

PSYCHOLOGICAL OUTCOMES AMONG TEACHERS IN SCHOOL ACOUSTIC CONTEXTS: A PRELIMINARY DESCRIPTIVE STUDY WITHIN THE INAIL BRiC PROJECT

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Abstract

Background: Teachers work in environments characterized by multiple occupational demands, while anxiety represents an important psychological outcome. However, evidence linking classroom acoustics to psychological outcomes remains limited. This preliminary study provides a descriptive overview of teachers' anxiety and the acoustic characteristics of the school environments in which they work.

Methods: Twenty-six teachers from three public schools (preschool, primary, and lower secondary) participated. State and trait anxiety were assessed using the State-Trait Anxiety Inventory Form Y (STAI-Y). Standardized acoustic measurements included Background Noise (NC), Reverberation Time (RT) and Speech Intelligibility (STI). Descriptive statistics and internal consistency analyses were performed.

Results: Complete anxiety data were available for 23 teachers. Mean STAI-State and STAI-Trait scores were 42.57 (SD = 9.20) and 42.04 (SD = 8.96), respectively. Descriptive statistics suggested some variability in anxiety levels across schools, while acoustic measurements reflected heterogeneous

environmental characteristics. No inferential analyses were performed to examine associations between anxiety and acoustic variables.

Conclusions: These preliminary findings show that standardized psychological assessments and objective acoustic evaluations can be conducted in educational settings and provide a basis for larger multidisciplinary studies.

Keywords: *state anxiety, trait anxiety, teachers, classroom acoustics, occupational health*

1. Introduction

Anxiety is a psychological response that may arise when situations are perceived as threatening. Although moderate levels of anxiety may facilitate alertness and adaptive responding, elevated anxiety may interfere with effective functioning [1]. State anxiety is influenced by both individual predispositions and the characteristics of the situation, supporting an interactional understanding of anxiety responses [2]. Workplace conditions, including excessive workload, high work pace, limited control, and poor physical working environments, may negatively affect workers' mental

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health [3]. Teaching can involve substantial occupational demands, and research has documented considerable variability in teachers' levels of stress, coping, self-efficacy, and burnout [4], [5]. Consequently, anxiety represents an important component of teachers' occupational well-being and so increasing attention has been devoted to educational teachers' psychological health. A recent scoping review of 33 studies found that teachers' vocal health was the most frequently investigated outcome, while other health and well-being outcomes were examined less consistently [6]. The review also highlighted limitations in the available evidence and called for further research to clarify how classroom acoustic conditions relate to teachers' health and well-being [6]. Individual studies have also considered psychological and occupational outcomes such as perceived stress, burnout, and self-efficacy alongside vocal health [7]. Furthermore, research conducted among Italian primary school teachers identified trait anxiety as a significant predictor of burnout, further supporting the importance of considering anxiety when investigating teachers' occupational well-being [12]. Other research has examined noise-related stress, vocal fatigue, and burnout among school teachers, highlighting the relevance of both noise sensitivity and teachers' subjective responses to classroom noise [8]. However, the available evidence presents several methodological limitations, and further research is needed to clarify how classroom acoustic conditions relate to teachers' well-being [6]. The present study was conducted within the framework of the INAIL BRiC 2024 Project (ID 07), a multidisciplinary research program investigating the extra-auditory effects of environmental noise in educational settings. The present exploratory study aimed to describe teachers' state and trait anxiety alongside an objective characterization of the acoustic conditions of the educational environments in which they worked.

2. Methods

2.1 Participants

Participants were recruited from three public schools representing three educational levels: preschool, primary school, and lower secondary school. To preserve confidentiality, the schools were anonymized as School 1, School 2, and School 3. Participation was voluntary and no financial or professional incentives

were provided. Only teachers who provided informed consent were included in the study.

2.2 Procedure

The study was conducted within the framework of the INAIL BRiC project. Schools in Central Italy were invited to participate in the project. Following agreement from the school administration, the aims and procedures of the study were presented to the teaching staff during dedicated meetings. Teachers who expressed interest in participating received detailed information about the study and provided written informed consent before enrolment. To ensure confidentiality, each participant was assigned a unique alphanumeric identification code. Questionnaire data were collected anonymously using Google Forms, and no directly identifying personal information was recorded. Participants completed the online questionnaire at their workplace using a dedicated link. Following completion of the psychological assessment, acoustic measurements were carried out by engineers from the INAIL BRiC research team. Measurements were performed in unoccupied classrooms, following standardized environmental acoustic assessment procedures, to characterize the objective acoustic conditions of each classroom independently of the presence of students or teachers. The acoustic measurements were considered contextual indicators of the educational environments and were not linked to individual participants. The study was conducted within the framework of the INAIL BRiC project. Project, which received institutional approval. Authorization to conduct the study was obtained from the Regional School Office and the participating school administrations. Participation was voluntary, all participants provided written informed consent, and questionnaire data were collected anonymously and processed in accordance with the applicable data protection regulations.

2.3 Measures

2.3.1 State-Trait Anxiety Inventory Form Y (STAI-Y).

The Italian version of the State-Trait Anxiety Inventory Form Y (STAI-Y) [1], [9] was used to assess state and trait anxiety. The instrument consists of 40 self-report items divided into 20-item subscales, assessing State Anxiety and Trait Anxiety. The State Anxiety (STAI-Y1) subscale assesses the intensity of anxiety experienced at the time of assessment, reflecting a transient emotional state. The Trait



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Anxiety (STAI-Y2) subscale evaluates a relatively stable predisposition to experience anxiety across situations. Each item is rated on a four-point Likert scale. Items are scored according to the STAI-Y manual, including reverse scoring where appropriate. The STAI-Y conceptualizes anxiety as a continuous construct rather than a categorical variable and therefore does not provide universally accepted diagnostic cut-off scores; higher scores indicate greater levels of state or trait anxiety. For descriptive purposes only, scores were classified as low, moderate, or high according to the thresholds proposed by [10]. These categories were not interpreted as diagnostic classifications.

2.3.2 Acoustic assessment

Objective acoustic measurements were performed by trained acoustic engineers to characterize the acoustic properties of the participating school environments. Assessments were conducted under unoccupied conditions following standardized procedures and current technical standards to evaluate the intrinsic acoustic characteristics of each setting. The acoustic assessment included indoor background noise (NC), reverberation time (RT) and speech intelligibility (STI). Reverberation time was measured according to UNI EN ISO 3382-1/2, whereas STI was assessed following IEC 60268-16. Measurements were obtained using a Class 1 sound level measurement system (SOLO 01dB-Stell) coupled with a Symphonie 01dB-Stell acquisition system and an omnidirectional dodecahedral sound source.

2.4 Statistical analysis

Descriptive statistics (mean, standard deviation, median, minimum and maximum) were calculated for participants' characteristics, State and Trait Anxiety scores and acoustic measurements. Internal consistency of the STAI-Y was evaluated using Cronbach's alpha. Acoustic measurements were obtained independently in each classroom associated with the participating teachers. Similar values observed across classrooms reflected comparable acoustic characteristics rather than repeated measurements of the same environment. Given the exploratory nature of the study, the limited sample size and the contextual nature of the acoustic measurements, no analyses of association between anxiety and acoustic variables were performed.

Missing values were present for some acoustic parameters owing to unavailable measurements. All statistical analyses were performed using jamovi (version 2.7; The jamovi Project, Sydney, Australia) [11]

3. Results

3.1 Sample characteristics and reliability

Complete STAI-State, STAI-Trait, and acoustic data were available for 23 teachers, who constituted the final analytical sample. Participants had a mean age of 48.58 years (SD = 8.72; range = 32-67 years), and most were women (n = 23, 88.5%). The majority were native Italian speakers (92.3%), worked full-time (92.3%), and had more than 15 years of teaching experience (50.0%). Additional occupational characteristics are presented in Table 1.

Table 1. Occupational characteristics of the study sample

Characteristic	n (%) / Mean $\pm$ SD
Teaching experience <5 years	4 (15.4)
Teaching experience 5–15 years	9 (34.6)
Teaching experience >15 years	13 (50.0)
Full-time employment	24 (92.3)
Part-time employment	2 (7.7)

3.2 State and trait anxiety

Descriptive statistics for anxiety scores are presented in Table 2. The mean STAI-State score was 42.57 (SD = 9.20), whereas the mean STAI-Trait score was 42.04 (SD = 8.96), indicating comparable levels of situational and dispositional anxiety within the sample. The STAI-State and STAI-Trait scales showed good and acceptable internal consistency, respectively (Cronbach's $\alpha = .899$ and $.759$). Participants were subsequently classified into low, moderate, and high anxiety categories according to the adopted scoring criteria. As shown in Table 3 and Figure 1 (A-B), approximately one-third of the sample fell within each category for state anxiety, whereas moderate trait anxiety represented the largest subgroup.

Table 2. Descriptive statistics and anxiety categories.

Variable	n	Mean (SD)	Low	Moderate	High
STAI-State	23	42.57 (9.20)	9 (39.1%)	6 (26.1%)	8 (34.8%)
STAI-Trait	23	42.04 (8.96)	7 (30.4%)	10 (43.5%)	6 (26.1%)

Table 3. Anxiety scores according to school



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School	Educational level	n	STAI-State Mean (SD)	STAI-Trait Mean (SD)
School 1	Preschool	4	40.3 (10.6)	38.5 (6.0)
School 2	Primary	2	46.0 (4.2)	41.0 (0)
School 3	Lower secondary	17	42.7 (9.6)	43.0 (10.0)

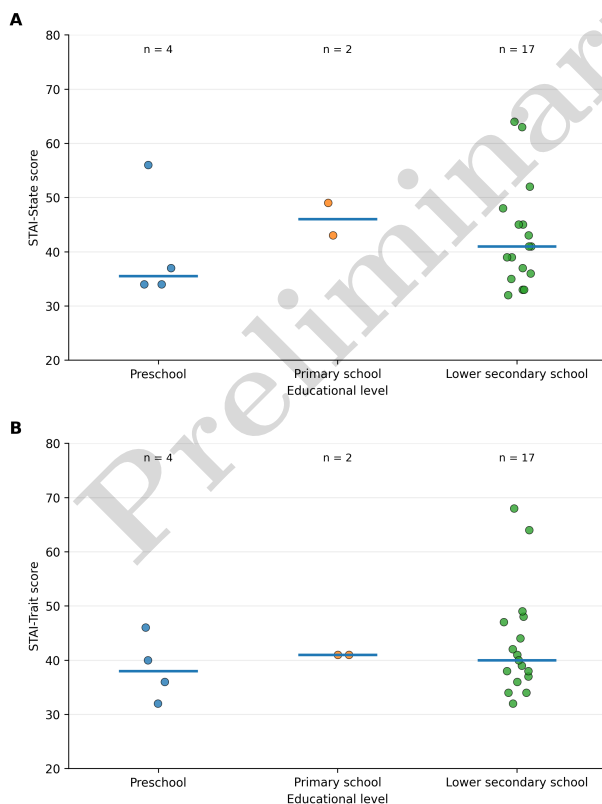
3.3 Acoustic characterization of the school environments

Descriptive statistics for the acoustic parameters are presented in Table 4. The measured classrooms showed variability in Noise Criterion (NC), Speech Transmission Index (STI), and reverberation time (RT). NC values ranged from 25 to 40, STI values from 0.510 to 0.740, and TR values from 0.14 s to 5.24 s.

Table 4. Descriptive statistics for the acoustic parameters.

Variable	n	Mean	SD	Median	Min	Max
NC	23	34.1	5.57	35	25	40
STI	20	0.599	0.083	0.560	0.510	0.740
RT	23	1.64	1.20	1.52	0.14	5.24

Figure 1 (A-B). Distribution of STAI-State (A) and STAI-Trait (B) scores across preschool, primary school, and lower secondary school teachers. Boxes represent the interquartile range, the horizontal line indicates the median, whiskers extend to $1.5 \times \text{IQR}$, and circles denote potential outliers.



4. Discussion

The present preliminary study provides a descriptive characterization of anxiety levels among teachers from the schools included in this study, together with objective measurements of classroom acoustic conditions. Overall, teachers reported similar mean levels of state and trait anxiety, while some descriptive variability was observed across the participating schools. These observations are consistent with previous evidence indicating that teaching is a profession characterized by multiple occupational demands, with teachers showing heterogeneous psychological responses to their working environment [4], [5]. Previous research has identified anxiety as a relevant component of teachers' occupational well-being, linking it to burnout and work-related distress [12]. At the same time, growing interest has focused on the possible role of classroom acoustics in influencing teachers' health, even though the available evidence is still relatively limited [6], [7], [8].

The acoustic assessment carried out in the present study highlighted variability in the measured classroom acoustic parameters, indicating heterogeneity in the acoustic characteristics of the surveyed educational environments. Although the present study did not examine associations between anxiety and acoustic parameters, the findings provide an initial descriptive characterization of both teachers' anxiety and classroom acoustics that may inform the design of future analytical studies. Combining standardized psychological assessment with objective acoustic measurements may provide a valuable multidisciplinary framework for future research in educational environments. These findings should be interpreted considering several limitations. First, the sample was relatively small and unevenly distributed across the three schools. In addition, the descriptive cross-sectional design precluded inferential analyses and did not allow the investigation of relationships between psychological and acoustic variables. Furthermore, acoustic measurements were performed under standardized unoccupied classroom conditions and should therefore be regarded as contextual indicators of classroom acoustic characteristics rather than estimates of individual teachers' daily acoustic exposure. Future studies including larger samples, multiple classroom measurements, and analytical designs will be needed to better clarify the relationship between classroom acoustics and teachers' psychological well-being.



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5. Conclusion

This preliminary study offers an initial overview of teachers' anxiety levels alongside an objective characterization of the acoustic conditions in different school environments. While the present findings do not allow conclusions to be drawn regarding the relationship between classroom acoustics and anxiety, they support the feasibility of integrating standardized psychological assessment with objective acoustic characterization in educational settings. Further multidisciplinary research will be needed to better understand the potential contribution of classroom acoustics to teachers' occupational well-being.

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