Preliminary communication

The impact of noise on human health and the quality of life

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Abstract: *This research paper deals with the problem of noise and analyses the relevant legal framework in the Republic of Croatia that regulates noise levels for the protection of health and the environment. Noise is recognized as a significant factor that can affect people's quality of life. Therefore, it is important to understand its impact and implement appropriate measures to address this challenge. The analysis of the legal framework shows that there are legal instruments, such as the Noise Abatement Act, which prescribe measures to prevent the negative effects of noise on human health and the environment. The measurement of internal and external noise was carried out with the Sauter SU 130, version 2.0. 04/2020, DE, which provides information about the actual noise levels in the analysed facility, a healthcare facility in Zagreb. Internal noise is often caused by staff and patient conversations and equipment, while external noise can be caused by traffic or other external sources. These findings provide a basis for understanding the challenges faced by workers and patients.The subjective experience of noise exposure is further analyzed in a survey of healthcare facility staff. The frequency of noise exposure, perceptions of the impact on concentration and productivity, and emotional reactions such as stress and sleep problems were analyzed to better understand the physical and psychological impact of noise on employees.The research also analyses employee awareness of noise-related regulations and policies and suggests measures to improve the situation. Indoor noise measurements with closed windows showed a deviation of 13.33% from the prescribed average noise level in a total of 60 measurements, while the deviation with open windows was 73.33%. The overall mean value of the noise measurement with closed windows is 42.9 dB(A), with the lowest mean value being 33.0 dB(A) and the lowest peak value 39.6 dB(A), while the highest mean value is 56.7 dB(A) and the highest peak value 73.6 dB(A). The average noise measurement with the windows open is 52.4 dB(A) overall, with the lowest mean value at 44.3 dB(A) and the lowest peak value at 48.1 dB(A), while the highest mean value is 59.0 dB(A) and the highest peak value is 71.2 dB(A). It is obvious that the noise levels are not satisfactory, and this experiment and analysis confirm a significant difference in noise levels between open and closed windows.The outdoor noise measurements showed a deviation of 38.33% from the average noise level with high peaks in a total of 60 measurements, which poses a potential risk to the health and quality of life of the exposed population. The lowest mean value is 57.2 dB(A), the lowest peak value is 64.7 dB(A), the highest mean value is 71.7 dB(A) and the highest peak value is 95.0 dB(A). High noise levels can also cause stress and disturbance to animals and disrupt their natural habitat and the balance of the ecosystem. In this part of the study, it was found that some of the noise levels do not meet the prescribed standard.A survey with 14 questions and 46 respondents revealed that noise is perceived as a potential disturbance and threat to one's health and ability to work. Disappointing results were also obtained regarding knowledge of noise protection regulations and guidelines: 82.6 % of respondents had insufficient or no knowledge of noise legislation and recommendations. This part of the study confirmed the negative effects of noise on personal mood and functioning in the workplace as well as the insufficient knowledge of the legal*

framework.In conclusion, the study emphasises the importance of a systematic approach to noise management to protect human health and recommends further steps to implement effective noise reduction measures.

Key words: *noise, environment, health, protective measures, experimental evidence, health effects*

1. INTRODUCTION

Sound is a complex phenomenon that refers to the vibrations of particles in a medium that propagate in space and are perceived by humans and animals as a sound experience and are ubiquitous in various forms and environments (Trbojević, 2011). Noise is any unwanted sound that occurs in the environment in which people work or reside and that may cause discomfort or negative health effects (Resanović et al., 2006). Noise is ubiquitous in urban environments and is often perceived as a nuisance that can affect people's quality of life. No less than 80% of noise sources in urban areas come from cars, while other noise sources are related to construction works, industrial facilities and various events and happenings (HAK Review, 2018). Noise is measured in decibels (dB), a unit of measurement for loudness, according to the International System of Units of Measurement. The extent of the harmful effect of noise varies depending on the psychological factors of the individual. Noise with an intensity of more than 85 to 90 dB can have a harmful effect if a person is exposed to it over a longer period of time (Marušić et al., 2023).

Daily noise pollution, be it environmental noise, community noise or general noise, as well as noise in residential areas, is one of the greatest challenges to the human environment, especially in urban areas (Gomzi 2005). Urbanisation and the rapid development of cities contribute to an increase in traffic and industrial activities, leading to a significant increase in noise levels in urban areas. Research into the effects of noise is becoming increasingly important as awareness of the harmful effects on human health, quality of life and the environment grows. In addition to potential physical and psychological problems, noise can impair communication and lead to increased stress in certain situations. Furthermore, constant exposure to noise can lead to certain disorders such as insomnia, hearing loss, increased stress levels, anxiety and depression. Overall, the World Health Organisation estimates that more than 466 million people (more than 5% of the world's population) suffer from severe hearing loss. Most European countries are confronted with the problem of traffic-related noise, with this being particularly pronounced in urban areas (European Environment Agency, 2020). Cities are endeavouring to regulate noise levels in order to maintain quality of life, with noise protection being particularly important in sensitive areas. These include areas where particularly noise-sensitive facilities are located, such as healthcare and educational institutions. The sensitivity of these facilities is considered, taking into account the demands of their users for a calm and quiet environment, while recognising the serious consequences that the opposite environment can have for these users (Bhave and Sayed, 2015). Noise affects not only humans but also the environment, especially animals, both in nature and in urban areas. Noise pollution can disrupt animal behaviour, migration and reproduction. Ecosystems also suffer from noise, which can lead to a decline in biodiversity and a disruption of the natural balance (Sordello et al. 2020). Given the increasing

challenges associated with noise in urban environments, it is crucial to integrate the understanding of this problem into management strategies for crisis situations. An effective response to crisis situations means not only saving lives and property, but also caring for the well-being of the population and protecting the environment. Understanding how to manage crisis situations and the impact of noise on human health and the environment can be key to developing strategies to manage crises in urban environments. In situations where there is already a high level of stress and discomfort, the effects of noise can exacerbate the situation. This results in the need for effective management of crisis events in the context of growing noise problems in the urban environment. This comprehensive approach enables the development of effective strategies to improve the safety of citizens and protect the environment in urban areas.
Hypotheses set forth in the paper:

H1: Noise transmitted from roads into enclosed spaces significantly affects the quality of performance of work tasks and the quality of life.
H2: The laws and regulations on noise protection in force in the Republic of Croatia are effective and provide protection for human health and the environment.

2. METHODS

A professional Sauter SU 130 noise level meter, version 2.0, was used to collect the noise level data. 04/2020, DE, calibrated according to ISO 9612:2009 standards. The sound level meter was installed inside the facility (private healthcare facility in Zagreb) where the employees worked during the research period and on the eastern exterior of the building facing the busy road. The indoor noise level was measured over a period of three weeks, every working day, with windows open and closed and under different weather conditions to obtain a variety of data. During this period, the relevant meteorological conditions were recorded at the same time as the outdoor noise to take into account their possible correlation with the noise level. The noise measurement data includes the average noise levels (LAeq) and the maximum noise peaks (LApeak) recorded in different weather conditions and during different periods of the day. These parameters are important because they provide the context for understanding the results.
For outhdor masurments the microphone for long-term measurements was mounted at a height of 1.5 metres above the ground using a tripod to ensure representative measurements. The noise metre was placed 1.5 metres from the facade and 3.5 metres from objects to minimise the influence of sound reflections on the measurements. The person carrying out the measurement was away from the noise metre itself in order to avoid negative influences on the measurement results. The measuring device was set up on a tripod or other suitable support.
In parallel to the noise measurements, a survey was conducted among employees to gain insight into their opinions and perceptions of the impact of noise on their health and mood. All participants were given instructions on how to complete the survey and how to keep their responses anonymous. Responses were collected from 46 employees of a healthcare facility in an urban environment. The data collected in the survey covered a variety of demographic groups and relevant noise factors. The questionnaire consisted of 14 questions and was

distributed to employees of the healthcare facility. The questions were asked in closed form using an ordinal scale and one question with multiple responses and the option of an open response. The questionnaire was sent via the official e-mail address and distributed in internal groups within the organization. All responses received were analyzed using the descriptive analysis method.
The measurement and survey were conducted in September 2023. After data collection, analyses were conducted to understand the impact of noise on the environment and human health.

3. RESULTS

The noise measurement method collects reliable and precise data to provide a complete picture of the noise problem. The noise measurement data forms the basis for further investigations and assessments of the effects of noise on the environment and people. Noise measurements are also important for assessing the significance of noise as a potentially harmful factor in the local environment. Knowledge of noise levels is essential for the planning and execution of construction projects with appropriate noise protection in order to minimise environmental impact.

The main guidelines for carrying out noise measurements in accordance with current laws and regulations include the following:

- Regulations for the protection of workers from noise exposure at work,

- HRN ISO 9612: 2000 standard in the field of acoustics, which provides for the measurement and determination of noise exposure in the working environment (ISO 9612:1997),

- the HRN ISO 1999:2000 standard in the field of acoustics, which relates to the determination of noise exposure in the workplace and the assessment of noise-induced hearing loss (ISO 1999:1990).

The device used for the measurement is the Sauter SU 130, version 2.0 04/2020, DE, a professional sound and noise measuring device for the environment, industry, shipbuilding, machinery and various workplaces with noisy environments. The dimensions of the device, length x width x height, are 236x63x26 millimetres and the weight is 170 grammes. The basic equipment of the device includes a case, an instruction manual, an inner foam cover and a protective cover for the microphone against the negative effects of wind. The device is capable of storing up to 30 measurements and transferring them to a computer (Figure 1.).

Figure 1: Sauter SU 130 noise measuring device used, version 2.0 04/2020, EN
Source: Own photo archive, 2023.

3.1. Noise measurement data

Experimental noise measurements were carried out from 4 September 2023 – 22 September 2023. every working day at 8:00, 12:00, 16:00 and 18:00, till the signal was stabile, cca 2 min.

The location of the healthcare facility was chosen in the Svetice district of Zagreb on Trpinjska street. The building faces Kneza Branimir street and the railway line on the east side and Donje Svetice street on the south side. Both streets are characterised by high traffic and a large intersection in the immediate vicinity with three lanes for each direction of travel in the city. The position of instrument was not with physical barrier. Not far from the healthcare facility are the Rebro Clinical Hospital Centre, the Maksimir Stadium, the Zagreb City Zoo and the Borongaj bus and tram junction. The time intervals were chosen to compare the noise levels during the hours when traffic is expected to be heaviest, i.e. at 8:00 and 16:00, and at 12:00 and 18:00, when traffic is expected to decrease, duraton of messurment 2 minits (Figure 2).

Figure 2: Location of the measurement carried out
Source: Google Maps, 2023.

To measure the average value of the internal noise, the device is set to LAeq mode in the slow channel, and to measure the peak values of the noise ("peaks"), the device is set to LApeak mode in the fast channel. The collected data was sorted and displayed using the Microsoft Office Excel programme.

3.2. Analysis of the results of the inner noise measurement

In accordance with the Regulation on the protection of workers from noise at work (Official Journal 46/2008) for more demanding office activities, doctors' surgeries, meeting rooms, school classes, direct speech and/or telephone calls, the permissible noise level from production sources is 55 db(A) and 45 db(A) for noise from non-production sources. In view of the fact that there are both production and non-production noise sources in the plant, the average value of 50 db(A) was used for the permissible noise level (Table 1.). Values that deviate from the

values prescribed in the Ordinance on the Protection of Workers from Noise at Work (Official Gazette 46/2008) are marked in red.

Table 1: Measured values of interior noise with closed and open windows
Source: Created by the authors, 2023

DATE	HOUR	MEAN VALUE LAeq (db)		„PEAK“ VALUE LApeak (db)	
		CLOSED WINDOW	OPEN WINDOW	CLOSED WINDOW	OPEN WINDOW
11.09.2023.	8:00	39,0	57,5	39,6	58,1
	12:00	40,5	56,6	41,2	61,0
	16:00	43,8	47,7	45,8	53,0
	18:00	43,2	48,5	45,7	54,7
12.09.2023.	8:00	40,1	51,2	41,6	61,9
	12:00	42,4	53,5	46,3	60,8
	16:00	43,5	50,1	45,7	55,4
	18:00	36,7	52,2	49,7	58,4
13.09.2023.	8:00	44,1	51,5	48,5	56,7
	12:00	47,8	56,4	57,8	59,4
	16:00	43,2	53,3	45,8	62,0
	18:00	44,8	55,9	48,8	59,5
14.09.2023.	8:00	52,4	53,9	54,0	58,2
	12:00	55,1	57,7	56,2	61,1
	16:00	42,8	44,7	62,0	64,2
	18:00	40,6	52,6	48,1	57,6
15.09.2023.	8:00	45,0	53,0	49,9	61,4
	12:00	43,9	50,0	56,9	58,2
	16:00	41,6	49,4	49,3	57,4
	18:00	35,3	52,2	45,3	55,0
18.09.2023.	8:00	43,8	49,9	45,5	57,7
	12:00	43,4	54,6	44,0	57,9
	16:00	42,2	49,1	45,9	60,9
	18:00	42,9	44,8	44,0	48,1
19.09.2023.	8:00	41,8	51,5	69,5	61,8
	12:00	41,4	56,5	43,7	59,4
	16:00	40,9	49,5	45,0	52,0
	18:00	53,0	57,1	73,6	67,2
20.09.2023.	8:00	50,5	54,3	59,2	60,1
	12:00	43,3	53,0	59,7	59,9
	16:00	34,0	52,5	63,4	54,1
	18:00	38,3	54,8	52,3	63,5

21.09.2023.	8:00	50,7	53,3	52,4	58,5
	12:00	52,2	57,8	65,8	68,9
	16:00	37,0	46,4	42,4	52,4
	18:00	39,5	56,4	44,1	60,1
22.09.2023.	8:00	50,3	51,2	58,1	56,0
	12:00	43,1	54,9	48,0	61,3
	16:00	35,7	54,5	42,5	57,4
	18:00	35,2	54,2	44,8	71,2
25.09.2023.	8:00	33,0	51,0	57,5	53,4
	12:00	44,8	49,6	51,6	56,2
	16:00	43,9	44,3	47,9	48,7
	18:00	46,1	55,4	56,2	61,4
26.09.2023.	8:00	37,4	49,4	49,2	55,2
	12:00	45,8	53,4	65,3	62,0
	16:00	36,5	53,5	50,2	60,3
	18:00	41,3	52,1	53,5	59,6
27.09.2023.	8:00	42,8	56,3	47,0	61,3
	12:00	48,5	57,7	50,6	60,0
	16:00	41,9	52,0	44,0	54,5
	18:00	34,7	53,8	49,1	55,5
28.09.2023.	8:00	44,0	49,8	47,3	57,5
	12:00	56,7	59,0	58,9	68,0
	16:00	45,6	52,7	58,4	54,9
	18:00	44,1	50,1	47,9	59,1
29.09.2023.	8:00	41,8	49,6	55,7	57,7
	12:00	36,3	50,2	63,8	62,9
	16:00	42,9	49,4	64,1	51,3
	18:00	42,3	51,4	49,0	54,6

The analysis of the results obtained shows that the inner noise level usually complies with the prescribed values when the windows are closed. At certain intervals, slightly higher peak values than prescribed were recorded, which were observed during the measurement procedure itself. The overall mean value of the noise measurement with the window closed is 42.9 dB(A) with a standard deviation of 5.17 db(A), which indicates a relative dispersion of the values around the mean noise level and the variability of the noise conditions during the measurement period. The lowest average value is 33.0 db(A) and the lowest peak value is 39.6 db(A), the highest mean value is 56.7 db(A) and the highest peak value is 73.6 db(A). If we look at the noise level indoors with the windows open, the noise levels is often higher than permissible. In this case, the noise is caused by external influences, most frequently by road and rail traffic in the immediate vicinity of the facility. The highest peak values were caused by passing vehicles such as motorbikes, large lorries and emergency vehicles with their sirens switched on. The overall mean value of the noise measurement with the window open is 52.4 db(A) with a standard deviation of 3.39 dB(A), which indicates relatively close values to the mean noise

level. The lowest mean value is 44.3 dB(A) and the lowest peak value is 48.1 dB(A), the highest mean value is 59.0 dB(A) and the highest peak value is 71.2 dB(A).

3.3. Analysis of the results of the outdoor noise measurement

To measure the mean value of the external (outdoor) noise, the device is set to LAeq mode in the fast channel, and to measure the peak values of the noise ("peaks"), the device is set to LApeak mode in the fast channel. The collected data was sorted and displayed using the Microsoft Office Excel programme.
According to Art. 5 of the Ordinance on the Maximum Permissible Noise Levels in the Working and Living Environment (Federal Law Gazette 145/2004), the noise level must not exceed 65 dB(A) for the day in an area with mixed, predominantly commercial and residential use.

Values that deviate from the levels specified in the regulations are marked in red (Table 2).

Table 2.: Measured values of outdoor noise measurement
Source: Created by the authors, 2023

DATE	HOUR	MEAN VALUE (LAeq)	„PEAK“ VALUE (LApeak)	T (°C)	Wind(km/h)	Wind direction	Rain (mm)	Moisture (%)	Pressure (hPa)
11.09.2023.	8:00	64,2	68,8	16,8	0,00	/	0	91	1017,1
	12:00	63,1	66,8	26,5	2,52	JZ	0	51	1016,2
	16:00	64,6	67,2	29,3	5,40	I	0	41	1014,0
	18:00	67,7	74,0	28,3	5,04	I	0	42	1013,3
12.09.2023.	8:00	61,9	71,8	17,0	0,36	I	0	88	1014,6
	12:00	61,9	72,7	28,5	6,12	J	0	44	1015,1
	16:00	62,5	66,0	30,0	7,20	Z	0	34	1012,9
	18:00	65,9	71,0	29,2	5,80	JZ	0	40	1012,7
13.09.2023.	8:00	64,8	70,1	18,8	6,10	JZ	0	72	1014,2
	12:00	64,8	95,0	25,9	13,70	JZ	0	48	1014,7
	16:00	67,5	69,4	29,5	11,88	JZ	0	41	1013,3
	18:00	65,5	71,8	28,2	12,60	JZ	0	46	1013,2
14.09.2023.	8:00	57,2	70,8	20,2	1,80	SZ	77,6/24h	81	1017,4
	12:00	61,1	69,7	23,2	3,24	SZ		72	1018,3
	16:00	63,9	69,1	18,1	5,04	SI		95	1019,4
	18:00	71,7	79,5	18,8	3,96	Z		94	1019,4
15.09.2023.	8:00	65,4	71,2	16,6	0,00	/	0	96	1020,4
	12:00	63,5	72,2	24,6	5,76	J	0	63	1018,1
	16:00	64,6	67,9	24,2	4,68	SI	0	56	1018,6
	18:00	67,1	73,9	23,5	2,52	SI	0	52	1017,2
18.09.2023.	8:00	64,1	73,6	17,4	1,80	SZ	0	90	1016,3
	12:00	65,1	72,3	26,4	6,50	JZ	0	63	1014,6
	16:00	64,5	69,8	27,4	9,40	J	0	54	1013,3
	18:00	62,6	69,1	26,0	7,20	J	0	59	1012,2
19.09.2023.	8:00	65,5	70,1	18,9	6,80	SZ	0	89	1013,2
	12:00	59,3	71,6	19,7	8,60	SI	0	89	1016,1
	16:00	60,4	64,7	23,6	6,10	J	0	60	1015,9
	18:00	64,0	70,2	23,4	3,20	JZ	0	64	1015,6
20.09.2023.	8:00	66,6	69,4	15,6	0,40	JI	0	94	1018,0

	12:00	60,0	67,8	22,3	3,60	SI	0	69	1017,5
	16:00	61,4	65,6	25,4	2,50	J	0	61	1014,9
	18:00	67,8	72,2	25,2	4,00	J	0	65	1014,1
21.09.2023.	8:00	63,2	70,8	18,6	2,20	J	0	90	1011,3
	12:00	66,5	71,8	25,6	10,40	JZ	0	52	1010,4
	16:00	65,5	74,3	24,1	12,60	J	0	57	1008,6
	18:00	68,8	72,0	21,8	7,90	J	0	67	1007,9
22.09.2023.	8:00	62,6	70,0	18,8	3,20	I	0	84	1007,7
	12:00	59,7	70,0	24,7	3,60	JZ	0	66	1008,0
	16:00	60,5	65,0	24,1	6,40	J	0	61	1008,4
	18:00	70,5	71,4	23,2	4,10	JZ	0	59	1008,2
25.09.2023.	8:00	66,9	69,1	15,9	16,60	SI	0	69	1022,2
	12:00	67,2	69,6	17,1	15,50	SI	0	73	1022,8
	16:00	64,4	70,1	17,5	13,70	SI	0	76	1023,8
	18:00	63,9	70,9	18,2	7,20	I	0	76	1023,7
26.09.2023.	8:00	65,0	70,1	13,7	3,20	JI	0	97	1023,2
	12:00	62,9	70,6	23,9	7,90	I	0	66	1022,3
	16:00	64,6	68,4	25,8	11,50	JI	0	52	1020,6
	18:00	63,5	71,3	24,7	6,80	JI	0	55	1020,4
27.09.2023.	8:00	66,1	70,2	14,9	0,00	/	0	96	1021,8
	12:00	67,0	68,4	24,5	9,00	I	0	48	1022,4
	16:00	65,1	78,7	26,0	13,70	SI	0	43	1020,8
	18:00	66,9	82,7	24,3	6,80	SI	0	50	1020,5
28.09.2023.	8:00	65,4	70,5	13,8	1,10	JI	0	92	1020,9
	12:00	61,4	67,8	23,5	5,80	SI	0	56	1020,9
	16:00	62,8	67,7	25,7	10,08	SI	0	43	1019,5
	18:00	64,4	66,2	24,2	7,92	SI	0	48	1019,3
29.09.2023.	8:00	61,7	66,8	13,2	0,00	/	0	91	1022,2
	12:00	61,6	71,0	23,3	3,60	S	0	47	1022,6
	16:00	64,4	73,9	25,7	4,68	JI	0	38	1021,0
	18:00	67,3	73,4	23,9	1,80	S	0	48	1020,4

As expected, this situation indicates a serious noise problem in the neighbourhood described, which calls into question the quality of life and health of the people living in the area. The measurement also detected high levels peaks, which means that the inhabitants of the area are exposed to sudden and very loud sound values. The lowest mean LAeq value is 57.2 db(A), the lowest peak value is 64.7 db(A), the highest mean LAeq value is 71.7 db(A) and the highest peak value is 95.0 db(A). The standard deviation of the mean noise value is 2.71 dB(A), which indicates a variety of noise values and a moderate dispersion around the overall mean value.
The meteorological factors recorded, such as wind speed, wind direction, temperature, air pressure, precipitation and weather conditions, can significantly influence sound propagation. A high wind speed can help the sound to propagate over greater distances, while a low temperature can influence the speed of the sound. Taking all of the above parameters into account, the dynamics of the noise in the area covered by the test are expected.

3.4. The results of a survey of employees on noise levels and the effects on work activity

The results obtained from analysing the noise measurements were supplemented by data collected as part of a survey to obtain a complete picture of the effects of noise on employees in a healthcare facility. The aim of the questionnaire is to analyse how employees of healthcare

facilities perceive noise in their workplace, i.e. their opinion on the impact on their productivity, their mood and their attitude towards noise exposure.
Of the total of 46 respondents, 31 respondents (67.4%) were female and 15 respondents (32.6%) were male, The information on age shows that a younger labour force is more strongly represented. Of the total of 46 respondents, 38 respondents (82.6%) were between 18 and 36 years old, 7 respondents (15.2%) were between 36 and 54 years old and 1 respondent (2.2%) was between 54 and older. Seven respondents (15.2%) spend 10-20 hours per week at their workplace. Three respondents (6.5%) spend 20-30 hours per week, while 36 respondents (78.3%) work 40 or more hours. Most of the respondents are employed full-time with occasional overtime, while a smaller proportion are employed on a work or student contract. Longer working hours can potentially increase the risk of negative effects of noise on health and mood.
Sixteen respondents (34.8 %) only work the morning shift, while 7 respondents (15.2 %) only work the afternoon shift. A total of 23 respondents (50%) work a combination of morning and afternoon shifts. This data is useful as they are exposed to different noise levels at different times of the day. 9 respondents (19.6 %) very rarely experience noise. Fifteen respondents (32.6 %) are occasionally exposed to noise. Twelve respondents (26.1 %) believe that they are frequently exposed to a noisy environment, while 10 respondents (21.7 %) believe that they are constantly exposed to noise. In response to the question with the option of multiple answers, 39 of the 46 respondents (84.8 %) stated that they were exposed to noise caused by verbal communication, i.e. conversations between staff, patients and the like. For the purposes of this study, it is important to note that 27 respondents (58.7%) experience external noise, e.g. from traffic, bad weather and other external factors. In addition, 9 respondents (19.6%) are confronted with noise from ventilation and air conditioning systems, and 18 respondents (39.1%) perceive noise from work equipment and devices, e.g. medical laboratory equipment, dental instruments, ultrasound equipment, computer components (printers) and the like.
Seven respondents (15.2%) identified a significant impact of noise on concentration and work efficiency, while 25 respondents (54.3%) identified a moderate impact. The remaining 14 respondents (30.4%) did not notice any influence of noise on concentration and work efficiency.
The above data shows that the majority of respondents, 32 in total (69.5%), perceive some form of noise impact and recognise a negative effect. 2 respondents (4.3 %) often feel stressed by noise pollution at work, while 26 respondents (56.5 %) occasionally feel stressed. 18 respondents (39.1%) stated that they do not feel stressed by noise. The majority of respondents, 28 in total (60.8%), experience some form of stress related to noise exposure.
Three respondents (6.5 %) stated that they often have problems sleeping or feel tired due to noise exposure at work, while 12 respondents (26.1 %) occasionally experience this. Thirty one respondents (67.4%) stated that they had no sleep problems that could be related to noise exposure. Thirteen respondents (28.3%) agree that noise significantly impairs communication with a client, party or patient within the organisation, while 26 respondents (56.5%) agree that noise moderately impairs interpersonal communication. Seven respondents (15.2%) do not notice the impact of noise on communication. More than 3/4 of respondents (84.8%) feel distracted by certain sources of noise during verbal communication with another person. 8 respondents (17.4%) believe that there is an urgent need to take action to reduce noise in the

workplace and 29 respondents (63%) believe that action should definitely be taken in the future. 9 respondents (19.6%) are of the opinion that no measures need to be taken to reduce noise levels. The majority of respondents (82.6%) believe that it is still necessary to think about ways to reduce noise levels in the workplace.
Only 8 of them (17.4 %) confirm that they are aware of the rules or guidelines regarding the wolf. 14 respondents (30.4 %) state that they are partially informed, while 24 respondents (52.5 %) believe that they are not informed about rules or guidelines regarding noise. The figure of 82.6% shows that respondents are poorly informed about laws, regulations or recommendations relating to noise.
The final open question was "Do you have any suggestions or ideas for improving the noise situation in the workplace?", and of the 46 respondents in total, 12 answered that it was necessary to work on better soundproofing the premises. One respondent replied that more modern equipment and devices with lower noise generation should be used.

4. CONCLUSION

The first hypothesis (H1) about the influence of road noise on the quality of the performance of work tasks and general well-being in enclosed spaces has been confirmed. The analysis of the collected data on noise levels during different time intervals and the answers of the respondents clearly indicate a significant negative impact of noise on the productivity and quality of life of people in enclosed spaces.
The second hypothesis (H2), which refers to the effectiveness of the existing legal framework and regulations regarding noise in the Republic of Croatia, is rejected with the conclusion that the mentioned measures are not effective enough to provide the necessary protection. This confirms the need to review and improve the legal measures in order to better address the negative effects of noise on human health and the environment.
Given the seriousness of the problem, preventive measures to reduce the negative effects of noise include improving the insulation of buildings, the use of noise barriers, speed limits (especially at night) and educating citizens and the working population about noise control. Given the development and modernisation of technology, particularly in the automotive industry, it is worth pointing out that the solution to the problem of traffic noise in the future will lie in the use of cars with electric and hybrid engines.
In conclusion, noise is a serious challenge for the environment and human health. Its negative effects are numerous and pervasive, with consequences for physical and mental health, quality of life and the survival of many species. Continuous research and conscious action are of great importance to reduce the harmful effects of noise and protect the environment and human resources.

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