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# Annoyance and noise sensitivity of teachers in relation to age, gender and measured noise in schools of Sao Paulo, Brazil

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## ABSTRACT

Noise is an environmental problem, especially in urban areas, affecting activities related to teaching and learning. Our aim was to investigate teachers' annoyance and sensitivity to noise. Methods: Noise meters were installed outside the buildings of seven schools. Measurements took place for one week (Sound level meter with data logger). It was calculated: daytime noise ($L_{day}$, 7AM-6:59PM, operation hours); background noise outside school hours ($L_{bg,}$ 5:30AM-6:59AM, 7:00PM-8:59PM). We asked 85 teachers about noise sensitivity (NoiSeQ-R) using a 4-point verbal scale; and annoyance using the 11-point numerical ICBEN scale. Mixed linear regression modeling was conducted to estimate associations measures. Results: The mean age of teachers was 44.4 (standard deviation: 7.8) years, most women (93%). Average $L_{day}$ was 65.7 (3.18) dB(A) and average $L_{bg}$ was 53.6 (1.0) dB(A). Regarding annoyance, the highest average was 6.3 (3.5) for conversation/shouting, followed by noise from other schools (5.4 (3.3) points). Teachers in the age group of 40 to 49 years were mostly annoyed about noise from nearby schools (p=0.034 compared to <40 years, p=0.259 for >50 years); whereas teachers > 50 years tended to be more annoyed from aircraft noise (p=0.070). General sensitivity to noise was highest in middle-aged teachers (40-49 years; p<0.001). Gender and $L_{day}$ were not associated with any annoyance measure but higher measured noise during the day was related to higher noise sensitivity scores (p=0.040). Conclusion: Noise levels present in schools are above recommended limits and results suggested negative age dependent impacts on teachers.

Keywords: Noise, annoyance, sensitivity, teacher, teaching and learning.

## INTRODUCTION

Noise has been found as a non-specific biological stressor which can cause negative effects that include speech interference, annoyance, sleep disturbance, cardiovascular problems, disorder in cognitive function and memory, and effects on behavior (1,2,3).

In learning environments, noise may affect teachers in many ways and studies showed that the level of noise a preschool teachers' is exposed were to was well above the health and safety legislation limit (4,5).

The type of noise and its characteristics, the duration of exposure, individual characteristics, and noise sensitivity determine the detrimental effects of noise (2). Previous study showed that some characteristics like age, gender, genetics, underlying diseases, personality traits, and other such as noise sensitivity could be involved in noise-induced non-hearing effects (6).

Our aim was to investigate teachers' annoyance and sensitivity to noise and whether some individual characteristics or the measured noise may be related to the perception of annoyance or sensitivity to noise.

## MATERIALS AND METHODS

### *Study Design*

This cross-sectional study involved the measurement of sound pressure levels in seven public schools in the western region of Sao Paulo (Figure 1), Brazil, and the application of questionnaires with teachers from these schools.

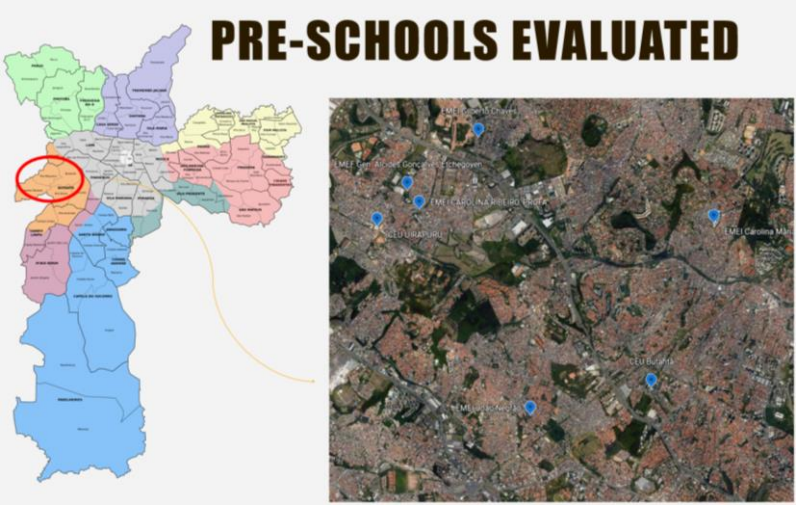


Figure 1: Western region of São Paulo (left) and seven schools evaluated (blue markers in map) (right)

### *Noise Measurements*

The noise meters (Noise Sentry RT type-II sound level meter data logger - Convergence Instruments, Sherbrooke, QC, Canada) were mounted within the schools' property, at external part of the building, what was considered to be the most exposed façade - facing the busiest streets. Special attention was given to the height of microphone positioning (height of 2-3 m).

Noise meters measured sound pressure levels (LAeq) averaged over one second intervals continuously for one week (7 to 15 March 2022 in all schools). Each sampling site was geocoded with a Global Positioning System (GPS).

The devices were calibrated before and after deployment in the field at 94 dB(A) (Pulsar Acoustic Calibrator Model 105 Class 1).

It was calculated: It was calculated: daytime noise ($L_{day}$, 7AM-6:59 PM, operation hours); background noise outside school hours ($L_{bg}$, 5:30AM - 6:59AM, 7:00PM - 8:59PM).

***Survey with teachers***

Questionnaires and scales were applied with 85 teachers of these schools:

- Noise Sensitivity Questionnaire - NoiSeQ-R (7): questions appraising work (four questions) and general (one question) sensitivity using a 4-point verbal scale going from “strongly disagree” to “strongly agree” (score values from 0 to 3).

- ICBEN (International Commission on Biological Effects of Noise) scale ranging from 0 to 10 (8,9): annoyance related to different noise sources using the 11-point numerical.

***Statistical analysis***

A mixed linear regression modeling was conducted to estimate association between the relevant variables from the questionnaires / scales and age, gender and measured noise. We adopted the level of alpha error to be less than 0.05.

## RESULTS

The mean age of teachers was 44.4 (SD: 7.8) years, most women (93%). Mean $L_{day}$ was 65.7 (SD: 3.18) dB(A) and mean $L_{bg}$ was 53.6 (SD: 1.0) dB(A).

Regarding noise annoyance (ICBEN scale), the highest mean was 6.3 (SD: 3.5) points for conversation/shouting, followed by road traffic 5.4 (SD: 3.3) points and street fair/parties 5.1 (SD: 3.8). Teachers in the age group of 40 to 49 years were mostly annoyed about noise from nearby schools (p=0.034 compared to <40 years, 0.259 for >50 years); whereas teachers > 50 years tended to be more annoyed from aircraft noise (p=0.070) (Table 1).

Table 1 - Mixed linear regression coefficients by annoyance categories.

| | Annoyance (ICBEN scale) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Road Coef | Parties Coef | School Coef | Shouting Coef | Aircraft Coef | Store Coef | Pub Coef | Neighbours Coef | Animals Coef |
| **Age (in years)** | | | | | | | | | |
| **28-39** | Ref[$] | Ref[$] | Ref[$] | Ref[$] | Ref[$] | Ref[$] | Ref[$] | Ref[$] | Ref[$] |
| **40-49** | -0.46 | 0.20 | 1.89* | 1.59** | -0.13 | 0.26 | 0.16 | 0.57 | 0.54 |
| **50-61** | -0.56 | 0.72 | 1.10 | -0.42 | 1.56** | -0.13 | 0.67 | 0.01 | 0.78 |
| **Gender** | | | | | | | | | |
| **Female** | - | - | - | - | - | - | - | - | - |
| **Male** | 0.85 | 0.41 | -0.29 | -1.18 | 1.63 | 0.18 | -1.30 | 0.72 | 1.13 |
| **$L_{day}$** | 0.13 | 0.02 | -0.07 | 0.01 | -0.10 | -0.08 | 0.05 | -0.01 | -0.09 |

Legend: Coef – coefficient; p-value - *p<0.05; **p=0.07; [$]Reference category

Table 2 - Mixed linear regression coefficients by categories of NoiSeQ-R.

| | General Coef | Work Coef |
|---|---|---|

| | | |
|---|---|---|
| **Age (in years)** | | |
| **28-39** | Ref[$] | Ref[$] |
| **40-49** | 0.82* | 0.16 |
| **50-61** | 0.28 | -0.19 |
| **Gender** | | |
| **Female** | Ref[$] | Ref[$] |
| **Male** | -0.1 | 0.51 |
| **$L_{day}$** | 0.05 | 0.04 |

Legend: Coef - coefficient; p-value - *p<0.05; **p=0.07; [$]Reference category

Regarding the NoiseQ-R, the mean general sensitivity to noise was 2.07 (SD: 0.89) and sensitivity to noise at work was 8.77 (SD:2.66). General sensitivity to noise was highest in middle-aged teacher (40-49 years; p<0.001) (Table 2). Gender and $L_{day}$ were not associated with any annoyance measure but higher measured noise during the day was related to higher noise sensitivity scores (p=0.040).

## DISCUSSION

We found that the variation in noise between schools is small and our sample is also small. Thus, the significant associations become more challenging to observe.

In general, we observed that middle-aged teachers were more annoyed and sensitive to noise. A previous study found that noise annoyance after 30 years constantly decreases with age, following an inverted-U pattern (10). Contrarily, another study that investigated rail noise in people aged between 5 and 75 years found that people in the 40 to 50 age group were more annoyed by noise (11). Therefore, several factors, such as age distribution, research method, among other variables, can influence on the effect of age on noise annoyance (12).

In our study, gender is not associated with any annoyance measure. Our findings are different from study of Abbasi et al. (2) that verified significant differences in responses between females and males during noise exposure. The authors found that the women were more sensitive to noise and experienced more noise-induced annoyance and fatigue.

Concerning measured noise, $L_{day}$ was not associated with any annoyance measure. However, higher measured noise during the day was related to higher NoiseQ score. This might indicate that teachers get more sensitive if exposed to high noise level. Different individuals can exhibit different reactions of annoyance to the same noise, and these individual differences can be attributed in part to differences in sensitivity to noise (13). In addition, noise annoyance and sensitivity are influenced by many psychological, economic and social factors (14).

Noise sensitivity can be considered an individual personality trait (15). Also, individual responses to noises depends on non-acoustical factors such as individual personalities, attitudes toward noises, previous experiences, and exposure to the noise environment, and acoustical factors such as noise levels and frequency characteristics. Therefore, to explain noise sensitivity, it is necessary to consider the characteristics of the noise itself and the various non-acoustical factors that affect individual responses (16).

Additional studies are needed, with a larger sample and taking into account other confounding variables.

## CONCLUSION

Noise levels present in schools are above recommended limits and results suggested negative age dependent impacts on teachers. The scales suggested that the noise present during classes has negative impacts on teachers, which can have consequences for the health of these individuals.

## REFERENCES


1. Basner, M.; Babisch, W.; Davis, A.; Brink, M.; Clark, C.; Janssen, S.; Stansfeld, S. Auditory and non-auditory effects of noise on health. Lancet 2014, 383, 1325–1332.

2. Abbasi, A.M.; Darvishi, E; Rodrigues, M.A.; Sayehmiri, K. Gender differences in cognitive performance and psychophysiological responses during noise exposure and different workloads. Applied Acoustics 2022, 189, 108602.

3. Tangermann, L., Vienneau, D., Saucy, A., Hattendorf, J., Schäffer, B., Wunderli, J. M., & Röösli, M. The association of road traffic noise with cognition in adolescents: A cohort study in Switzerland. Environmental Research 2023, 218, 115031.

4. Kristiansen, J., Lund, S. P., Nielsen, P. M., Persson, R., & Shibuya, H. Determinants of noise annoyance in teachers from schools with different classroom reverberation times. Journal of Environmental Psychology 2011, 31(4), 383-392.

5. Tomek, R. & Urhahne D. Relating teachers' coping styles to student noise and perceived stress, Educational Psychology 2022, 42(3), 375-395.

6. Golmohammadi R., Darvishi E. The Combined Effects of Occupational Exposure to Noise and Other Risk Factors: A Systematic Review. Noise Health 2019;21:125–41.

7. Griefahn, B., Marks, A., Gjestland, T., Preis, A., 2007. Annoyance and noise sensitivity in urban areas. In: Pap. Present. ICA 2007 (Madrid).

8. Brink, M., Schreckenberg, D., Vienneau, D., Cajochen, C., Wunderli, J. M., Probst-Hensch, N., & Röösli, M. Effects of Scale, Question Location, Order of Response Alternatives, and Season on Self-Reported Noise Annoyance Using ICBEN Scales: A Field Experiment. International journal of environmental research and public health 2016, 13(11), 1163.

9. Fields, J.M., De Jong, R.G., Gjestland, T., Flindell, I.H., Job, R.F.S., Kurra, S., Lercher, P., Vallet, M., Yano, T., Guski, R., Felscher-Suhr, U., Schumer, R. Standardized general-purpose noise reaction questions for community noise surveys: research and a recommendation. Journal of Sound and Vibration 2001. 242, 641- 679.

10. Van Gerven, P.W.M.; Vos, H.; Van Boxtel, M.P.J.; Janssen, S.A.; Miedema, H.M.E. Annoyance from environmental noise across the lifespan. Journal of Acoustical Society of America 2009;126(1):187–94.

11. Tang, J.; Liu, Y.; Luo, Y.; Lu, K. On the annoyance of residents along urban rail viaduct lines caused by low frequency noise. Urban Mass Transit 2017, 20 (10) 25-29.

12. Ni, K; Huang, Y. An investigation of the age effect on acoustical annoyance developed from data of previous studies. Applied Acoustics 2022. 192, 108720.

13. Shepherd, D., Welch, D., Dirks, K. N., & Mathews, R. Exploring the relationship between noise sensitivity, annoyance and health-related quality of life in a sample of adults exposed to environmental noise. International journal of environmental research and public health 2010, 7(10), 3579–3594.

14. World Health Organization. Guidelines for Community Noise. World Heal. Organ, Geneva, Switz. 1999.

15. Zimmer, K. & Ellermeier, W. Psychometric properties of four measures of noise sensitivity: A comparison. *Journal of Environmental Psychology 1999.* 19, 295–302.

16. Jo, H.I., Lee, K. & Jeon, J.Y. Effect of noise sensitivity on psychophysiological response through monoscopic 360 video and stereoscopic sound environment experience: a randomized control trial. Scientific Reports 2022. 12, 4535.