A cross sectional study on the vocal handicap index applied to a sample of teachers in nurseries and primary schools

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Abstract

Background. *Acoustic pollution is generally analysed in relation to the risks for the hearing apparatus, omitting the extra-auditory effects, such as the damage that the noise can cause to the speaker's voice and listening to the learning of the vocal message. These damages are mainly found in school environments among teachers.*

Objective. *A cross-sectional study was carried out to verify the influence that the noise of the classrooms can have on the physical and mental health of the teachers examined.*

Methods. *This study involved four schools of Rome, for a total of 60 teachers, who were interviewed via online questionnaires, which consisted of a socio-demographic data section and 3 other sections: Vocal Handicap Index (VHI), SF-12, Job Content Questionnaire.*

Results. *50 responses were received. 68% of teachers exceeded the normative value of 2.83 and perceived a disorder of the voice, and only 32% had a value lower than the standard considered (mean=7.34; median=5). The medians of MCS12 and PCS12 scores (52.9 and 54.2) were very close to those of the general population, as well as the distribution of the scores obtained from the Job Content Questionnaire. Furthermore, there was a direct association between the VHI-10 score and the age (B=0.321 p=0.016), the marital status (B=0.345 p= 0.009), and an indirect association with the MCS12 (B=-0.283 p=0.033).*

Conclusions. *In general, the teachers examined are exposed in the classrooms to a high acoustic climate (median=75 dB) and, consequently, to a vocal effort during the didactic activities. Although it has not been possible to verify whether teachers with a high vocal disturbance were in the classrooms with a worse acoustic climate, the descriptive analyses provide a solid basis for further studies on the association between noise pollution and vocal effort.*

Introduction

The damage that noise can cause to the speaker's voice and to listening to the vocal message is among the least studied item. This is mainly found in the school environment, where teachers have to counter the background noise or reverberation with their voices in order to have the vocal message received by the students, maintaining an intensity of the voice around 10-15 dB higher than the noise. All school premises, including classrooms, canteens and gyms, are characterized by high levels of noise and excessive reverberation, which can reduce the quality of listening, teaching and training in general. The noise

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present in schools should be considered a disturbing agent that is in close relationship with the health (psychophysical stress) of teachers and students, even if it is part of the group of factors of ergonomics (acoustic ergonomics). In most cases the presence of this disturbance is caused by the lack of application of the minimum acoustic requirements such as to make the structures suitable for their function.

The World Health Organization (WHO) addresses these issues in "Noise in schools" (1), which also indicates some of the minimum requirements that should be respected. For example, the school building should be erected as far as possible away/ far from sources of noise due to transport and industry; the interior spaces should be distributed in order to isolate noisier areas from areas that require greater tranquility. The maximum of background noise level Leq allowed in classrooms during educational activities must be 35 dB (A), while the reverberation time should be not less than 0.4 s and not more than 0.6 s.

Another reference on acoustics in schools is represented by ANSI S12.60 (2), which considers the reverberation time as the background noise in terms of noise coming from outside the building and from the facilities. Furthermore, it establishes the limit values according to the size of the school environment and the type of activity carried out within the organization.

According to the European and American normative parameters, the Italian legislation established the maximum admissible noise level in the classrooms during the educational activity equal to 35-45 dB and the reverberation level equal to 0.4-0.6 s. However, these values are not respected and often reach 65-80 dB in nursery schools and 65-70 in primary schools (3).

Objective

This study aimed to verify the influence that the noise and acoustics of the classroom can have on the physical and mental health of the teachers examined.

Materials and Methods

Study design and sample size

A cross-sectional study was carried out according to the STROBE checklist (4).

Four schools of Rome were involved (1 kindergarten, 3 primary schools), for a total of 60 teachers (tenured teachers, substitute teachers, support teachers) and 37 classrooms.

Instruments for data collection

A questionnaire was administered online to the teachers. It was composed by a socio-demographic data section and 3 other sections:

- *Vocal Handicap Index* (VHI) questionnaire: a self-assessment validated tool to quantify the functional, physical and emotional impact of a voice disorder on the person's quality of life.

In this study the Italian short version was adopted: VHI-10 questionnaire, it is regarded as the subjective assessment for dysphonia. It contains 10 questions in total, each scaled from 0 (no impairment) to 4 (maximum impairment) (5).

The final score, VHI-10, ranged 0-40 and it was considered as outcome.

- *SF-12*, short version of the SF-36 questionnaire to evaluate the "quality of life and state of health" through two synthetic indexes of the 8 original scales: PCS12 Physical Component

Summary (range 0-100), MCS12 Mental Component Summary (range 0-100) (6).

- *Job Content Questionnaire*, for the evaluation of the work-related stress. It is composed of 49 items and measures the social and psychological characteristics of the work. The scale used are: decision latitude, job demand. The score attributed to each item ranges from 1 for the absolutely

discordant opinion to 4 for the very concordant opinion (7).

Statistical analyses

All analyses were carried out using SPSS for Windows (Statistical Package for the Social Sciences, Version 25; SPSS, Inc., Chicago, IL).

The qualitative variables were described as frequencies and percentages, while the continuous variables (VHI-10, MCS12, PCS12 scores) as mean, median, range and Standard Deviation (SD).

A multivariate linear regression model with backward elimination procedure of non-significant variable was performed to study the association between the outcome, VHI-10, versus MCS12, PCS12, decision latitude, job demand and other demographic qualitative variables.

The goodness of fit for the model was assessed with R^2.

Significance threshold was set at $p < 0.05$ for all analyses.

Results

50 (83%) responses were obtained from online interviews to the 60 teachers.

The frequencies of the socio-demographic characteristics of teachers are shown in Table 1.

68% of teachers exceed the normative value of 2.83 (8) and perceive a disturbance to the voice. The mean of the Vocal Handicap Index scores is equal to 7.34 (SD=7.45), the median is 5 (minimum=0; maximum=32) (Table 2), which means that only 32% of teachers have a value lower than the standard

Table 1 - Socio-demographic characteristics of the sample

Variables	Groups	N (%)
Marital status	Single	10 (20.0)
	Married/Cohabiting	40 (80.0)
Age	<45 years	9 (18.0)
	45-54 years	23 (46.0)
	55-64 years	18 (36.0)
Graduation	Not graduates	26 (52.0)
	Graduates	24 (48.0)
Work Experience	4-9 years	6 (12.0)
	> 9 years	44 (88.0)

considered. The distribution of frequency obtained from the answers to the VHI-10 are shown in the Table 3.

The medians of MCS12 and PCS12 of the study sample almost coincides with the medians of the general population (51.3-53.3) (9). It is possible to state that the population examined is in good physical health and does not present mental health problems (Table 2).

The scores obtained from the answers to the Job Content Questionnaire demonstrates that 26% of the sample is in the worst working condition, in which the teachers have a high work demand and low decision-making freedom (High Strain), while 12% of the sample is in the optimal condition, with high decision-making freedom and low work demand (Low Strain). 30% of teachers appear in the condition of full involvement, high job demand and high decision latitude (Active), and the remaining 32% in the condition of dissatisfaction with low demand and lack of decision-making autonomy (Passive).

The multivariate regression model

Table 2 - Descriptive statistics of variables concerning the quality of life and VHI-10

Outcome	N	Mean	SD	Median	Minimum	Maximum
VHI-10	50	7.34	7.45	5.0	0.00	32.00
MCS12	50	48.61	8.42	52.9	22.37	58.75
PCS12	50	51.37	6.72	54.2	36.02	63.52

Table 3 - Frequency distribution of answers to the VHI-10 questions in 50 teachers
(0= Never; 1= Almost Never; 2 = Sometimes; 3 = Almost Always; 4 = Always)

Question	Never		Almost never		Sometimes		Almost always		Always	
	N	%	N	%	N	%	N	%	N	%
My voice makes it difficult for people to hear me	25	49.0	8	15.7	16	31.4	1	2	1	2
People have difficulty understanding me in a noisy room	17	33.3	11	21.6	21	42.2	0	0	2	3.9
My family has difficulty hearing me when I call them throughout the house	25	49.0	12	24.5	12	24.5	0	0	1	2
I use the phone less often than I would like to	34	60.7	9	17.6	8	15.7	0	0	0	0
I tend to avoid groups of people because of my voice	44	86.3	5	9.8	2	3.9	0	0	0	0
I speak with friends, neighbors, or relatives less often because of my voice	17	33.3	9	17.6	22	43.1	1	2	2	3.9
People ask me to repeat myself when speaking face-to-face	23	45.1	12	23.5	12	25.5	1	2	2	3.9
My voice difficulties restrict my personal and social life	30	58.8	8	15.7	9	17.6	3	5.9	1	2
I feel left out of conversations because of my voice	42	82.4	3	5.9	4	7.8	1	2	1	2
My voice problem causes me to lose income	38	74.5	5	9.8	6	11.8	1	2	1	2

is reported in Table 4. There is a direct association between the VHI-10 score and age (*B*=0.321 *p*=0.016), because the more the age increases the more the questionnaire result is high and there is a disturbance to the voice. Same association with the marital status (*B*=0.345 *p*=0.009), which leads to an aggravation of vocal effort due to the possible presence of children in the family. The mental health index (MCS12) is indirectly associated (*B*=-0.283 *p*=0.033), so the teachers with no mental health problems don't perceive any vocal disorder. There is no relationship with the other independent variables.

Discussion

The noise pollution up to now has been analyzed mainly in relation to the risks for the hearing apparatus, ignoring the extra-auditory effects. Some studies consider the profession of the teacher at high risk for vocal disorders, demonstrating a high prevalence of dysphonia and symptoms of vocal fatigue in teachers and, at the same time, a high level of loss of attention, headache and fatigue on the part of the students with probable lowering of their performance levels. Furthermore, they form evidence of an association between noise exposure and vocal stress and development of symptoms of vocal fatigue, but also symptoms of cognitive fatigue after work (10-12).

As reported in an article taken from the same study (13), it can be said that the acoustic climate measured in the classrooms is high (median of 75 dB), so that, to get an understanding of the speech, it is necessary to raise the tone of the voice by at least 15 dB and this causes a vocal effort during the teaching activity.

The analysis of the results of the

Table 4 - Linear regression model of VHI-10

Independent variables	VHI-10	
	B	**p**
PCS12	-0.092	0.483
MCS12	-0.283	**0.033**
Married/Cohabiting versus single*	0.345	**0.009**
Graduates versus not graduates*	0.069	0.623
Age groups		
55-64 years versus ≤54 years*	0.321	**0.016**
Decision latitude	-0.012	0.930
Job demand	0.005	0.978
Work experience	0.035	0.826
R²– Goodness of fit	0.266	

*reference group

questionnaire for the self-assessment of the voice status (VHI-10) shows that 70% of the teachers examined have a disturbance to the voice. This result is directly associated with age (as the age increases, the perception and the damage of the vocal disorder also increases) and with the current task (the tenured teachers have obtained high final scores). An interesting aspect is also the significance of the result of the VHI-10 with the marital status of teachers, especially in married and cohabitants, which suggests a worsening of the vocal effort due to the possible presence of children. From the results of the SF-12 and the Job Content Questionnaire, the population in question can be equated with the general population. The only thing to underline is an indirect association with the final result of the VHI-10 and the MCS12 mental health index, since the teacher appears not very mentally stable (MCS12 low score) the more he strives the voice (VHI-10 high score).

Limitations of the study

In the verification phase of the questionnaires, an important missing data to correlate the Leq dB (A) calculated with the individual questionnaires was the classroom. In fact, to keep the answers anonymous, it was not possible to correlate the Leq dB (A) of the single teacher with the result of the questionnaire. Thus it was not possible to verify if teachers with a high vocal disturbance were in the classrooms with a worse acoustic climate. Furthermore, the VHI-10 questionnaire is a self-assessment tool and doesn't allow the objective evaluation of the vocal damage.

Conclusions

Even if it was not possible to match classrooms' data with teachers, this study presents some indications that high noise levels in the schools may contribute not only to the occurrence of hearing apparatus symptoms, but also to the onset of vocal effects among teachers. The descriptive analyses from teachers interviews provided a solid basis for carrying out further studies to deepen the association between acoustic pollution and vocal effort caused by an incorrect use of the voice during the course of the teaching activity. Moreover it would be desirable to identify control strategies for voice production that are effective for occupational safety.

Riassunto

Uno studio trasversale sul vocal handicap index applicato ad un campione di insegnanti nelle scuole materne ed elementari

Introduzione. L'inquinamento acustico è generalmente analizzato in relazione ai rischi per l'apparato uditivo mettendo in secondo piano gli effetti extra-uditivi, come il danno che il rumore può provocare all'apparato vocale del parlante e sull'ascolto finalizzato all'apprendimento del messaggio vocale. Questi danni vengono riscontrati soprattutto negli ambienti scolastici tra gli insegnanti.

Obiettivo. È stato condotto uno studio cross-sectional per verificare se il rumore all'interno delle aule possa avere degli effetti sulla salute fisica e mentale degli insegnanti.

Metodi. Questo studio ha coinvolto quattro scuole del comune di Roma, per un totale di 60 insegnanti, che sono stati intervistati tramite questionari online, che erano a loro volta composti da una sezione anagrafica e altri 3 questionari: Vocal Handicap Index (VHI), SF-12, Job Content Questionnaire.

Risultati. Sono state ricevute 50 risposte. Il 68% degli insegnanti supera il valore normativo di 2,83 e percepisce un disturbo della voce, e solo il 32% ha un valore inferiore allo standard considerato (media=7.34; mediana=5). Le mediane dei punteggi dell'MCS12 e del PCS12 (52.9-54.2) si avvicinano moltissimo a quelle della popolazione generale, così come la distribuzione dei punteggi ottenuti dal Job Content Questionnaire. Inoltre è stata riscontrata un'associazione diretta tra il punteggio del VHI-10 e l'età (B=0.321 p=0.016), lo stato civile (B=0.345 p=0.009), e un'associazione indiretta con il MCS12 (B=-0.283 p=0.033).

Conclusioni. In generale gli insegnanti esaminati sono esposti nelle classi ad un clima acustico elevato (mediana=75 dB) e, di conseguenza, ad uno sforzo vocale durante le attività didattiche. Sebbene non sia stato possibile verificare se nelle aule con un clima acustico peggiore si trovino i docenti con un elevato disturbo vocale, le analisi descrittive forniscono una solida base per effettuare ulteriori studi sull'associazione tra inquinamento acustico e sforzo vocale.

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