

Short Communication

Voice Disorders of Adults with Intellectual Disability

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Keywords

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Abstract

Background: The voice is an essential aspect for age and gender identification. Disorders can be a symptom of a systemic or localized disease. To evaluate voice pathologies in people with intellectual disability, participants of the Special Olympics were examined.

Methods: Acoustic and perceptual voice measurements were performed including a computer based acoustic analysis and a perceptual evaluation.

Results: Forty athletes (27 male, 13 female, mean age of 27 years), participated in the study. Voice frequency was out of the normal range in approximately half of the participants. Pathologic voice parameters concerning hoarseness and regularity of the voice were found in 65% of the participants by acoustic analysis of the voice signal and in 48% by perceptual evaluation with accordance in between the results.

Conclusion: About half of the participants showed abnormal voice characteristics. A comprehensive medical care for people with intellectual disability should include a clarification of pathologic voice findings.

ABBREVIATIONS

PWID: Persons with Intellectual Disability; OAE: Otoacoustic Emissions of the Cochlea

INTRODUCTION

Voice plays an eminent role not only as mean to make oneself understood but also as a part of our individual appearance. In addition, the fundamental frequency of a voice and its spectral characteristics are essential for the perception of the age of a speaker [1]. Often the first impression of the voice determines certain personality features to the counterpart such as trustworthiness, competence or dominance [2]. Furthermore, the voice is an important aspect of gender identification for adults. During early adulthood the female voice usually has a fundamental frequency F0 between 200 and 250 Hertz; the male voice between 100 and 150 Hertz [1]. With age especially the voice of women deepens lightly more so that the pitches of voice assimilate.

Only few are known about voice disorders of adult persons with intellectual disabilities (PWID). For a couple of genetic disorders which are linked to intellectual disability, the

appearance of voice dysfunction is well-described, e.g. Down's syndrome or Prader-Willi-syndrome [3]. For people with Down's syndrome morphological anomalies of the voice organs have been described, which can result in a voice disorder [4]. In young adults with Down's syndrome higher fundamental voice frequency has been specified [5]. Besides organic changes, functional pathologies can also lead to an alteration of the voice. Deficient interaction of muscle tension, respiration, and posture and also the psyche play a major role in the genesis of voice problems [6,7]. Aim of the present study was to evaluate the incidence and phenomenology of voice disorders in adult PWID applying a commonly used acoustic and perceptual voice assessment. Therefore, a cross sectional study was performed with participants of the Special Olympics of Bavaria.

MATERIALS AND METHODS

During the 4., Bavarian Special Olympics winter games which took place from 10th to 13th of February 2014 in Lam (Bavaria), participating athletes voluntarily underwent an examination of their voice. The examination was part of the Bavarian Special Olympics health program. During the games participants were able to compete in one or more of the following disciplines: skiing,

snowboarding, cross country skiing, snowshoe running, floor ball and indoor hockey. Voice examinations were performed in a calm part the main-building of the event were participants had the opportunity to come together to eat and exchange experiences between the competitions.

All athletes were working or living in institutions for intellectual disabled persons. The origin of the intellectual disability was only known in persons with Down's syndrome. A minor to mediate form of mental disability can be assumed for most participants as all were able to participate in the Special Olympics sport event. The participation in the above mentioned health program was voluntarily, each participant or respectively their relatives gave written consent of the examination as well as of the use of the thereby gained data for the health program of Special Olympics. Forty volunteers with a mean age of 27 years (SD +/- 11 years, range from 17 to 60 years) participated in the study, here of 27 men and 13 women. One female had Down's syndrome.

Voice was evaluated perceptually during an interview with the participants. It was performed by an experienced speech therapist. The voice was interpreted according to the RBH-classification, common in the German language area which corresponds to the GRBAS-classification without taking A and S into account. GRBAS is an acronym for a five dimensional scale of measurements of voice properties. The properties are grade, roughness, breathiness, asthenia and strain [8]. Using the RBH-classification, the quality of voice is evaluated according to two essential characteristics for hoarseness, namely roughness and breathiness. 0 stands for "normal", 3 for a maximal disorder. The RBH classification was tested before referring to its reliability and showed high intra- and inter-rater accuracy for experienced raters [9].

Furthermore, fundamental voice frequency F0, Jitter, Shimmer and HNR were measured during sustained phonation. To avoid provoking a significant deviation of the pitch of voice while phonating the sustained vowel, it was the final syllable of a declarative sentence ("Brötchen und Kaffeeeeeee..." meaning "bagels and coffeeeeeee"). For the acoustic examination the program Praat Version 5.3.65 was used [10]. The microphone for recording (hama, VoIP Micro) had a resistance of 1,4 kilo ohm, was equipped with a frequency range of 30-16000 Hertz and had a sensitivity of -62 to +/- 3 decibel. The analysis was performed using SigmaStat (Jandel Corp., San Rafael, Ca, USA). For the descriptive report of the results the arithmetic averages as well as the standard deviation (SD) were calculated.

RESULTS AND DISCUSSION

Perceptual evaluation

The perceptual evaluation of the voice (RBH) performed by an experienced speech therapist showed pathologic scores (>0) in 6 out of 13 women (46.1%), two of the female participants showed scores of 2 and four showed scores of 1; for men 10 out of 27 (37.0%) showed abnormal scores, one of which had a maximum score of 3, two had a score of 2 and 7 showed a score of 1.

Acoustic analysis

Many athletes were incapable of saying "...Kaffeeeeeee..." with

the last vowel sustained for at least 2 seconds. For men the median length of the analyzed sustained vowel was 1.3s +/- 0.9s with a median fundamental frequency of 161.1 Hertz +/- 41.9 Hertz. For 13 out of the 27 male participants (48%) the fundamental frequency was above the upper limit for the male fundamental frequency of 150 Hertz.

For women the median length of the analyzed vowel averaged 1.3s +/- 1.1s with a median fundamental frequency of 256.2 Hertz +/- 68.7 Hertz. Five women (38%) ranged above the female upper limit for the fundamental frequency of 250 Hertz, two women (15%) were well below the lower threshold of 200 Hertz. They showed a fundamental frequency of 139 and 142 Hertz, respectively (Table 1).

The evaluation of the irregularity of the fundamental frequency showed a median jitter of 0.621 +/- 0.478 % for participating women and 0.554 +/- 0.864 % for participating men. Values of 10 women (76.9%) were beyond 0.4%, the commonly used cut-off-value, and two out of 13 female athletes (15.4%) were even beyond the cut-off value given by the program Praat of up to 1.04%. Among the male athletes 10 (37%) ranged above 0.4 % and three (11.1%) were above 1.04%. The median shimmer of the examined female participants was 3.864 +/- 2.976 % whereas it was for men 4.241 +/- 3.901 %. Thereby five of the 13 female participants (38.5%) and nine of the 27 male participants (33.3%) stood out of the normal range of up to 3.810%.

The median quotient of harmonic to noise in the voice was for the females 21.2 +/- 5.2 decibel, the one for males was 21.1 +/- 5.1 decibel. Five women (38.5%) and 8 men (29.6%) were below the cut-off-value of 20dB for harmonics-to-noise-ratio (Table 2).

All athletes with a perceptual evaluation score (RBH) of 2 or 3 also showed deviant acoustic voice characteristics (Jitter, Shimmer, HNR); for a hoarseness values of 1, 8 participants also showed abnormal perturbation parameters and for 4 athletes they were in the normal ranges.

The one female athlete with Down's syndrome did not show any abnormal results referring to the acoustic or perceptual evaluation except for a decently higher fundamental frequency of 258 Hertz.

CONCLUSION

Approximately half of the participating athletes of the Special

Table 1: Demographic data of the participating volunteers with hearing test results. When OAE were detectable we suppose a sufficient hearing for speech control.

	Amount	Percent
Participants	40	100
Mean age in years (range)	27 (17 - 60)	
Gender		
Male	27	67,5
Female	13	32,5
OAE detected	30	75
OAE not detected	6	15
Hearing test not feasible	4	10

Abbreviations: OAE: Otoacoustic Emissions of the Cochlea

Table 2: Results of the computer assisted voice analysis by Praat.

Gender	F0 (Hz)	Vowel duration	Jitter local (%)	Shimmer local (%)
Male	161,1 ± 41,9	1,3 ± 0,9	0,554 ± 0,864	4,241 ± 3,901
Female	256,2 ± 68,7	1,3 ± 1,1	0,621 ± 0,478	3,864 ± 2,976

Olympics of Bavaria, which were all intellectually disabled, showed abnormalities of the voice, which could result from a systemic or localized organic dysfunction, a non-organic or an emotional impairment. The ability to communicate as well as the role function of the aggrieved person could be affected in a negative way. The results indicate that there is a great necessity for specialized examinations of communication disorders for people with intellectual disability. Further studies with a larger group of people should target the causes of voice disorders and correlate the reasons and the characteristic of the intellectual disorder.

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