

## The Prevalence of Voice Problems in a Sample of Collegiate a Cappella Singers

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### Abstract

A large number of collegiate a cappella singing groups exist on college campuses across the United States. The purpose of this study was to collect preliminary data on the frequency of reported voice problems among a sample of collegiate a cappella singers and associated demographic characteristics. Information was obtained from 72 collegiate a cappella singers from a single academic campus using a survey instrument. Results demonstrated a past or present voice problem prevalence of 36% within the sample. The data suggest that collegiate a cappella singers are at a high risk for voice problems, with a small subset manifesting a past history of benign vocal fold lesions. The information reported in this study may be of clinical relevance to vocal health professionals who treat individuals from this population.

**Keywords:** Voice problems; A Cappella; Singers

### Introduction

Collegiate a cappella singers represent a subgroup of amateur singers for which no clinically relevant empirical data related to the prevalence or risk factors associated with voice problems exists. The term a cappella is an Italian derivative of the Latin “a capela”, which can be translated literally as “in the style of the chapel”. Contemporary use of the term a cappella relates to the description of singing without musical accompaniment. Thus, individuals engaged in collegiate a cappella groups (or any individual singing in a cappella style) produce music without any instrumentation other than their own voices. Collegiate a cappella groups are a national phenomenon. The number of collegiate a cappella groups associated with institutions of higher education in the United States exceeds 1,000 (for a partial list of groups at various colleges & universities see [www.collegiate-acappella.com](http://www.collegiate-acappella.com)). With group memberships between 10 to 20 individuals, a conservative estimate would put the number of participants engaged in collegiate a cappella performance in the United States between 10,000 and 20,000 individuals. These groups perform locally, and compete at regional and national competitions (e.g., the International Championship of Collegiate A Cappella is held annually and include groups from around the U.S and Europe-see [www.varsityvocals](http://www.varsityvocals) for additional information).

Contemporary collegiate a cappella performance varies widely across musical genres including pop, rock, Christian/gospel, and country among others. In addition, the repertoire of any one group can range across a wide variety of music categories. Group membership includes male or female only, or co-ed consisting of both genders. Howard has published a series of studies documenting the intonation or pitch tuning of four-part a cappella quartets, and the reader is directed to those studies for an in-depth discussion of pitch control in a cappella singing. Unlike traditional barbershop or soprano-alto-tenor-bass a cappella quartets, collegiate a cappella groups utilize a large number of voices to produce percussive and other instrumental sounds, in addition to voices engaged in harmonizing. The large

variety of vocal parts inherent in contemporary collegiate a cappella requires singers to use their voices in non-traditional ways compared to traditional unaccompanied choral singing. Due to the nature of this type of performance, it is unclear if the degree and type of vocal load required for collegiate a cappella performance may put individuals at a high risk for voice problems.

Vocal load is a term which signifies the demands imposed on the vocal mechanism by voice use needs [1]. Any increase in vocal load which taxes the biological protective mechanisms and/or wound healing capacity of the vocal fold tissue beyond physical limits puts an individual at risk for the development of a voice problem [1]. Voice problems/disorders have been defined using varying terminology by different sources, but for the purposes of this paper will be defined as “a deviation in voice quality that negatively influences the sound of voice production, the effort of voice production, or communication with others.” It is known that specific populations experience greater vocal load demands due to job-related roles and responsibilities—individuals within these groups are referred to as professional voice users [2]. Not surprisingly, these individuals comprise a large percentage of the treatment-seeking cases reporting to voice clinics [1-4].

Singers who maintain an active practice and/or performance schedule, whether professional or amateur, represent a population who experience heavy vocal loads and experience voice problems at rates greater than typical voice users [1-4]. It is a common belief among singing pedagogues and health professionals who treat voice problems that vocal training, which targets efficient technique, decreases the risk of voice problems in singers [5]. However, even well-trained singers develop voice problems which likely originate from accumulated vocal load and/or lifestyle behaviors. Health professionals who treat singers with voice problems must obtain information specifying the degree of vocal load and lifestyle behaviors in order to generate valid suppositions of the etiological substrates of a current problem. This information will also be used to create an effective treatment plan. It is important, then, that the characteristics of vocal demands and lifestyle

behaviors are recognized and understood for effective clinical management of voice problems in singers.

Individuals who participate in collegiate a cappella groups do experience voice problems and do seek treatment. It has been the clinical experience of the author that, in addition to heavy vocal loads, etiological factors associated with the typical college lifestyle are often associated with the development of voice problems in those collegiate a cappella singers who seek treatment. It is known that many aspects of college life are not vocally hygienic (that is, they put the vocal fold tissue at risk for irritation and/or make it more susceptible to injury), including high rates of tobacco and alcohol use, caffeine consumption, as well as sleep deprivation and a high frequency of sleep disorders among college students [6,7]. It is suspected that the typical individual who engages in collegiate a cappella (whether a treatment seeking individual or not), in addition to experiencing heavy vocal loads, also frequently engages in lifestyle activities which put the vocal fold tissue at risk.

This pilot study was initiated to determine if collegiate a cappella singers report a large frequency of past or present voice problems and what performance demands and lifestyle behaviors might be associated with those problems. Specifically, this study addressed the following questions: (1) What is the prevalence of past and/or present voice problems in collegiate a cappella singers at an academic institution and (2) what vocal load demands and lifestyle factors are characteristic of collegiate a cappella singers? To answer these questions, data was obtained from survey questions submitted to a sample of collegiate a cappella singers at a university in the United States. It was believed that information obtained from this study would be of clinical value, in that knowledge of the characteristics of vocal load associated with collegiate a cappella singing and the lifestyle of those engaged in this activity would place the clinician in a better position to understand the etiological factors associated with voice problems in this subgroup of amateur singers, assist in the diagnostic process (e.g., facilitate the generation of appropriate history questions), and assist in the development of appropriate management plans.

## Methodology

**Participants:** A non-probability purposive sample was utilized to recruit collegiate a cappella singers. A total of 72 individuals were asked and agreed to volunteer for the study. Inclusion criteria included: (1) current enrollment in an institution of higher education and (2) currently active in a campus-based a cappella group. The participants represented approximately 80% of the total number of individuals performing with a cappella groups at the academic institution, and 75% of the total number of groups (6/8) on campus. Three all-female groups, two all-male groups, and one co-ed group were represented in the sample, which included 50 females and 22 males.

**Survey Instrument:** The investigation was conducted utilizing a custom 47-item survey (Appendix A) developed to obtain information related to voice history, vocal load, and lifestyle characteristics of each participant. The primary goal of the instrument was to measure (a) the frequency with which collegiate a cappella singers experienced current or past voice problems and (b) factors associated with vocal load or lifestyle which may have contributed to these reports. "Voice problem" for this study was operationally defined for the participants as follows: "any deviation in voice quality that negatively influences the sound of your voice, the effort it takes to use your voice, or affects communication with others." The survey was organized into seven

different content areas including: (A) demographic information (Questions 1-4), (B) college life characteristics (Questions 5-6), (C) training history (Questions 7-9), (D) vocal use characteristics (Questions 10-20), (E) vocal health information (Questions 21-35), (F) current voice status (Questions 36-40), and (G) past voice history (Questions 41-47). Data from selected items in each content area were analyzed separately for descriptive analysis. In addition, data from selected items within the content areas of college life, training, vocal use, and vocal health were summed to serve as composite predictor variables for reports of voice problems using logistic regression analysis. Composite sum scores are commonly used in educational and psychological measurement [8]. Combining individual items has the advantage of increasing score reliability. It also improves the precision of the estimated logistic regression coefficients, by reducing the number of predictor variables and increasing the ratio of sample size to number of predictors. Response choices were organized so that increasing values on a nominal or ordinal scale represented increasing vocal load demands or risk for vocal injury.

**Procedures:** All procedures were approved by the author's university institutional review board. Targeted groups were initially contacted via e-mail in order to request permission to be approached for volunteering in the study. The investigator met with the six a cappella groups in person at a respective practice session, where surveys were given to all present at that session. The investigator explained the purpose of the study, and was present while all participants completed the survey in order to respond to questions. All 72 individuals who agreed to participate completed the survey.

**Analyses:** Information from the different content areas was tabulated and descriptive statistics, frequency counts, and percentages were applied to organize and analyze the data trends. Graphical analyses were also utilized to investigate response trends and observation of data patterns. Finally, a logistic regression analysis was used to evaluate the association between the binary outcome (voice problem or no problem) and the nominal and ordinal predictor variables that were formed by summing individual survey items. As this was a preliminary exploratory study the number of included predictor variables was large and based on response patterns indicating a likely association with voice problems. Binary outcome variables result in a nonlinear relationship between the probability of an outcome of interest (here the probability of a voice problem) and the predictor variables. In logistic regression, the log of the odds of voice problem to no problem results in a linear relationship. The logistic regression coefficients may be interpreted by taking their exponent. The exponent of the coefficient (i.e. the values in the "Estimate" column in the Table 4 below) produces the odds ratio. Odds ratios greater than one reflect an increase in the chance of a voice problem, while odds ratios less than one indicate a decrease in the chance of a voice problem (or an increase in no problem). An odds ratio of 1 indicates a 50-50 chance of a voice problem. The magnitude of odds ratios less than one may be compared to those larger than one by taking the inverse.

## Results

Table 1 displays demographic information for the study participants. Figure 1 illustrates the frequency with which individuals reported a current voice problem, a past voice problem, both, or no history of voice problems. From a corpus of 72 participants, 36% (95% CI=24%-52%) of respondents (26 individuals) indicated that they have experienced either a past or a current voice problem. Of these, 5.5% (4

individuals) reported both a current and past voice problem (both), 11% (8 individuals) reported a current voice problem only, and 19% (14 individuals) reported a past voice problem only. Of the 12 individuals who were currently experiencing a voice problem, 58% (7 individuals) indicated that the problem affects both their speaking and singing voices, with the remaining 32% (4 individuals) indicating the problem affecting the singing voice only. No respondent who experienced a current or past voice problem indicated effects on the speaking voice only. Of the 18 individuals who reported a past voice problem, 72% (13 individuals) indicated that the problem affected both their speaking and singing voices, with the remaining 28% (5 individuals) reporting only the singing voice affected.

Demographic Category	# Participants	% of Sample
<b>AGE RANGE</b>		
18-20	40	0.56
21-23	31	0.43
24-26	1	0.01
<b>GENDER</b>		
Female	50	0.69
Male	22	0.31
<b>CLASS</b>		
<b>Freshman</b>	6	0.08
Sophomore	24	0.33
Junior	16	0.22
Senior	26	0.36
<b>MAJOR/MINOR</b>		
Comm. Disorders	5	0.07
Music/Voice	17	0.24
Theatre	4	0.06
Other	46	0.64
<b>VOICE TRAINING</b>		
Yes	47	0.65
No	25	0.35

**Table 1:** Demographic Profile of Participants.

Only 8 of the 26 individuals who reported a current or past problem also reported seeking out a diagnosis from a health professional. A total of 63% (5 of 8) of these individuals indicated a confirmed diagnosis of benign vocal fold mass (4 nodules, 1 polyp). The remaining reported diagnoses included sinusitis, upper respiratory infection, and “vocal cord strain”. For all participants who reported experiencing current or past voice problems, the most common symptoms reported included vocal fatigue and loss of high notes during singing (42% and 42% of individuals, respectively), followed by breathy (39%) and rough (39%) voice qualities.

Table 2 displays frequency and percentage responses to selected questionnaire items which share clinical relevance, in that they are typically queried during a voice diagnostic as part of the history information. As would be expected of college students, the majority (90%) of participants reported going to “loud” parties at least once a week, drinking caffeine regularly (84% consumed at least 1 caffeinated beverage a day), and consuming alcohol every week (43% reported drinking between 2-8 alcoholic beverages a week; 22% reported drinking 9 or more alcoholic beverages a week!). A series of chi square tests for independence were computed to test for differences between individuals who reported a history of voice problems and those who did not, across the items listed in Table 2. In addition, a series of Spearman’s rho tests were applied to this data to determine the relationship between questionnaire items in Table 2 and the history of a reported voice problem. No significant relationship between those with a history of voice problem and those without were found, and as can be seen in Table 2, the correlation coefficients for all comparisons were very low.

Descriptive statistics for each composite variable are listed in Table 3. The scores are not directly comparable as each contains a different number of items, and is, therefore, measured on a different scale. Although for research purposes score reliability for psychological measures should approximate 70, score reliability for the composite variables is low (Table 3). However, score reliability for these composites is higher than it would be if each variable (i.e. survey item) were treated individually.

No variables in the logistic regression were statistically significant (Table 4), likely a result of the small sample size relative to the number of variables. However, the estimated logistic regression coefficients reveal some interesting patterns from the sample. First, the largest odds ratio was associated with Singing Training. This odds ratio was obtained by inverting the value in the table ( $1/0.52=1.92$ ). As singing training increases by one unit the odds of no disorder increase by 1.92. Stated differently, the odds of a disorder decrease by 0.52. Vocal Use had the second largest odds ratio. As Vocal use increases by one unit, the odds of having a Disorder increase by 1.24. Interestingly, College Life, which represented the frequency with which participants attended “loud parties” and the amount of time the slept each night, was associated with a decrease in the chance of having a disorder.

## Discussion

The purpose of this study was to collect pilot data (data from a sample representing one academic institution) from collegiate a cappella singers to investigate the frequency of reported voice problems and the vocal load and lifestyle demands which might be related to those problems. We sampled 72 collegiate a cappella singers, representing both genders as well as male only, female only, and co-ed groups. Our first research question asked, “What is the prevalence of past and/or present voice problems in collegiate a cappella singers at an academic institution?”. Results indicated that 37% of this sample has experienced a voice problem, either past or present (e.g., in their lifetime), with 16.5% reporting a current problem. This result is consistent with prevalence and/or incidence figures from other published studies which have investigated the general population and specific subsets including individuals with heavy vocal load demands, including teachers (57% lifetime prevalence) and telemarketers (31% current prevalence) [9-12]. Seven percent of respondents in this study (5 individuals) reported a diagnosis of benign vocal fold lesion. This is also consistent with reports from collegiate vocal (non a cappella)

majority [13]. However, a number of the individuals in this sample who reported a voice problem did not seek treatment or obtain a differential diagnosis, so that the frequency of benign vocal fold lesion in the sample may be underreported.

These results indicate that, similar to other activities/professions which require heavy vocal loads, collegiate a cappella singers report a high frequency of voice problems. Compared to earlier reports which placed the general prevalence of voice problems between 3% and 9%, collegiate a cappella singers experienced voice problems at a much greater rate than the general population [14-16]. A more recent study reported lifetime prevalence rates for the general population in the United States at 29%, though this higher rate is still at level which the present sample of a cappella singers exceeded [9].

The problems reported by the participants in this study occurred in both singers with and without a history of professional voice training. Furthermore, many of these individuals did not seek treatment for their voice problem (70%), even when it affected both speaking and singing voices and lasted for more than one week. For example, 9 individuals reported a past voice problem which lasted for either longer than 1 week or was chronic. Only 5 of those individuals consulted a physician. Continued heavy vocal load demands would put these individuals at a greater risk for the development of benign vocal fold lesions (e.g., 4 of the individuals with past voice problems lasting 1 week or more were diagnosed with either nodules or polyp). The relative frequency of voice problems in this sample of collegiate a cappella singers, along with the lack of consultation for a voice problem lasting longer than 1 week, provides an argument for an educational intervention program aimed at collegiate a cappella singers. Data from this study, especially that related to the second research question, would be valuable for developing such a program to facilitate awareness among collegiate a cappella singers of the factors characteristic of their population which may put them at a high risk for voice problems.

Our second research question asked, "What vocal load demands and lifestyle factors are characteristic of collegiate a cappella singers?" The results indicated that the participants in this sample experienced high vocal load demands and engaged in lifestyle behaviors which are considered (among voice clinicians) as vocally unhygienic. Relative to vocal load, over 50% of the sample engaged in vocal practice (exclusive of performances) for 6 or more hours per week. In addition, 79% of the sample was singing outside of a cappella groups (these were unpaid recreational singing activities). It is common that heavy vocal demands can fatigue the laryngeal musculature [17]. 35% of the sample in this study reported that they usually, frequently, or always sing or talk when their voice is fatigued. This is a clinically relevant finding, as it is commonly believed that continued voice use with a fatigued vocal mechanism can put an individual at risk for a more considerable vocal pathology [18].

Relative to lifestyle behaviors, the current sample of collegiate a cappella singers engaged in a number of behaviors which are often associated with risk factors for disorders, and which are assessed during routine voice evaluations [18-20]. As a group the sample of a cappella singers consumed a large quantity of alcohol on a weekly basis. 65% of the sample consumed 2 or more alcoholic beverages per week, 35% consumed 5 or more alcoholic beverages, and 22% consumed 9 or more per week. While empirical evidence documenting the chemical effects of ingested alcohol on vocal fold hydration status is limited, it is very common that clinicians view the diuretic effects of alcohol as having a systemic dehydrating influence on the vocal fold

tissue, putting it at risk for injury. Similar to alcohol, caffeine is believed to dehydrate the vocal fold tissue. The majority (83%) of the study sample consumed caffeinated beverages daily (18% consumed 3 or more per day). Additionally, almost 1/3 of the study sample (32%) reported sleeping 6 hours or less per night. 17% of the study sample (12 participants) also reported the current use of tobacco.

We were unable to find any individual item which was statistically significantly related to reports of past or present voice problems. We used statistical procedures to investigate the degree of relationship between individual items and reports of past or present voice problems (using Spearman's Rho—see Table 2). The correlation coefficients for each item evaluated were low, and no comparison reached significance. We then used logistic regression to determine if composite scores formed by pooling related items (e.g., items related to College Life, Vocal Use, Vocal Health, and Singing Training) could significantly predict whether or not a participant report experiencing a past or present voice problem (see Table 4). Again, no variable was statistically significant [21,22].

The odds ratios did suggest trends in the present sample. For example, the Vocal Use predictor variable included summed responses related to vocal load demands. The direction of the odds ratio for this predictor variable suggested that as vocal load increases (e.g., summed Vocal Use scores are greater), individuals were more likely to report a past or present voice problem. The opposite was evidenced in the Singing Training (which reflected a history and frequency of singing training) predictor. The direction of the odds ratio for this variable indicated that individuals with a history of voice training and/or more years of training were less likely to report a history of past or present vocal problems.

## Limitations

A number of limitations were inherent in this study which would necessitate guarded generalizations outside of the current sample. The sample size, while including the majority of a cappella singers at the academic institution of interest, was small and represented at best less than 1% of the population of collegiate a cappella singers in the United States (using the conservative estimate of 10,000 collegiate a cappella singers). As such this study represents a very preliminary investigation of voice risks in collegiate a cappella singers that will need to be validated in future studies with larger samples. The low sample size undoubtedly influenced the logistic regression analyses (low power due to the small sample size was one factor likely influencing the statistical outcomes). It is also possible that the survey instrument did not account for all, or possibly even the most important, factors which might be associated with or predict voice problems in this collegiate a cappella sample. These limitations will be accounted for with more inclusive and broader designs in future investigations.

## Appendix A

### Voice Questionnaire

Please circle the number next to the appropriate answer and/or fill in the blanks:

#### Demographic Information:

- What is your age?

a= ≤ 17



- 
- b=18-20  
c=21-23  
d=24-26  
e=27-30  
f= ≥ 31
- What is your gender?  
a=male  
b=female
- College Life:**
- What year in school are you?  
a=Freshman  
b=Sophomore  
c=Junior  
d=Senior  
e=Graduate student
  - Is your major or minor in any of the following areas?  
0=not listed  
1=Communication Sciences and Disorders  
2=Music, vocal performance  
3=Theatre
  - How many “loud parties” do you attend in a week (this also includes going to clubs)? A loud party is an environment where there is one or more of the following: loud music playing in the background, having to talk over others, loud TVs, near speaker systems, frequent laughing/yelling/screaming.  
0=none  
1=1-2  
2=3-5  
3= ≥ 6
  - How many hours of sleep do you get on an average night?  
0= ≥ 9  
1=7-8  
2=5-6  
3= ≤ 4
- Training:**
- Have you ever had formal/professional voice training?
  - For singing voice:  
0=Yes  
1=No (go to #10)
  - For speaking voice:  
0=Yes  
1=No (go to #10)
- How many years of lessons did you receive?  
• For singing voice:  
0= ≥ 4  
1=2-3  
2= ≤ 1
  - For speaking voice:  
0= ≥ 4  
1=2-3  
2= ≤ 1
  - How long has it been since your last professional training lesson?  
0= <6 months  
1=6 months-1 year  
2=1-2 years  
3=>2 years
- Vocal Use:**
- How long have you been singing in groups?  
• A cappella  
0= <1 year  
1=1-2 years  
2= 2-4 years  
3= ≥ 5 years
  - Accompanied Group  
0=<1 year  
1=1-2 years  
2=2-4 years  
3= ≥ 5 years
  - Since starting with these groups, has your participation been consistent or have you taken breaks?  
0=breaks  
1=consistent
  - How often do you participate in activities outside of singing that require extensive use of the voice? (sample activities=attending sports games, participating in sports, social activities requiring voice, acting, etc.)  
0=never  
1=1-3 times a month  
2=1 time a week  
3=2-3 times a week  
4= ≥ 4 times a week
  - What is the average length of a typical group practice?  
0=<1 hour  
1=1 hour  
2=2 hours
-

- 3= ≥ 3 hours  
 0=1 group  
 1=2 groups  
 2=3 groups  
 3= ≥ 4 groups
- 0=<1 hour  
 1=1-2 hours  
 2=3-5 hours  
 3= ≥ 6 hours
- Currently, how many groups do you perform with?
  - Currently, how many hours a week do you practice singing (excluding performances)?
  - Do you sing outside of these group practices and performances?
- 0=no  
 1=yes

Question / Choices	# Responding	% of Sample	Correlation to current or past voice problem (Spearman's rho)
<b># of loud parties you attend?</b>			-0.15
None	7	0.097	
1-2 per week	57	0.792	
3-5 per week	7	0.097	
>6 per week	1	0.014	
<b>How much sleep do you get a night?</b>			-0.02
>9 hours	3	0.042	
7-8 hours	45	0.625	
5-6 hours	22	0.306	
<4 hours	1	0.014	
<b>Professional voice training for singing?</b>			-0.19
Yes	47	65.2	
No	25	34.8	
<b>Hours a week practicing singing?</b>			0.19
<1 hour	3	4.2	
1-2 hours	6	8.3	
3-5 hours	26	36.1	
>6 hours	37	51.4	
<b>How many caffeinated beverages</b>			-0.17
0 per day	12	16.7	
1-2 per day	47	65.3	
3-4 per day	11	15.3	
>5 per day	2	2.8	
<b>How many alcoholic drinks?</b>			-0.02
None	7	0.097	
1-3 per month	8	0.111	
1 per week	10	0.139	
2-4 per week	22	0.306	
5-8 per week	9	0.125	

>9 per week	16	0.222	
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**Table 2:** Participant responses and relationship strength to history of voice problems for selected clinically relevant questionnaire items.

- If yes to #17, approximately how many hours per week does this involve?
  - 0=<1 hour
  - 1=1-2 hours
  - 2=3-5 hours
  - 3= ≥ 6 hours
 Please estimate how long (on average) you use your voice each day:
- Talking on the telephone
  - 0=<1 hour
  - 1=1-2 hours
  - 2=3-5 hours
  - 3= ≥ 6 hours
- Talking with friends
  - 0=<1 hour
  - 1=1-2 hours
  - 2=3-5 hours
  - 3= ≥ 6 hours
- When singing, how would you characterize the style in which you use your voice? (circle all that apply)
  - Group
    - a=Relaxed voice
    - b=Tension/emotion in the voice
    - c=Effortful voice
    - d=Soft voice
    - e=Loud voice
  - Solo
    - a=Relaxed voice
    - b=Tension/emotion in the voice
    - c=Effortful voice
    - d=Soft voice
    - e=Loud voice
- Do you ever have to sing/talk when your voice is fatigued (worn-out)?
  - 0=Never
  - 1=Sometimes (1-49%)
  - 2=Usually (50-70%)
  - 3= Frequently (70-90%)

4=Always (90-100%)

**Vocal Health:**

- Do you have any diagnosed illnesses or diseases?
  - 0=no
  - 1=yes (please specify)
- Do you have a history of respiratory problems, other than allergies?
  - 0=no
  - 1=yes (please specify)
- Do you have a history of hearing loss?
  - 0=no
  - 1=yes
- Have you ever been diagnosed as suffering from reflux?
  - 0=no
  - 1=yes
- Have you ever been prescribed medication for reflux? (e.g. Protonix, Nexium, Prilosec, Zantac)
  - 0=no
  - 1=yes

Variable	Mean	Standard Deviation	Reliability
College Life	2.3	0.8	0.36
Vocal Use	10.3	2.61	0.37
Vocal Health	8.17	2.7	0.23
Singing Training	0.34	0.48	--
Disorder	0.38	0.49	--

**Table 3:** Descriptive statistics and score reliability for composite variables.

Variable	Estimate	Odds Ratio	standard error	z	p-value
Intercept	-2.33	0.1	1.32	-1.77	0.08
College Life	-0.34	0.71	0.35	-1	0.32
Vocal Use	0.22	1.24	0.11	1.9	0.06
Vocal Health	0.06	1.07	0.11	0.59	0.55
Singing Training	-0.65	0.52	0.58	-1.11	0.27

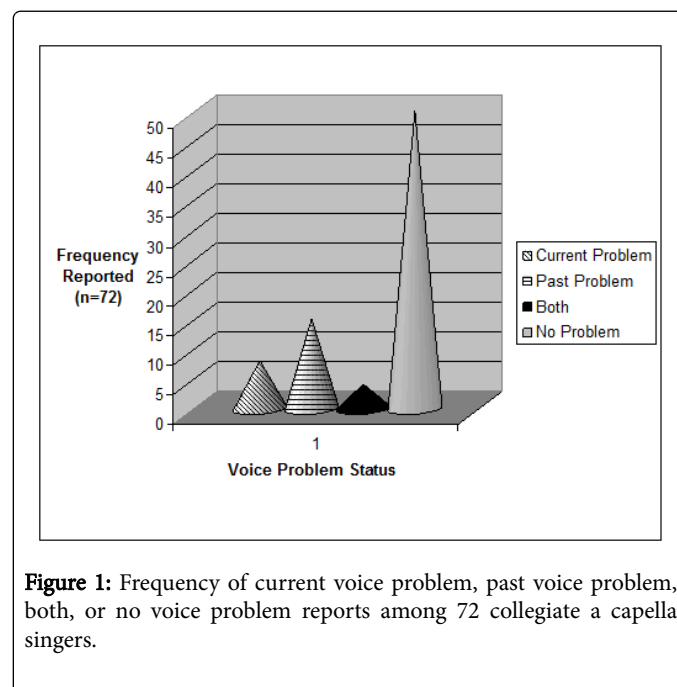
**Table 4:** Logistic regression estimates.

- How many caffeinated beverages (coffee, tea, caffeinated soft drinks) do you drink per day?  
0=0 per day  
1=1-2 per day  
2=3-4 per day  
3= $\geq$  5 per day
- On average, how many glasses of water or non-caffeinated beverages do you drink each day? glasses/bottles of water (e.g., 8 to 12oz per glass)  
0=0 per day  
1=1-2 per day  
2=3-4 per day  
3= $\geq$  5 per day
- other non-caffeinated beverages (e.g. herbal tea, juice, milk, caffeine-free soda)  
0=0 per day  
1=1-2 per day  
2=3-4 per day  
3= $\geq$  5 per day
- How many alcoholic beverages do you drink?  
0=none  
1=1-3 per month  
2=1 per week  
3=2-4 per week  
4=5-8 per week  
5= $\geq$ 9 per week
- Do you currently use tobacco (even if only socially)?  
0=no  
1=yes
- Are you currently taking any medications?  
0=no  
1=yes  
Please list the names of the medications you are taking:
- How frequently do you suffer from allergies that cause you to have upper respiratory symptoms (e.g. runny nose, sneezing, coughing, etc.)?  
0=Never  
1=Once a year or less  
2=A few times a year  
3=Every few months  
4=Monthly
- Do you take any medication to treat your allergies?  
1=no

2=yes

Please list medication(s):

- How often do you complete voice warm-ups prior to practice or performance?  
0=Always (90-100%)  
1=Frequently (70-90%)  
2=Usually (50-70%)  
3=Sometimes (1-49%)  
4=Never
- Are your practice and performance areas usually air-conditioned?  
0=no  
1=yes
- Are you typically amplified when singing?
- Group  
0=yes  
1= no
- Solo  
0=yes  
1=no



**Figure 1:** Frequency of current voice problem, past voice problem, both, or no voice problem reports among 72 collegiate a capella singers.

**Current Voice:**

- Do you think you are currently experiencing a voice problem? A voice problem is any deviation in voice quality that negatively influences the sound of your voice, the effort it takes to use your voice, or affects communication with others.  
0=no (go to question 41)  
1=yes



- Does this problem involve your singing voice, speaking voice or both?  
1=singing only  
2=speaking only  
3=singing and talking
- Which category best describes your voice problem? (circle all that apply)  
a=Voice spasms  
b=Voice fatigue  
c=Hoarse/Rough voice  
d=Breathy voice  
e=Weak voice  
f=Other (specify)  
g=Loss of high notes in singing range  
h=Loss of low notes in singing range  
i=Loss of ability to speak or sing loudly  
j=Loss of ability to speak or sing quietly  
k=It requires a lot of effort/strain to speak
- Has a physician or other health professional diagnosed your current voice problem?  
0=no  
1=yes  
Please specify diagnosis given:
- For your current voice problem, have you received any of the following:  
(circle all that apply)  
1=Medication (specify)  
2=Voice therapy (describe)  
3=Surgery (describe)
- **Voice History:**
  - Have you ever had a voice problem in the past?  
0=no (you are finished with survey)  
1=yes
  - Did this problem involve your singing voice, talking voice or both?  
1=singing only  
2=talking only  
3=singing and talking
  - Choose the item that best describes the past voice problem pattern of occurrence:  
0=Occurred for one week or less, has not recurred  
1=Occurred for more than one week, has not recurred  
2=Occurred several times for periods of one week or less  
3=Occurred several times for periods of more than one week  
4=Has been present intermittently since onset  
5=Has been present persistently since onset  
Other (please specify)
- Which category best describes your past voice problems? (circle all that apply)  
a=Voice spasms  
b=Voice fatigue  
c=Hoarse voice  
d=Breathy voice  
e=Weak voice  
f=Other (specify)  
g=Loss of high notes in singing range  
h=Loss of low notes in singing range  
i=Loss of ability to speak or sing loudly  
j=Loss of ability to speak or sing quietly  
k=It requires a lot of effort/strain to speak
- Was a diagnosis given by a physician or other health professional for your past voice problem?  
0=no  
1=yes  
Please specify diagnosis given:
- For your past voice problem, did you received any of the following:  
(circle all that apply)  
1=Medication (specify)  
2=Voice therapy (describe)  
3=Surgery (describe)
- What do you think may have caused your past and/or present voice problem?  
Past problem:  
Present problem:

## Conclusion

The data from this study suggested that collegiate a cappella singers in our sample had a high prevalence of voice problems, approximating prevalence estimations of voice disorders in other professional voice user groups and college vocal majors. A number of factors, including vocal load and lifestyle behaviors, put them at risk for the development of benign vocal fold lesions due to abuse and misuse of the vocal mechanism. However, this was a preliminary study with a relatively small sample size. Additional studies incorporating larger sample sizes with greater methodological control are needed so that reasonable conclusions can be drawn. Knowledge of voice use and voice risk features of collegiate a cappella singers is needed to better characterize the behavioral patterns of individuals belonging to this unique category singer, and thus further research is needed to increase our understanding of this population.

## References

1. Wilkman E (2004) Occupational safety and health aspects of voice and speech professions. *Folia Phoniatr Logop* 56: 220-253.
2. Titze IR, Lemke J, Montequin D (1997) Populations in the U.S workforce who rely on voice as a primary tool of trade: a preliminary report. *J Voice* 11: 254-259.
3. Coyle SM, Weinrich BD, Stemple JC (2001) Shifts in relative prevalence of laryngeal pathology in a treatment-seeking population. *J Voice* 15: 424-440.
4. Fortes F, Imamura R, Tsuji D, Sennes L (2007) Profile of voice professionals seen in a tertiary health center. *Braz J Otorhinolaryngol* 73: 27-31.
5. Watts C, Barnes-Burroughs K, Andrianopoulos M, Carr M (2003) Potential factors related to untrained singing talent: a survey of singing pedagogues. *J Voice* 17: 298-307.
6. Wechsler H, Dowdall GW, Maenner G, Gledhill-Hoyt J, Lee H (1998) Changes in binge drinking and related problems among American college students between 1993 and 1997. Results of the Harvard School of Public Health College Alcohol Study. *J Am Coll Health* 47: 57-68.
7. Tsai LL, Li SP (2004) Sleep patterns in college students: gender and grade differences. *J Psychosom Res* 56: 231-237.
8. Lord F, Novick, M, Birnbaum A (1968) *Statistical theories of mental test scores*. Reading, MA: Addison-Wesley: 585.
9. Roy N, Merrill R, Thibeault S, Parsa R, Gray S, et al. (2004) Prevalence of voice disorders in teachers and the general population. *J Speech Lang Hear Res* 47: 281-293.
10. Jones K, Sigmon J, Hock L, Nelson E, Sullivan M, et al. (2002) Prevalence and risk factors for voice problems among telemarketers. *Arch Otolaryngol Head Neck Surg* 128: 571-577.
11. Cohen SM, Kim J, Roy N, Asche C, Courey M (2012) Prevalence and causes of dysphonia in a large treatment-seeking population. *Laryngoscope* 122: 343-348.
12. Cohen SM (2010) Self-reported impact of dysphonia in a primary care population: an epidemiological study. *Laryngoscope* 120: 2022-2032.
13. Lundy DS, Casiano RR, Sullivan PA, Roy S, Xue JW, et al. (1999) Incidence of abnormal laryngeal findings in asymptomatic singing students. *Otolaryngol Head Neck Surg* 121: 69-77.
14. Leske M (1981) Prevalence estimates of communicative disorders in the U.S: Speech disorders. *ASHA* 23: 217-225.
15. Wilson F (1972) The voice-disorderd child: A descriptive approach. *Language, Speech and Hearing Services in Schools* 4: 14-22.
16. Laguaite J (1972) Adult voice screening. *J Speech Hear Disord* 37: 147-151.
17. Carroll T, Nix J, Hunter E, Emerich K, Titze I, et al. (2006) Objective measurement of vocal fatigue in classical singers: a vocal dosimetry pilot study. *Otolaryngol Head Neck Surg* 135: 595-602.
18. Stemple JC, Glaze L, Klaben B (2010) *Clinical Voice Pathology: Theory and Management*. San Diego: Plural Publishing.
19. Howard D (2003) A capella SATB quartet in-tune singing: Evidence of intonation shift. *Proceedings of the Stockholm Music Acoustics Conference, SMAC-03 2: 462-466*.
20. Howard D (2003) Larynx closed quotient in a capella SATB quartet singing. *Proceedings of the Stockholm Music Acoustics Conference, SMAC-03 2: 467-470*.
21. Howard D (2007) Intonation Drift in A Capella Soprano, Alto, Tenor, Bass Quartet Singing With Key Modulation. *J Voice* 21: 300-315.
22. Rigotti N, Lee J, Wechsler H (2001) Cigarette use by college students in smoke-free housing: results of a national study. *Am J Prev Med* 20: 202-207.