

Oświadczam, że niniejsza praca została przygotowana pod moim kierunkiem i stwierdzam, że spełnia ona warunki do przedstawienia jej w postępowaniu o nadanie tytułu zawodowego.

Podpis opiekuna pracy.....

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Podpis autora pracy

Abstract

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Keywords: tonsillectomy, halitosis, PCA.

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Chapter 1

Introduction

Tu będzie napisane:

Czym jest halitoza, przyczyny halitozy (substancje chemiczne, badania mikrobiologiczne, dieta, choroby układu pokarmowego, choroby układu oddechowego, schorzenia ogólnoustrojowe), diagnostyka halitozy (badania subiektywne i obiektywne), leczenie halitozy, cel badawczy: czy istnieje związek między przewlekłym przerostowym zapaleniem migdałków podniebiennych a halitozą? Czy halitoza może być predyktorem do przeprowadzenia zabiegu tonsillektomii? Jakie inne objawy mogą wpływać na halitozę?

Chapter 2

Material and methods

2.1 Material

41 patients including 29 women and 13 men, ranging age from 18 to 56 years (mean 27.02, SD 7.86) with chronic hyperplastic tonsillitis and halitosis were qualified for tonsillectomy and therefore selected for the study. A detailed anamnesis was conducted by otolaryngologists and dentists, and microbiological tests were carried out in the laboratory of the Academic Clinical Hospital in Wroclaw. Also, routine laboratory tests and two surveys were conducted in order to eliminate causes of halitosis other than those indicative of tonsillitis. Patients answered questions related to their medical history, food habits, smoking cigarettes and oral hygiene. Those who confirmed the occurrence of any gastrointestinal, pulmonary or other systemic metabolic disorders in the survey were eliminated from the research group. Another exclusion criteria included smokers, heavy alcoholic drinkers, improper oral hygiene and *Helicobacter pylori* carriers. Dental examination excluded also patients with carious lesions, exposed tooth pulps, peridontal diseases and thick tongue coat.

2.2 Methods

Patients underwent both subjective and objective evaluation of oral odor. For a subjective assessment of an unpleasant odor in the mouth each patient underwent organoleptic examination before tonsillectomy. Patients were neither allowed to take antibiotics for a period of three weeks, consume garlic, onion and spicy dishes for 24 hours nor apply perfume. Within 12 hours, it was also recommended to avoid food intake and drinks, brush teeth, use breath fresh-

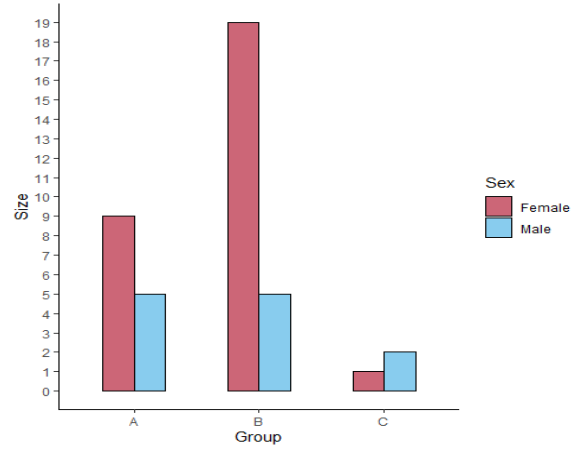
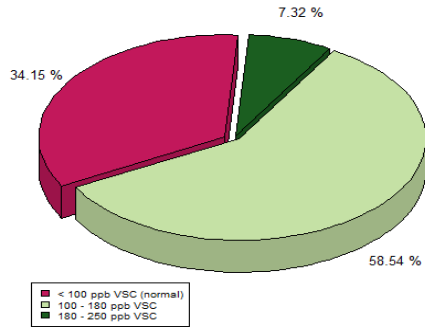
eners and smoke cigarettes. During the study, the smell of air exhaled through the mouth was compared with the smell of air exhaled through the nose (when mouth closed). The patient then exhaled into a transparent tube 10 cm long and 2.5 mm in diameter. In order to assess the intensity of the unpleasant smell from the mouth a six-grade Rosenberg [1] scale was used which is the most widely used scale of halitosis. The odor was classified between 0 and 5, where: 0 - absence of odor, 1 - barely noticeable odor, 2 - slight malodor, 3 - moderate malodor, 4 - strong malodor and 5 - severe malodor.

For objective assessment of halitosis each patient underwent a Man-hal-II Halimeter test as well. This sulfide monitor measures volatile sulfur compounds (VSCs) such as hydrogen sulfide, methyl mercaptan and dimethyl sulfide which are contributing factors for halitosis. Each sample was taken after 3 minute re-stabilization period when patients were breathing through the nose with mouths kept closed. During the test the device's straw was inserted into the subject's mouth and one was asked to exhale briefly for 30 seconds. The procedure was repeated in three trials for each patient and the peaks' values were recorded in parts per billion (ppb) sulfide equivalents [2]. In order to obtain reliable results, patients could not eat, drink, smoke, chew gum, brush their teeth, use the brush, fresheners or oral hygiene products for 12 hours prior to the halimetric test. It was also recommended not to use cosmetics such as perfumes, aftershave or lipstick.

Organoleptic and halimetric examination was repeated for each patient, at least 2-3 months after removal of the palatine tonsils and completion of the healing process.

The value of the average of the three measurements of VSC was used for further statistical analysis. Depending on the chosen criterion of division, two or three groups of patients have been distinguished. First one considered 100 ppb as threshold dividing group into normal (when below) and abnormal (when above the threshold). Second, more detailed criterion included intermediate states as follows: the range up to 100 ppb considered as correct, 100 - 180 ppb as a light form of disease and above 250 ppb as a severe one [3]. However, the study group did not include patients belonging to the latter (Fig. 2.1).

Principal Component Analysis (PCA) was used in order to validate the above classification. This method enables finding the directions of maximum variance in high-dimensional data and project it onto a smaller dimensional subspace while retaining most of the information. In the following work script written in R programming language was used to perform the analysis. PCA



(a) the ratio of groups with different forms of the disease

(b) the gender distribution within groups A: < 100 ppb, B: 100 - 180 ppb, C: > 180 ppb VSC

Figure 2.1: Groups of patients due to the level of VSC before tonsillectomy.

was performed using *FactoMineR* which is an R package dedicated to multivariate Exploratory Data Analysis, as well as *factoextra* to extract and visualize the results. There are also other, built-in R functions available - *princomp()* and *prcomp()*. The preceding one uses the spectral decomposition approach, while the functions *prcomp()* and *FactoMineR::PCA()* use the singular value decomposition.

Comparisons between groups and within groups were made using appropriate statistical tests, after checking the assumptions authorizing to carry them out. The gender distribution was included in each group. Considered level of significance for all of the statistical tests was 5% ($p < 0,05$).

Chapter 3

Results

3.1 Comparison between groups

3.1.1 General statistics

Feature	Female n = 29	Male n = 12	Total n = 41	Comparison (<i>p-value</i>)
Age				
mean	26.69	27.83	27.02	0.6391
sd	8.49	6.32	7.86	
me	24.00	27	25.00	
spread	18.00-56.00	19.00-36.00	18.00-56.00	
Living place				
village	5 (17.24)	0 (0.00)	5 (12.20)	0.3078
town	2 (6.90)	1 (8.33)	3 (17.85)	
city	22 (75.86)	11 (91.67)	33 (80.49)	
Profession				
school-age student	2 (6.90)	2 (16.67)	4 (9.76)	0.1834
student	6 (20.69)	1 (8.33)	7 (17.10)	
blue-collar worker	3 (10.35)	4 (33.33)	7 (17.10)	
white-collar worker	18 (62.07)	5 (41.67)	23 (56.10)	
Education				
elementary	1 (3.45)	2 (16.70)	3 (7.32)	0.2699
secondary	13 (44.80)	5 (41.70)	18 (43.90)	
higher	15 (51.70)	5 (41.70)	20 (48.80)	

The comparison of features: Age, Living place, Profession and Education

between men and women was made with Student's t test (*stats::t.test*) after checking the assumption of normality and homogeneity of variance. No statistically significant difference was observed in terms of analyzed features ($p > 0.05$).

3.1.2 Halitometry results

VSC [ppb]	Female n = 29	Male n = 12	Total n = 41	Comparison (<i>p-value</i>)
Before tonsillectomy				
mean	115.03	107.92	113.00	
sd	37.89	67.81	47.76	0.5378
me	120.00	105.00	117.00	
spread	22.00-186.00	25.00-238.00	22.00-238.00	
After tonsillectomy				
mean	43.52	45.08	43.98	
sd	19.20	24.81	20.66	0.8185
me	50.00	36.00	40.00	
spread	7.00-80.00	23.00-113.00	7.00-113.00	

The comparison of measurement before tonsillectomy was made with Wilcoxon test (*stats::wilcox.test*) due to heterogeneity of variance between groups (female vs male, $p\text{-value} = 0.01564$).

The comparison of VSC before and after tonsillectomy was made with Welch Two Sample t-test (*stats::t.test* with `paired=FALSE` argument). According to $p\text{-value} = 0.8471$ we do have basis to accept the null hypothesis that the means in both groups are equal.

After tonsillectomy, there was only one patient with light form of halitosis - a 29-year old man with 113 ppb of VSC. The average level of VSC dropped by 106.51 ppb.

3.2 PCA results

In order to determine the minimum number of principal components (PCs) that account for most of the variation in analyzed data two methods were used. The first one was based on the proportion of variance that the components explain. The acceptance level of variance was set to 80%, thus PC3 might be

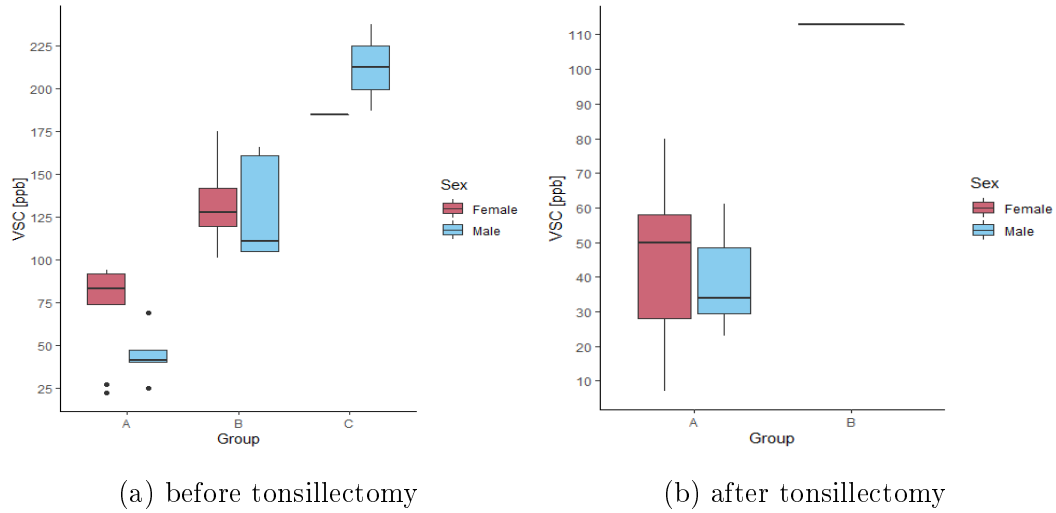


Figure 3.1: Levels of VSC in groups with split on gender. Groups A: < 100 ppb, B: $100 - 180$ ppb, C: > 180 ppb VSC

taken as the cut-off point.

```
> pca <- PCA(dataPCA, graph = FALSE)
> eig.val <- pca$eig
> eig.val
```

	eigenvalue	percentage of variance	cumulative percentage of variance
comp 1	5.3277594717	48.434177015	48.43418
comp 2	2.0581239836	18.710218033	67.14440
comp 3	1.7013837135	15.467124668	82.61152
comp 4	0.9905987590	9.005443264	91.61696
comp 5	0.3050842107	2.773492825	94.39046
comp 6	0.2083183631	1.893803301	96.28426
comp 7	0.1968523253	1.789566594	98.07383
comp 8	0.0944343019	0.858493653	98.93232
comp 9	0.0704664934	0.640604486	99.57292
comp 10	0.0466963054	0.424511868	99.99744
comp 11	0.0002820724	0.002564294	100.00000

Figure 3.2: Eigenvalues.

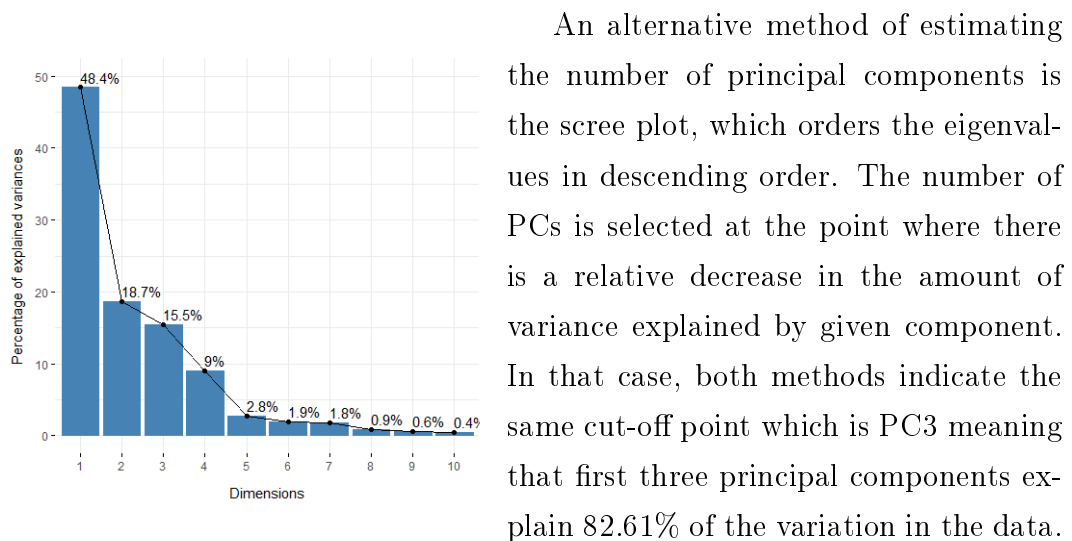


Figure 3.3: Scree plot.

An alternative method of estimating the number of principal components is the scree plot, which orders the eigenvalues in descending order. The number of PCs is selected at the point where there is a relative decrease in the amount of variance explained by given component. In that case, both methods indicate the same cut-off point which is PC3 meaning that first three principal components explain 82.61% of the variation in the data.

Examining the magnitude and direction of the coefficients for the original variables allows to interpret each principal component. In these results, first and second principal component has positive associations with the average measurements of VSC (before and after tonsillectomy), so this component primarily measures surgery effectiveness. The second component has positive associations with individual measurements of VSC, so this component primarily measures repeatability of results. The third component has large positive associations with height and weight, so this component primarily measures the patient's body mass index.

A PCA biplot (Fig. 3.4) shows both principal component scores of samples (here already grouped into three) and loadings of variables (so called loading plot). The further away vectors (variables) are from the origin, the more influence they have on that principal component. From loading plots we can notice how well are the variables correlated with each other: a small angle implies positive correlation, a large one suggests negative correlation. A right angle indicates no correlation between two features.

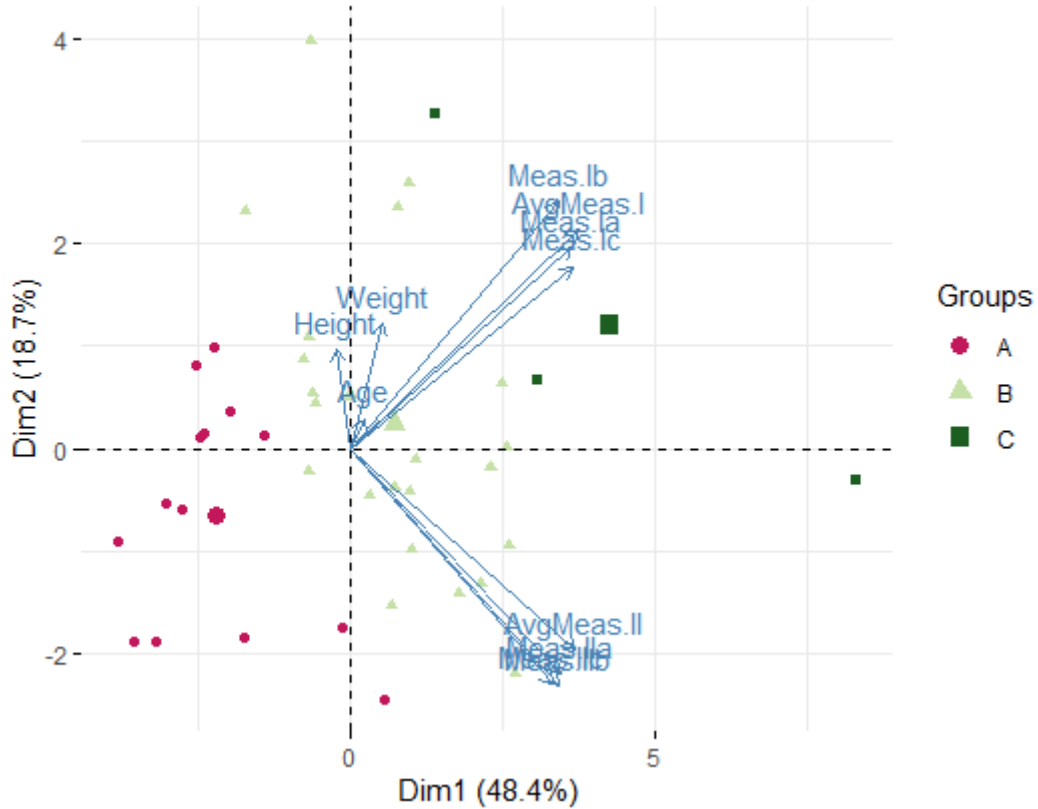


Figure 3.4: Biplot.

3.3 Additional factors

Impact of air pollution, diet etc.

Chapter 4

Discussion

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