PARAMETERS INFLUENCING ANNOYANCE FROM NOISE POLLUTION IN ATHENS, GREECE

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ABSTRACT

Noise pollution is one of the most important environmental problems with severe impacts on human health and quality of life. The present research examines the annoyance caused by noise pollution in Athens, the capital of Greece. A survey was conducted using a questionnaire addressed to 470 inhabitants of Athens. Annoyance from noise pollution and its main sources have been investigated in both residential and working environments. The results show that the main noise pollution sources in residence areas are traffic, neighborhood noise, civil works and entertainment, while the corresponding sources in working environments are traffic and construction works. Finally, results show that a significant portion of the population of Athens suffers from a high level of noise annoyance.

KEYWORDS

annoyance; Athens; noise pollution; traffic noise; urban environment

1. INTRODUCTION

Noise pollution is one of the most important social and environmental problems with severe impacts on human health and the quality of life. Several researchers have examined noise levels in various cities around the world. Previous study has analyzed noise annoyance from road traffic of the Ile-de-France region, concluding that its levels are generally higher in low education neighborhoods [1]. Traffic is usually reported to be the main noise source in other regions too, such as the Romanian city of Cluj-Napoca[2], Canada[3, 4] and the European cities of Amsterdam, Munich and Madrid[5]. Other works study the noise pollution of other activities, such as ports[6].

However, it must be pointed out that there is a significant difference between noise level and annoyance. Not all people experience equal amount of annoyance for the same noise level since noise annoyance is subjective. Previous studies have indicated that ageing explains a degree of variation in the annoyance of individuals[7, 8]. Annoyance caused by road traffic noise in city centers and densely built urban areas is often highlighted as major disturbance[9, 10].

As far as Greece is concerned, the first relevant research for estimating and monitoring noise pollution focused on the central area of its capital, Athens[11]. Most of the respondents indicated that noise was affecting considerably their health and, as a result, 19% of them were using pills or tranquilizers to deal with noise annoyance. Furthermore, the vast majority of them considered noise pollution as a more important environmental problem than the atmospheric pollution (Simantonis 1976). Other research carried out in some of the largest cities of Greece showed that one third of their urban population was living under high levels of environmental noise[12]. This was even more profound for Athens. Transportation noise, especially from motorcycles, was considered as the primary pollution source. A significant proportion of the sample argued that life in the city was deteriorating due to the increasing noise levels (Greek Ministry of Environment, Planning and Public Works 1988). Similar results were marked by the permanent residents and the tourists of Rhodes Island[13].

Although noise levels in Greek cities are reported to be quite high, there is a lack in recent works regarding the noise annoyance of their inhabitants.

The current work focuses on the annoyance caused by noise pollution in the city of Athens, the capital of Greece, and by applying targeted questionnaires in order to determine the annoyance level.

2. METHODOLOGY

Sample and collection method

The survey was conducted from February to April 2019, using a structured questionnaire addressed to residents of Athens, the capital of Greece. The questionnaires were completed through personal interviews. To cover the largest possible distribution of Athens population, the questionnaires were collected in 12 different places of the city, in different hours of the day and different days of the week. The sample was pre-stratified to be similar to the Athenians population aged over 18 years old in terms of gender and age distribution. Due to high unemployment rate during the period of research (19.3% in 2018, Eurostat 2018), the unemployed respondents were excluded from the analysis of the questions concerning the annoyance in workplaces.

Analysis

Analysis was initially performed using descriptive statistics: mean values (MV) and standard deviation (SD) of the answers, or the frequency distribution of each answer. Then, a chi-square ($\chi 2$) test was used to reveal statistical significant correlations between the answers and the socio-demographic characteristics of the respondents. A statistical significant correlation is considered if $p<0.05$.

3. RESULTS AND DISCUSSION

General questions about the environment

The results show that 87% of the respondents are “much” or “very much” interested in the environment,, while 91% of them agree “much” or “very much” on the statement that it is a crucial aspect of their everyday life Furthermore, the five most severe environmental problems mentioned from the sample are atmospheric pollution, which was expected as, according to previous study, the majority of the Greek households are currently burning biomass for heating purposes, resulting in high levels of atmospheric pollution[14]. The other environmental problems mentioned are water pollution, ecosystems destruction, solid waste management and climate change.

From our results, more than six out of ten respondents (63.4%) consider noise pollution as an equally important environmental problem, while relatively few Europeans (10%) reported their worry regarding noise pollution[15]. A significant majority (69.1%) characterizes environmental protection as both a technical and a political issue, contrary to the 27.7% and 2.8% who conceive it merely politically and technically respectively. Finally,

more than eight out of ten respondents (81.7%) expressed no or little trust in the public authorities for taking measures/actions for the benefit of the environment. This deep mistrust of the Greek governments is also evident in previous works[16-18] as well as within the EU, since only 34% of the Europeans trust their national governments[19].

Main sources of noise annoyance

Figure 1 shows the percentage of the respondents annoyed "moderately" to "very much" in residence and workplaces from each one of the noise pollution sources, while figure 2 shows the distribution of responses for the four noise pollution sources creating the highest annoyance. It is observed that transport noise emerges as the main noise pollution source in both cases, which is consistent with the key figures already reported[12,13,20]. The next sources are neighborhood noise, construction works noise, entertainment noise, bells, garages, commercial activities, schools and sport activities.

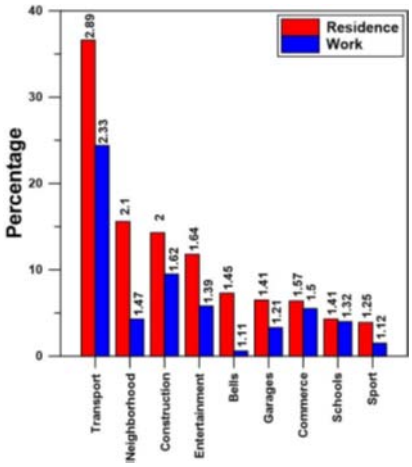

Figure 1. Percent of respondents annoyed for each of the noise pollution sources in residence and workplaces. Numbers on the bars: mean values of each category on a five point scale (1: not at all, 2: little, 3: moderately, 4: much. 5: very much disturbed)

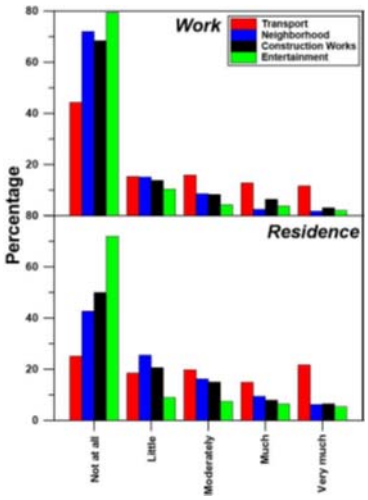

Figure 2. Distribution of noise annoyance caused by the four main noise sources (transport, neighborhood, construction works and entertainment) in residence and workplaces.

Noise annoyance from transport

As shown in figure 1, transport is the main source of noise annoyance. A minority of 25.1% and 44.3% of the sample claims no annoyance at residence and workplace respectively, while the 38.3% and the 31.2% are little and moderately annoyed for the two locations. It should be noticed that a significant part of the sample, 36.6% in the case of residence and 24.4% in the case of works, is much and very much annoyed from transport noise pollution. This last finding shows the impact of transport on annoyance of citizens and indicates that urgent measures must be undertaken to decrease this annoyance.

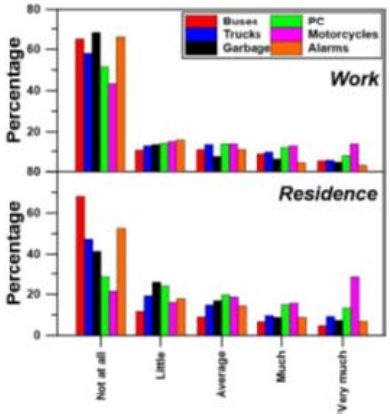

Figure 3. Level of annoyance in residence and workplaces per mean of transport noise pollution (where Garbage: garbage collection vehicles, PC: passenger cars, Motorcycles: motorbikes /motorcycles

Figure 3 shows the level of annoyance at residence and workplaces per means of transport. As already reported in previous works[21,22], motorcycles constitute the primary transportation noise pollution source for both places, since 44.0% of the respondents are "much" or "very much" annoyed at their households and 27.3% at their workplaces. Passenger cars were considered as the second source causing annoyance from noise pollution. Almost one out of three respondents (28.1%) at their residence and one out of five (20.0%) at their workplace are significantly disturbed by the noise emitted from passenger cars. The next noise pollution source is heavy vehicles: trucks, buses and garbage collection vehicles. The 18.8%, 11.3% and 15.9% of the respondents are greatly annoyed by each category at their residence, while slightly lower percentages (15.0%, 13.8% and 10.7% respectively) are annoyed at their work. These values indicate that about 1/9 to 1/5 of Athenians are notably annoyed by the noise of heavy vehicles. The lower annoyance from buses, which is perceived compared to that of passenger cars could be attributed to the fact that buses are fewer than PCs and, furthermore, to the fact that buses circulate only in the main streets of the city, disturbing only those living or working around these streets.

The statistical correlation analysis of the previous results indicates that both genders equally perceive in their residence the annoyance from noise transport. Men are more affected from transport noise pollution as age increases, while women do not show such a correlation. Furthermore, time spent at home seems to be positively correlated with noise annoyance, as unemployed, retired and housekeepers show significantly higher annoyance from transport noise compared to the economically active people, such as employees of public or private sector and freelancers.

Additionally, the older the dwelling, the higher the perceived annoyance from transport noise. Recently constructed buildings present improved characteristics (increased insulation, soundproof fenestration, etc.). It should be noticed that as the vast majority of old buildings are located in the city center of Athens, the inhabitants of the center are subjected to higher noise than those of the suburbs.

As far as workplaces are concerned, the statistical analysis of the results shows that individuals who perform demanding work tasks are less tolerant to transport noise annoyance (i.e. MV of freelancers: 2.86, against MV of public employees: 2.14). However, higher sensitivity to noise could not be attributed only to the work type and increased stress, but probably also to the building itself, for example the quality of acoustic insulation.

Neighborhood noise annoyance

Neighborhood activities are the second source of noise annoyance (Fig 1). As expected, this annoyance is very low in the case of workplaces, as the 72% report no annoyance, the 23.3% little or moderate and only the 4.3% are much of very much annoyed. However, only the 42.7% of the respondents report no annoyance at home, the 41.7% little or moderate annoyance, but a 15.6% of them are significantly annoyed.

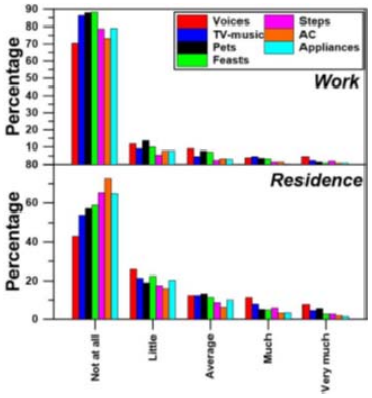

Figure 4. Level of annoyance in residence and workplaces from different types of neighborhood noise pollution sources

Figure 4 shows the annoyance in both the residential and the working environment caused from various noise sources of the neighborhood. The voices generated by the neighbors are the major contributors of neighborhood noise pollution source in

residencies, with the 19.0% of the sample being 'much' and 'very much' annoyed. Moreover, the 12.4% of the respondents is significantly annoyed by the noise produced from TV/music, while the 10.6% are annoyed from pets. Other noise sources reported are footsteps (8.6% of the sample, mainly from high-heeled shoes), organized festivities (7.5%), noise from air conditioning units (5.1%) and household appliances (4.9%).

In relation to the working environment, voices also correspond to the primary neighborhood noise pollution source, with the 19.0% of the respondents being significantly annoyed. Furthermore, the 7.2% mentioned that TV/music are the main cause of their disturbance, while the 5.3% blame pets. Secondary sources of neighborhood noise pollution in workplaces that 'much' and 'very much' affect the sample are festivities of neighbors (4.3%), sound made by footsteps (3.8%), noise from air conditioning units (2.5%) and household appliances (1.2%).

On the whole, the annoyance level from neighborhood sources is lower in workplaces than in residences. This is expected for several reasons. Firstly, workplaces are often located within to exclusive office-buildings, where neighborhood sources such as TV or music, do not exist. Secondly, some noise almost always exists within a working environment due to human movements, conversations, etc. or due to the operating equipment, counterbalancing the noise created by outside sources.

In residences, the younger the respondent, the less annoyed he/she feels by the neighborhood's noise: the MV decreases from 2.45 for those aged 18-24 years to 1.3 in the case of those aged over 75 year-olds. However, no such linear correlation is found for workplaces. Furthermore, married people show higher tolerance than singles in both the residential and the working places, indicating that usually families are used to higher noise because they are responsible for producing it at higher levels than single people. Moreover, in residences, unemployed individuals are found to be less tolerant than employed ones, possibly because they spend more time at home than employed people. However, retired people, employees of the public sector and housekeepers show the lowest annoyance, while students and employees of the private sector the highest.

In workplaces, freelance employees and private sector employees report the highest annoyance, while public sector employees the lowest. This is probably due to the more demanding conditions of the private sector than the public one or to the high inside noise of the public buildings, which counterbalances outside disturbances. Results coincide partially with previous research findings[23] that highlight that social characteristics such as the marital status (singles), absence of children or a longer stay at home due to unemployment or retirement may all constitute factors that eventually lead to higher noise annoyance.

Entertainment noise annoyance

Noise from entertainment activities can be quite disturbing, especially when secondary noise, such as that generated by vehicles transporting people to and from the entertainment venues, is generated. Most of the respondents claimed no frustration by entertainment noise at both residencies and workplaces (71.9% and 79.4% respectively), an outcome which is expected since the entertainment places are usually not spread in the city, but rather located in certain areas provoking impacts only to the locals. However, a notable minority of the sample is highly annoyed: 11.8% at residencies and 5.8% at workplaces. The lower percentage of annoyance at workplaces can be attributed to the fact that entertainment noise is mainly produced outside the typical working hours.

Motorcycles and private passenger cars are the main noise pollution sources, with 22.4% of the respondents being 'much' or 'very much' annoyed at home and 14.6% at work. Furthermore, loud music is indicated as a major disturbance by the 16.0% (residence) and 7.8% (work) of the sample. Voices are reported the third noise pollution source, annoying significantly the 14.2% and the 11.8% of the

respondents at home and at work respectively. Finally, 9.2% of the respondents at home and the 10.3% of the respondents at work pointed out their annoyance from the equipment noise. The statistical analysis of the above results shows that no correlation exists between the annoyance in residence from entertainment noise and sample's characteristics, indicating that the annoyance is the same to all respondents independent of gender, age, family and professional status, etc. In workplaces, the professional background is the only that shows a correlation: freelance employees report higher annoyance, compared to employees of the public sector, similarly to the case of neighborhood noise annoyance. This is probably due to the working place and hours: very often, freelances work at home and during evening hours.

Annoyance from construction works noise

Construction works comprise an important noise pollution source at both residences and workplaces (Fig 1). Even taken into consideration that the 50% and 68.4% of the sample report no annoyance and the 35.6% and the 22.1% show low annoyance at home and workplace respectively, the 14.4% and the 9.5% respectively are very annoyed. Although construction works are a noise source for the nearby area for a limited time and the amount of annoyance varies according to the area and construction works characteristics, globally, that annoyance is not negligible and must be taken into consideration from the public authorities. The statistical analysis of the above results shows that no correlation exists between the annoyance from the noise created from construction works and the sample's characteristics in relation to both residences and workplaces. This is quite expected, as this annoyance is generally quite strong for all type of residences and, moreover, is not constant on location and time[24].

4. CONCLUSIONS

A significant statistical sample of the residents of Athens considers that noise pollution is an important environmental problem. Transportation is considered the most important noise pollution source both in residences and workplaces, with motorcycles and passenger cars being the main noise pollution sources. Neighborhood noise is the second most important noise pollution source in residencies, with voices of neighbors, TV/music and pets being the three main noise pollution sources. Entertainment and construction works are the following sources. The characteristics of the surrounding environment were also found to influence noise annoyance, people who live in residential zones built in the last decade were found to be less annoyed by transport noise than those who live in older buildings, since recent buildings are more sound-insulated than older ones.

Conclusively, individual characteristics, mainly age, marital status, and working profile, are factors determining noise annoyance level. Younger people were found to be less tolerant to neighborhood noise, while married people and families showed higher tolerance. Furthermore, unemployed people were found to be less tolerant to noise at home and people under highly demanding work conditions, such as self-employed, were proven less tolerant to noise at work.

However, a number of tackling noise measures, such as the modernization and the sound insulation of the buildings, the optimization of the transportations noise characteristics and information and education of residents about noise pollution, could reduce the levels of the noise annoyance in the residents and improve their quality of life.

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