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# The VHI in Patients with Chronic Lung Disease.

Rob Zeijger
3459985

Supervisie:
prof. Dr. P.H. Dejonckere
prof. Dr. F.N.K. Wijnen

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Mentor : prof. Dr. P.H. Dejonckere

Co-mentor : prof. Dr. F.N.K. Wijnen

Student : Rob Zeijger- 3459985



**Abstract**

**Introduction:** The pulmonary ventilation system plays an important role in phonation, as it generates the lung pressure, a basic condition for vocal fold vibration. Thus it could be expected that patients with chronic impairment of respiratory function experience voice problems in daily life.
The aim of this study is to examine if patients with chronic lung disease and reduced lung function experience lower 'voice related quality of life'- measured by VHI- than the normal population.
Patients with asthma and patients with COPD (Chronic Obstructive Lung Disease) are compared, as these are by far the most frequent chronic lung diseases, and are considered among the world's most common health problems.
**Method:** The voice related quality of life was measured using the Voice Handicap Index, a questionnaire of 30 statements. This questionnaire was filled in by 44 outpatients diagnosed with asthma and 30 outpatients diagnosed with COPD. All patients further underwent a complete spirometric investigation. Each patient also filled in the MRC scale (Medical Research Council) : a scale for subjectively assessing the severity of dyspnoea.
**Results:** Globally the VHI-scores of patients with chronic lung disease (11,0) are slightly but significantly higher than those of the normal healthy population (6,0), but about 75% of chronic lung patients score within the normal range ( a score of 32,8 corresponds to the $95^{th}$ percentile of the normal population).
There is no significant difference between the median VHI score of asthma (9) and COPD (14) patients.
Also no significant difference for gender is found .There is further no statistically significant correlation between the degree of impairment of the respiratory function – as measured with the spirometric parameters - and the VHI-score.
However, the relation between MRC- and VHI scores is statistically significant.
**Conclusion:** Chronic lung patients without specific voice complaints report a slightly but significantly decreased voice-related quality of life when compared to the normal healthy population. There is no significant difference in the voice related quality of life between the asthma and COPD group. There is no correlation between objective respiratory function and VHI score.
Patients with a severe subjective score on the MRC-scale (high level of breathlessness) also report a quite serious impairment in their voice related quality of life.



**Keywords:**
Voice Handicap Index (VHI)* asthma*COPD * FEV1 and FVC* Voice related quality of life, MRC

## INTRODUCTION

### 1.Pulmonary ventilation and voice

The pulmonary ventilation system plays an important role in phonation, as it generates the lung pressure which is a basic condition for vocal fold vibration. Thus it could be expected that patients with chronic impairment of respiratory function experience voice problems in daily life. For most people the voice is still the most important tool to communicate in their daily social activities, despite the growing importance of other real-time means of communication such as social networks, chat and , twitter. Approximately one third of the working population nowadays needs the voice to earn a sustainable income (Vilkman, 2000), and it goes without saying that any impairment of the voice will therefore have a large impact both on daily work and social activities for many people (Hakkesteegt, 2009).
At the outpatient clinic of the Department of Pulmonology patients with asthma and COPD (Chronic Obstructive Pulmonary Disease) have a regular follow-up and are monitored for their lung function. These are by far the most frequent chronic lung diseases, and are considered among the world's most common health problems (ComScience, 2012; Lopez et al., 2006; Murray & Lopez., 1997)
During the assessment of these patients the anamnesis is mainly focused on : dyspnoea, physical and social restrictions, smoking behavior, weight and medication use. For quantitative assessment, the pulmonologist relies upon spirometric data as well as upon Function-related and Quality-of-Life questionnaires (LAN, 2010).
The quality-of-life questionnaires mainly contain items pertaining to social activities. Interestingly, the 'quality of well-being activity 'section does not mention voice, even though one might think voice is essential for most social activities.
The absence of a voice related questionnaire is noticeable, considering the direct link between breathing and voice production. Previous studies demonstrated that speech breathing patterns of patients with pulmonary disease differed from those of healthy subjects in a disease-specific manner (Loudon et al., 1988; Lee et al., 1993). Whether these physiological differences extend to patients' perception of voice and voice-related quality-of-life is unknown.
This study concerns the relation between lung function impairment and self-reported quality of life in patients with asthma and COPD.

### 2.Obstructive pulmonary diseases:

#### 2.1. Asthma

Asthma is a chronic lung disease wherein the airways are recurrently inflamed and narrowed. Asthma patients have as main symptoms recurrent periods of wheezing (a whistling sound when they expire), chest tightness, shortness of breath, and coughing.
Asthma affects people of all ages, but it most often starts during childhood. Asthma patients tend to react strongly to certain inhaled substances (allergens). Secretory cells in the airways produce more mucus than normal, further narrowing the airways.
Symptoms occur each time the airways are inflamed. When symptoms get more intense the attacks are called exacerbations.
The exact cause of asthma is not known. Researchers think some genetic and environmental factors interact to cause asthma. These factors include: an inherited tendency to develop allergies, parents who have asthma, certain respiratory infections during childhood and contact with some allergens, conveyed through the air ( U.S. Department of Health & Human Services, 2012).

2.2. Chronic Obstructive Pulmonary Disease

The term "COPD" includes two main conditions: emphysema and chronic bronchitis, both frequently occurring in the same patient.
In emphysema, the walls between many of the 'air sacs' (acini and alveoli) are damaged, causing them to lose their shape and become floppy. This damage also can destroy the walls between the 'air sacs', leading to fewer and larger air sacs instead of many tiny ones. If this happens, the amount of gas exchanges in the lungs is reduced.
In chronic bronchitis, the surface of the airways is constantly irritated and inflamed. Thick mucus formed in the airways, makes it even harder to breathe.
The main cause of COPD is smoking. Other causes that may contribute are: air pollution, inhalation of chemical gases or dust ( U.S. Department of Health & Human Services, 2012).

| | Asthma | COPD |
|---|---|---|
| Obstruction | Variable | Permanent |
| Age | young and old | >40 years |
| Risk factor | Allergy | Smoking |
| Genetically determined | + | + |
| Inhaled corticosteroid (ICS) | + | marginal effective |
| Lung function | variable (possibly normal) | Reduced |
| Life expectancy | normal | Reduced |

Table 1 shows a comparison between both pathological entities (Ponsioen,2010).

**3. Assessment techniques**

Spirometry is a physiological test that measures in – and exhaled air volumes as a function of time. It is important as a screening test of respiratory health and as a diagnostic test in case of pathology (Hannink et al., 2011).
The most important outcomes of spirometry are (1) the forced vital capacity (FVC), which is the volume exhaled during an expiration made as forcefully and completely as possible starting from full inspiration, and (2) the forced expiratory volume (FEV1) in one second, which is the volume delivered in the first second of an FVC manoeuvre (Miller et al., 2005).
The FEV1/FVC ratio (or FER) in adults is normally higher than 0.75 to 0.80. Any values less than these suggest airflow limitation (GINA, 2011).
FEV1 may be strongly influenced by inhaling a broncho-dilator, particularly in asthma : The degree of FEV1 improvement suggesting the diagnosis of asthma is generally accepted as 12% (Pellegrino et al, 2005).
In obstructive lung disease, the FEV1 is reduced due to an obstruction of air escaping from the lungs. Subsequently, the FEV1/FVC (Forced Expiratory Ratio) will be reduced (http://www.gp-training.net ). More specifically, the diagnosis of COPD is made when the $FEV_1$/FVC ratio is less than 70% post-bronchodilator (Nathell et al., 2007).
However , clinical experience shows that there is only a weak correlation between FEV1, and impairment of a patient's health-related quality of life (LAN, 2010). So the MRC scale (Medical Research Council) is recommended for subjectively assessing the severity of symptoms, particularly the dyspnoea.

**4. Quality of Life and disease-specific questionnaires**

4.1. The MRC dyspnoea scale

The Medical Research Council (MRC) dyspnoea scale is a simple and validated method for categorizing patients with asthma or COPD in terms of their disability. It can be used to complement the FEV1 in the classification of asthma or COPD severity (Bestall et al, 1999) . The MRC-scale consists of five statements: 1. Not troubled by breathlessness except on strenuous exercise, 2. Short of breath when hurrying or walking up a slight hill, 3. Walks slower than people of the same age on the level because of breathless, or has to stop for breath when walking at own pace, 4. Stops for breath after about 100 m or after a few minutes on the level, 5. Too breathless to leave the house, or breathless when dressing or undressing.The score is the number that best fits the patient's level of activity. All the questions relate to everyday activities.

4.2. The Voice Handicap Index:

In speech therapy patient-based measuring instruments regarding quality of life and perceived handicap have become important. In 2001 the European Laryngological Society indicated the Voice Handicap Index (VHI) as one of the five main dimensions for the assessment of voice disorders (Dejonckere et al., 2001). The VHI was introduced by Jacobson et al. (1997) and consists of 30 items, divided into three subscales of 10 items each. These subscales identify 'Functional'(F), 'Emotional'(E) and 'Physical'(P) items, with corresponding subscores VHI-P, VHI-E and VHI-F, beside the VHI total (VHI-T) score. The score for each item ranges from 0 (no problem at all) to 4 (maximal handicap), resulting in a maximum total score of 120.- A low VHI value, i.e. of 0-30 points denotes the absence of voice problems or only slight voice problems, a score of 31-60 points indicates a moderate handicap level, while scores of 61-120 points indicate severe voice impairments. (Jacobson et al, 1997)

Jacobson et al. (1997) tested the reproducibility and internal consistency of the VHI, which appeared to be good. Various publications ( review in Hakkesteegt, 2006) confirmed that the VHI is a clinically relevant tool. The VHI questionnaire has been translated into Flemish (De Bodt et al., 2000). Recent international projects have demonstrated that VHI results obtained from studies conducted in different countries are comparable. (Verdonck-de Leeuw et al, 2008)

Some studies have shown that VHI scores not only evaluate the biopsychosocial impact of dysphonia, but that they also could be considered as a screening tool for distinguishing between individuals with a healthy voice and those with a vocal dysfunction. (Grassel et al, 2008; Ohlsson et al, 2009). However, the VHI is primarily intended (i) to examine voice patients, (ii) to compare voice patients with a normal population or (iii) to compare voice patients pre- and post therapy (Neumann & Dejonckere, 2009).

The VHI has even been also used to compare different groups within the normal population, for example to compare professional voice users with the working population without special voice use (De Jong et al., 2006). The VHI can also be used to classify levels of voice handicap (Fairfield and Richards., 2007). VHI scores lower than 20 were considered to be "minimal", scores from 20-39 as "moderate", 40-59 as "severe", and 60 and up as "very severe". Normative values have been computed by Maertens and de Jong (2007) : the median score of normal healthy subjects is 6.0 and 95% of the normal subjects score under 32,8.

There are only very few publications dealing with voice problems in chronic lung patients. A study by Dogan et al. (2007) showed that 40% out of 40 mild-to-moderate adult asthmatics had VHI scores higher than 16 (considered by these authors as the limit of normality). They also report that, in asthmatic patients, maximum phonation time, frequency, and amplitude perturbation parameters were impaired, but that the vital capacity and the duration of illness did not correlate with these findings.

Lee et al., 1998 and Fox et al., 1989 mentioned that pulmonary diseases, like COPD, have a negative effect on communication. They found 53% of the COPD patients to experience difficulties, compared to 7% of the healthy control group, but these studies are primary focusing on speech, not on voice. Concerning voice, lack of volume and hoarseness was pointed out in COPD patients by Lakerveld-Heyl et al. (2005) in a guideline dealing with paramedical care, based on a review of literature.

The aim of this study is to examine if - and to what extent - patients with chronic lung disease and reduced lung function (but without explicited voice complaints) experience a meaningful reduction of their 'voice related quality of life' measured by VHI. Subsequent questions can be formulated :
Is there a significant difference between asthma and COPD patients ? Do female and male patients score differently ?
An additional step in the analysis is a separate look for a possible difference in the three subscales of the VHI questionnaire: functional, emotional and physical.
The following analysis step is the relation between on the one hand the physiological measurements FEV1,FVC and FER and on the other hand the VHI. Lower scores in the FEV1, FVC and FER are expected to influence negatively the voice through the decrease of the 'bellows' function of the lungs. This will be examined by computing correlation coefficients between FEV1,FVC and FER and the VHI. The null-hypothesis (Ho) is Rho = 0.
A further analysis step concerns the effect of age on the VHI. Actually the subjects of the asthma and COPD groups don't have a similar median age. Again, the correlation coefficient will be computed, and the null-hypothesis (Ho) is again Rho = 0.
In the final analysis step the relation between MCR and VHI-Total will be investigated.

**MATERIAL and METHODS**

1. Subjects

Seventy-four adult patients (56 female, 18 male) without known voice complaints participated in this study at the outpatient clinic of the department of pulmonology of the Sint Fransciscus Gasthuis (Rotterdam). They all were visiting a lung specialist at the hospital between May 2012 and June 2012. All of them had to be diagnosed with either stable asthma or Chronic Obstructive Pulmonary Disease. With "stable" the following was meant : Inclusion criterion: clinically stable situation for at least four weeks with the use of a fixed dosage of corticosteroids. Bronchodilators and steroids are commonly used in the treatment of asthma and COPD. All of the 74 patients use inhaled steroids. Exclusion criteria: exacerbation within four weeks and/or the use of antibiotics because of respiratory problems.

2. Methods

All patients were asked to fill in two questionnaires anonymously : the MCR-dyspnoea scale and the VHI-form.
The forms were then handed over to the lung specialist who completed the form with additional medical information.
All patients further underwent a complete spirometry, including FVC and FEV1. With the use of FEV1 and FVC the FEV1/FVC-ratio (FER) can be found, which is an indication for airway obstruction (GINA ., 2011; GOLD., 2011).
The Flemish translation of the VHI (De Bodt et al., 2000) was used.

3 Statistics

Statistical analysis was performed using SPSS (version 19) software. The VHI scores of the particular subgroups were not normally distributed, so the differences between the subgroups were analyzed using the nonparametric Mann-Whitney U test. The correlation between VHI scores and other parameters in the study groups were calculated using Pearson's correlation coefficient (in case of normal distribution) and Spearman's Rho (in case of non-normal distribution).

**RESULTS**

Seventy-four adult patients (56 female, 18 male) with a mean age of 55.6 ± 16 years were examined. From this group, 44 patients had asthma and 30 COPD. The group's statistics of the VHI-total shows that the median score of asthma patients is 9.0 with a range of 0-77. The median score of COPD patients is 14.0 with a range of 0-80. (Fig. 1)

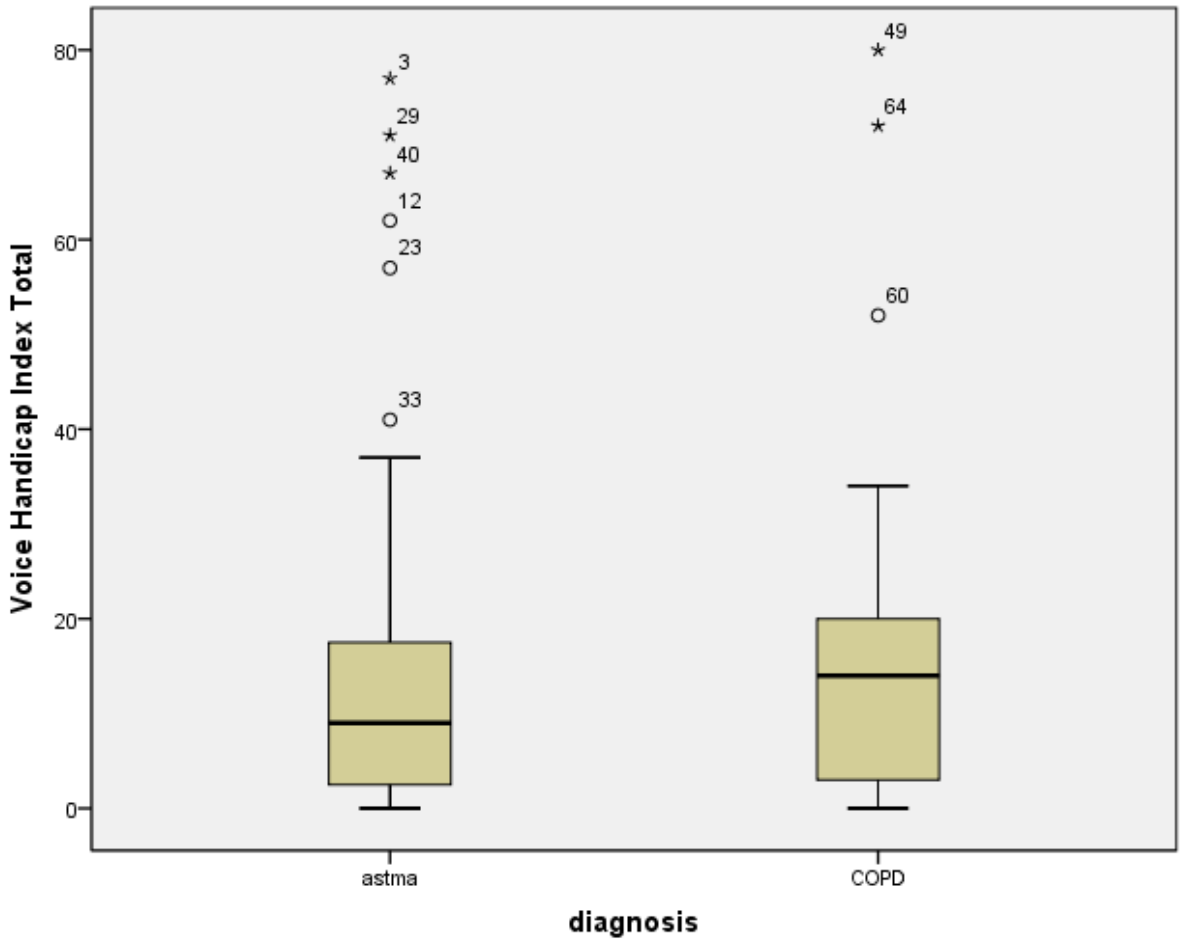


Figure. 1. Total VHI scores among asthma and COPD patients.

These values are slightly higher than the median value of the normal population (6,0) : the global proportion of patients scoring above (48/74) this value of 6 is 0,649 (C.I. : 0,53 – 0,75) : as 0,53 > 0.50, this means that the global proportion of lung patients scoring higher than the median value of the normal population is significantly increased ($p < 0,05$). However, actually about 75% of all our chronic lung patients score within the normal range ( 32,8 is percentile 95 of the normal population).

The second step in the analysis is to check if there is a difference between the two categories of patients. In the asthma and COPD groups the dependent variables (VHI-T, VHI-P, VHI-E and VHI-F), are not normally distributed. All the significance values of the Shapiro-Wilk Test are below 0.05 so the data distribution significantly deviates from the normal distribution.

The differences between the study groups are analyzed by the nonparametric Mann-Whitney U test, which is a nonparametric alternative to the independent t-test. The COPD group shows the highest mean rank but there is no statistically significant difference between the asthma and the COPD group's VHI's ( *U* = 579.5, *P* = 0.375; *U* = 538, *P* = 0.173; *U* = 583, *P* = 0.344; *U* = 622, *P* = 0.675).

| | Asthma | COPD | Total | P-values of difference asthma-COPD |
|---|---|---|---|---|
| VHI-total, median (range) | 9 (0-77) | 14 (0-80) | 11 (0-80) | 0.375 |
| VHI-P, median (range) | 1.5 (0-23) | 3.5 (0-24) | 2 (0-24) | 0.173 |
| VHI-E, median (range) | .0 (0-27) | 0.5 (0-27) | .0 (0-27) | 0.344 |
| VHI-F, median (range) | 5 (0-27) | 8.5 (0-29) | 7 (0-29) | 0.675 |

Table 4 shows the median and range of the total scores and the sub-scores of the VHI form for asthma, COPD and the total group.

The third analysis step is to compare the patient's VHI scores with the VHI scores reported in literature in normal control groups. Maertens & de Jong (2007) found a median of 6 points on the VHI-T score in normal subjects. In the asthma group 60% had a score above 6. In the COPD group the percentage reached 70%.
To analyze the distribution of the VHI-T scores of asthma and COPD patients respectively under or above this median a chi-square test is done. The Chi-square test is used to check if there is a relationship between two categorical variables. The Chi-square (1) = 0.916, p = 0.339. So there is no statistically significant association between both diagnoses and VHI-T (<6 and >6).
The strength of association between the variables is weak according to Phi and Cramer's V test p = 0.339.

A fourth analysis step investigates if female and male patients demonstrate significantly different scores on the VHI. (Fig. 2)
H0: μ-female = μ-male. (VHI-T)
In the asthma group were 40 females (91%) and 4 males (9%). In the COPD group there were 16 females (53%) and 14 males (47%).

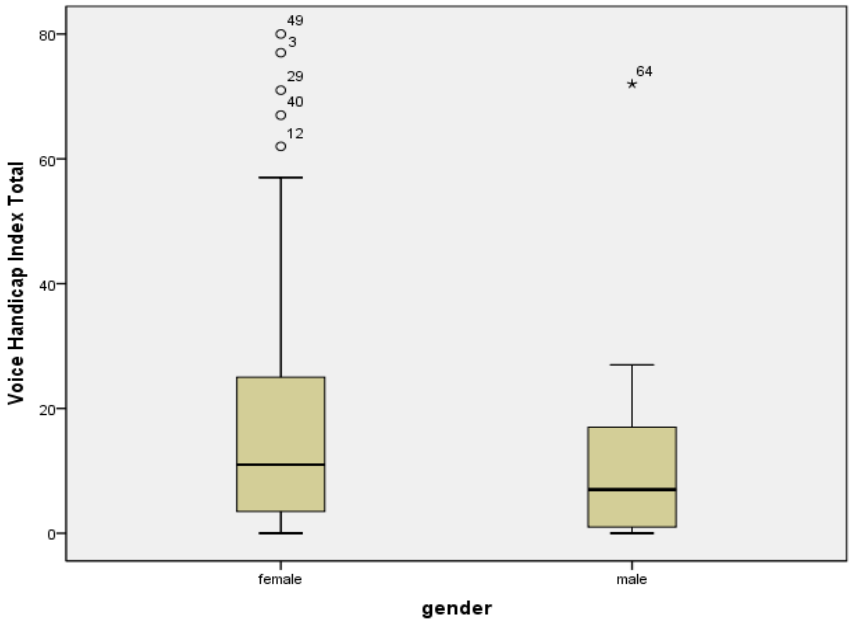

Figure. 2. Total VHI scores for female and male patients.

According to the Kolmogorov Smirnov and the Shapiro-Wilk Test, the dependent variables (VHI-T, VHI-P, VHI-E and VHI-P), are not normally distributed. All the significance values are below 0.05, so the data significantly deviate from a normal distribution.

The differences between the study groups were analyzed using the nonparametric Mann-Whitney U test. From this test it can be concluded that there is no statistically significant difference between the female and the males group's VHI's ($U$ = 391, $P$ = 0.183; $U$ = 409, $P$ = 0.264; $U$ = 386, $P$ = 0.119; $U$ = 392, $P$ = 0.184), despite the fact that the female group shows slightly higher scores on VHI-T, VHI-P, and VHI-F.

| | Female | Male | Total | P-values of difference Female-Male |
|---|---|---|---|---|
| VHI-T, median (range) | 11 (0-80) | 7 (0-72) | 11 (0-80) | 0.183 |
| VHI-P, median (range) | 8 (0-29) | 5 (0-26) | 2 (0-24) | 0.264 |
| VHI-E, median (range) | .0 (0-27) | .0 (0-26) | .0 (0-27) | 0.119 |
| VHI-F, median (range) | 2 (0-24) | 1.5 (0-20) | 7 (0-29) | 0.184 |

Table 5. shows the median and range of the total scores and the sub-scores of the VHI form for female, male and the total group.

The fifth analysis step compares the results of the female and male groups to scores reported in literature. To find out if the proportion of the VHI-T scores under and above a value of 6 (Maertens & de Jong, 2007) differs in males and females a chi-square test is achieved. The Chi-square = 2.155, p = 0.142. It can be concluded that there is no statistically significant association between gender and VHI-T ( < 6 and > 6 ). That is, both female and male score comparably on VHI-T.
The strength of association between the variables is very weak, p = 0.142, according to both tests (Phi and Cramer's V).

A sixth additional analysis step investigates if a subgroup from the study group shows at least a moderate voice handicap (score of 20 and higher).
For this we take as reference the study by Fairfield and Richards., 2007. : VHI scores lower than 20 were considered to be "minimal", scores from 20-39 as "moderate", 40-59: "severe", and 60 and up: "very severe".
In the present study 17 of the 74 patients (23%) showed at least a moderate voice handicap.
The Chi-square test for independence is used to check if there is a relationship between the two categorical variables. For the asthma group 23% scored at least a moderate voice handicap. For the COPD group this was also the case.
The Chi-square (1)=0.004, p= 0.951. It can be concluded that there is no statistically significant association between diagnosis and VHI-T (< 20 and > 20). That is, both asthma and COPD patients score comparably on the VHI-T (< 20 and > 20).

A seventh analysis step investigates the difference between the three subscales of the VHI questionnaire (Fig. 3)

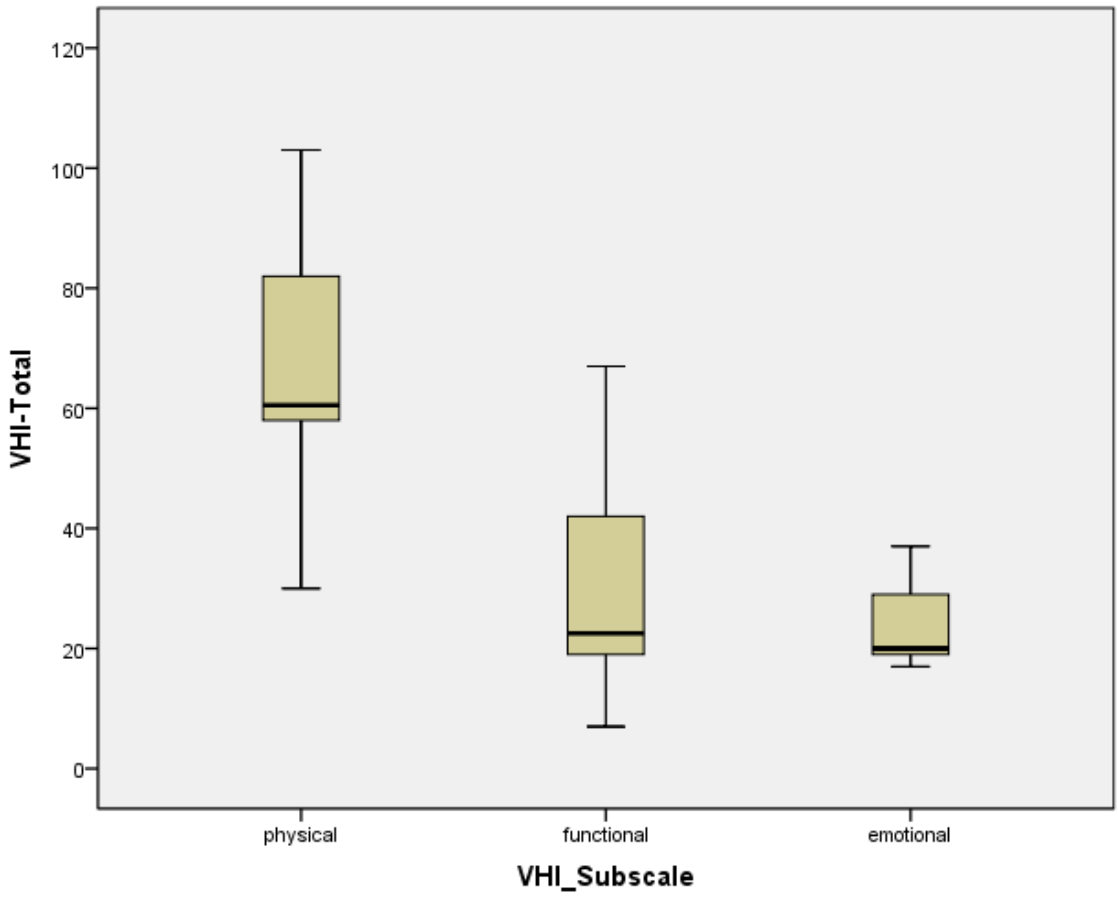


Figure 3. Box-plot of the scores on the VHI subscales (N74).

Statistics

VHI_SubTot

| | | | |
|---|---|---|---|
| Physical | N | Valid | 10 |
| | | Missing | 0 |
| | Median | | 60,50 |
| Functional | N | Valid | 10 |
| | | Missing | 0 |
| | Median | | 22,50 |
| Emotional | N | Valid | 10 |
| | | Missing | 0 |
| | Median | | 20,00 |

Table 6. Statistics show the number of questions per subscale and the median score.

The scores of the three subscales are compared in the total group of patients in order to determine if there are any significant differences.
The Levene's *F* statistic has a significance value of 0.036. It can be concluded that the Levene's *F* is significant, which means that there are no similar variances and it is required to refer to the Robust Tests of Equality of Means Table instead of the ANOVA Table.
By using the Welch test it can be concluded that the significance value is less than 0.05 meaning there is a statistically significant difference between the three subscales as a whole. There is further a significant difference between VHI- physical and as well VHI-functional as VHI- emotional (*p* = respectively 0.001 and 0.000). However, there is no difference between VHI-functional and VHI-emotional (p = 0.630).
This indicates that lung patients report higher impairment for the physical aspects of voice related quality of life.

More in detail, the highest ranked items were:
P2: 'I run out of air when I talk.' (103/644) → 16%
P4: 'The sound of my voice varies throughout the day.'( 87/644) → 14%
P17: 'The clarity of my voice is unpredictable.'( 82/644) → 13%

(644 is the total score of all 74 patients for the "physical" subscale of the VHI)

An eighth, interesting analysis step is to investigate the strength and direction of associations between on the one hand FEV1,FVC and FER and on the other hand the VHI.

It was necessary to use the Spearman's Rho because variables FEV1 and VHI-T are not normally distributed and there are outliers (*r* = -.073, n = 74, *P* = 0.541). A Spearman's Rank Order correlation was run to determine the relationship between FEV1 and VHI-T in 74 patients. There is a very weak, negative correlation between FEV1 and VHI-T, which is statistically not significant ($r_s(72) = -.120$, *P* = .311).

Similarly, it was necessary to use the Spearman's Rho because variables FVC and VHI-T are not normally distributed and there are outliers ($r$ = -.148, n = 74, $P$ = 0.211). A Spearman's Rank Order correlation was run to determine the relationship between FVC and VHI-T in 74 patients. There is a very weak, negative correlation between FEV1 and VHI-T, which is statistically not significant ($r_s(72)$ = -.134, $P$ = .260).

Finally, it was also necessary to use the same Spearman's Rho because variables FER and VHI-T are not normally distributed and there are outliers ($r$ = .028, n = 74, $P$ = 0.811). A Spearman's Rank Order correlation was run to determine the relationship between FER and VHI-T in 74 patients . There is a very weak, negative correlation between FER and VHI-T, which is statistically not significant ($r_s(72)$ = -.036, $P$ = .764).

A ninth analysis step investigates the effect of age on the VHI in the asthma and COPD groups. A Spearman's Rank Order correlation was run to determine the relationship between 74 patients' age and VHI-T. There is a very weak, positive correlation between age and VHI-T, which is statistically not significant ($r_s(72)$ = .009, $P$ = .938).

A tenth analysis step investigates the relation between the self-reported degree of dyspnoea in daily life (MRC-score) and the VHI in the asthma and COPD patients (Fig. 4)

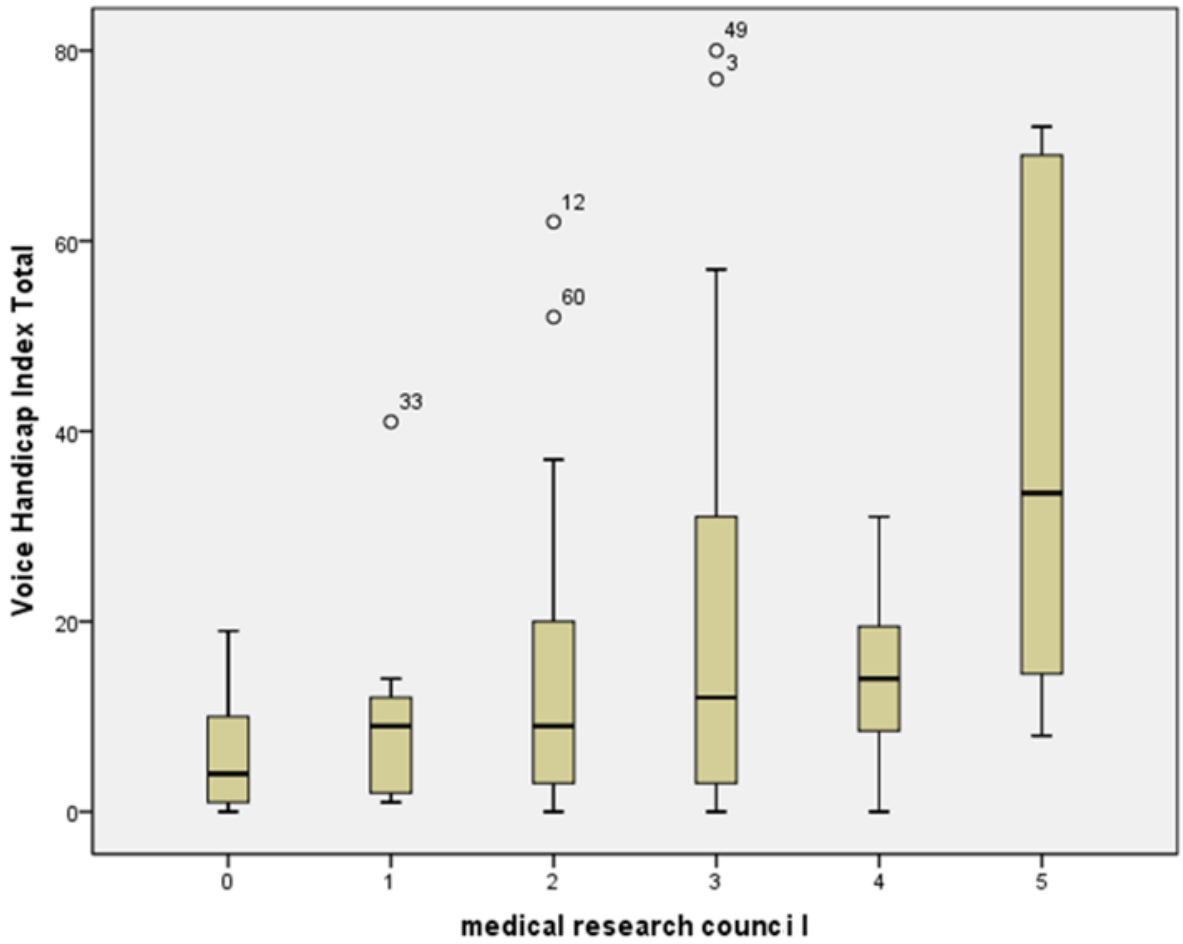


Figure 4. Box-plot of the MRC scores and the VHI-T scores.

There are outliers requiring the use of a non-parametric test such as Spearman's Correlation.
A Spearman's Rank Order correlation was run to determine the relation between 74 patients' MRC and VHI scores. There is a weak positive correlation, which is statistically significant ($r_s(72) = .388$, $P = .001$). Fig. 4 shows that particularly the patients with the most severe level of the MRC scale report a quite high voice handicap.

The last analysis step is to compare VHI scores ( at least at moderate level, thus > 20) and MRC scores higher than 2.
The Chi-Square test for independence, is used to check if there is a relationship between two categorical variables. The Chi-square is (1) = 5.521, $P = 0.019$, indicating that there is a statistically significant association between MRC and VHI. That is, a high MRC score generally corresponds with a high VHI score.

Phi and Cramer's V are both tests of the strength of association. We can see that there is low association (.1 to .3) between the variables (0.277, p = 0.019).

**DISCUSSION**

The present study is aimed to assess the VHI-scores in patients with chronic lung disease, and to compare the two main categories of these patients : patients with asthma and patients with COPD. The VHI is currently considered the best suited tool for reflecting the voice related quality of life.

Globally it appears that, in general, the VHI-score of patients with chronic lung disease is slightly but significantly higher than the median value of the normal population (6,0). However about 75% of chronic lung patients score within the normal range ( a score of 32,8 corresponds to the 95$^{th}$ percentile of the normal population (Maertens & de Jong, 2007).

When considering the qualification of the VHI total scores as proposed by Fairfield and Richards., 2007 ( VHI scores lower than 20 = "minimal", scores from 20-39 = "moderate", 40-59 = "severe", and 60 and up = "very severe") , 57 out of the 74 patients (77 %) reported no or a minimal voice handicap (score < 20), and the percentage is comparable for asthma and COPD patients.
Dogan et al. (2007) found that 40% out of 40 mild-to-moderate adult asthmatics had VHI scores higher than 16 (considered by these authors as the limit of normality). In our study, 34 % reach scores above 16. These proportions are roughly comparable. It is interesting to notice that Dogan et al. (2007) also report that, in their asthmatic patients, maximum phonation time, frequency, and amplitude perturbation parameters were impaired, but that the vital capacity and the duration of illness did not correlate with these findings. However it must be noticed that the asthma patients of Dogan's article were younger (mean age 39,9 +/- 11.9 years) than those of the present study (55.6 +/- 16 years).

We did not find a significant difference between the VHI scores of asthma (9) and COPD (14) patients. Referring to van Gogh et al. (2007), a difference score of 15 points or more should be necessary for being considered as clinically relevant when comparing groups of patients.

This lack of difference between asthma and COPD patients is corroborated by the analysis based on different threshold limit values : The VHI scores (total and subscale scores) of the patients with asthma and COPD were compared with respect to the scores of 6 (median of normal healthy population) and 20 (upper limit of 'minimal' impairment) : again, no significant difference could be shown. However, the median score of the COPD group is slightly higher than the results of the asthma group. A possible explanation could be that in the COPD population the airway obstruction increases with time. It might be that COPD patients have permanently to adapt to their new situation. Another explanation might be that the general health condition of asthma patients is better on average than that of COPD patients.
The biopsychosocial handicap related to voice problems seems to be slightly worse among women than men, but the scores don't differ significantly. It is well known that, as a rule, voice problems occur more frequently in women. Rosen and Murry (2000) also found that in general the females scored higher on the VHI.
An analysis of the correlation between the VHI score and FEV1, FVC and FER yielded no significant relationship. The absence of a significant correlation between these measurements indicates that objective measurements of lung function do not correlate with the patient's subjective vocal well-being. In other words, the perceived voice handicap of the patient and the physical reality do not match per se. In contrary, there is a statistically significant association between MRC- (subjective dyspnoea scale) and VHI-scores. That is, a higher MRC score generally corresponds with a higher VHI score. However, as can be seen in Fig. 4 , the VHI score is mainly increased in level 5 of the MRC scale, i.e. patients reporting that they are " Too breathless to leave the house, or breathless when dressing or undressing".

Regarding age, no clear associations were found in this study with the VHI , as well in the asthma as in the COPD group.
Our data seem to corroborate the statement (Meulenbroek, 2010) that the Voice Handicap Index is a reliable instrument to assess vocal handicap regardless age, gender or disease type, and that it is useful to assess the consequences of the voice handicap independently of the etiology.
Concerning the subscales of the VHI, some consistency is found between the results obtained by Woisard et al., (2007) (voice pathology in general) and this study: the highest level of handicap pertains to the physical subscale, while the lowest one pertains to the emotional subscale. These results are also concordant with the findings of Kooijman et al. (2007), who postulated that – in general - the physical aspects of voice disorders exert the strongest impact on the total VHI score. In our study, when comparing the mean VHI scores in subscales, the between-subgroup differences were significant only between the physical subscale and respectively the functional and the emotional subscales. This indicates that the voice handicap seems to result mainly from the physical aspects of the voice.

In the present study, it was not possible to have – for comparison - objective data of voice analysis. Also information about the vocal fold status of the patients is missing. The consequence is that the conclusions exclusively rely upon the self-reported voice-related quality of life, and not on the voice quality itself.

**Conclusion**

Chronic lung patients without specific voice complaints report a slightly but significantly decreased voice-related quality of life when compared to the normal healthy population. However, about 75% of all our chronic lung patients score within the normal range (percentile 95 of the normal population) .
There is no significant difference in VHI scores between asthma and COPD patients.
The absence of a significant correlation between VHI and measurements like FEV1, FVC and FER, indicates that objective measurements of pulmonary function do not correlate with the patient's subjective vocal well-being.
The physical aspects of voice exert the strongest impact on the VHI score.
There is further a statistically significant association between MRC- (subjective dyspnoea scale) and VHI-scores, particularly for the most severe level of the MRC scale. This seems to point out that patients with high scores on the MRC-scale – even without having specific voice complaints- could benefit from logopedic advices pertaining to voice use and voice hygiene.

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**LIST OF ABBREVIATIONS**

| | |
|---|---|
| COPD | Chronic Obstructive Pulmonary Disease |
| ENT | Ear-Nose-Throat |
| FER | Forced Expiratory Rate |
| FEV1 | Forced Expiratory Volume in 1 second |
| FVC | Forced Vital Capacity |
| GOLD | Global Initiative for Chronic Obstructive Lung Disease |
| GINA | Global Initiative for Asthma |
| LAN | Long Alliantie Nederland |
| MRC | Medical Research Council (Dyspnoe score) |
| VHI | Voice Handicap Index |
| VHI-T | Voice Handicap Index Total |
| VHI-F | Voice Handicap Index Functional subscale |
| VHI-E | Voice Handicap Index Emotional subscale |
| VHI-P | Voice Handicap Index Physical subscale |
| VLS | Videolaryngeostroboscopic |

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