The Prevalence of Voice Disorders in 911 Emergency Telecommunicators

Heidi Johns-Fiedler and Miriam van Mersbergen, *DeKalb, Illinois*

Summary: Objective/Hypothesis. Emergency 911 dispatchers or telecommunicators have been cited as occupational voice users who could be at risk for voice disorders. To test the theoretical assumption that the 911 emergency telecommunicators (911ETCs) are exposed to risk for voice disorders because of their heavy vocal load, this study assessed the prevalence of voice complaints in 911ETCs.

Study Design. A cross-sectional survey was sent to two large national organizations for 911ETCs with 71 complete responses providing information about voice health, voice complaints, and work load.

Results. Although 911ETCs have a higher rate of reported voice symptoms and score higher on the Voice Handicap Index-10 than the general public, they have a voice disorder diagnosis prevalence that mirrors the prevalence of the general population.

Conclusions. The 911ETCs may be underserved in the voice community and would benefit from education on vocal health and treatments for voice complaints.

Key Words: Voice disorders–Prevalence–911 Emergency telecommunicators.

INTRODUCTION

The 911 emergency telecommunicators (911ETCs) answer and dispatch emergency calls and are the intermediaries between those in crisis and the workers who will respond with aid. In addition, their role is to coordinate public safety. Because of the importance of their job, the quality and consistency of a 911ETC's voice is necessary for their job performance.

Owing to the nature of their employment responsibilities, the 911ETCs would be considered occupational voice users.[1–3] They use their voice to communicate to individuals in crisis and to the crews being dispatched to help.[1,4] According the to the Bureau of Labor Statistics,[5] the duties of a 911ETC include answering emergency and nonemergency phone calls, determining relevant information from the caller, providing location and nature of the emergency to the responders, providing additional information to the caller for medical and safety concerns, and keeping responders abreast of the situation. The 911ETC's work can be stressful. They frequently work long hours (8–12 hours a day) and take numerous calls, many of which deal with alarming situations. Because the nature of emergencies is unpredictable and constant, the 911ETCs are employed 24 hours a day, 7 days a week, including weekends and holidays.[5] The 911 Lifeline, an organization that provides resources, education, and advocacy for emergency telecommunicators across the country, recognizes that the 911ETCs rely on their voice for their profession using it heavily throughout their work shifts. This increased voice use predisposes them to the repetitive voice injuries and increased vocal load that could affect vocal function if their vocal load surpasses what their bodies can handle.[6] The 911 Lifeline estimates that 911ETCs answer 240 million calls per year. They describe 911ETCs as the link between the individual in crisis and the safety personnel who will respond to the call for help. Therefore, the 911ETCs may have a higher prevalence of voice disorders owing to the vocal demand of their occupation in comparison with the general population because of their constant demand to speak and vocalize.[7,8]

In addition to the voice problems caused by increased vocal load, the 911ETCs can also be predisposed to stress-related disorders. Pierce and Lilly[9] found that the 911ETCs are at an increased risk of developing post-traumatic stress disorder owing to the emotional demand of their jobs. The addition of increased stress could also affect voice functioning because stress and emotional state have been noted to be linked to voice disorders leading to frustration, depression, and isolation on the part of the professional voice user.[1,10,11] The relation between stress and voice might also be bidirectional, such that voice difficulties in this population might add stress to an already high-stress job. Such relationships are yet to be investigated in this population; nonetheless, the complicated relationship between voice functioning and employment stress raise the stakes for this occupation as it has in the population of teachers.[12]

Additional concerns about voice difficulties in the 911ETCs are more financial in nature. In most instances, the 911ETCs are municipal government employees with their salaries and benefits paid for by the city and county tax revenues where they are employed. Hence, the consequences of a poor voice, and subsequent lack of work, could also impact taxpayer dollars.[13] For example, a 911ETC who is unable to perform her job can result in higher costs to the municipalities owing to sick pay, overtime rate paid to replacement dispatchers, and increased health care costs related to treating voice disorders.

Purpose of the study

Because of the importance of voice quality and consistency in 911ETCs, it is important to know the prevalence of voice disorders in this population. Unfortunately, no current research addressing voice problems and disorders for 911ETCs exists. The purpose of this research is to determine the existence of voice disorders in the population of 911ETCs, to identify

Accepted for publication August 13, 2014.

From Allied Health and Communicative Disorders, Northern Illinois University, DeKalb, Illinois.

Address correspondence and reprint requests to Miriam van Mersbergen, Northern Illinois University, 1425 Lincoln Avenue, DeKalb, IL 60115. E-mail: mvanmersbergen@niu.edu

Journal of Voice, Vol. 29, No. 3, pp. 389.e1-389.e10
0892-1997/$36.00

http://dx.doi.org/10.1016/j.jvoice.2014.08.008

potential relationships with voice complaints and job performance, and to elucidate any preventative measures that could be effective in reducing voice complaints.

METHODS

Participants

Participants for this research were self-identified 911ETCs. All participants were provided with consent to participate, a copy of their *Health Insurance Portability and Accountability Act* rights, and an explanation of the survey. The participants were 911ETCs and were contacted through their national and professional organizations, 911Lifeline.org and 911Magazine.com, or were recruited via fliers and phone calls to local law enforcement agencies. They were sent an introductory letter, via e-mail, explaining the research and requesting participation. No compensation was provided.

Instrumentation and collection

A cross-sectional research design was used to determine the prevalence of voice disorders in 911ETCs. Data collection via an original survey developed based on past research[7] were available through Surveymonkey.com where a link was e-mailed to all potential participants or was printed in nationally distributed media. Sample surveys were submitted to the board of directors of Lifeline.org, a national association of emergency dispatchers and by members of the occupations who were excluded from the research for comments on appropriateness of questions and relevance to the field.

The survey questions were primarily force choice and designed to gather information on occupational and personal voice usage; pertinent information on current or past voice problems, symptoms, or disorders; work environments and professional standards; and general health and voice-related health questions. The questions were developed based on past research questionnaires that address voice use, vocal health, and prevalence of voice disorders in various populations. Replicating previously established epidemiological work in voice disorders that addressed vocal load, voice handicap, and functional impairment and adapting questions specific to the population of 911 ETCs provided the theoretical background for the questions presented in this questionnaire.

Questionnaire outline

Demographics. The initial questions queried general background information, agreement to participate, age, gender, and ethnicity.

Health and personal habits. Health-related questions asked about general health (current medical diagnosis) and personal habit questions (tobacco use, water intake, sleep habits, and so on), which provided information for secondary analysis if data presented obvious health-related trends.

Voice disorders and symptoms. Specific questions about voice disorder diagnosis (eg, nodules, polyps, and cysts) and symptoms of a potential voice disorder (eg, hoarseness, aphonia, and odynophonia) offered valuable information about prevalence of official diagnosis and about conditions that might be markers of an undiagnosed voice problem. Along with a list of possible diagnosis and symptoms, participants provided information about the cause, duration of the difficulties, and possible treatments for diagnosis.

Voice behaviors. Participants responded to answers regarding functional and occupational usage of their voice (ie, when voice is used most, what type of assistive device is used during the day, and voice symptoms that might impair job performance). Respondents provided information about voice use both during work and non-work activities.

Quality-of-life measurements. Respondents completed the Voice Handicap Index-10 (VHI-10)[14] to ascertain the level of perceived handicap that voice usage may impart and an informal voice stress survey to determine the participant's stress surrounding voice usage. The inclusion of the stress inventory was intended to be a comparison among 911ETCs and other emergency responders. Because this study received no data on other emergency responders to make this comparison, we did not score or include this inventory in our results or discussion.

Variables for analysis

Data from the survey were reduced into pertinent variables for analysis. Variables were divided into three main sections to answer the three research questions. These sections included voice disorders and symptoms, voice impact, and voice behaviors.

Voice disorders and symptoms. For the purposes of this type of research, defining voice disorders may include any number of inclusion or exclusionary parameters. The strictest definition of voice disorder requires a medical diagnosis from a physician. Additional definitions uses a complex of variables from a set number of symptoms experienced,[7] a complex of symptoms and physical signs (ie, videoendoscopic evidence of lesions),[15] and the achievement of a score above a cutoff on self-reported measures such as the VHI-10.[16] To gain a complete picture of the voice difficulties experienced by 911ETCs, we used three definitions of a voice problem in this research.

Voice disorder diagnosis. Participants responded to direct questions regarding diagnosis of a variety of possible voice disorders. If they received a diagnosis, they also reported on when this diagnosis occurred; in the past year, in the past 5 years, or the past 10 years. They reported on if treatment was sought and the nature of treatment.

Voice symptoms. Respondents identified the number of voice symptoms experienced during the past year. The symptom choices contained the following choices, namely painful to talk, dry throat, vocal fatigue (tired after a short time talking), changes in voice pitch (high or lowered pitch), flat voice with no inflection, unsteady voice (tremor), no voice, hoarseness, swallowing difficulties (coughing or feeling of food getting stuck when eating), globus sensation (feeling as if something is stuck in your throat), shortness of breath, effortful speech

(feeling of having to force the voice out), throat clearing, or none of the above. The final variable included the total number of reported symptoms experiences within the last year.

Voice Handicap Index-10. Previous investigations[12,16,17] used the standardized VHI-10[14] to determine a functional or clinical presence of a voice disorder. The VHI-10 total score for each participant was calculated and used as a third marker of the presence of a voice disorder.

Voice impact. To determine the impact that voice problems may be having on the participant's employment, respondents provided information about potential factors that would influence job performance and security.

Career change. Participants were asked direct questions about potential job changes owing to voice concerns. If a participant identified situations where he or she made, planned, or considered a career change, then that participant was given a positive marker for this variable.

Job performance. Participants responded to direct questions if they were aware that their voice affected job performance. If they responded to any questions with an affirmative situation of voice affecting job performance, then they were given a positive marker for this variable.

Work absences. Participants responded to direct questions about requiring time off from their job because of their voice. Any reported work absence was considered a positive marker for this variable; in addition, this variable was quantified to the amount of days missed and quantified for analysis.

Personal lives. Under the assumption that voice problems affect both personal and professional life, participants reported any situation where voice difficulties affected personal life. Any report received a positive marker for this variable.

Voice behaviors. To understand if voice use at work was the largest contributor to vocal load, we assessed the nature and amount of voice use outside of work to control for any confounding activities.

Outside voice activity. Respondents reported the number of activities requiring voice in which they engaged. They supplied information on if they regularly engaged in sports cheering, coaching, physical activity requiring aggressive voice use, and singing. This variable was measured by the total number of activities tallied.

Outside voice use. Respondents described the number of hours participants reported actively using their voice outside of work. They provided responses to the number of hours engaged in non-work voice usage (ie, talking on the phone and social interactions) in 2-hour intervals: 0, 1–2, 3–4, 4–5, and 6–7 hours.

Personality. Personality/talkativeness self-ratings were based on a scale of one to seven with one being a shy and quiet person and seven being an outgoing and loud person. Because personality is associated with certain voice disorder diagnoses,[18] these self-ratings assisted in determining the propensity for increased voice use.

To determine what factors at work may be contributing to voice problems, we assessed certain voice components of employment.

Devices used. The total number of devices that 911ETCs used in their communications provided information on potential voice-preserving activities. They responded to questions about usage of a speaker phone, telephone handset, telephone headset, keyboard, and radio. This variable comprised the total number of devices used during work.

Noise level. The 911ETCs rated the noise level in their work environment to determine whether background noise was increasing vocal load. The choices included minimal (no noise and not distracting), moderate (noise is tolerable and distracting), and loud (annoying and cannot focus on task). This variable was given a graduated value of noise with one being minimal noise level, two being moderate noise level, and three being loud noise level.

Shift length. Because the length of shifts may contribute to increased vocal load, participants reported the number of hours of their average shift. Responses included 4, 6, 8, 10, 12, or 24 hours and the variable contained the hours reported.

Call volume. Participants reported on number of calls received per shift. The variable included the total calls per shift individuals reported. We chose volume per shift in contrast to volume per hour as many organizations have requirements per shift and not per hour because call volumes are frequently different depending on the time of day and day of week. So, to present a uniform variable across the differences in participant's time of shift (day, evening, and night), total call volume per shift was chosen and normalized if shift lengths differed. Owing to the variability in the nature of 911 calls—with some calls taking a report on a small incident, which can take less than 1 minute, whereas others talking someone through cardiopulmonary resuscitation techniques, which can take up to 20 minutes—capturing actual minutes of voice use in a questionnaire format proved unattainable.

Physical symptoms. Because pain in other areas of the body, specifically the neck, shoulders, back, and arms, could contribute to overall discomfort, we included physical symptoms in the analysis to control for overall reports of discomfort in voicing. We added the number of reported physical symptoms by participants.

End-of- shift difference. Participants rated their voice quality on a scale of one to seven (one represented excellent and seven represented poor) at the beginning of their shift and at the end of their shift. The end-of-shift difference was figured by subtracting the voice rating at beginning of shift rating from the rating at the end of the shift to determine how much participants felt their voices had changed during the day.

Statistical analysis

To determine the existence of voice disorders in the population of 911ETCs, the percentage reported in this population was compared with the research literature citing the prevalence of

voice disorders in the general population of approximately 6%[7] or a range of 3–9%.[8] Data on the number of respondents who reported voice disorders, voice symptoms, and the VHI-10 were compared with previously reported percentages. To determine whether or not voice symptoms had an impact on job performance, percentages were reported on questions pertaining to employment concerns. Visual scrutiny of data via bar graphs and scatter plots on the relationship between voice symptoms and behaviors showed that the variables of voice symptoms, call volume, shift length, use of assistive devices, noise level, and outside voice usage appeared to co-vary. These variables underwent at Pearson product moment correlations. If any variables that appeared to be more dichotomous (bimodal responses) than continuous (variable responses), chi-squared tests of independence was used as a post hoc analysis to analyze relationships.

RESULTS

The survey link was sent to two national professional organizations and seven local community safety organizations inviting individuals to complete the questionnaire. A total of 153 participants responded to the survey. Three participants did not consent, so their responses were eliminated. Owing to an unrecoverable error through the web site, 62 participants' data were lost. Additionally, nine participants completed less than 20% of the survey, and eight participants reported another primary profession resulting in their data being removed from analysis. Data were analyzed on 79 participants who completed most of the survey.

Descriptive statistics

Demographics. *Age.* Average age of participants was 45.06 years (standard deviation [SD]: 11.1). The largest age group was from 40 to 49 years of age (30%), then 30–39 (27%), 50–59 (22%), 60 and above (13%), and 20–29 years (8%).

Sex. There was a small difference in female versus male respondents with 56.3% females and 43.7% males providing data.

Ethnicity. Of those who responded, 93.7% stated that they were White, 5.1% were Hispanic, and 1.3% or one person listed Korean as their ethnicity.

Overall health. Most respondents reported to be in good health, responding with excellent (7.7%), very good (37.2%), and good (47.4%). Less than 10% reported that they were in fair health (7.7%), and no participants reported poor health (0%).

Tobacco use. Most respondents (59.5%) never used tobacco products. About a quarter of respondents reported quitting the use a tobacco (22.8%) and 14% still smoked cigarettes at the time they answered the survey. Less than 5% smoked cigars, smoked pipes, or chewed tobacco.

Occupation. Most participants chose 911ETC (88.7%) as their primary occupation. Some respondents reported other professions as their primary employment and their involvement in responding to 911 calls remained unclear. Because they did not report on voice data, their data were not included in any of the analysis. A complete breakdown of demographics is provided in Table 1.

TABLE 1.
Participant Demographics

Demographics	Male	Female	Total Number
Age			
20–29	3	3	6
30–39	7	13	20
40–49	11	11	22
50–59	7	10	17
≥60	5	5	10
Total	33	42	75
Ethnicity			
White	33	41	74
Hispanic	0	4	4
African American	0	0	0
Asian	0	0	0
Asian Indian	0	0	0
Japanese	0	0	0
Korean	1	0	1
Vietnamese	0	0	0
Chinese	0	0	0
Filipino	0	0	0
American Indian/Alaska Native	0	0	0
Native Hawaiian	0	0	0
Guamanian	0	0	0
Samoan	0	0	0
N/A	0	0	0
Total	34	45	79

Demographics	Participant (%)	Number
Overall health		
Excellent	8	6
Very good	37	29
Good	47	37
Fair	8	6
Poor	0	0
Total		78
Tobacco use		
Never	59	47
Quit	23	18
Cigarettes	14	11
Cigars	3	2
Pipe	1	1
Smokeless (chew)	3	2
All four	1	1
Total		79
Primary occupation		
911ETC	89	63
Firefighter	3	2
EMT/paramedic	0	0
Police officer	6	4
None of the above	3	2
Total		71

Abbreviations: N/A, not available; EMT, emergency medical technician.

Voice symptoms and disorder diagnosis

Participants completed questions about prevalence of voice disorders in 911ETC, specifically voice diagnosis, voice symptoms, and the VHI-10 for analysis.

Voice disorder diagnosis. Of the respondents who answered this question (71), 14.1% reported having received a diagnosis of viral laryngitis, 4.2% received a diagnosis of a vocal fold polyp, whereas 81.7% reported no diagnosis of voice disorders. Of note, viral laryngitis was not considered a voice disorder as it is a short-term voice impairment.

Voice symptoms. Most (76.4%) participants reported one or more voice symptoms indicative of a voice disorder and 56% reported at least three or more symptoms. The number of participants reporting no vocal difficulties was 23.6%. Participants were asked to check all that may apply so that percentage scores will equal more than 100% on this table.

Voice Handicap Index-10. According to Rosen et al,[14] a score of 11 or greater on the VHI-10 reflects a voice problem. Based on this scoring, 45.9% (31/69) of participants who completed the VHI-10 reported no voice handicap, 29% (20/69) reported some functional sign of a voice disorder, and 25% (17/69) scored in the clinical range for a having a voice disorder. A complete breakdown of voice disorder diagnosis and symptoms is provided in Table 2.

TABLE 2.
Voice Disorder Diagnosis and Symptoms

Voice Disorders	Participant (%)	Number
Voice disorder diagnosis		
Viral laryngitis	14	10
Polyp	4	3
Nodule	0	0
Vocal fold paralysis	0	0
Voice/laryngeal cancer	0	0
None	82	58
Other	0	0
Total		71
Voice symptoms		
Pain with talking	35	25
Dry throat	56	40
Vocal fatigue	12	9
Voice changes	26	19
No inflection	7	5
Unsteady voice	3	2
No voice	10	7
Hoarseness	53	38
Swallowing difficulties	28	20
Globus	28	20
SOB	6	4
Increased effort	3	2
Throat clearing	28	20
None of the above	24	17
Total		72
Voice Handicap Index-10 rating		
0–4	46	31
5–10	29	20
≥11	25	17
Total		68

Abbreviation: SOB, shortness of breath.

Impact of voice on employment

Response rate for voice impact questions was inconsistent with certain questions having only three of 71 participants respond.

Career change. Most participants would not consider a job change, with 92.9% answering "no" they would not consider a job change. Only 4.3% responded "yes" and 2.9% were unsure.

Job performance. Most participants (70) who replied stated that voice did not interfere with job performance (87%), and those who replied that voice did interfere with job performance were 12% of the sample.

Work absences. Only three participants responded to this question with one (33.3%) individual reporting that they had missed work owing to voice difficulties.

Personal lives affected by voice. Less than half of the respondents answered this question, but of those who did, only 10% of the respondents (10.7%) reported that their voice difficulties affect their personal lives. Data on voice impact are provided in Table 3.

Voice behaviors

Respondents replied to specific questions about behaviors that either directly used voice or had the potential to impact the voice. For many of the questions, participants were asked to check all that may apply, so percentage scores will equal more than 100%.

Outside voice activity. A small number (34) of respondents reported participating in outside activities that could affect voice quality. Most participated in exercise/sports (76.5%), intense sports fan (23.5%), singing/acting (14.7%), weightlifting (11.8%), and coaching (5.9%). Most respondents skipped this question.

Outside voice use. Participants (71) reported outside voice usage (the amount of time an individual spends actively using their voice outside of work) of 1–2 (43.7%), 3–4 (29.6%), 4–5 (18.3%), 6–7 (7.0%), and 0 hours (1.4%).

Personality. Participants were asked to rate their personality on a scale of one to seven, where one represented a shy, quiet individual and seven represented an outgoing, loud individual. The average response was 4.52 (SD = 1.36). Participants usually rated themselves more outgoing and loud than shy and quiet. The greatest number of respondents rated themselves 4, (28.12%), followed by 5 (26.64%), then 6 (23.68%), 3 (13.32%), 2 (7.4%), 7 (4.44%), and 1 (1.48%) on the scale.

Devices used. Respondents (70) chose the type of devices they have to aid in their communications. Most identified the use of a radio (92.9%), then keyboards (85.7%), headset (78.6%), telephone handset (55.7%), and speaker phone (18.6%).

TABLE 3.
Voice Impact Data

Voice Impact	Participant (%)	Number
Career change		
Yes	4	3
No	93	65
Unsure	3	2
Total		70
Job performance		
Yes	13	9
No	87	61
Total		70
Work absences		
Yes	33	1
No	67	2
Total		3
Personal lives affected		
Yes	11	3
No	89	25
Total		28

Noise level. Environmental noise levels were rated as relatively high with most reporting moderate noise level (82.9%) and loud noise (1.4%). Reports for minimal noise levels (15.5%) were lower.

Shift length. More than half of the participants reported working 12-hour shifts (52.2%) followed by 8 (37.7%) and 10 hours (10.1%).

Call volume. Call volume per shift appeared relatively high, with most reporting a call volume per shift of 100 calls (30%), followed by 200 (25%), 50 (25%), 150 (11%), and 10 calls (11%).

Physical symptoms. Of those who responded (68), 13% had throat pain, 54% had neck pain, 66% had shoulder pain, and 25% reported no pain. Complete list of voice behaviors are listed in Table 4.

Bivariate analysis

Impact on job. To further clarify if voice symptoms were related to impact on job performance, Pearson bivariate correlations were performed for voice symptoms, the VHI-10 which captures some aspects of job performance, and direct question relating to job impact. The correlation between the voice symptoms an individual has and the self-ratings of the VHI-10 was statistically significant, $r\ (70) = 0.52$, $P = 0.000$ (two tailed). The $r^2 = 0.27$, thus approximately 27% of the variance in symptoms could be predicted by the VHI-10 self-ratings. Therefore, the variable voice symptoms presents with some independent information that the VHI-10 score does not capture, but it relates modestly with VHI-10 scores. Pearson correlations for voice symptoms and job impact were less informative about the impact of voice symptoms on job performance. The correlation between voice symptoms and job impact was not statistically significant, $r\ (10) = 0.224$, $P = 0.533$ (two tailed). Correlations listing are provided in Table 5.

TABLE 4.
Voice Behaviors

Voice Behaviors	Participant (%)	Number
Outside voice activity		
Singing/acting	15	5
Coaching	6	2
Exercise/sports	77	26
Weight lifting	12	4
Intense sports fan	24	8
Total		34
Outside voice use (h)		
0	1	1
1–2	44	31
3–4	30	21
4–5	18	13
6–7	7	5
Total		71
Personality (1 = shy and 7 = outgoing)		
1	1	1
2	7	5
3	13	9
4	28	19
5	27	18
6	24	16
7	4	3
Total		71
Devices used		
Telephone handset	56	39
Telephone headset	79	55
Speakerphone	19	13
Keyboards	86	60
Radio	93	65
Total		70
Noise level		
Minimal	16	11
Moderate	83	58
Loud	1	1
Total		70
Shift length (h)		
4	0	0
6	0	0
8	38	26
10	10	7
12	52	36
24	0	0
Volunteer	0	0
Total		69
Call volume		
10	11	6
50	25	14
100	30	17
150	11	6
200	25	14
Total		57
Physical symptoms		
Throat	13	9
Neck	54	37
Shoulders	66	45
None	25	17
Total		62

TABLE 5.
Total Correlations: Voice Symptoms, Voice Impact, VHI-10, and Physical Symptoms

Parameters	Voice Symptoms	Voice Impact	VHI-10	Physical Symptoms
Voice symptoms				
Correlation	1	0.224	**0.520***	−0.012
Significance		0.533	0.000	0.934
N	70	10	70	50
Voice impact				
Correlation	0.224	1	0.583	0.158
Significance	0.533		0.077	0.685
N	10	10	10	9
VHI-10				
Correlation	**0.520***	0.583	1	0.234
Significance	0.000	0.077		0.101
N	70	10	70	50
Physical symptoms				
Correlation	−0.012	0.158	0.234	1
Significance	0.934	0.685	0.101	
N	50	9	50	50

* Correlation is significant (bold print) at the 0.01 level (two tailed).

Preventative measures. To determine if any voice activities degraded or preserved voice, bivariate correlations were conducted among the variables, voice symptoms, noise level, call volume, number of devices used, shift length, and outside voice usage. The correlation between voice symptoms and noise level was statistically significant, $r\ (69) = 0.308$, $P = 0.010$ (two tailed). The r^2 was 0.09, thus 9% of the variation in the number of voice symptoms could be predicted from increased noise levels. The correlation between call volume and the number of devices used was also statistically significant, $r\ (56) = 0.367$, $P = 0.005$ (two tailed). The $r^2 = 0.13$, thus approximately 13% of the increased call volume could be predicted by the number of devices available for use. The correlation between the number of devices used and the noise level was statistically significant, $r\ (69) = 0.287$, $P = 0.017$ (two tailed). The $r^2 = 0.08$, thus approximately 8% of the use of devices could be predicted by the noise level (Table 6). However, the Pearson correlations between voice symptoms and shift length, $r\ (68) = 0.004$ and $P = 0.971$ (two tailed); number of devices, $r\ (69) = 0.061$ and $P = 0.620$ (two tailed); call volume, $r\ (57) = 0.091$ and $P = 0.500$ (two tailed); and outside voice usage, $r\ (70) = -0.039$ and $P = 0.747$ (two tailed) was not statistically significant.

To further probe the nature of the voice symptoms, the difference between respondents rating of voice functioning at beginning of the shift was compared with their rating at the end of the shift. This difference was correlated with the length of the shifts. The correlation between shift length and difference at end of the shift was statistically significant, $r\ (68) = 0.308$, $P = 0.011$ (two tailed). The $r^2 = 0.09$, thus approximately 9% of the end of shift difference, can be predicted by the length of the shifts. The correlation between overall voice symptoms and difference at end of shift rating was statistically significant, $r\ (70) = 0.457$, $P = 0.0001$ (two tailed). The $r^2 = 0.21$, thus approximately 21% of the symptoms could be predicted by the end of shift difference rating. This suggests that voice symptoms may occur more often at the end of the shift and be greater for longer shifts (Table 7).

Because the variables of shift length and call volume appeared to be better modeled with dichotomous data, a chi-squared test of independence was performed to further probe any meaningful relationship. Number of voice symptoms did not appear to vary with the length of shift, $\chi^2\ (2, n = 68) = 19.06$, $P < 0.388$. Number of voice symptoms experienced did not appear to vary with the call volume, $\chi^2\ (2, n = 57) = 44.12$, $P < 0.164$.

DISCUSSION

To our knowledge, this is the first study investigating the prevalence of voice disorders in the 911ETCs. Additionally, this study addressed potential voice practices related to voice problems and the impact voice problems may have on employment for this population. Although this sample of 911ETCs did not report a medical diagnosis of a voice disorder greater than the general population (3–9%),[7,8] this study confirmed that there is an increase in voice disorder symptoms with 56% reporting more than three symptoms compared with the general population (21%).[18]

In this investigation, more than three-quarters of the respondents reported experiencing at least two functional markers of a voice disorder,[7] whereas an additional three markers were reported by more than 50% of the population. Prevalence of a voice disorder based on the VHI provides additional insight into the voice problems of this population. Scores higher than 11 on the VHI-10 indicate a voice disorder.[19] One in four respondents (25%) scored higher than 11 and had a clinical sign of a voice disorder, whereas 29% reported a functional sign of a voice problem. If the VHI-10 was used as an indicator of a voice disorder, as was done in numerous studies,[12,16,17] then this population indeed has a greater prevalence of voice disorders. It does appear that 911ETCs present with an increased prevalence of voice problems, whether they are officially diagnosed or not, suggesting that this population is underserved in our voice community.

The second aim of this research was to investigate if voice problems affect job performance. We simply could not answer this question because a most respondents failed to complete the questions designed to address this relationship. Only three people responded to the question about absenteeism owing to voice symptoms. Furthermore, correlations using only those who responded revealed no statistically significant data. This poor response rate could be owing to the clarity of the question asked. This reason appears unlikely given that the questions were vetted through outside judges and professional organizations. It could be that the response attrition could have contributed to poor response to these questions. Again, this appears unlikely given that those who omitted these questions went on to complete the rest of the survey. It is also a possibility that this population chose not to answer based on some personal

TABLE 6.
Total Correlations: Voice Symptoms, Shift Length, Number of Devices, Noise Level, Outside Voice Use, and Call Volume

Parameters	Voice Symptoms	Shift Length	Devices Used	Noise Level	Outside Voice Use	Call Volume
Voice symptoms						
Correlation	1	0.004	0.061	**0.308***	−0.039	0.091
Significance		0.971	0.620	0.010	0.747	0.500
N	70	68	69	69	70	57
Shift length						
Correlation	0.004	1	−0.100	0.048	0.234	0.085
Significance	0.971		0.422	0.700	0.055	0.531
N	68	68	67	67	68	56
Devices used						
Correlation	0.061	−0.100	1	**0.287***	0.005	**0.367†**
Significance	0.620	0.422		0.017	0.971	0.005
N	69	67	69	69	69	56
Noise level						
Correlation	**0.308***	0.048	**0.287***	1	**0.237***	0.243
Significance	0.010	0.700	0.017		0.050	0.071
N	69	67	69	69	69	56
Outside voice use						
Correlation	−0.039	0.234	0.005	**0.237***	1	0.004
Significance	0.747	0.055	0.971	0.050		0.977
N	70	68	69	69	70	57
Call volume						
Correlation	0.091	0.085	**0.367†**	0.243	0.004	1
Significance	0.500	0.531	0.005	0.071	0.977	
N	57	56	56	56	57	57

* Correlation is significant (bold print) at the 0.01 level (two tailed).
† Correlation is significant (bold print) at the 0.05 level (two tailed).

motivation for not acknowledging a potential problem in their careers. Participants might feel as if their employment would be jeopardized if they were to answer such questions. Furthermore, acknowledging that voice problems impact job performance could be uncomfortable to admit owing to an inability to address the problem. It might be that it would be easy to deny a problem affecting one's employment with little knowledge or resources to manage the problem.

TABLE 7.
Total Correlations: Voice Symptoms, Shift Length, End of Shift Rating Difference, and Call Volume

Parameters	Voice Symptoms	Shift Length	End of Shift Rating	Call Volume
Voice symptoms				
Correlation	1	0.004	**0.457***	0.091
Significance		0.971	0.000	0.500
N	70	68	70	57
Shift length				
Correlation	0.004	1	**0.308†**	0.085
Significance	0.971		0.011	0.531
N	68	68	68	56
End of shift rating				
Correlation	**0.457***	**0.308†**	1	−0.030
Significance	0.000	0.011		0.827
N	70	68	70	57
Call volume				
Correlation	0.091	0.085	−0.030	1
Significance	0.500	0.531	0.827	
N	57	56	57	57

* Correlation is significant (bold print) at the 0.01 level (two tailed).
† Correlation is significant (bold print) at the 0.05 level (two tailed).

The third aim was to investigate any relationship between voice symptoms and factors that degrade or protect voice function to develop preventative measures that could protect voice use. Correlations among voice symptoms, outside voice activity, outside voice use, personality, devices used, noise level, shift length, call volume, and physical symptoms addressed this aim. Insights from this analysis remain unclear and will be discussed in the following paragraphs.

Voice symptoms and call volume (the required number of calls per shift) were not statistically significant, hence a relationship between these factors could be proven. This finding is surprising because one who would assume greater call volume would increase voice usage and vocal load.[6] Additionally, the relationship between voice symptoms and the shift length was also not significant. This finding remains puzzling given that long shifts would most likely mean increased voice usage. This assumption might not be the case. Further investigations about the concentration of voice use would be required to clarify that vocal load does not necessarily increase with shift length.

However, increased shift length varied with worse self-ratings of voice functioning reported at the end of the day.

So, shift length is related to worse voice self-ratings at the end of the day but not necessarily with longstanding voice symptoms. Additionally, as mentioned earlier, symptoms were not correlated with call volume. Despite this, voice symptoms were correlated with worse voice self-ratings at the end of the day. Why voice symptoms are not directly related to shift length but are with worse end-of-day voice self-ratings remains unclear. It could be that voice self-ratings at the end of the day may reflect overall fatigue and the more an individual fatigues the more likely they will experience longstanding voice symptoms. However, if fatigue at the end of the day is not necessarily directly related to voice symptoms, it stands to reason that the shift length would not influence longstanding voice symptoms. Further clarification of these findings is warranted and given the response rate was overall poor in this study, additional research in this area would be necessary for definitive answers.

Voice symptoms do not appear related to the number of assistive devices (telephone headset, microphones, and so on) used throughout the day. We would have expected that this correlation would be negative, given that the more assistive devices an individual used, the more protection from vocal load they would receive. If a headset is used regularly, then inefficient vocal technique from poor neck posture would be reduced, reducing potential vocal pressing. Additionally, if a microphone is used, then vocal loudness could be managed and assisted in reducing vocal load. Interestingly, we did note a modest correlation between voice symptoms and noise level, suggesting that louder environments may indeed increase vocal load and subsequent voice symptoms. So why would the use of devices, which all participants reported as having used, not significantly influence the reduction of voice symptoms when clearly noise levels elevate them? It could be that those who report increased noise level did not use such devices, which could exaggerate their self-ratings of noise level. Further analysis of this relationship would clarify this relation.

Reported voice symptoms did not correlate with outside voice activity. This finding is perplexing given that increased voice use outside of work would increase vocal load. However, in this study increased vocal load did not necessarily translate into voice symptoms. Nonetheless, outside voice use and personality self-ratings are positively correlated, suggesting that the more outgoing an individual is, the more likely they are to engage in outside voice activities. The finding is entirely expected and lends some validation to the accuracy of personality self-ratings.

Noteworthy findings

In this sample, those who reported increased physical symptoms (neck, shoulder, and back pain) rated themselves as more shy and quiet and did not engage in outside voice use. Although this finding did not directly answer our question, it does suggest that outside voice activity in some way reflects some mechanism for protection against physical complaints. Because increased voice use is often viewed as negative, this finding might reflect the positive aspects of voice use or the mechanisms that correlate highly with increased voice use.

Another thought-provoking finding is that although 911ETCs report longstanding voice symptoms, very few have received a medical diagnosis of a voice disorder. Although it may be common to ignore symptoms, particularly if they are not severe, it does seem unusual that so few sought relief from symptoms that directly relate to job responsibilities. It might be that the symptoms reported were not severe enough to cause concern. However, it could also be that voice symptoms can easily be blamed on another ailment such as allergies or cold. The lack of awareness that increased voice use may be related to such symptoms could reflect a general naiveté about voice functioning. Because this population is at higher risk for developing a voice disorder and indeed fall within many independent definitions of a voice disorder, education on the prevalence, identification, prevention, and treatment of voice disorders might be warranted.

Limitations of this study

The largest limitation of this study is the poor response rate. To improve statistical findings and strengthen relationships, more participants are necessary. The limited response rates and small population could also lead to bias. It is possible that those who recognize voice impairments in this population were the participants who responded to the survey. Another limitation was the length of the survey. It could be that the length to complete the survey (about 20 minutes) might have caused many participants to leave the surveys incomplete. Some of the questions in the survey may need revisions now that primary data on voice symptoms has been gathered. Indirect as opposed to direct questions addressing job performance might also assist in gathering more data on the impact of voice symptoms.

Owing to the lack of participation in this survey, a larger scaled study should be completed on this population. Our original research was to investigate the prevalence of voice disorders in 911ETCs compared with other emergency first responders (ie, firefighters, emergency medical technicians, and police officers). We received very little data from the control group to determine a difference between them. We are unsure of the reason for a low participation rate. We speculate that some of it was owing to loss of data and difficulties with the website collection system. We also experienced some resistance from local agencies about their workforces participating in the research.

Future research

Future research should focus on a longer, larger scale project that could involve direct contact with supervisors or department personnel to gain greater specificity in job-related voice use. Given the difficulty of gathering precise data on actual voice use, future research should also include more specific data on voice use such as frequency and intensity measures that could be captured with an ambulatory monitoring device. Future research could pilot educational programs and institute simple vocal hygiene and conservation techniques that might reduce voice symptoms.

Acknowledgments

This work was conducted by the first author as partial fulfillment for a master's degree in speech language pathology. The authors would like to thank Dr. Wendy Bostwick and Dr. Arlene Keddie from the public health program at Northern Illinois University for their research guidance and support. The authors would also like to thank the 911 dispatcher community that replied to the survey and those organizations that provided the survey to their organizations, Danny Franks, and the Board of Directors at 911 Lifeline and the editors at 911 Magazine. Finally, the authors would like to thank the reviewers of this work and their helpful comments. This research was supported by research grant G8A 0027 from the College of Health and Human Sciences at Northern Illinois University.

REFERENCES

1. Lehto L, Laaksonen L, Vilkman E, Alku P. Occupational voice complaints and objective acoustic measurements-do they correlate? *Logoped Phoniatr Vocol*. 2006;31:147–152.
2. Williams NR. Occupational groups at risk of voice disorders: a review of the literature. *Occup Med*. 2003;53:456–460.
3. Titze I, Lemke J, Montequin D. Populations in the U.S. workforce who rely on voice as a primary tool of trade: a preliminary report. *J Voice*. 1996;11:254–259.
4. Hunter E, Tanner K, Smith ME. Gender differences affecting vocal health of women in vocally demanding careers. *Logoped Phoniatr Vocol*. 2011;36:128–136.
5. Bureau of Labor Statistics. Occupational Outlook Handbook 2012-2013: Police, Fire and Ambulance Dispatchers. Retrieved from: U.S. Department of Labor. Available at: http://www.bls.gov/ooh/office-and-administrative-support/police-fire-and-ambulance-dispatchers.htm. Accesses March 15, 2013.
6. Titze I, Svec J, Popolo P. The vocal dose measures: quantifying accumulated vibration exposure in vocal fold tissues. *J Speech Lang Hear Res*. 2003;46:919–932.
7. Roy N, Merrill RM, Thibeault S, Gray SD, Smith EM. Voice disorders in teachers and the general population: effects on work performance, attendance, and future career choices. *J Speech Lang Hear Res*. 2004;47:542–551.
8. Verdolini K, Ramig L. Review: occupational risks for voice problems. *Logoped Phoniatr Vocol*. 2001;26:37–46.
9. Pierce H, Lilly MM. Duty-related trauma exposure in 911 telecommunicators: considering the risk for posttraumatic stress. *J Trauma Stress*. 2012;25:211–215.
10. Dietrich M, Verdolini Abbott K, Gartner-Schmidt J, Rosen CA. The frequency of perceived stress, anxiety, and depression in patients with common pathologies affecting voice. *J Voice*. 2008;22:472–488.
11. Gerritsma EJ. An investigation into some personality characteristics of patients with psychogenic aphonia and dysphonia. *Folia Phoniatr (Basel)*. 1991;43:13–20.
12. Gassull C, Casanova C, Botey Q, Amador M. The impact of the reactivity to stress in teachers with voice problems. *Folia Phoniatr Logop*. 2010;62:35–39.
13. Simberg S. Prevalence of vocal symptoms and voice disorders among teacher students and teachers and a model of early interventions. Presented at: University of Helsinki; 2004; Helsinki, Finland. p. 30.
14. Rosen CA, Lee AS, Osborne J, Zullo T, Murry T. Development and validation of the Voice Handicap Index-10. *Laryngoscope*. 2004;114:1549–1556.
15. Ahlander V, Rydell R, Lofqvist A. How do teachers with self-reported voice problems differ from their peers with self-reported voice health? *J Voice*. 2011;26:e149–e161.
16. Ohlsson A, Andersson E, Sodersten M, Simberg S, Barregard L. Prevalence of voice symptoms and risk factors in teacher students. *J Voice*. 2011;26:629–634.
17. Sampaio M, Borges des Reis J, Carvalho F, Porto L, Araujo T. Voice effort and voice handicap among teachers. *J Voice*. 2012;26:820.e15–820.e18.
18. Roy N, Bless D, Heisey D. Personality and voice disorders: a superfactor trait analysis. *J Speech Lang Hear Res*. 2000;43:749–768.
19. Arffa RE, Krishna P, Gartner-Schmidt J, Rosen C. Normative values for the Voice Handicap Index-10. *J Voice*. 2011;26:462–465.