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AUTHOR	Hanna Vertanen-Greis, Eliisa Löyttyniemi, Jukka Uitti, Tuula Putus
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Work ability of teachers associated with voice disorders, stress, and the indoor environment:

A questionnaire study in Finland

Hanna Vertanen-Greis<sup>a</sup>, Eliisa Loyttyniemi (Löyttyniemi)<sup>b</sup>, Jukka Uitti<sup>c,d</sup>, Tuula Putus<sup>e</sup>

<sup>a</sup> Department of Clinical Medicine, University of Turku, FI-20014 University of Turku, Finland

<sup>b</sup> Department of Biostatistics, University of Turku, FI-20014 University of Turku, Finland,

[eliisa.loyttyniemi@utu.fi](mailto:eliisa.loyttyniemi@utu.fi)

<sup>c</sup> Faculty of Medicine and Health Technology, Tampere University, Arvo Ylpön katu 34, 33520

Tampere, Finland, [jukka.uitti@tuni.fi](mailto:jukka.uitti@tuni.fi)

<sup>d</sup> Clinic of Occupational Medicine, Tampere University Hospital, PO BOX 2000, FI-33521

Tampere, Finland

<sup>e</sup> Professor, Department of Occupational Medicine, University of Turku, FI-20014 University of

Turku, Finland, [tuula.putus@utu.fi](mailto:tuula.putus@utu.fi)

Corresponding author: Hanna Vertanen-Greis<sup>a,1</sup>

Postal address: University of Turku, FI-20014 University of Turku, Finland

E-mail: [hanna.m.vertanen@utu.fi](mailto:hanna.m.vertanen@utu.fi)

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<sup>1</sup> [hvertan@gmail.com](mailto:hvertan@gmail.com)

## 1. Introduction

A well-functioning voice is important in the teaching profession. Nevertheless, voice disorders are common in teachers, and previous research has suggested alarming findings on the association between voice symptoms and the indoor environment, such as dry indoor air, changing temperatures, stuffy air, or the noise of pupils <sup>1-4</sup>. In addition, stress—especially work-related stress—is suggested to be a high risk factor for voice disorders in teachers <sup>4,5</sup>.

Previous studies have suggested that teachers with voice problems are more likely to have absences compared to their healthy colleagues. de Medeiros et al. <sup>6</sup> found that 18% of absences due to sickness in the previous year was explained by voice disorders in a study of 6 510 Brazilian schoolteachers. Similarly, in a sample of 467 Swedish teachers, Lyberg-Åhlander et al. <sup>2</sup> reported that sickness absence caused by voice problems was significantly more prevalent in teachers with voice problems than without such problems (35% vs. 9%). A speaker breathes mostly through the mouth, allowing indoor air exposures to be transmitted directly to the larynx. Thus, exposure to such conditions as dry air, irritations, or temperature changes are all found to associate with voice problems in teachers <sup>1,3</sup>.

Together with—and also apart from—vocal disorders, stress is often present in cases of decreasing work ability <sup>7</sup>. Work-related stress is found to associate with both long- and short term sickness absences <sup>8,9</sup>. In a study of 4114 employees <sup>9</sup>, stress predicted sick leave of 21 days or more, while in another cohort study (n = 17.795) <sup>8</sup>, stress was associated with sick leave regardless of length.

Sickness absence, as an indicator of work ability, is suggested to associate with an insufficient indoor environment <sup>3,10</sup>. In a register study, Ervasti et al. <sup>10</sup> concluded that the risk of one to three

days of sick leave was lower for teachers working in schools with good indoor air compared to those in schools with poor indoor air. In addition, Patovirta et al.<sup>11</sup> showed there were more days of absence in the previous year for teachers working in moisture damaged schools than their colleagues in a non-damaged building (22 vs. 2 days,  $p = 0.015$ ). Furthermore, insufficient thermal conditions have been suggested as having adverse effects on teaching ability<sup>12</sup>. These findings were consistent even though some were based on certain indoor air variables measured by civil engineers<sup>11,13</sup> and others on varying self-reported environmental factors<sup>1,2</sup>.

As described, voice disorders, stress, and a poor indoor environment, appear to decrease work ability in teachers. However, there is little research on this topic where all these three factors are taken into consideration, and further studies are needed<sup>12,13</sup>. The aim of this cross-sectional study of Finnish teachers was to determine the association between self-reported work ability and the three factors of voice disorders, stress at work, and perceived indoor environment quality (PIEQ). The present study is a part of an epidemiological research designed to address voice disorders and focuses on the work ability of teachers. According to our previous results, stress is the most significant explanatory variable with a 3.6-fold risk as regards voice disorders<sup>4</sup>. Based on the previous findings<sup>1,4,10,11</sup>, we hypothesized that decreased work ability in teachers is connected to voice disorders, stress at work, and poor PIEQ.

## 2. Material and methods

We performed a cross-sectional study by employing a questionnaire that was completed by comprehensive schoolteachers. (See Supplemental Materials from questionnaires used for the study.) The design is described in detail in our previous publication<sup>4</sup>. Briefly, a questionnaire with two reminders was sent in March 2017 to the work email addresses of 4 071 subjects in three cities across Finland; this number was slightly more than was calculated for as an adequate sample size ( $n$

= 4 000). We received the email addresses from the employers; however, 246 email addresses were incorrect or invalid. The response rate was 33%. As inclusion criteria, only full-time teachers working in Finnish speaking primary and secondary schools were included. We excluded the respondents who were working in two or more buildings or whose specific working building was not identified. The final sample size for analysis was  $n = 1\,198$  (See [dataset] questionnaire data from the teachers <sup>14</sup>). Of the participants, 81% were females and 19% males, and the mean age was 44 years (SD 9.1); on average, the teachers had worked for 16 years.

The Ethics Committee of the University of Turku gave their ethical approval (Statement 26/2016). The Education Departments of the cities in which questionnaire was sent and the study performed endorsed the request for permission to conduct the study. We sent the questionnaire directly to the work email address of the teachers and they were able to answer the questionnaire voluntarily and anonymously. The participants gave a written informed consent before taking part. We designed the questionnaire with a limited number of questions and the principals were asked to inform and encourage their teachers to participate in the study.

### 2.1. Assessments

The outcome variable was the *Work Ability Score (WAS)*, assessed by using a validated single-item question <sup>15</sup>. The question concerned current work ability compared with a lifetime best, recorded on a scale from 0 (“completely unable to work”) to 10 (“work ability at its best”) <sup>16</sup>. WAS is a part of the *Work Ability Index* which has the highest discriminating power over the entire index. The index consists of dimensions related to, for example, job demands, current illnesses, and mental resources. In the analysis, we used the classification of WAS which has been found to correspond best with that of the *Work Ability Index* <sup>16</sup>: poor (0–5 points), moderate (6–7), good (8–9), excellent (10). We combined good and excellent work ability and used three categories in the analyses. The results

were as follows, there were 72 subjects having poor WAS, 269 subjects having moderate WAS, and 848 subjects having good or excellent WAS (Figure 1). To compare the results with other studies, we reported the distribution in two ways. In view of the fact that the distribution was skewed, the median with quartiles was used. However, because of the large sample size and the values only being between 0-10, the mean is almost the same as the median and, thus, can also be reported.

In addition to *WAS*, the participants also reported the *number of days absent due to sickness* during the previous year. As stated, the agreement between the annual number of self-reported and the annual number of recorded days of absence due to sickness was relatively good <sup>17</sup>.

As predictors, we measured three factors of interest that have been highlighted in recent studies <sup>4,6,12,13</sup>. First, we investigated *voice disorders* with a screening questionnaire consisting of questions about the occurrence of different vocal symptoms. The symptoms were *morning hoarseness, voice becomes strained or tired, voice becomes low or hoarse, voice breaks, difficulty in being heard, throat clearing or coughing, and pain around the larynx*; the response alternatives were *every day, every week, less often, and never*. Teachers who reported two or more voice symptoms occurring weekly or more often in the previous 12 months were considered to have a *voice disorder*. The vocal symptoms with different combinations have previously been used in several questionnaire studies <sup>4,5,18,19</sup>. As found in Vertanen-Greis et al. <sup>4</sup>, altogether 54% (CI 95% 51–57) of the subjects were suffering from voice disorders.

Secondly, we measured *stress at work* using a validated single-item question with a 5-point Likert scale focusing on the experience of stress <sup>20</sup>. In the analysis, the variable dealt with three categories of stress which were reported by the teachers as follows: ‘not at all’ or ‘little’ 39%, ‘somewhat’ 36% and ‘rather’ or ‘very much’ 25%.

Third, we utilized *PIEQ* as an indicator of the teacher's working environment; this was generally the classroom. *PIEQ* is based on the MM 040 questionnaire <sup>21</sup> which includes complaints raised over the last three months as regards *draught, temperature too high, varying room temperature, temperature too low, stuffy "bad" air, dry air, insufficient ventilation, smell of mold or an earthen cellar, other unpleasant odors, dust or dirt, and noise* in the indoor environment. The options were *weekly, sometimes, and no, never*; the last two were combined for the analysis. All the environment complaints associated with WAS. (Our recent findings confirm the agreement between perceived indoor air quality and a technical assessment of the school buildings. However, the findings have not as yet been published <sup>22</sup>). For analysis purposes, we built a sum variable and named it the *PIEQ index*. For this index, we optimized the cut-off point based on those observations reporting that 3 out of the 11 complaints had had the greatest effect on work ability. Teachers who reported two or less *PIEQ* complaints were considered to have a negative *PIEQ index* (indicating good *PIEQ*) and those who reported at least three complaints were considered to have a positive *PIEQ index* (indicating poor *PIEQ*). All the complaints had the same weight in the index because no theory appears to exist that supports a certain stronger association between a single complaint in relation to work ability or voice disorders.

Background variables included *sex, age, and use of medication*. We also asked whether *the voice gets worse in the workplace*, analyzing the variable in two categories; “No” (*no—I cannot say*) and “Yes” (*yes, almost immediately—yes, within half an hour—yes, within a few hours*). The results of other background variables (*asthma, smoking, the number of working years*) are described in Vertanen-Greis et al. <sup>4</sup>; where it was found that *smoking* was not associated with *voice disorders*.

## 2.2. Statistical analyses

When evaluating the association between one background variable and WAS separately, we performed a Chi-square test or a Fisher's exact test. A logistic regression model was used to study associations between the WAS and *voice disorders, stress, PIEQ index, use of medication, sex, and age*. In addition, adjusted odds ratio (aOR) for these factors were calculated and adjusted with *sex* and *age*. We tested the association between WAS and *the number of working years* and *the number of days absent due to sickness* with the Kruskal Wallis test because these variables were skewed. The association between WAS and *age* was tested with one-way Anova because the variable *age* was normally distributed. All statistical tests were performed with a significance level set at 0.05 (two-tailed). The analyses were performed using a JMP 14.2.0 Pro for MacOS and an SAS® System, version 9.4 for Windows (SAS Institute Inc., Cary, NC, USA).

### 3. Results

According to our findings, the WAS median was 8 (Q<sub>1</sub>: 7, Q<sub>3</sub>: 9). Of the subjects, 71% (CI 95% 69%–74%) reported good work ability (WAS 8–10). Moderate work ability (WAS 6–7) was reported by 23% (CI 95% 20%–25%) of the subjects and 6% (CI 95% 5%–8%) reported poor work ability (WAS 0–5). Female teachers had a significantly lower WAS than male teachers ( $p = 0.034$ ). The median of the number of days absent due to sickness during the previous year was 4 (Q<sub>1</sub>: 2, Q<sub>3</sub>: 10). Overall, 16% of the subjects had absences of over 14 days due to sickness during the previous year.

There was significant association between WAS and sickness absences; the lower the WAS, the more days of sickness absences ( $p < 0.0001$ ). Accordingly, teachers having absences of over 14 days due to sickness during the previous year, had significantly more often a lower WAS (both 0 to 5 or 6 to 7) than the others. Forty-one percent of the participants used respiratory medication at the time the study was conducted. The most used medications were grouped according to their use;



antihistamines (12% of the subjects), corticosteroids (8%), bronchodilators (7%), and nasal medication (6%). The use of these four medicines was significantly associated with WAS; the lower the WAS, the more use of medication ( $p < 0.0001$ ).

The PIEQ index was negative in 554 (52%) of the subjects and positive in 520 (48%) of the subjects. More than 30% of the occupants reported of *stuffy "bad" air, dust or dirt, dry air, insufficient ventilation, or noise* in the indoor environment. Altogether, 58% of the subjects reported that their voice got worse in the workplace; the variable *voice gets worse in the workplace* was also significantly associated with voice disorders. It should also be mentioned that the PIEQ index associated significantly with stress at work ( $p < 0.0001$ ).

We found WAS to be significantly associated with voice disorders, stress, and the PIEQ index (all  $p$  values  $< 0.0001$ ) (Table 1). Teachers with voice disorders, rather or very much stress, or a positive PIEQ index (indicating poor PIEQ), reported a lower WAS. To study the association between work ability and these three factors more deeply, we created a model including background variables (*sex, age, use of medication*). As Table 2 shows, they were all clear risk factors for WAS, adjusted with sex and age.

#### 4. Discussion

Our results show that decreased work ability in teachers is associated with the occurrence of voice disorders, stress at work, and poor PIEQ; with PIEQ being most strongly related to the occurrence of stress at work. The subjects with good work ability had clearly less absence due to sickness compared to those with poor work ability. In addition, the association between stress at work and poor PIEQ was significant.

Female teachers reported a lower WAS than male teachers, and this is consistent with the findings of Van Houtte et al.<sup>23</sup> where female teachers had more sick leave than male teachers ( $p = 0.008$ ). Further, age was not connected to work ability in our study whereas a higher age was reported to predict lower work ability in another study<sup>24</sup>. However, an inconsistent relationship between age and work ability has also been reported in different occupations<sup>25</sup>.

#### 4.1. The relationship between work ability and voice disorders

Our results reveal that teachers with voice disorders assess their work ability lower than their healthy colleagues and there is significantly more absence due to sickness for those teachers with voice disorders than those without. The finding confirms earlier results assessed with large sample sizes around the world (from 354 up to 6 510 subjects) that work ability is significantly lower<sup>26</sup> and absenteeism is significantly more common<sup>2,6,23,27</sup> in teachers with voice problems compared to their healthy colleagues. Most of the findings are based on questionnaires<sup>2,6,23,27</sup>, but our results are also in line with Giannini et al.<sup>26</sup> who assessed voice disorders using a clinical evaluation of voice disorders. Many researchers have noticed that the sick leave does not normally exceed one week<sup>6,23,27</sup>. However, given that the risk of voice disorders to decreased work ability is assessed as being relatively high—even with an adjusted odds ratio 12.2<sup>26</sup>—there is also an urgent need to pay attention to voice disorders when supporting work ability in teachers. This is all the more alarming because teachers, in the main, are pleased with their occupation but consider that voice problems restrict their work<sup>2</sup>. The findings are also of concern as regards our results related to voice disorders. More than half of the subjects reported that their voice gets worse in the workplace. In addition, 70% of the teachers who reported a poor PIEQ had voice disorders, whereas only 34% of the other subjects had voice disorders. Thus, while a poor indoor environment associates with voice disorders, it also has a connection to reduced work ability in teachers.

Antihistamines, corticosteroids, bronchodilators, and nasal medication were the most used medicine groups. They are all generally used for asthma and allergies. These diseases, in turn, are prevalent in subjects with voice disorders <sup>4</sup>, but asthma is also shown to associate with poor indoor air, specifically related to dampness and mold <sup>28</sup>. This supports our findings as regards the association between voice disorders and the working environment.

#### 4.2. The relationship between work ability and stress

Stress is the strongest risk factor for WAS in our study, and this is in line with previous studies <sup>29,30</sup>. We also found a clear association between stress and absence due to sickness; for teachers with rather or very much stress the occurrence of 14 days or more of sick leave was higher than for those with not at all or little stress. It is clear that stress is very present in teaching work and also a cause of absenteeism; stress arises from the various demands of the work, for example, heavy workload, pupil behavior, cooperation with colleagues, teaching quality <sup>30</sup>. In addition, the participants working in a poor indoor environment reported that they had rather or very much stress more often than the other participants (70% vs. 30%).

#### 4.3. The relationship between work ability and the indoor environment

According to our findings, teachers with poor or moderate work ability reported more often a poor indoor environment than those with good work ability, and those who reported a poor indoor environment had more sickness leave than the other subjects. (See Supplementary Material for a figure which illustrates the associations between PIEQ complaints and WAS.) Although our results are based on self-evaluation, they agree with previous findings that have employed an external evaluation of indoor air quality; these assessments were made by pupils <sup>10</sup> or by utilizing microbial investigations <sup>11</sup>.

#### 4.4. Strengths and limitations

Our study was conducted with a large sample across Finland using well-defined questionnaires that are widely used. We assessed work ability by using WAS, which is a reliable instrument to assess work ability<sup>16,31</sup>. WAS refers not only to current work ability compared with a lifetime best, but also other work-related aspects, such as job demands, doctor-diagnosed diseases, and mental resources<sup>15,16</sup>. Our findings indicate that in the teaching occupation, voice disorders and the indoor environment also contribute to work ability. We assessed stress at work with the one-item stress scale that was originally validated in different working groups in Finland and the Nordic countries<sup>20</sup>. According to the authors, the questionnaire may identify well-being at work better than illness-based health instruments. A further strength of our study was that the amount of missing data was very low because the subjects answered almost every question.

As with all studies, there are some limitations that warrant discussion. As noted, work ability in teachers is associated with multiple aspects. We focused only on the indoor environment, voice disorders, and stress, that have been highlighted in recent studies and have been found to be significantly associated with work ability in teachers<sup>4,6,12,13</sup>. It is also obvious that there may be other risk factors associating with work ability, both general, such as mental and musculoskeletal disorders, as well as some unknown risk factors. As regards the evaluation of the indoor environment of teachers, the MM 040 questionnaire is a validated instrument consisting of a wide range of environmental aspects<sup>21,32</sup>. However, studying the association between work ability and all the 11 questions separately would pose challenges to the main intent of the study—to take into account all the three factors of interest. Thus, we built a single-item variable that reflected the teachers' indoor environment with sufficient accuracy and simultaneously allowed us to handle the

three factors of interest. However, while the analysis succeeded, it may have narrowed the interpretation.

The cross-sectional study design did not allow us to make any conclusions about causality. The design is also a potential source of bias because of possible over- or under-reporting in the questionnaire. In our sample, the mean WAS was 7.9 (SD 1.5; CI 95% 7.8–8.0), which is lower than for Finnish teachers in general (8.3)<sup>33</sup> and lower than reported in a recent study of Finnish teachers (8.7)<sup>24</sup>. The response rate was 33% despite the limited number of questions. A possible reason is that teachers receive multiple surveys by email and are therefore often reluctant to participate in them all. What is also to be noted, the number of incorrect or invalid email addresses was relatively high ( $n = 246$ ) although we received them from the employers. In addition to the low response rate, the results may have been affected by the fact that we named the subject title “Indoor questionnaire for teachers” when sending the questionnaire; this title may have motivated participation specifically from those who worked in schools with indoor air problems or suffered from respiratory or other symptoms. Thus, perceived symptoms, stress, and complaints about PIEQ are possibly emphasized in the sample, causing potentially both a selection bias and an observation bias, also called the Hawthorne Effect<sup>34</sup>. The Hawthorne effect explains the general effort made by individuals to modify their behavior when being observed. The effect may be especially present in sensitive issues like work ability or stress – or indoor air problems, which is an issue that generates strong negative emotions. However, the teachers in our sample had clearly less absenteeism than Finnish teachers in general (e.g., class teachers; mean 8.1 (SD 11.1; CI 95% 7.2–9.1) vs. 11.0 days per year)<sup>35</sup>. The differences may be related to the fact that our data were self-reported whereas the reference data were based on the employer’s register. Thus, although the agreement between self-reported and the recorded number of days of sick leave has been assessed as being relatively good<sup>17</sup>, some recall bias may have occurred. Nevertheless, our sample was representative as regards sex

and age in Finnish teachers <sup>4</sup>, possibly supporting the generalizability of our results for Finnish school teachers.

Overall, our results are consistent with earlier studies on similar topics with both perceived and objective assessment. Our findings confirm the hypothesis that decreased work ability in teachers is connected to voice disorders, stress at work, and poor PIEQ. We agree with Lyberg-Åhlander et al. <sup>2</sup> that it is essential to take voice disorders in teachers as an occupational question when there are problems in the indoor environment. As regards policy implications, we recommend supporting the work ability of teachers by offering special awareness in the form of occupational health care, especially when there are problems with the indoor environment that are accompanied by voice disorders and stress. This is not only to ensure positive learning outcomes in pupils but also to maintain work ability in teachers and prevent early withdrawal from the teaching profession. The three factors of interest may possibly act as a bundle having an impact on work ability. Follow-up studies are needed to investigate other possible factors in the bundle and study the causality of their interaction with the work ability of teachers.

## 5. Conclusion

We conclude that decreased work ability in teachers is connected to voice disorders, stress at work, and poor PIEQ. Thus, we recommend supporting the work ability of teachers by providing special awareness in the form of occupational health care, especially when there are problems in the indoor environment that are compounded by voice disorders and stress in teachers.

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Supplemental material

Supplemental File. Figure.

Supplemental File. Questionnaire.

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## Figure captions

Figure 1. Study flow chart.

Abbreviations: WAS: Work ability score; PIEQ: Perceived indoor air quality

Table 1. Association between Work Ability Score categories and the background variables (n = 1 198).

Variable		Total <i>n</i> <sup>1</sup>	WAS 0-5	WAS 6-7	WAS 8-10	<i>p</i> value
Sex <i>n</i> (%)	Male	222	5 (2)	54 (24)	163 (74)	0.034
	Female	941	64 (7)	210 (22)	667 (71)	
Age, Mean (min-max)		1 176	43 (27–61)	44 (25–63)	44 (24–65)	0.36
The number of working years, Median (Q <sub>1</sub> –Q <sub>3</sub> )		1 180	12 (6–20)	15 (10–24)	15 (8–22)	0.053
Voice disorders	No	549	10 (2)	72 (13)	467 (85)	< 0.0001
	Yes	637	61 (10)	197 (31)	379 (59)	
Stress	Not at all or little	466	9 (2)	53 (11)	404 (87)	< 0.0001
	Somewhat	430	17 (4)	102 (24)	311 (72)	
	Rather or very much	290	46 (16)	113 (39)	131 (45)	
The number of sick leave days during the previous year, Median (Q <sub>1</sub> –Q <sub>3</sub> )		1 183	12 (5–26)	7 (3–15)	3 (1–7)	< 0.0001
Sick leaves > 14 days	No	992	39 (4)	199 (20)	754 (76)	< 0.0001
	Yes	191	33 (17)	69 (36)	89 (47)	
Use of medication	No	685	26 (4)	133 (19)	526 (77)	< 0.0001
	Yes	491	46 (10)	134 (27)	311 (63)	
PIEQ index	Negative	549	8 (1)	75 (14)	466 (85)	< 0.0001
	Positive	517	51 (10)	161 (31)	305 (59)	

<sup>1</sup> All variables, including some missing data.

Abbreviations: WAS: Work Ability Score; Q<sub>1</sub>: lower quartile; Q<sub>3</sub>: upper quartile.

*p* values were calculated with chi-square test and one-way Anova.

*Table 2. Adjusted odds ratio for voice disorders, stress, perceived indoor environment quality (PIEQ) index and the use of medication for decreasing work ability under 8 (n = 1 198).*

		aOR (95% CI)	p value
Voice disorders	Yes–No	2.44 (1.73–3.44)	< 0.0001
Stress	Rather or very much–Somewhat	2.88 (2.00–4.15)	< 0.0001
	Somewhat–Not at all or little	2.27 (1.53–3.37)	
	Rather or very much–Not at all or little	6.53 (4.31–9.90)	
PIEQ index	Positive–Negative	2.63 (1.86–3.71)	< 0.0001
Use of any medication	Yes–No	1.48 (1.07–2.03)	0.017

Abbreviations: aOR: Adjusted odds ratio; PIEQ: perceived indoor environment quality index. Analyzed with the logistic regression model (adjusted for age and sex).