

Factors associated with perception of loud occupational noise by school teachers in basic education in Brazil

Fatores associados à percepção de ruído ocupacional intenso pelos professores da educação básica no Brasil

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ABSTRACT: *Objective:* To determine the prevalence of the perception of loud noise in basic education schools in Brazil and the associated factors. *Methods:* A cross-sectional study with a representative national sample of teachers. The data collection was conducted with 6,510 teachers from October 2015 to March 2016. All teachers answered a telephone questionnaire with questions related to health and working conditions. The measure of association was prevalence ratio, estimated using Poisson regression. *Results:* The prevalence of reported loud occupational noise was 33.0%. There was a positive association in the outcome of classroom disturbance reports (PR = 3.41; 95%CI 3.07 – 3.75), feeling of working under high-pressure levels (PR = 1.33; 95%CI 1.22–1.45), having suffered verbal abuse from students (PR = 1.21; 95%CI 1.11–1.31), teaching in different teaching modalities (PR = 1.21; 95%CI 1.02–1.42), more than 30 active teachers in the school (PR = 1.28; 95%CI 1.07–1.54). The teachers who reported a pleasant school environment (PR = 0.81; 95%CI 0.75–0.87), along with the teachers who worked in rural areas (PR = 0.84; 95%CI 0.75–0.95), experienced less noise at work. *Conclusion:* The prevalence of loud noise perception in Brazilian schools reached high levels and showed statistical significance with the characteristics of schools and teacher's work environment. These results demonstrate the need for developing public policies that take into consideration the reduction of noise levels in schools.

Keywords: Occupational noise. Teachers. Occupational health. Working conditions. Cross-sectional studies.

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RESUMO: *Objetivo:* Estimar a prevalência e os fatores associados à percepção de ruído intenso nas escolas da educação básica no Brasil. *Métodos:* Estudo transversal com amostra nacional representativa dos professores. A coleta de dados foi realizada com 6.510 professores, de outubro de 2015 a março de 2016. Todos os professores responderam a um questionário via telefone com perguntas referentes à saúde e às condições de trabalho. A medida de associação foi a razão de prevalência (RP), estimada com a regressão de Poisson. *Resultados:* A prevalência de ruído ocupacional intenso referido foi de 33,0%. Houve associação positiva ao desfecho os relatos de agitação em sala de aula (RP = 3,41; IC95% 3,07 – 3,75), percepção de trabalhar sob alto nível de exigência (RP = 1,33; IC95% 1,22 – 1,45), ter sofrido violência verbal praticada pelos alunos (RP = 1,21; IC95% 1,11 – 1,31), lecionar para diferentes modalidades de ensino (RP = 1,21; IC95% 1,02 – 1,42) e a escola contar com número de professores atuantes superior a 30 (RP = 1,28; IC95% 1,07 – 1,54). Os professores que relataram um ambiente agradável na escola (RP = 0,81; IC95% 0,75 – 0,87), assim como os que atuavam na área censitária rural (RP = 0,84; IC95% 0,75 – 0,95), perceberam menor ruído no trabalho. *Conclusão:* A prevalência de percepção de ruído intenso nas escolas brasileiras foi elevada e apresentou significância estatística com as características da escola e do trabalho de professores da educação básica. Esses achados demonstram a necessidade de planejamento de políticas públicas que considerem a redução dos níveis de ruído no ambiente escolar.

Palavras-chave: Ruído ocupacional. Docentes. Saúde do trabalhador. Condições de trabalho. Estudos transversais.

INTRODUCTION

Noise has become one of the major environmental problems in large urban centers and is thus considered a threat to public health¹. In the school environment, records show that noise levels vary from 68 to 80 dB (A) in the classroom, higher than the recommended level of 40 to 50 dB (A), according to Brazilian technical guidelines (NBR 10.152/ABNT)². In elementary schools, it was found that teachers' voice intensity ranged from 54.3 to 86.6 dB (A), showing a positive correlation with the noise level of the classroom. The higher the noise level, the greater the need was for the teacher to raise his/her voice to be heard and able to communicate³, thus hampering the development of the class and the interaction between teacher and students⁴⁻⁶.

In addition, loud noise has been one of the occupational risk factors for the development or worsening of morbidity in these professionals⁵. To elucidate the damage to teachers' health, noise assessment in schools can be carried out objectively^{3,4,7} or in a perceptive way⁸⁻¹¹. The objective measurement enables comparisons to the levels recommended by current standards. The perceptual form refers to the report of the subject exposed to noise, which provides valuable information for understanding the problem¹¹.

The prevalence of teachers' perception of loud noise in Brazil has ranged from 25 to 90% in recent years^{8,10}. Among the consequences of noise to the health of these professionals, auditory and non-auditory morbidities, such as voice disorders, stress, concentration

disturbances and irritability^{5,11}, are among the most cited. In addition, cognitive fatigue at the end of the day is another reported consequence¹².

In Brazil, public policies have been established to deal with noise pollution in the country¹³⁻¹⁵. However, it is necessary to extend our knowledge of the relationship between noise in schools, sociodemographic characteristics and working conditions of teachers, to assist in proposals for interventions.

Therefore, the aim of the present study was to determine the prevalence of the perception of loud noise in basic education schools in Brazil and the associated factors.

METHODS

This was a cross-sectional study with a national representative sample of Brazilian school teachers, approved by the Research Ethics Committee of the Federal University of Minas Gerais (UFMG) (CAAE 48129115.0.0000.5149, judgment 1.305.863).

To perform the sample calculation, data from the 2014 Census were considered¹⁶. The estimated sample size was 6,500 teachers, to obtain a minimum number of interviews considering the sampling criteria established. Stratified sampling was performed by simple random selection in the strata, proportional to the number of teachers. The stratification was defined based on a plan that considered the characteristics of the national education system and the combination of domains of interest pre-established for the study: macroregion; census area; age group; sex; administrative dependence of the school; type of connection; and teaching level.

To calculate the sample size, the 95% confidence level was considered; 20% maximum refusal, maximum error of about 2 percentage points and 38% prevalence of at least one absence from work. Those who no longer worked at school at the time of contact for the interview were considered ineligible; and losses included those who worked in schools without a telephone or where the contact telephone number obtained from the 2014 School Census was wrong, and those who did not respond to 15 contact attempts to conduct the interview. At the end of the data collection, weighting was performed in which sample weights were associated with each participant, as well as the treatment of non-response cases. More details on aspects of sample design are presented in another publication¹⁷.

In addition to the primary data from the interviews cited in this article, administrative data from the 2014 School Census were used. The census is a declarative survey conducted annually by the National Institute for Educational Studies and Research Anísio Teixeira (INEP), an agency linked to the Ministry of Education. Primary data were obtained through the Educatel questionnaire¹⁸. It is a questionnaire prepared by researchers at the Center for Health and Work Studies (NEST/UFMG), which is based on validated questions that investigated course and workload, the perception of psychosocial aspects of work, absenteeism, conditions of work environment, health, lifestyle and socioeconomic aspects. The adequacy and applicability of the instrument were tested in a pilot study. Data collection was

performed by telephone between October 2015 and March 2016, conducted by a company hired for this purpose.

The perception of loud noise was considered a dependent variable and was determined through the following question: “How often is the noise at work so loud that you have to raise your voice to talk to someone?” The possible answers were: “often”, “sometimes”, “rarely” and “almost never or never”. The dichotomization occurred in:

- “sometimes”, “rarely”, “almost never or never”;
- “often”.

The other variables studied were analyzed as independent variables, composed by:

- sociodemographic characteristics: sex*, age*, race, marital status, number of children, census area*;
- working conditions: time working at school, number of teachers per school*, teaching levels*, weekly workload, number of teaching aids*, demands at work, calm and pleasant environment at school, environment disturbed by indiscipline, and verbal abuse from students.

The variables identified by * correspond to the variables of the questionnaires employed in the 2014 School Census.

The variable “number of teaching aids” was constructed to investigate the relationship between noise and the absence or insufficiency of teaching resources, considering that the presence of such equipment, such as video player and overhead projector, support classroom activities¹⁹. The number of teaching aids was grouped from 0 to 10, from 11 to 30 and over 30.

The variables “high demands at work”, “calm and pleasant environment” and “unruly environment” were defined from the following questions, respectively: “Does your job demand too much from you?”; “Is there a calm and pleasant environment where you work?”; and “How often is your work environment unruly because of student indiscipline?” For these questions, the possible answers were: “often”, “sometimes”, “rarely” and “almost never or never”. The categorization occurred in: “yes” for the answer “often”, and “no” for the answers “sometimes”, “rarely” and “almost never or never”.

“Verbal violence from students” investigated by the question, “In the last 12 months, have you suffered verbal violence from students?” The answer options were “never”, “once” and “two or more times”. The categorization was performed as: “yes” for “once” and “two or more”; and “no” for “never”.

The measure of association was the prevalence ratio (PR), determined using Poisson regression, and statistical inference was according to the 95% confidence interval (95%CI). Thus, in the first stage, the association between loud noise and independent variables was determined. In the second stage, those variables with $p \leq 0.20$ were included in the multivariate model. The sequential deletion procedure was used, starting with the exclusion of those variables with the higher p value until only the variables with $p \leq 0.05$ were submitted to the model. The “svy” procedure (with weighting factors) was used, suitable for data

analysis obtained by a complex sampling plan. In all stages, the deviance test was used to determine the adequacy of the model with 5% significance.

The data collected were digitized and analyzed using Microsoft Excel and STATA 13.0 (STATA Corp., College Station, TX, United States).

RESULTS

A total of 6,510 Brazilian school teachers were interviewed. Regarding eligible teachers, there was a loss of 14.8% due to refusal to participate or situations in which it was not possible to conduct the interview with the selected individual.

We found a 33.0% prevalence of perception of loud noise in the schools. Univariate analysis showed that teachers from rural areas had a lower prevalence of perceived loud noise when compared to those from urban areas (PR = 0.75; 95%CI 0.66 – 0.86). The other socio-demographic variables showed no differences between the groups (Table 1).

Regarding working conditions, there was a predominance of reports of intense noise in schools with more than 30 teachers (36.6%), compared to schools with up to 10 teachers and those teaching combined stages (35.9%), having as reference those who taught youth and adult classes and vocational classes. Working with weekly workload of 40 hours (33.2%) or more (40.5%), compared to those working less than 20 hours, increased the prevalence of perception of loud noise. Regarding teaching resources, there was a lower frequency of reported loud noise perception in schools with more than 31 teaching aids (27%), compared to when teachers worked in schools with less teaching equipment. Teachers who reported working under high demands (41.4%), in an environment disturbed because of indiscipline (68.4%), as well as having experienced verbal abuse from students (52.4%) noticed loud noise more frequently, compared to those who had no such work experiences. Most teachers who reported that the work environment was not calm and pleasant also reported high noise levels (47.1%) (Table 2).

In the final model, the following remained associated with at the 5% significance level: rural area (PR = 0.84; 95%CI 0.75 – 0.95); teaching more than one education level (PR = 1.21; 95%CI 1.02 – 1.42); more than 30 teachers per school (PR = 1.28; 95%CI 1.07 – 1.54); environment disturbed by indiscipline (PR = 3.41; 95%CI 3.07 – 3.75); verbal violence from students (PR = 1.21; 95%CI 1.11 – 1.31); calm and pleasant environment at school (PR = 0.81; 95%CI 0.75 – 0.87); and high work demands (PR = 1.33; 95%CI 1.22 – 1.45) (Table 3). The model showed good fit according to the deviance test ($p = 1.00$).

DISCUSSION

This study aimed to determine the prevalence of perception of loud noise and associated factors, in a representative sample of Brazilian teachers. The loud noise mentioned

was significantly positively associated with reports of classroom disturbance, verbal violence from students, perception of working under high demands, teaching for different modalities and more than 30 teachers working in the school. Basic education teachers who reported a pleasant environment at school, as well as those working in rural areas, noticed less noise at work compared to those who did not report pleasantness and taught in urban areas.

For the first time in the country, results were obtained regarding the perception of loud noise, representing the population of teachers working in primary schools. However, these results are not optimistic due to the high prevalence found: one-third of teachers reported

Table 1. Prevalence of loud occupational noise perceived by Brazilian teachers and prevalence ratios according to sociodemographic characteristics, Educatel 2015–2016 (n = 6,510).

Variables	Loud noise at work	
	Frequently (%)	PR (95%CI)
Sex		
Male	33.6	1
Female	32.9	0.97 (0.90 – 1.06)
Age (years)		
Up to 34	33.1	1
35 to 44	33.3	1.00 (0.90 – 1.11)
45 to 54	34.3	1.03 (0.92 – 1.15)
Over 55	28.8	0.87 (0.74 – 1.02)
Race		
Not declared	33.9	1
White	33.7	0.99 (0.89 – 1.09)
Brown	31.1	0.91 (0.81 – 1.03)
Black/Yellow/Indigenous	31.9	0.94 (0.75 – 1.18)
Marital status		
Single	31.4	1
Married/widowed with partner	33.6	1.07 (0.96 – 1.18)
Divorced/separated/widowed	34.1	1.08 (0.93 – 1.26)
Children		
No	33.4	1
Yes	32.9	0.98 (0.90 – 1.07)
Census area		
Urban	34.4	1
Rural	26.1	0.75 (0.66 – 0.86)

PR: prevalence ratio; 95%CI: 95% confidence interval.

Table 2. Prevalence of loud occupational noise perceived by Brazilian teachers and prevalence ratios according to working conditions, Educatel 2015–2016 (n = 6,510).

Variables	Loud noise at work	
	Frequently (%)	PR (95%CI)
Time working at school (years)		
Less than 10	33.6	1
10 to 20	32.3	0.96 (0.86 – 1.06)
More than 20	32.8	0.97 (0.87 – 1.09)
Number of teachers per school		
Up to 10	22	1
11 to 20	28	1.27 (1.02 – 1.59)
21 to 30	32.6	1.48 (1.19 – 1.84)
More than 30	36.6	1.66 (1.36 – 2.02)
Teaching level		
EYA and vocational education	21.6	1
Pre-school	27.4	1.26 (0.99 – 1.61)
Elementary	34.6	1.60 (1.30 – 1.97)
Middle	32.8	1.51 (1.21 – 1.90)
Others ^a	35.9	1.66 (1.37 – 2.02)
Weekly workload (hours)		
Less than 20	26.1	1
20 to 39	29.8	1.14 (0.93 – 1.39)
40	33.2	1.27 (1.04 – 1.54)
More than 40	40.5	1.55 (1.27 – 1.88)
Number of teaching aids		
Over 31	27	1
11 to 30	36.4	1.34 (1.15 – 1.57)
0 to 10	31.6	1.17 (1.00 – 1.36)
High demands at work		
No	22.8	1
Yes	41.4	1.80 (1.64 – 1.98)
Environment disturbed by indiscipline		
No	16.5	1
Yes	68.4	4.15 (3.79 – 4.54)

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Table 2. Continuation.

Variables	Loud noise at work	
	Frequently (%)	PR (95%CI)
Verbal abuse from students		
No	24.8	1
Yes	52.4	2.11 (1.94 – 2.28)
Calm and pleasant environment at school		
No	47.1	1
Yes	25.7	0.54 (0.50 – 0.59)

PR: prevalence ratio; 95%CI: 95% confidence interval; EYA: education of youths and adults; ^acombined teaching modality.

Table 3. Final model of factors associated with perception of loud occupational noise among Brazilian school teachers, Educatel 2015–2016 (n = 6510).

Variables	Loud noise at work
	PR (95%CI)
Census area	
Urban	1
Rural	0.84 (0.75 – 0.95)
Teaching level	
EYA and vocational education	1
Pre-school	1.21 (0.98 – 1.49)
Elementary	1.15 (0.96 – 1.37)
Middle	1.14 (0.94 – 1.39)
Others ^a	1.21 (1.02 – 1.42)
Number of teachers per school	
Up to 10	1
11 to 20	1.15 (0.94 – 1.40)
21 to 30	1.16 (0.96 – 1.41)
More than 30	1.28 (1.07 – 1.54)
Environment disturbed by indiscipline	
No	1
Yes	3.41 (3.07 – 3.75)

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Table 3. Continuation.

Variables	Loud noise at work
	PR (95%CI)
Verbal violence from students	
No	1
Yes	1.21 (1.11 – 1.31)
Calm and pleasant environment in school	
No	1
Yes	0.81 (0.75 – 0.87)
High demands at work	
No	1
Yes	1.33 (1.22 – 1.45)

PR: prevalence; 95%CI: 95% confidence interval; EYA: education of youths and adults; ^acombined teaching modality.

the need to raise their voice due to the loud noise in the school. The results are in agreement with the literature, as noise is an environmental problem in education, observed in Brazil⁷ and other countries^{11,20}. A previous study found that 41% of school teachers (n = 90) in the state of Minas Gerais reported high to unbearable noise in the school⁸. In São Paulo there was a 25 to 90% variation in noise reports (n = 165 teachers) in different basic education schools⁹. In Denmark, 59% of teachers reported being exposed to disturbing noise for at least a quarter of their work time, which is higher than the average of all other occupational groups (42%)¹². The interpretation of reports of loud noise suggests the need for the teacher to make vocal adjustments beyond what is usually expected to be able to communicate in the classroom³.

Knowing the factors associated with the perception of noise in the school context, through its impact on oral communication, allows us to identify precarious work situations that trigger morbidities, which may or may not be modifiable. As the subject experiences loud noise in the workplace, the likelihood of vocal symptoms increases, especially pain and dryness in the throat⁸. One study found that the frequency of reported vocal alteration was significantly higher (60%) among those who complained of loud to unbearable noise, both in the classroom and other areas of elementary schools in Florianópolis, Brazil.²¹ It is known that the teacher develops skills and creates strategies, including changing the vocal pattern, to deal with the manifestations of indiscipline²².

The overall noise intensity at a school is related to the number of people working in it²³. In a convergent way, the results described showed a 28% higher proportion of loud noise reports in schools with more than 30 teachers. Aspects of school infrastructure, related to room acoustics and the number of students in each class, may or may not favor this view²⁴.

Regarding teaching level, teaching for different modalities was associated with a higher prevalence of loud noise perception compared to teaching in youth and adult education and vocational education. The profile of the student (child or adolescent) and the characteristics of the curriculum and pedagogical strategies in use, requiring more or less interaction in the classroom, would tend to explain the extent of communicative activities for each modality²⁵. Adapting to different work processes tends to require more adjustments in oral communication, which may explain the result found. In addition, the teacher who works in more teaching modalities is more likely to face prolonged working hours and consequently would be more exposed to noise. The example of university professors, although not reflecting the characteristics of the sample analyzed, reinforces the associations found. It was observed that, in higher education, strategies for student education have a more favorable environment for sound comfort and less demanding oral communication standards¹⁰.

Teaching in rural areas was associated with a lower prevalence of reporting loud noise. The result is consistent, considering the lower turmoil in this area when compared to the urban one²⁶. Lower environmental noise intensity and fewer students in the classroom, characteristic of the rural school environment, may explain the result.

The perception of intense noise was most commonly reported among those who worked in an environment stirred by the indiscipline of students. This result is understandable since indiscipline characterized, for example, by constant conversations about or outside the content or object of the class, or even by movement in the class would be sources of local noise. There is a direct relationship between noise and tension perception between students and teachers²². On the other hand, it was found that the calm and pleasant environment decreased the prevalence of the report that characterized the outcome. These findings reinforce that part of the perception of loud noise at school is a product of the relational context between teachers and students^{4,6}.

Converging with the above interpretation, exposure to verbal abuse from students, increased the prevalence of intense noise perception. It is possible that family, generational and social needs are expressed in less environmentally friendly behaviors like in school. If the school is guaranteeing the principle of equal access, it will have to prepare for the new student profile. Or would the school be poorly equipped to receive and deal with heterogeneous student body? In one case or another, we would have explanatory elements for aggressive and violent events²⁷.

One should recall that a negative psychosocial environment is associated with a worse physical and mental health situation²⁸. Danish teachers (n = 107) reported a more competitive, conflicting and less comfortable social climate, with a greater intention to quit work in schools whose classrooms produced more reverberation⁴. The perception of intense noise was more often among those who worked under high demands in the scope of professional practice. The results corroborate previous research that showed that teachers working under high demands have higher prevalence of disease complaints²⁹, including voice disorders³⁰.

It is noteworthy that the question used as a reference to assess the perception of loud noise evoked an important feature by mentioning the need for the respondent to raise his

voice to communicate. The fact that teachers reported raising their voice in situations of exposure to intense noise, indiscipline, and in the face of episodes of verbal violence may indicate their attempt to control the classroom environment using their voice. But it is possible that the group with voice disorders was more likely to report a noisy environment. On the other hand, this perception may indicate a higher risk of developing vocal and emotional problems due to cumulative effects, especially at the end of the day, when vocal and mental fatigue overlap¹².

The associations between the perception of intense noise and the teachers' working conditions found in this study were consistent. It is worth mentioning, however, the limitations of our study. Since this was a cross-sectional study, it was not possible to establish causal inferences between the associations found. The interview is an instrument prone to memory bias, and it may have been minimized when the questions referred to recent periods for the investigated event. In addition, no hearing complaints were evaluated, which may compromise sound perception. Classroom noise exposure is not commonly attributed to noise-induced hearing loss.¹², given the intensity at which it occurs. However, auditory symptoms such as tinnitus are reported⁹.

The measure to evaluate noise in this study was advantageous when considering the subject's perception, since the objective measurement of noise levels, according to occupational health guidelines, does not take into consideration the impact as perceived by the teacher in oral communication. Through the interview, it is possible to reliably know about the individual's perception of various aspects of their behavior. However, there are disadvantages, where the perception or behavior reported by the individual does not always represent reality itself³¹.

Self-report is a specific and sensitive tool for identifying workers exposed to noise, especially when direct and repeated exposure measures for these workers are not feasible³². In addition, the use of telephone surveys makes it possible to evaluate a substantial number of individuals in a relatively short time and at low cost³³.

The results of this study reinforce the problem involving noise in the school environment. Strategies for educational health-promoting measures, such as guidance on decreasing noise pollution, and for taking effective noise reduction measures, such as the development of considerate acoustic designs for the construction or renovation of Brazilian schools, are desirable. In addition, health protection and promotion measures in schools would be beneficial, such as guaranteeing a multidisciplinary team to meet health demands and greater social support for teachers.

CONCLUSION

The prevalence of the perception of loud noise was shown to be high in schools in Brazil. The teachers who reported raising their voices in the presence of loud noise were the ones who most commonly worked in an environment disturbed by indiscipline, suffered verbal

abuse from students, felt that they worked under high demands, taught for different teaching levels and whose schools had more than 30 active teachers. Teachers who reported a pleasant environment at school, as well as those working in rural areas, noticed less noise at work. These findings demonstrate the need for intervention measures in the school environment to reduce noise levels and thus improve teaching conditions and minimize the negative effects on teachers' health.

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