

Revisão bibliográfica: o ruído urbano como um poluente ambiental

Literature review: urban noise as an environmental pollutant

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RESUMO: Objetivo: Analisar os estudos sobre o ruído como poluição ambiental nos centros urbanos, com foco em suas fontes e os níveis sonoros na tentativa de entender se modelo urbano atual é adequado para a saúde individual e coletiva. Material e Métodos: BVS, Pubmed e Cochrane foram usados para pesquisar artigos originais de pesquisa relacionados com o ruído ambiente. Resultados: Este artigo de revisão analisa 19 estudos relacionados ao ruído como um poluente ambiental. Conclusão: Muitos estudos estão sendo conduzidos para quantificar o ruído urbano e seu potencial de perturbação causada na população, utilizando-se diferentes metodologias. Nosso trabalho demonstra que o ruído está presente no ambiente urbano e geralmente extrapola os atuais níveis tolerados pela lei, sendo um estressor em potencial. Portanto, a sua presença em várias atividades humanas, especialmente no trânsito, reflete um modelo de cidade atual que precisa ser repensado. Os resultados deste estudo podem ser úteis para o desenvolvimento de novas pesquisas sobre o ruído urbano e desenvolvimento de políticas públicas.

DESCRITORES: Ruído; Perda auditiva provocada por ruído; Poluição ambiental; Meio ambiente; Literatura de revisão como assunto.

ABSTRACT: Purpose: Analyze studies on noise as environmental pollution in urban centers, focusing on their sources and sound levels in attempt at understand whether current urban model is suitable for individual and collective health. Material and Methods: The BVS, PubMed and Cochrane were used to search original research articles related to the environmental noise. Results: This review article analyses 19 studies related to noise as an environmental pollutant. Conclusion: many studies have been conducted to quantify the urban noise and potential disturbance caused in the population, using different methodologies. Our work demonstrates that the noise is present in the urban environment and commonly extrapolates current levels tolerated by the law, being a potential stressor. Therefore, their presence in various human activities, especially in traffic, reflects a model of the current city that needs to be rethought. The results of this study may be useful for the development of new research on the urban noise and public policy development.

KEYWORDS: Noise; Hearing loss, noise-induced; Environmental pollution; Environment; Review literature as topic.

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BACKGROUND

The environmental pollution is defined by any degradation of the environmental conditions, or even more important, the habitat of the humanity, inducing a relative loss in the health quality⁹. In 1980, WHO defined that noise pollution as the third cause in the main environmental problems of the planet, surpassed only by air and water pollution. In 1999, it was created the “Guidelines for community noise” 25 and stated that, taking into account any noise caused by transport, about half of EU citizens are not residing in a zone that ensure adequate acoustic health.

MATERIALS AND METHODS

Articles were selected from BVS, PubMed and

Cochrane. We excluded articles that were restricted to the occupational hazard of workers exposed to chronic and very high noise in factories. And there was included mainly studies that defined noise as an environmental pollutant under existing environmental laws. We prioritized articles of the last 15 years in order to analyze the urbanization process which took place in the developing countries. The keywords used were: noise, urban noise.

RESULTS

Summary of the studies analyzed, organized by year of publication (Table 1).

Table 1. Summary of the studies analyzed in this review

Reference and article origin	Objective	Source of noise	Method	Conclusion	Limitations/ Problems
Paz et al. ⁶ 2005 Brazil	Analyze the perception of Urban noise of inhabitants on an acoustic controlled zone and one uncontrolled. Searching some association with biological effect and human perception of noise.	Vehicle traffic, trains, aircraft, and neighborhood.	Objective evaluation of 25 points on the controlled zone and 97 of the uncontrolled between 7AM and 10 PM in the main avenues in each zone, with one for each zone, gathering 122 measures.	In control zone was found $Leq = 53.3$ dB (A) and the area was not controlled $Leq = 72.9$ dB (A). 95.5% in the center and 98% in the district believe that noise can cause you harm in relation to health. About 50.5% in the suburbs and 94.0% in downtown feel disturbed by noise. In both regions studied, low concentration and irritability are the most frequent organic effects. In addition, the noise coming from the vehicle traffic was nominated as the type of noise that causes more discomfort.	There was not proposed any strategy to reduce the noise emission.
Zannin et al. ⁷ 2003 Brazil	Examination of two hypotheses: violation of the Municipal Act 8583 (SMMA, 1995), which sets the limit of 55dB (A) as maximum permissible sound level for green areas during daytime (from 7 to 19 hours), and nuisance caused to patrons by noise levels surrounding the park.	Vehicle traffic.	Measurements of sound levels at different points of the park; Using a questionnaire developed by the authors through interviews. The interviews were conducted by two interviewers, Monday to Friday totaling ten interviews per day in the period from 6 to 7 pm, more use of the park a sent.	The Botanical Garden park showed elevated sound levels, mostly (90.5%) above that allowed by the Municipal Act 8583, which establishes the limit of 55dB (A) for green areas. 47.6% of the points had noise levels above 65dB (A), ie above the limit set by preventive medicine as the threshold of damage to health. Despite high levels of noise, most people (52%) considered the park a peaceful place, causing no major disturbance. However, 24% of people reported feeling disturbed by noise and 22% by concern for the safety spot, which shows that this pollution becomes more troublesome than other disturbing nuisance and 28% indicated the neighbors.	The small sample size of 50 respondents, due to the difficulty in obtaining the cooperation of park goes to answer the questionnaire. This difficulty can be explained by the fact that the interviews were conducted during the exercises and took some time of the people.
Zannin et al. ⁸ 2002 Brazil	Show the reactions of discomfort suffered by the population compared to urban noise, as well as what are the main noise sources that cause discomfort.	Car Traffic and neighbourhood, besides noncontinual noise makers as fireworks, sirens, nightclubs and construction sites	A questionnaire was developed with questions about demographics of urban residential environment and discomfort caused by noise. Survey participants were contacted by telephone. Later, received the questionnaire by mail. After two weeks, 50 employees were given the task of searching the questionnaires at the residence of each participant. There was a return of 86% of the thousand questionnaires sent.	44% responded that sometimes bothered. About 32% of participants responded that bothered regularly. When asked which sources of noise that bothered them most, 73% of respondents indicated traffic, followed by neighbors. Furthermore, it was found that 52% of respondents who had lived more than five years at the same address, 73% noticed an increase in noise of your street this period, 54% said the traffic noise as a source of nuisance and 28% indicated the neighbors.	People who are part of the subgroup “disturbed by urban noise” confessed present at least one of the above effects reported, predominantly irritability and poor concentration, but there was no methodology explaining these data.

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Petian ⁹ 2008 Brazil	Estimate the prevalence of annoyance caused by noise among workers. Identify knowledge and Opinion regarding the noise. And Identify sociodemographic factors associated with dissatisfaction, knowledge and opinion regarding the noise.	Street noise, traffic and the property itself	Sent questionnaire s to 500 shops and interviews were made by trained interviewers from June to September 2007.	65.75% considers the noisy work environment. 62.5% proved bothered by the noise location. The main problems caused or aggravated by noise according to workers are: hearing loss (72%), stress (29%), irritability (9%), headache (7%), nervousness (3%) and alteration of sleep (1%). The average sound pressure ranging between 70.4 and 88.6 dB (A).	Not found a validated questionnaire for the proposed objective. Not included variables such as marital status, family income, smoking, alcohol and drugs, diabetes and hypertension.
Barceló Pérez ¹⁰ 2001 Cuban	Estimate the sound level of traffic in the capital, defining the impact of urbanization and traffic on the welfare and health of housewives	Manufacturing and service sources	Cross section al study on combined housewives, applying a general questionnaire, perceived stress test (PSS) and abbreviated test of health status (SF36) in 133 individuals between 20 and 40 years living in characteristic places in the City of Havana (20052006).	26% stated that the noise bothers enough. 40% identified the car traffic as the main source of noise and bother with half the noise of voices and music. Mechanical noise sources affecting 2 to 10 women, and 90% believe it is harmful to health. The annoyance caused by noise is related to perceived stress	There was not proposed any strategy to reduce the noise emission, as well as there was no clear distinction of the sources of noise.
Rossi et al. ¹¹ 2002 Brazil	Mapping of noise expanded center of São Paulo. Compare the Audiometric profile of operators with the CET Traffic profile Rangers. Relating risk and occupational hearing loss.	Traffic of cars undergoing intense circulation.	113 operators, 25 Cantareira guards, and 16 guards of the Serra do Mar: Total of 154 individuals Made history questionnaire and otoscopy, measurement of sound pressure levels, dosimetrias	Nonoccupational noise may be related to an audiometry suggestive of NIHL	Small sample to demonstrate that the environmental condition of housing influences the audiological profile of the population
González et al. ¹² 1998 Peru	Make a survey of noise levels in the city of Montevideo in order to create an Acoustic map.	Vehicle traffic	to take samples during 15minutes in daytime at random points on the city, seeking to relate the number of sampling points with the density of occupation of the area. The values obtained were the equivalent continuous sound level and maximum level measurement every minute, equivalent continuous sound level the event as a whole.	Method effective for traffic.	Ineffective for another sources of noise
Alleyne Quildan ¹³ 1997 Peru	Estimating the extreme and prevalent noise levels; estimating the chance of disease; estimating the physiological alterations for healthy individuals; localize geographically the values of equivalent Continuous sound level and compare these with the ones permissible for Cuba.	Vehicle traffic.	Sound level estimation during 15 minutes in the areas with heavy traffic daytime.	Identification of the most intense and most likely excessive noise	Method cannot detect other noise sources
Irmtraut Fauser ¹⁴ 1998 Peru	Analyze the human perception of noise compared to the same quantification	Teenagers in school period.	Application of questionnaire	Monitoring contributes to realization of population	Perception has not generated increased mobilization for change
Sibilla et al. ¹⁵ 2000 Argentina	Analyze the impact of airport noise in the western region near the perimeter of the Córdoba International Airport.	Aircrafts	Monitoring with a sound level meter. It was obtained from each flight the maximum sound level for each site measured. A discomfort index was assigned to each question to evaluate the impact, each answer had a numerical value between 0 and 1.	direct impact on the hearing of the exposed population is unlikely. However it was observed that in the areas close to the airport, at least 69% of people suffered from any kind of interference in their activities usual. 40.8%, declared annoyed and 4.3% highly annoyed.	Cities not too dense complicates the measurement of impact.

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Bisi Zorzal et al. ¹⁶ 2002 Brazil	Validate a model that identifies the sound quality at different points in the city of Curitiba and point and compare it with the maximum allowed by CONAMA.	Vehicle traffic	Should be performed three independent measurements for each district, in at least three distinct points, totaling 675 measurements. With a sound meter were identified the maximum and minimum sound level as well as the most frequent value.	Levels above the tolerated across all central districts	No proposal for noise reduction
Bisi Zorzal ¹⁷ 2003 Brazil	The overall goal of this work is to show the sound quality at any point in the city of Curitiba through a geographic information system. And to compare the sound with the maximum allowed by Municipal law.	Vehicle traffic	Three measurement points per neighborhood. In a two minute interval were extracted the maximum and minimum values and the most frequent value.	In most of the points of the four noise zones of Curitiba, the average sound levels exceeded those set by the law. The downtown is where the sound level exceeded most.	Measurement during 2 minutes may not measure the real trend.
Fernandes et al. ¹⁸ 2003 Brazil	Analysis of the 3 main malls in Natal (RN)	Not determined	Measurements in low (March 1518) and high (December 1213) season, during day and night in the food court. There was used a sound meter to determine the average sound levels.	Inadequate levels for continuous exposure (such as employees) at all points analyzed. The study revealed that all malls are above the maximum noise level established by the legislation, which is 60 dB	Construction during the measurements at one of the malls led to abnormal values
Moreira ¹⁹ 2005 Paraguay	Analysis of the noise level in areas of high noise in the city of Palmas (TO) to elaborate forms of reducing noise pollution.	Public bus, religious cults, vehicle traffic and people	Measurements between August and December 2004 using a digital decibel meter at a distance of approximately 15m from the emitting source of noise, and also observed the peak sound emitted.	High amounts of noise in all regions analyzed. all of the values exceeded 70.6 dB.	Wide range of sound sources implies high consistency in coordination.
Pasqualetto ²⁰ 2006 Uruguay	The study identified the points of higher levels of noise in the urban area of Goiânia, comparing them with the recommended by the local law as acceptable.	Vehicle traffic	Was used ta decibelimeter. measurements were made at a distance of about one meter from the focus of sounds on the 3 main avenues of the city. the measurements were made in two seasons(12/0 3 and 05/28), there were four samples with intervals of five minutes.	Overcome legal limits of noise in all measures. All the average sound levels per season exceeded 78.75 dB.	The time for measurements in the two seasons and between the 3 main avenues were not standardized.
Sousa; Cardoso ⁴ 2002 Brazil	Estimate sound pressure levels in areas with heavy traffic and local traffic in the city of São Paulo and compare the results with the limits established by local law;	Vehicle traffic	Rating the city streets in heavy traffic and local traffic and measurements using a portable Mediator. Sound pressure levels in the points located in roads with heavy traffic were measured during 2 minutes, while the measurement in those points with local traffic lasted 1 minute. The points were evaluated from Monday to Friday during working time (8am to 5pm). Were measured Leq, Lmax, and Lmin.	High levels of sound pressure were observed in the city. For roads with heavy traffic, the mean sound pressure level surpassed even the higher accepted threshold established by the law [70 dB(A) for industrial areas]. The mean sound pressure level for roads with local traffic was also high, being above the acceptable for residential and commercial areas.	The study did not evaluate the southern and northern areas of the city of São Paulo, but infers that the results would not be different in these areas;

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<p>Barrión Morillas et al.² 2002 Spain</p>	<p>Determine noise pollution in urban area of the city of Cáceres, Spain; evaluate the statistical method of categorization to improve it and generalize it to other small towns.</p>	<p>Vehicle traffic</p>	<p>The campaign was conducted in June 1999, on working days and during working hours, from 8 a.m. to 8 p.m., at 2h intervals. Each measurement lasted 15 min. The measurements were made in randomized points of categorized types of streets. The sound levels considered were Leq, L10, L50, L90, Lmax, and Lmin.</p>	<p>In the overall analysis of the results, 90% of the measurements were higher than 65 dB(A), and always above 55 dB(A), showing that, even for a city this small in size and of a nonindustrial type, traffic noise is a major pollutant. The results showed there to be a clear relationship between urban noise due to traffic and the traffic volume.</p>	<p>The analyzed sample sites are subjected to a previous interpretations and also, according to Brown and Lam in "Urban Noise Surveys, Appl Acoust 1987, 20, 2339", only the item "type of use of the street" of the method of choice is suitable for categorization</p>
<p>Zannin et al.³ 2002 Brazil</p>	<p>Show the measurements of noise made in different urban areas of the city of Curitiba, Brazil.</p>	<p>Environment</p>	<p>The measurement of the equivalent sound level values - LAeq 2hr—were done for the locations by integrating and logging sound level meters. The measurements were carried out during the afternoon in 1000 locations spread through zones. There were two measurements of one hour long from 12:00 to 1:00 pm and 6:00 to 7:00 pm.</p>	<p>About 93.3% of the locations measured in this study show during the day equivalent sound levels over 65 dB(A), the limit for preventive medicine. Over forty percent (40.3%) of the locations measured show during the day extremely high values of equivalent sound levels over, 75 dB(A).</p>	<p>The study did not specify the source of the noise.</p>
<p>Jawed et al.²¹ 2010 India)</p>	<p>To analyse the effects of traffic noise on the hearing ability of individuals exposed to traffic noise.</p>	<p>Vehicle traffic</p>	<p>A hospital based prospective study with 200 individuals selected according to a significantly exposure to traffic noise. These included rickshaw drivers, traffic policemen and shopkeepers in central area of trade. All subjects were questioned according to a Performa after ENT examination was performed followed by Pure Tone Audiometry.</p>	<p>The subjects are exposed to sound pressure level in the potentially harmful metropolis of Karachi.</p>	<p>The study did not attempt to isolate the noise arising from other sources which are not the traffic</p>

From the research in the literature (BVS, PubMed and Cochrane) were selected 19 articles placed in the table above with characteristics most important in our analysis.

From the Table, we observe that from the 19 articles, concerning noise source, nine^{2,4,9,12,13,16,17,20,21} were exclusively from vehicular traffic, in five^{6,8,9,11,19} the sources were varied, but they included the traffic noise mostly, in one article was not determined the source of the noise¹⁸, one considers the source noise produced by teenagers¹⁴, one considers the source aircraft¹⁵, one considers the environment as a source of noise but it does not specify what elements¹³ and one of the articles analyzed, shows as a source the production and manufacturing services¹⁰. Of the articles studied, ten are from national origin (Brazil)^{3,4,6-9,11,16-18}, in addition, the Latin American countries have a total of six articles (Argentina¹⁵, Uruguay²⁰, Paraguay¹⁹, three Peru¹²⁻¹⁴), one is Indian²¹, one is Spanish² and one is Cuban¹⁰.

In six^{8-11,14,21} articles, were carried out questionnaires

regarding the noise and discomfort associated to it, in eleven^{2-4,6,12,13,16-20} measurements with specialized audiometers and in two^{7,15} were performed both questionnaires and measurements.

Deleterious effects on health impairment were suggested in two of the articles, and nonoccupational exposure to noise is related to changes suggestive to audiometric hearing loss induced by noise in traffic operators as pointed by Rossi¹¹. Jawed²¹ demonstrated a strong direct association between noise induced hearing loss and duration of noise exposure, and this situation more associated with people who live or work in commercial areas in the Indian city of Karachi.

In about six studies was reported some degree of discomfort in the exposed population. In one study (Barceló¹⁰), 24% of housewives said they were bothered by noise in urban and other one (Petian⁹), 62.5% of the commercial street workers reported the same. Three associated the vehicular noise source as the largest generator of discomfort (Paz⁶, Zannin⁷, Petian⁹). In

one of the articles 69% of the population living near the international airport said some change in usual life activities (Sibilla¹⁵).

CONCLUSIONS

Compared to other pollutants, urban noise is rarely addressed in public policy of sustaining the environment and collective wellbeing, but it is one of the factors widely studied in the literature which certainly diminishes the quality of life causing negative responses such as anger, dissatisfaction, discomfort, stress, withdrawal, helplessness, distraction, anxiety and exhaustion.

Most studies take the hassle (annoyance) as the end point for environmental noise assessment of its impact, because the mechanisms of physiological and psychological changes are not yet known due to inconsistency of the studies. Many of the changes are so genuine that would require a much larger sample of the population, ie a very strong statistical power for their identification and confirmation.²⁴ The guideline itself “Burden of disease from environmental noise” WHO23, for example, found it difficult to calculate effect related hearing loss and stated preference as to the effect annoyance. Remembering that this document provides technical support for policy makers for quantitative risk assessment of environmental noise through the window of the sum of years of potential life lost due to premature death and years of life equivalent “healthy” lost.

Annoyance associated with questionnaires have the presence of a moderate ignorance of the population in relation to noise, while recognizing that the presence of the same, is concerned not similar to other forms of pollution, and this is perhaps one of the main reasons for the absence of public policies for intervene in noise, thus bringing the increasing values of urban noise in town of any size. There is a tendency, therefore, noise exposure, increasing in Europe, for example, when compared with other stressors (Exhibition of tobacco, dioxins and benzene), which are falling²³.

As demonstrated in places like Caceres, Spain and Palmas, TO, Brazil, urban noise is also a problem of the least urbanized regions, not restricted to places like Curitiba and São Paulo, recognized that urban centers have many other environmental problems unsolved beyond noise.

The results lead to a reflection on the current model of the city, both large metropolises (São Paulo^{4,7}, Curitiba^{3,16}, and Córdoba¹⁵), as in small city (Karachi²⁰, Caceres², Las Tunas¹³) suggesting that a resolution to the problem, must rethink also on the actual urban model, not only reducing solutions applicable in large cities, since the problem is not restricted to such areas.

The main source of urban noise is studied vehicle traffic, both being reported by research of an individual and subjective by Petian⁹ as of an objective measurement of the emission sources as a means majority of this pollutant Gomes¹⁹. It may be noted that although this way is becoming ubiquitous, the sound is perceived, if not in its entirety, but as part of a form of complication of urban life.

Within the available research, some differences were found as method: Measurements short time (up to 5 minutes) in Zannin⁷; regarding more extensive measurements (8 hours) in Perez¹⁰, which makes it difficult to comparison between them and, in some cases, determines the reliability of the results.

DISCUSSION

The health effects generated by Annoyance present difficult measurement, normally through subjective questionnaires, thus making it impossible to accurately understand the impact social, mental and even urban economic of this contaminant. One difficulty is the presence of confounding factors as worse physical condition of the neighborhood, low socioeconomic status, coexistence of other factors such as air pollution, and individual susceptibility²⁴. Among the most discussed is the bias of selection in which some people are more sensitive to noise, especially those who live a long time in areas with high ambient noise, and ultimately overstate actual effect. However, some studies show that this bias is relatively inconsistent, because the residents of noisy areas showed improvement in reaction when exposed to the least amount of noise, as well as worsening reaction to much noise²⁴. Still, there is a concern among scholars as the standardization of questionnaires that noise should refer only indirectly to the interviewee’s response is not induced, as well as tell you just the end of the interview about the real focus of the research.

And, despite all the difficulties of measuring this impact, laboratory study that focus on objective data corroborate the results of the qualitative questionnaires. We can mention the increased level of catecholamines, sleep interruption mechanisms, increased heart rate and increased blood pressure.

One should also consider the relevance of a possible publication bias, where only jobs that show irregularities and changes in the manifestations of urban noise, achieve maturity level to be available in publications and large databases as consulted during this revising as considered by Wright⁵. This bias can lead to a distorted perception of the overall framework of urban noise, since it is possible to omit the apparently contradictory results with the current situation expected in large centers and major producers of urban noise.

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