THE IMPACT OF TRAFFIC NOISE ON THE ENVIRONMENT OF HEALTHY LIVING IN URBAN AREAS

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Abstract

Traffic noise has a great impact on the quality of public health. The paper shows the main characteristics and importance of green dams in urban areas, the role of green dams; area, layout, ground cover, planting density, vegetation and the like. Green dams were demonstrated and presented as the best solution for noise regulation arising from traffic in urban areas.
For the purpose of researching this issue, a survey was conducted with the aim of gaining insight into the attitudes of the population in terms of traffic noise in urban areas.
Green dams play a major role in urban areas, firstly they affect the reduction of environmental pollution, and then they play a major role in the reduction of noise in urban areas from city traffic.

Keywords: *traffic noise, green dams, public health ,urbanity*

1 INTRODUCTION

Noise, in general, means loud, unwanted and unpleasant sounds in the range of 20 to 120 dB. Noise can also be defined as any sound whose level exceeds the permitted level prescribed by law, taking into account the time and place where it occurs and the environment in which people work and live. A source of noise is considered any object with means of work and transport, devices and installations, as well as the noisy activities of people and animals, as well as other objects and actions that spread sound, and which exceed the permitted level for that type of noise. Traffic noise has a great impact on the quality of life, mental and physical health. Noise in the environment is unwanted or harmful sound for human health and the environment in outdoor space caused by human activity, including noise emitted by: means of transport, road traffic, rail traffic, air traffic, maritime and river traffic, as well as facilities and operations for which according to by special regulations in the field of environmental protection, obtains a decision on the unified conditions of environmental protection, i.e. a decision on the acceptability of interventions for the environment.

According to the World Health Organization, noise is the second biggest cause of health problems related to the environment, right after the effect of air pollution (floating particles). Long-term/year-long exposure to noise affects the cardiovascular and metabolic system, cognitive impairment in children, sleep disorders, etc.

In the observed region of the Central Bosnian Canton (Srednjobosanski kanton), no monitoring of the impact of traffic noise on urbanity was previously carried out, and accordingly the issue was not recognized in local strategies. The results of the survey that was conducted in the observed region will show that the population is aware of the impact of traffic noise in urban areas, the impact on public health, and improvement measures will be presented, which is only the beginning of supplementing the LEAP (Local environmental action plan) strategy of the observed region when it comes to noise. from traffic in urban areas.

2 EMISSIONS FROM THE ASPECT OF NOISE

According to Huddart L., the quality of life of the inhabitants of a city is closely related to its environment, however, all cities face a worrying degradation of the environment, with a high level of pollution. The report of the World Health Organization (WHO) indicates that environmental noise is the second leading cause of disease, after air pollution, and not only as an environmental nuisance, but also as a public health problem of the modern world.

In 2002th, the European Parliament defined the concept of noise in the environment as unwanted or harmful external sound caused by human activity, including noise emitted by vehicles, road, rail and air traffic and industrial activities ("DIRECTIVES 2002/49/EC", 2002)[1]. Sources that create noise are part of everyday life in the city, however, no attention has been paid to environmental noise pollution because its effect is not immediate and obvious, but latent. The report on noise in the environment warns that noise in urban areas is a threat to health, excess sound that changes normal environmental conditions in a certain area is not cumulative or transmitted, has a serious impact on people's quality of life and as such is not adequately controlled. Significant attention should be paid to reducing the noise level

[1] https://www.piarc.org/en/PIARC-knowledge-base-Roads-and-Road-Transportation/Road-Administration/Environment/Act-on-Road-Traffic-Noise

from traffic in cities because there is a danger that the noise in the environment will remain the same or will worsen. The reason for this is the constant increase in the number of vehicles[2].

2.1 Impact of traffic noise on public health

Next to emissions from the atmosphere, noise ranks second in terms of impact on citizens' health. The number of people who are exposed to noise in urban areas is increasing, and the intensity of traffic noise is associated with health problems, which mostly affects increased stress, stroke or cardiovascular diseases. Laws that protect citizens from noise caused by traffic are completely inadequate. As solutions for traffic noise in urban areas, the provision of quiet public transport, reduced speed, the use of buildings as effective sound barriers, and the use of green barriers are proposed, which is considered a good urban plan. The emphasis is still on planning and construction in urban areas. Long-term exposure to traffic noise affects sleep disturbances, effects on the cardiovascular system, metabolic system, as well as cognitive impairment, especially in children.

Without noise mapping, it is not possible to solve the negative impact of noise, as well as reduce the risk to the health of the population. A noise map is a presentation of data on the existing or predicted noise situation using noise indicators. The map also indicates the exceedance of any relevant prescribed limit value, the number of people affected by noise in a certain area or the number of housing units exposed to certain noise indicator values in a certain area. There are also strategic noise maps intended for a comprehensive assessment of the population's exposure to noise from various noise sources or for comprehensive predictions for a specific area[3]. A noise map is necessary in order to identify areas with high noise values, assess the extent of the impact on the population, and foresee preventive measures or adequate infrastructure solutions that will reduce the impact of noise on the health of the exposed population. Along with the noise map, an action plan with measures to reduce the impact of noise is drawn up. The process of urbanization and the increased need for mobility increase the risk of population exposure to noise[4]. Noise-related problems cannot be adequately assessed and solved if noise maps or action plans required by the Directive are not created in cities, roads, airports, and railways.The impact of noise on public health in SBK, BiH is generally neglected. This problem, which is located elsewhere, has not yet been found in the strategic and planning documentation in BiH in the field of environmental protection or spatial planning[5]. At all levels, it is necessary to create a legal framework that will enable the creation of strategic traffic noise karate and action plans, which enables better planning in terms of protecting the population from the impact of noise.

Currently, what is being done in Bosnia and Herzegovina, when it comes to actions related to the protection of citizens from the impact of traffic noise, is the drafting of legal regulations that will enable the creation of noise maps, strategic noise maps, noise reduction action plans, and noise monitoring[6].

The above should contribute to better management of this problem, all with the aim of reducing the population's exposure to

[2]Lakušić, S., Dragčević, V., Rukavina, T. (2005). Mjerezasmanjenje buke od prometa u urbanimsredinama. Građevinar, 57 (1), 1-9

[3]Analiza stanja okoliša u Federaciji Bosne i Hercegovine, BIH ESAP 2030+, Maj 2020. Priručnik.

[4]**https://pf.sum.ba/wp-content/uploads/2022/06/2022-13.clanak-cl.pdf**

[5]https://www.piarc.org/en/PIARC-knowledge-base-Roads-and-Road-Transportation/Road-Administration/Environment/Act-on-Road-Traffic-Noise

[6]Analiza stanja okoliša u Federaciji Bosne i Hercegovine, BIH ESAP 2030+, Maj 2020. Priručnik.

noise and improving the quality of life in the long term.

3 GREEN DAMS IN URBANITY AND THEIR ROLE

The role of green dams in regulating the flow of traffic on the living environment in the city is great considering that according to the Strategy of adaptation and low-emission development of BiH from 2020-2023. year wants to achieve a reduction in gas emissions, where the results are expected through the electrification of transport. A big role would be in the application of electric or hybrid cars. However, as a bigger goal in the future, better training of railway traffic or greater activation of water traffic is planned, both at the international and intercity level. In addition to the goal and trend of reducing gas emissions and reducing the impact of traffic on the greenhouse effect, it would indirectly affect the reduction of other factors that affect the quality of healthy living in urban areas, where physical noise pollution has been increasingly evident lately, which it greatly affects the environment of healthy living, and the same arises from the process of transport-traffic.As a good practice, green city dams are singled out, which reduce noise by 6 dB and even up to 10 dB, depending on the density and width of tree planting. Noise reduction is greatly influenced by soil, leaves, absorption, plant vegetation and the like.

According to the relevant researchers, the methods used for monitoring noise in the urban environment are weekdays, weekends, mornings, afternoons when there are crowds due to people's work, bridges, the proximity of tunnels, highways and the like, of course where the highest concentration of traffic is.

3.1 The importance and role of green dams

The role of green dams, i.e. the arrangement of trees, the density of planting, the height of trees, the slope of the terrain and the coverage greatly influence the noise, the spread of noise caused by traffic in urban areas. Given the fact that sound can be reflected and dispersed by plant components such as trunks, branches, trees, leaves, and sound is absorbed or destructively interferes with sound waves where the ground cover plays the main role. In addition to the characteristics of the vegetation, the distance from the source of the sound waves also plays a big role.

Green areas, such as rows of trees or green dams along roads, can play a significant role in reducing traffic noise. Green dams have the following role:

- Sound absorption: The leaves of trees and bushes can absorb sounds, especially high frequencies. This reduces the overall noise level emitted by the traffic.
- Sound barrier: A dense green dam can act as a physical barrier to sound, reducing the transmission of noise to surrounding areas.
- Other effects: Green dams can also improve air quality, which can contribute to the general well-being of the community.
- Aesthetic and psychological effects: Green areas are aesthetically pleasing and can help reduce noise-related stress, which can have a positive effect on the mental health of people living next to roads.

Studies have shown that the presence of greenery along roads can reduce noise by several decibels, which can be a significant factor for the urban environment. In addition, green areas contribute to other aspects of sustainability and quality of life in cities. The plants that are recommended as green dams in urban areas are: all types

of fir, myrtle, ficus, evergreen ash, bamboo, which is divided into groups in the following work. The mentioned types of plants that are used for green dam purposes in urban areas for the effects of noise reduction caused by traffic also play a big role in absorbing toxins in the air, so they are useful and necessary for environmental protection. In addition to the above, there are also cover plants, which make up the earth's cover, whose function is to prevent noise from traveling from the source of the waves, i.e. from traffic in urban areas. The main characteristics of plants when selected for green dams are: thick leaves and dense growth, abundant, thick and large branches, significant height at maturity, width and depth and evergreen growth.

3.1.1 Green dams in noise suppression

Designing and noise protection measures along roads is a demanding process, and it includes numerous or even unavailable input data. Traffic greenery is planted along roads as a special green strip or isolates the area during the implementation of main routes of road and railway traffic within city centers. In addition to the above, traffic greenery should be decorative, resistant to urban pollution, anti-allergenic, etc. Noise suppression facilities are built from "inanimate" and living plant material, and can be: greened earth embankments (with gentle green slopes), greened steep embankments (supporting structures with a large slope, filled with earth and green), green walls for noise protection (structures are made of metal, wooden, glass, concrete walls, and contain plants on one or both sides[7].

Beck (1965, 1968) investigated some peculiarities of dendro-species in relation to the effects of noise reduction, who categorized plants into six groups. The first group is the most unfavorable, and the sixth is the most favorable. The types of the third and fourth groups are especially suitable. Some of the mentioned species are not used for noise reduction in our country, most of them are non-native and can be used in horticulture.[8]

III-group: „*Betula pendula, Alnusincana, Cornussanguinea, Cornus alba, Pterocaryafraxinifolia, Forsythia intermedia, Sambucusnigra, Loniceramaackii, Cratageusprunifolium, Loniceraladebourii, Populuscanadensis, Corylusavellana, Tilia cordata*.“

IV-group: "*Philadelphuspubescens, Carpinusbetulus, Syringa vulgaris, Fagus silvatica, Ilex aquifolium, Ribesdivaricatum, Quercusrobur*”

V-group: "*Populusberolinensis, Viburunum lantana, Viburunumrhytidophyllum, Tilia platphyllos*."

Group VI: "*Acer pseudoplatanus."*

Sometimes the noise cannot be completely removed, but it can be "masked" using more pleasant sounds (gurgling water, rustling leaves, music, etc.). Plants, especially trees, have the characteristic of attracting birds and other animals, whose singing and chirping contribute to mitigating unpleasant sounds (e.g. aspen, birch, apple tree, acacia, liriodendron, bamboo, etc.).[9] Protection procedures can be focused on the biological-technical procedures of afforestation and the raising of plantations

[7]Cvejić, J. (2010). Inžinjerskabiologija. Beograd: Biolološki fakultet. de Toledo, M.C.B., Donatelli, R.J., Batista, G.T. (2012). Relation between green spaces and bird community structure in an urban area in Southeast Brazil. Urban Ecosyst 15, 111-131.

[8]Spasojević, S. (2016). The role of the barriers in traffic noise protection. U: Ž. Živković, ur. Book of proceedings. International May Conference on Strategic Management - IMKSM2016 May 28 – 30, 2016, Bor: Technical faculty, University of Belgrade, 139-142

[9]Klepac, D., Meštrović, Š. (1981). Upotreba drveća i grmlja u uređivanju čovjekova okoliša. Šumarski list 1-2, 38

in order to mitigate the impact of the wind. The choice of plant species depends on different climate zones, biological and ecological characteristics of the species, but also the composition with landscape elements.[10]

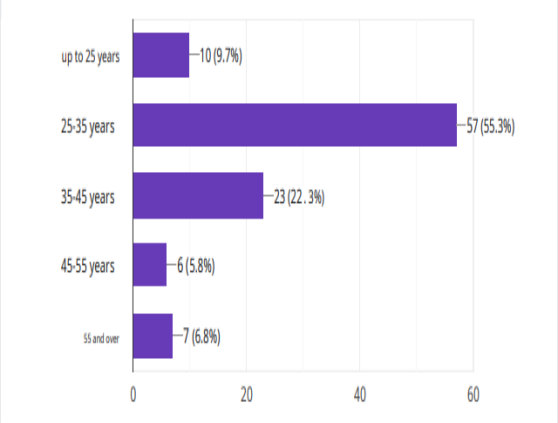
4 ANALYSIS OF THE SURVEY FROM THE ASPECT OF NOISE IN URBANITY

Considering that during the investigation of this issue we did not have access to empirical data that would give us an overview of the state of the noise problem in urban areas, we conducted a survey "The impact of traffic noise on the environment of healthy living in urban areas". The goal is to analyze the survey to get a picture of the impact of traffic noise on citizens.

The survey questionnaire was composed of 12 questions that were intended for the population. Most of the questions were asked in the form of a Likert scale, therefore the survey questionnaire is predominantly of the closed type of questions. A pilot study was conducted with the aim of determining the clarity of the questions in the survey questionnaire, during which two people were interviewed. The survey was conducted online. All answers received were analyzed using a descriptive analysis method.

4.1 Research results

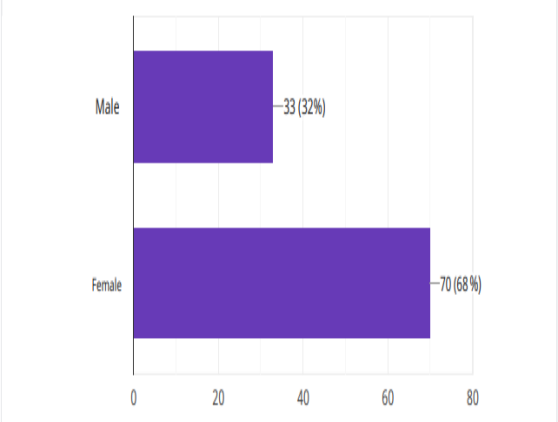
103 responses were collected through the survey. The analysis determined that the survey was completed by citizens from the following areas: Travnik, Vitez, Bugojno, Novi Travnik, Turbe, Vitez, Živinice, Donji Vakuf, Zenica, Tuzla, Jajce Sarajevo. The majority of respondents are from the area of the Central Bosnian Canton with their place of residence in Travnik. Below is a presentation of the obtained results in the form of a graph. Graph 1 shows the responses to the first survey question.



Graph 1. Age structure of respondents

More than half of the respondents, ie 55.3%, are in the age group between (25-35) years, 22.3% between (35-45) years, followed by 9.7% under 25 years, 6.8% between 55 and over and 5.8% between (45-55) years.

Graph 2 shows the responses to the second survey question.



Graph 2. Gender structure of respondents

The gender structure of the respondents shows that there were more women 68% and 32% men.

[10]Tomašević, A. (1996). VjetrozaštitaSinjskogpolja. Šumarski list, CXX (1-2), 19-34.

Graph 3 shows the responses to the third survey question.

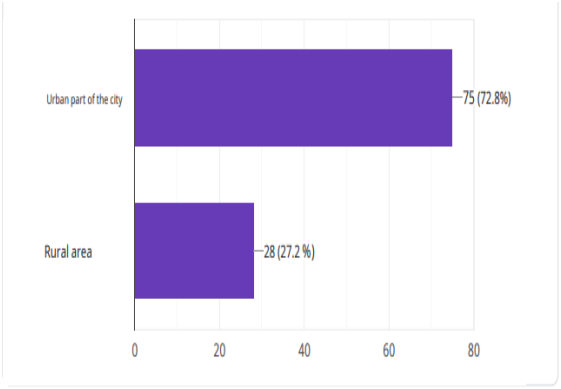


Chart 3. Structure of respondents according to place of residence

Most respondents live in the urban part of the city, 72.8%, while 27.2% of respondents live in rural areas.

Graph 4 shows the responses to the fourth survey question.

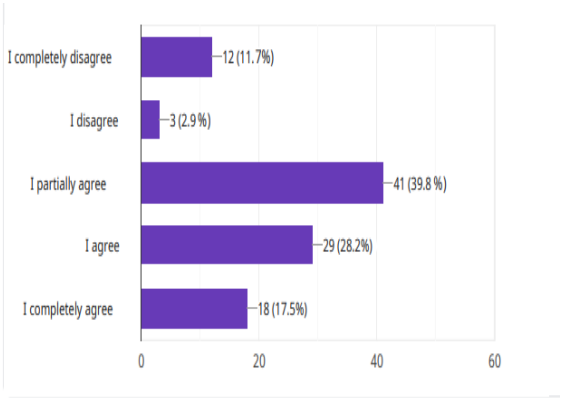
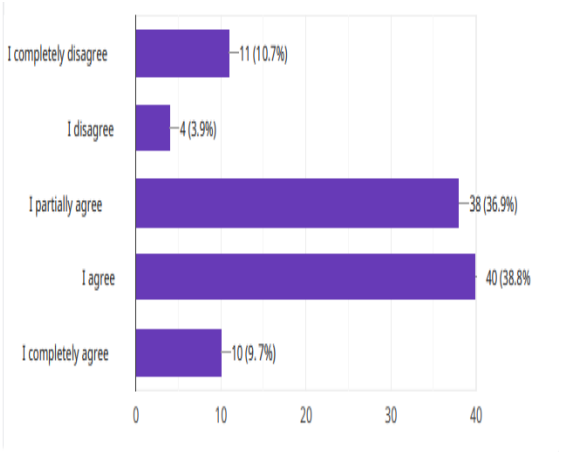


Chart 4. The display answers the question "Noise caused by traffic is a problem today"

The results showed that the majority of respondents (39.8%) partially agree with the statement that traffic noise is a problem today, then 28.8% of respondents agree, while 17% completely agree. For 11.7% of respondents, noise is not a problem, and they completely disagree with the above statement. Looking at the results, we can conclude that most respondents are aware of the problem of noise caused by traffic.

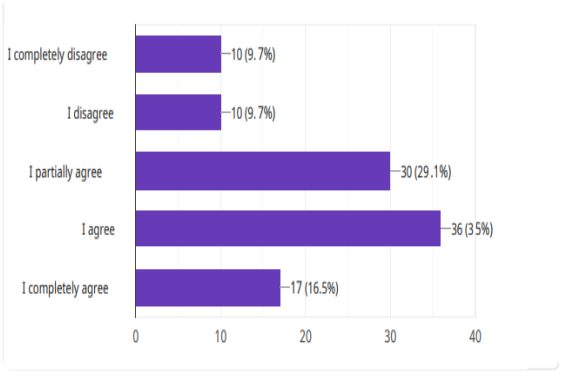
Graph 5 shows the responses to the fifth survey question.



Graph 5. Display of answers to the question "Noise caused by traffic impairs the quality of life"

That noise caused by traffic impairs the quality of life is confirmed by the majority of respondents, 38.8% who agree, 36.9% partially agree, while 9.7% completely agree. 10.7% of respondents completely disagree with this statement, and 3.9% disagree.

Graph 6 shows the responses to the sixth survey question.

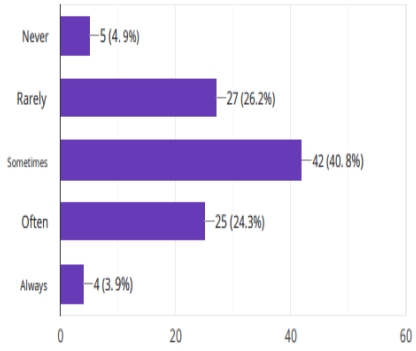


Graph 6. Display of answers to the question "Noise caused by traffic has a harmful effect on health"

The majority of respondents, 35%, agree that noise caused by traffic has a harmful effect on health, and 29.1% partially agree, while 16.5% of respondents completely

agree. 9.7% of respondents strongly disagree and disagree.

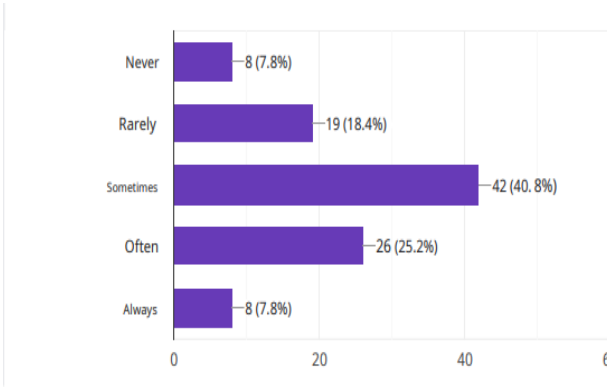
Graph 7 shows the responses to the seventh survey question.



Graph 7. Display of answers to the question "Noise caused by traffic affects my efficiency"

The majority of respondents (40.8%) have the opinion that sometimes noise affects their efficiency, and for 24.3% it is often and 3.9% always. The attitude of 26.2% of respondents is that noise rarely affects their efficiency, and 4.9% never.

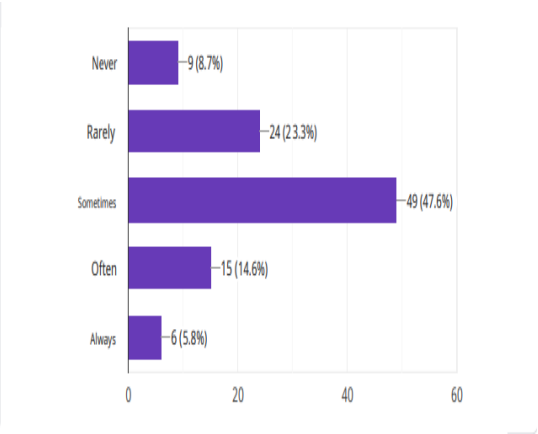
Graph 8 shows the responses to the eighth survey question.



Graph 8. Display of answers to the question "Noise caused by traffic affects the reduction of one's own concentration"

The opinion of the majority of respondents, 40.8%, is that sometimes traffic noise affects their concentration, while for 25.2%, it is often, and for 7.8% of respondents, always. That noise never affects the reduction of one's own concentration is the opinion of 7.8%, and rarely 18.4%. chart 9.

Graph 9 shows the responses to the ninth survey question.



Graph 9. Display of answers to the question "Noise caused by traffic makes me feel restless"

Noise caused by traffic sometimes causes restlessness for the majority of respondents 46.6%, while for 14.6% sometimes and 5.8% always. While for 23.3% rarely, and for 8.75% never.

Graph 10 shows the responses to the tenth survey question.

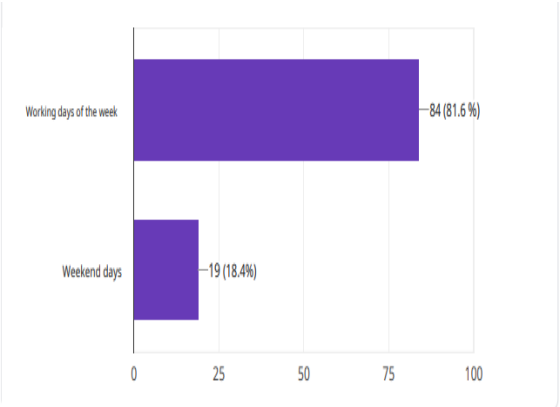
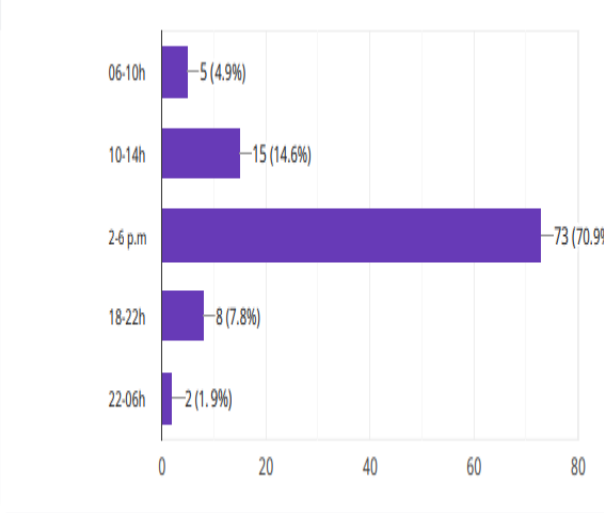


Chart 10. Display of answers to the question "Days of increased presence of traffic noise"

For the majority of respondents, 81.6% of weekdays have an increased presence of traffic noise, and 18.4% for weekend days.

Graph 11 shows the responses to the eleventh survey question.



Graph 11. Display of answers to the question "Time of increased traffic noise"

For the majority of respondents, 70.9% of the time of increased traffic noise is in the period from 14:00 to 18:00, then for 14.6% it is from 10:00 to 14:00, for 7.8% from (18:00 to 22:00), for 4.9% from (6:00 to 10:00) and for 1.9% from (22:00 to 06:00). Looking at the results of the survey, we can say that the majority of respondents are aware of the noise problem and 39.8% of respondents partially believe that noise caused by traffic is a problem today. Approximately the same percentage of respondents, 38.8%, partially agree with the thesis that noise caused by traffic impairs the quality of life. It can be said that the respondents are aware of the negative impact of noise on people's health, considering 35% of affirmative answers. The obtained results show us that traffic noise is a problem for the population, which should be a guide for solving it.

Analyzing the answers about the impact of traffic noise on efficiency and concentration, it was observed that noise sometimes has an impact on the respondents (40.8%). Also, for the majority of respondents (47.6%), traffic noise sometimes causes restlessness.

CONCLUSION

When it comes to noise caused by traffic in urban areas, there are numerous methods that can be applied to reduce the impact of noise and to increase the environment of healthy living. In addition to affecting the quality of the healthy living environment, noise also has a great impact on the health of citizens. The analysis of the conducted survey "Impact of traffic noise on the environment of healthy living in urban areas" shows that respondents are aware of the problem of traffic noise, and that it affects their efficiency, concentration and sometimes causes restlessness.

It can be safely said that the absorption of sound waves is not made by a couple of trees, but one should not lose sight of the psychological and aesthetic effect provided by green barriers. That is why it is important to develop knowledge and skills about the way and application of trees in urban areas as a green barrier to reduce noise. With sustainable and careful planning, and by connecting experts from different disciplines, cities could develop effective strategies to combat noise, thus contributing to the creation of healthier and more pleasant urban environments.

Local community management should integrate noise reduction strategies into urban plans of local communities. Promoting public transport, cycle paths and pedestrian zones can reduce traffic noise in urban areas. Building sound barriers along roads can significantly reduce traffic noise. Plants, trees and green areas can act as natural noise absorbers. Increasing green areas/dams in cities can help reduce noise. These approaches can be combined to create a more pleasant and healthy environment in urban areas.

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