

**Perceptions and Experiences of Noise Pollution in Selected Districts of Yerevan, Armenia:**

**A Qualitative Study**

Master of Public Health Integrating Experience Project

Professional Publication Framework

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*List of abbreviations*

ARLIS - Armenian Legal Information System

AUA - American University of Armenia

CDC - Centers for Diseases Control and Prevention

CNOSSOS- EU - Common Noise Assessment Methods in Europe

CVD - cardiovascular disease

DALYs - disability-adjusted life-years

GDG - Guideline Development Group

HA - Highly Annoyed

IHD - Ischemic Heart Diseases

IRB - Institutional Review Board

MI - myocardial infarction

MOH - Armenian Ministry of Health

MPH - Master of Public Health

US EPA - United States Environmental Protection Agency

WHO - World Health Organization

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## **Executive Summary**

Noise pollution is a public health issue. Adverse health effects from environmental noise pollution include cardiovascular disease (CVD), cognitive impairments among children, hearing impairment and tinnitus, sleep disturbance, and annoyance. Noise-induced annoyance leads to higher risks of depression, migraine, hypertension, etc. There are different types of noise pollution; the current study is focused on road traffic noise, the leading cause of environmental noise pollution. Considering the scarcity of noise-related studies in Armenia, the student investigator conducted this qualitative study to understand the perceptions and experiences of road traffic noise pollution according to those living in the most densely populated districts of Yerevan. The student investigator conducted five focus group discussions with four participants in each group using an instrument adapted from another study and analyzed the data using the six-phase thematic content analysis method suggested by Braun and Clark. The study participants include an adult population aged 18-70 living in the most densely populated districts of Yerevan. Five major themes are identified after analysis: reported factors that affect traffic noise pollution, seasonal and daily noise differences, effects of noise pollution, participant's perceived control over noise pollution, and participant's recommendations. Findings revealed that the study participants perceive road traffic noise as an issue. The findings related to honking and the participant's residential areas are consistent with the findings of other studies conducted in different countries. The student investigator suggests that future researchers conduct quantitative noise measurements to understand the actual scope of road traffic noise in Yerevan.

## **1. Introduction**

### **1.1 Background information**

Noise is “unwanted or disturbing sound.”<sup>1</sup> “Sound becomes unwanted when it either interferes with normal activities such as sleeping, conversation, or disrupts or diminishes one’s quality of life.”<sup>1</sup> Noise pollution is a growing concern of the World Health Organization (WHO) and European policymakers.<sup>2</sup> European people perceive noise pollution as harmful to their health and well-being.<sup>2</sup> Since June 2007, the European Council has required “noise maps” developed for all major roads from all the EU member states for road traffic and other types of sources of noise on a five-year basis.<sup>3</sup>

Various sources of noise pollution include road traffic, railway, aircraft, wind turbine, and leisure noises (concerts, live music, etc.).<sup>2</sup> Road traffic is defined as the leading cause of environmental noise.<sup>2</sup> “The road traffic noise source is determined by combining the noise emission of each individual vehicle forming the traffic flow. These vehicles are grouped into four separate categories with regard to their characteristics of noise emission (light motor vehicles, medium heavy vehicles, heavy vehicles, powered two- wheelers).”<sup>3</sup> The CNOSSOS-EU (or “Common Noise Assessment Methods in Europe”) explores various types of noise sources, such as point source and source line/ source line segment.<sup>3</sup> Traffic flow is an example of a source line.<sup>3</sup> Population density (total number of people per unit land area) is one predictor of noise levels.<sup>4</sup> In England, population density positively correlates with complaints as a result of noise.<sup>5</sup> In addition, the proximity of households to major roads is associated with being exposed to road traffic noise.<sup>6</sup>

In European quality-of-life surveys conducted every four years, 31% of the population reported difficulties due to noise pollution.<sup>2</sup> One 2017 study of 27 European countries found that

80% of the study population perceived noise as a harmful factor to their health.<sup>2</sup> A standardized questionnaire is widely used to assess annoyance levels due to noise pollution, and the percentage of people who report being highly annoyed (HA) is the most common indicator of the prevalence of annoyance in a population.<sup>7,8</sup> For every 10 dB increase in exposure, the “percentage of highly annoyed people” increases (OR=3.03, 95% CI: 2.5-3.55).<sup>2</sup>

Adverse health effects from environmental noise pollution include cardiovascular disease (CVD), cognitive impairments among children, hearing impairment and tinnitus, sleep disturbance, and annoyance.<sup>2</sup> Noise-induced annoyance leads to higher risks of depression, migraine, hypertension, etc.<sup>9</sup> “Sound is measured in decibels (dB). A whisper is about 30 dB, normal conversation is about 60 dB, and a motorcycle engine running is about 95 dB.”<sup>10</sup> Exposure to road traffic noise ( $L_{den}$ ) significantly raises the Incidence Rate Ratio of MI (myocardial infarction) by 12% per each 10 dB noise (95% CI 1.02-1.22) when adjusted for potential confounders.<sup>10</sup> Approximately one year of residential exposure to traffic noise for surfaces that are exposed the most is associated with 1.11 times higher risks of CVD (95% CI 1.05-1.17) and 1.10 times higher risks of stroke (95% CI 0.98-1.23) after making adjustment for covariates as age, sex, level of education, income, unemployment, smoking status, alcohol consumption, and sports.<sup>11</sup> For each 10 dB more exposure to road traffic noise among children aged 0-7 increases the risk of hyperactivity/inattention (by 10%) and peer relationship problems (by 6%).<sup>12</sup>

The burden of noise pollution can also be assessed by “disability-adjusted life-years (DALYs)”. The DALYs attributed to noise pollution among western Europeans is nine hundred three thousand years as a result of sleep disturbance, six hundred and fifty-four thousand for



annoyance, sixty-one thousand because of Ischemic Heart Diseases (IHD), forty-five thousand for cognitive impairments among children, and twenty-two thousand for tinnitus.<sup>2</sup>

Hence, noise pollution is an issue in the public health field that should be addressed by researchers, public health professionals, and policymakers. In addressing this issue, residential areas, educational institutions, hospitals, and workplaces should be considered.<sup>2</sup>

The WHO's Guideline Development Group (GDG) has set thresholds for road traffic noise levels. However, these levels exceed the recommended values in some countries, including Greece and South Africa.<sup>2</sup>

Scientists believe that people's perceived ability to influence the environment affects their perception of environmental health.<sup>13</sup> Although high noise levels are a public health problem, populations seem to have different views and perceptions regarding noise. For example, a study conducted in Delhi focusing on honking as a common habit in India analyzed people's (aged 17-70) perceptions of noise pollution and revealed that noise is a complex cultural and personal experience.<sup>14</sup> In other words, some people are annoyed by it, as they described honking as a "form of violence, a form of abuse," or "sometimes honk without any real reason, just to irritate others." Others get used to this kind of noise and state, "I think it's part of the habit," "Everyone is affected by honking and yet we all do honk," and "The more you honk the more powerful you are."<sup>14</sup>

In Armenia, a limited number of noise pollution studies have been conducted. In 2006, a Masters of Law student at the American University of Armenia (AUA) conducted her thesis project on "How to Solve Noise Problem in Armenia," which was mainly focused on leisure noise coming from entertainment places such as restaurants, and clubs.<sup>15</sup> The study found that

Armenian residents mostly struggle with clubs located inside residential buildings and outdoor cafes.<sup>15</sup> According to the Armenian Ministry of Health (MOH), the sound level ( $L_a$ ) and equivalent sound level ( $L_{aeq}$ ) should not be more than 55 and 45 dB between 6:00 to 22:00 (day-time) and 22:00 to 06:00 (night-time) time intervals, respectively.<sup>16</sup> According to a study conducted by the municipality of Yerevan in 2015 in the Achapnyak district, the average traffic noise levels exceeded the maximum recommended levels (mostly during 22:00 to 02:00 time intervals) in most of the residential points.<sup>17</sup> No studies to date specifically explored people's views and perceptions regarding noise pollution. Considering the scarcity of studies regarding noise pollution and the lack of investigations into people's views and perceptions of the situation in Yerevan, additional studies are needed.

## **1.2 Aim**

This study aims at understanding the perceptions and experiences of road traffic noise pollution for people living in the most densely populated districts of Yerevan. The study questions are:

1. What perceptions and experiences of road traffic noise pollution have adults aged 18-70 living in the most densely populated districts of Yerevan?
2. How do adults aged 18-70 living in Yerevan's most densely-populated districts perceive their abilities to affect road traffic noise?

## **2. Methods**

To investigate the questions of this research, the student investigator selected a qualitative study design. Qualitative studies are well suited for environmental health issues because they identify perceptions, views, and experiences of study participants, and qualitative methods engage local residents in environmental health problems.<sup>13</sup> The approach was based on

a study conducted in Australia that focused on perceived barriers/facilitators of students to take part in physical activities. This study used four focus group discussions with 3-4 participants in each group and a six-phase thematic content analysis method suggested by Braun and Clark.<sup>13</sup> Additional details of this method are described in the analysis section.

## **2.1 Study design**

The student investigator used a qualitative research method to investigate the study population's experiences with noise within their environment.<sup>18</sup>

## **2.2 Sample selection**

The student investigator calculated the population density of twelve areas of Yerevan by dividing the total population by area (table 1). Considering the population density of each district, she selected the most dense areas of Yerevan: Kanaker-Zeytun, Kentron, Nor Nork, Arabkir, and Avan, with population densities of 9.79, 9.45, 8.92, 8.88, and 6.54 (1000 people/km<sup>2</sup>), respectively.<sup>19</sup> The student investigator initially only selected four districts but added Avan after when results had not reached code saturation. She held discussions with four participants from each district using purposive convenience sampling by asking her acquaintances, relatives, and friends to participate. The student investigator called the potential participants to invite them and provided oral informed consent. If they agreed, she provided the predetermined place and time of the discussion. She conducted the face-to-face focus group meetings approximately one week after recruitment, and there was one reminder as a text message thirty minutes before the start of the session.

Participants were ages 18 to 70, living in Yerevan for at least one year, and speaking Armenian. Within each district, the student investigator assigned two participants living within a hundred meters of proximity of their major road and two participants living in more than a

hundred meters from a major road. A major road is “a road where commuters are given the advantage of crossing when the intersection is unregulated.”<sup>20</sup> On the demographic questionnaire, the student investigator asked the participants about their residential addresses. Based on the information provided, she measured the approximate distance between their home and the nearest major road using Google Maps.

### **2.3 Exclusion criteria**

1. Living outside of Yerevan
2. Having hearing difficulties (hearing impairments) diagnosed by a physician
3. Having psychiatric or nervous system disorders diagnosed by a physician

### **2.4 Study setting**

The student investigator conducted the face-to-face focus group discussions. She invited each group of participants to a café in their living district.

### **2.5 Instrument**

The student investigator adapted an interview guide from another similar study.<sup>21</sup> Changes were made to meet the study's purposes (appendices 2 and 5).

### **2.6 Ethical considerations**

The student investigator obtained Institutional Review Board (IRB) approval from AUA before starting the study. She kept the contact information, recordings, and demographic data obtained from the participants confidential and deleted after the end of the study. She provided oral informed consent (appendices 3 and 6) to the participants on the recruitment day (approximately one week before the meeting) and its hard copy before the start of the discussion.

## **2.7 Logistics**

The student investigator started the study after obtaining IRB approval, and the data collection lasted approximately three weeks. The focus group discussions were conducted only by the student investigator. She used her password-protected computer, where she saved the transcripts, and her password-protected smartphone, where she saved the recordings. The study's expenses included one cup of coffee for each participant.

## **3. Data analysis**

The student investigator fully transcribed the interview results of each participant into a Word document and analyzed the data using the thematic content analysis method. In qualitative studies, coding is an important part of the analysis, and grounded theory is the most common analytical framework.<sup>13</sup> The student investigator followed the six steps of thematic content analysis; “Familiarizing yourself with your data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report.”<sup>22</sup> The student investigator developed the codes based on the statements of participants as such: If a participant reported an effect due to noise, she developed the “effects of the loud noise” as one of the main codes. If they mentioned certain effects, such as sleep disruption, she developed the subcode of “sleep disruption” under the main code. Hence, she coded the entire dataset with the same principle, and she created the codebook. After creating the codebook, she grouped the most relevant codes and developed a common theme for each group. She reviewed and revised the themes and generated a thematic map (Figure 2).

## **4. Results**

Out of 21 participants who were invited, one person refused to participate. Five focus group discussions were conducted with four participants in each group (twenty participants

total). The mean age was thirty-five years, with a median age of thirty-two ranging from 19-60. Five participants were male, and fifteen were female. Half of the participants live within 100 meters of a major road, and the other half live more than 100 meters from the road). None of the participants reported having hearing impairments, psychiatric, or nervous system disorders diagnosed with a physician. After thematic analysis, the student investigator identified five major themes; Reported factors that affect traffic noise pollution, seasonal and daily noise differences, effects of noise pollution, participant's perceived control over noise pollution, and participant's recommendations.

#### **4.1 Reported factors that affect traffic noise pollution**

According to the participants, traffic jam in the streets is the primary source of road traffic noise pollution. Hence, anything that increases this factor also increases the level of noise pollution. For example, in Yerevan, since the quality and performance of public transportation are poor, many people prefer to use their personal cars instead of taking public transportation. The participants declared that in Yerevan, the buses arrive late, the number of metro stations is limited, and all kinds of public transport are outdated and cramped (there aren't enough seats for everyone). Hence, they think that they need new buses and more metro stations.

*"I think that in every household, many of us can take subway or bus, but many people prefer to have their own cars, which causes traffic jams. Due to that, constant noises disturb us." G2*

*"Why don't I take public transport? It's not comfortable for me, because the buses are full (cramped) and it's more convenient for me to use my own car." V2*

*“I think if the number of metro stations was more, it would be so good, it would ease the traffic jam much more, the noise would be reduced, the air would be cleaner, and there would be fewer problems related to the transportation of people.” G4*

*“The condition of the buses is terrible as well. The condition of the subways is the same. Also, time has no value in Armenia. The metro can come in 10 minutes, it can come in 15 minutes. There is no certain time.” G2*

The situation in the Kentron district is more complex than the other districts; the city's best cafes, restaurants, working offices, universities, Governmental institutions, etc., are located in the Kentron district. Due to that, many people go to this district for different purposes, which causes terrible traffic jams in the streets and, consequently, noise pollution.

*“Everything is concentrated in Kentron. All the opportunities are in Kentron. People think that if they need to have a business, they want it to be in Kentron. Perhaps the problem comes from there. If it was not concentrated in Kentron, if it was developed in other places, even the same restaurants, the same cafes and schools could have been developed not only in Kentron, maybe it would be a little better. Now, we all know that the best places are in Kentron, the best schools are in Kentron, and the best cafes are in Kentron.” G2*

*“Moreover, around 6-7 p.m., [the city] is the noisiest. Whether it's the traffic jam, the cars, or people who are already returning home from Kentron from their workplaces.”*

*G2*

There are different vehicles that produce road traffic noise, such as heavy vehicles (mainly construction trucks), police cars, emergency vehicles, and light motor vehicles. The most

frequently mentioned source was cars (light motor vehicles) that honk and accelerate and screech tires.

*“The big cars always pass by our house, so we can't open the window to let fresh air into the house.” H1*

*“When there is a traffic jam, those continuous honks, one after the other, are bothering.”*

*T3*

*“To me, the noise of the car's exhaust when we are in Kentron, and they pass quickly.*

*Also, the drifting cars. It scares us.” B5*

Participants living in the Kentron district mentioned the artificially modified noise that comes from the car's exhaust.

*“Some cars that make loud noises are done mostly on purpose, [their systems are] even modified to make a weird noise. This causes a bigger problem.” V2*

Another source was heavy vehicle engines that produce enormous noise, especially when driving fast.

*“The noise of the engine is heard a lot, especially that of trucks when they drive fast.” E4*

Also, the police who honk and talk with the speaker annoy people.

*“The noise of the police car annoys me a lot. That is a lot, and it seems that the SHARP sound gets on my nerves all the time, and I can't concentrate.” N2*

The noise of emergency vehicles such as ambulances is declared extremely stressful and scary.



*“To me, the thing that affects me a lot, the first thing that I would like to change is the emergency ambulances. I wish that voice wouldn’t exist at all. Because every minute when they pass by when you are at home, it’s very clearly heard, and you feel that you’re stressed out every time. I don’t like the emergency ambulance’s sound the most.” X1*

Among 10 participants who were living far from the major road, five participants (50%) complained about the noise without mentioning the effect of their proximity to the road, three participants (30%) mentioned that they get annoyed mainly when they go out, and two participants (20%) mentioned they don’t be affected by road traffic noise since they live far from the major road.

*“In the streets of Kentron, when you walk on the sidewalks, all that noises are present, but when you enter the courtyards, there is a kind of calmness. That noise is kind of relieved.” A2*

*“Since I live in such an area that my building is far from the road (there is a park in front of us) and we are surrounded by buildings, when I am at home, traffic noise is not an issue for me, and it doesn’t bother me.” R3*

*“My living place is far from the main street, so the traffic noise doesn’t bother me at all. Also, my workplace is inside a yard, and there is no transportation to disturb me.” T3*

Among those living near (within hundred meters to) a major road (10 people), six participants (60%) believe that they are being affected by noise since they live near the major road, and the rest of them (40%) complained about the noise without mentioning the effect of their proximity to the road.

*“Since we live on the “X” Avenue, there’s a lot of noise coming from cars near us.” G4*

*“Since we live close to the road, the noise disturbs us. I believe if we were living in another place, we would have peace.” V5*

#### **4.2 Seasonal and daily noise differences**

Traffic noise varies by season and the time of day. Summer is the noisiest season in Yerevan, compared to the other seasons, because residents and tourists travel to different places for leisure activities in the pleasant weather. This increases crowding and traffic jams.

*“In summer, there is more noise at night than in winter. The city is more awake (crowded) in the summer.” H1*

*“Why is there so much traffic in the summer? So many people go out of the city on this road, and I think it's also related to that, so to speak, there is more traffic.” L1*

Participants had different views on the timing of noise. Some of them believed peak hours are the noisiest time of the day; In other words, when the working hours start and finish (around 9 a.m. and 6 p.m.). However, others believe that during daytime (approximately 8 a.m. to 7 p.m.), the noise level remains high.

*“The highest noise is in the morning when people go to work and in the evening when they come back home.” D4*

Conversely, participants agreed that the noise level is generally low during the night when there are no traffic jams.

#### **4.3 Effects of noise pollution**

Being exposed to road traffic noise generally bothers people, makes them nervous, prevents them from concentrating, causes stress, prevents children from sleeping, etc. Becoming annoyed is the most frequently mentioned effect of noise pollution.

*“That loud noise constantly bothers me, even at home, studying, or doing anything.” H1*

*“The biggest problem is the problem of concentration. When you want to do work that requires concentration, you need to count something, but you can't.” V2*

*“Even if we don't leave the house, especially in the summer when the windows are open, we hear and constantly get nervous, have headaches, etc. It definitely affects us negatively.” N2*

*“That noise disturbs you and you want to take a rest, but the noise disturbs you and you can't concentrate on taking a little bit of rest after work.” I1*

*“I would also add that they cause stress and make people nervous and scared. People are afraid when they (drivers) suddenly honk.” Z3*

*“In our case, we have a grandson, and we can't make him sleep during the day at all.”*

*X1*

#### **4.4 Participant's perceived control over noise pollution**

The majority of participants believe that they don't contribute to the noise level since they use public transportation, and those who drive do not honk or produce any kind of noise that disturbs others.

*“I personally do not honk. Most of the time, I use the horn just to avoid accidents, but I always turn up the volume of the music. But since my car is in the factory's default setting, that is, it's in the standard, and I myself have not changed anything artificially. I feel that the factory has taken into account how to do it so that the noise doesn't disturb the surroundings. There is no problem from my side.” M3*

*“I don't think that I make any kind of noise during the day that disturbs others because I use public transportation; Of course, it causes noise, but it does not depend on me. I don't listen to loud music or TV at home either. Basically, I think I don't affect the noise.”*

*H1*

The participants mentioned that to escape from the noise, they mainly close the windows (regardless of the season), stay at home, put on headphones, or simply try to get along with the situation since they have no other choice. In other words, the residents don't have control over traffic noise level.

*“In that hot temperature, we have to close the windows, no matter how the weather is, you have to close them tightly so that the noise doesn't bother us, but it still can be heard and doesn't let me make him [the grandchild] sleep.” X1*

*“Well, we are getting nervous. What can we do? But since we live in Kentron, there's no other choice.” N2*

#### **4.5 Participant's recommendations**

Participants mentioned that politicians and policymakers can change the situation. According to the participants, politicians should generate certain rules specifically for road traffic noise and apply heavy fines to make residents comply with the law. In other words, they should prevent a light motor vehicle from unnecessarily honking, drifting, and artificially amplifying the sound of their car exhaust.

*“I think if this is done by law and with heavy fines, everyone will comply with it.” H1*

*“I think there should be a law that every car that honks or something applies a fine so that people don't make noise as much as they want. In very rare cases, as in European countries.” XI*

*“Of course, politicians and policymakers should apply a new law to ban unnecessary honking and making noise to prohibit them from making that much unnecessary noise.”*

*II*

*“I would say that rules should be set (there is a huge gap in our legislation regarding road traffic noise), and if they fix it and fill that gap, that is, if a law is adopted, I believe that the problem will be solved. There is a law, but not specifically regarding the noise of these vehicles. Literally, there is none.” S4*

On the other hand, they believe the policymakers should prevent traffic jams by improving the function of buses and increasing the number of metro stations so that more people will use public transportation instead of personal cars.

*“Definitely the municipality by adding more buses and metro stations. That's the only way to control traffic jams. If they add more buses, more people will use them.” F5*

Moreover, they should promote cycling by creating certain lines special for cyclists instead of using personal vehicles.

*“In my opinion, the National Assembly should adopt these laws; if it is possible to set special rules for cyclists or to improve public transportation and the metro so that they are less cramped. I am very much in favor of adopting such laws.” E4*

## 5. Discussion

Factors that increase heavy traffic jam also increases participant's perceived noise pollution. These factors include inadequate public transportation, daytime hours (especially during peak hours), summer season, and concentration of all the cafes, restaurants, offices, etc., in the Kentron district. Since improper public transportation is a key determinant of noise pollution, the participants believe that they need high-quality buses, more metro stations, and appropriate roads for cyclists to avoid traffic jams, and this is the responsibility of the Government. Noise-induced health outcomes, including annoyance, stress, and sleep disturbance among children mentioned by participants are consistent with other study findings. As described in the literature, these factors can cause serious health effects.<sup>2,9</sup> For example, noise-induced annoyance can increase the risk of depression, migraine, and hypertension among people exposed.<sup>2,9</sup> The study findings related to honking are similar to the study conducted in Delhi.<sup>14</sup> Moreover, consistent with another study's findings, participants who live close to a major road were more annoyed than those living in the yard, farther from a major road.<sup>6</sup>

Regarding participants' perceived abilities to affect traffic noise pollution and recommendations for changing the situation, most believe that they don't produce noise since they use public transportation and rarely honk. The only effort as a measure to escape from the noise is close the windows, stay at home, or simply get used to it. They recommend that politicians should take measures to solve the problem of noise pollution in Yerevan.

Some studies suggest that informing the residents about their noise exposure level affects their perception of noise pollution, and it's the first step to dealing with such environmental issues.<sup>23</sup> The WHO's GDG suggests that policymakers follow the other country's successful efforts and conduct certain interventions, such as decreasing traffic flow rate by constructing

bypass roads, setting time restrictions for trucks, building noise barriers along roads, and improving the quality of road surface to reduce the road traffic noise consequence on residents.<sup>2,24</sup>

Conducting focus group discussions, as opposed to individual interviews, enabled participants to not only respond to the questions but also express their opinion about other participants' statements. In addition, the participants were not restricted to choosing predefined answers between multiple choice as they would be in quantitative surveys. They were able to fully discuss the phenomenon to identify different perceptions of noise pollution in their surrounding environment, which resulted in enriched data.

This study has certain strengths and limitations. The current study is the first conducted in Armenia to exploring the population's perceptions and experiences of noise pollution. Since the topic wasn't sensitive, none of the participants refused to answer any of the questions. Also, the study reached code saturation. In other words, by analyzing the last focus group discussion, no new codes or subcodes were added to the codebook. Also, the student investigator kept a research diary to ensure reflexivity.

Since the convenience sampling method is a non-probability method, the study sample is not representative of the Yerevan population. Selecting the student investigator's friends, relatives, and acquaintances could potentially bias the responses. Because hearing impairments and psychiatric and nervous system disorders were reported by the participants, this issue is subject to misreporting. Since the interviewer had background information about the topic and the results of a previous study in Achapnyak district of Yerevan, interviewer bias could threaten the study's internal validity. Authority bias was detected in some groups and is a possible threat

to this study; Some participants tried to lead others to agree with their statements. Also, social desirability bias could possibly affect participant's responses.

Higher noise pollution perceived by the participants during summer compared to the other seasons can be due to open windows during summer. Considering the fact that proximity to a major road impacts noise exposure, the investigator recruited an equal number of participants living close to and far from the major road. Because participants were recruited from Yerevan's most densely populated districts, the results aren't attributable to the general population of Yerevan. Also, this study did not quantitatively measure the participant's noise exposure nor annoyance levels. In addition, there may be additional unidentified factors that could affect participants' perceptions and experiences of noise pollution. Hence, follow-up quantitative research studies need to be done to identify the noise pollution levels in different areas and times in Yerevan.

## **6. Conclusion**

Despite the fact that noise measurements are unavailable and residents are unaware of their actual exposure, noise pollution is perceived as an issue in Yerevan, especially in summer and during certain hours of the day. Continuous noise monitoring investigations and various noise-related studies in all of Yerevan's districts during different seasons and times of the day are needed in order to gain a stronger understanding of noise exposure and its possible effects on health. For example, to obtain the percentage of HA people in Yerevan, future researchers can use the standardized questionnaire widely used in other countries. Quantitative measurements will increase people's understanding of the problem and aid with behavior change, and it will enable politicians and policymakers to compare values in Yerevan to international standards and make informed decisions accordingly.



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## Tables

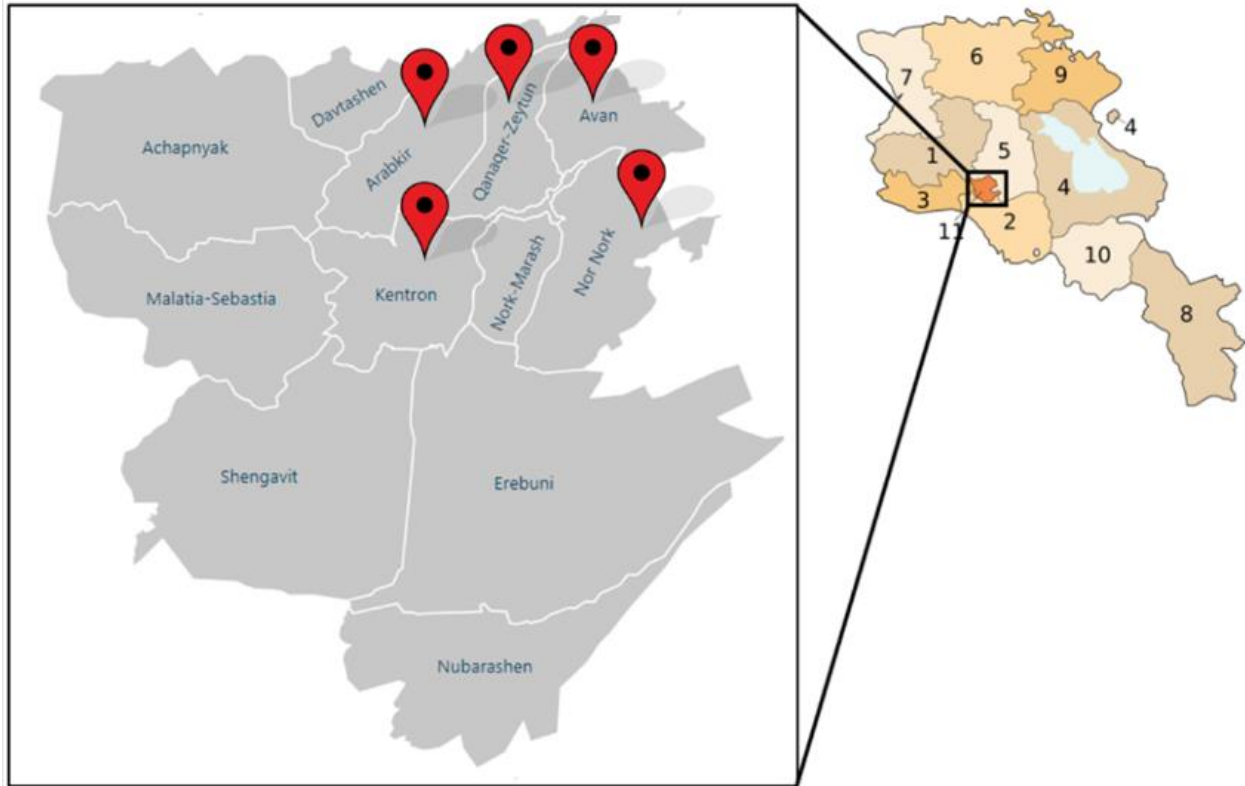
**Table 1. Population density of Yerevan by administrative districts. Five most densely populated districts are indicated in bold text.**

<i>District</i>	<i>Permanent population of Yerevan by administrative districts (1000 people)</i>	<i>Area (km<sup>2</sup>)</i>	<i>Population density (1000 people/km<sup>2</sup>)</i>
Achapnyak	109.6	25.8	4.25
<b>Avan</b>	<b>53.1</b>	<b>8.12</b>	<b>6.54</b>
<b>Arabkir</b>	<b>117.704</b>	<b>13.25</b>	<b>8.88</b>
Davtashen	42.207	6.52	6.47
Erebuni	126.3	48.5	2.60
<b>Kentron</b>	<b>126.6</b>	<b>13.4</b>	<b>9.45</b>
Malatia-Sebastia	142.6	25.2	5.66
<b>Nor Nork</b>	<b>129.4</b>	<b>14.5</b>	<b>8.92</b>
Nork-Marash	11.3	4.7	2.40
Nubarashen	9.7	17.24	0.56
Shengavit	137.4	40.9	3.36
<b>Kanaker-Zeytun</b>	<b>74.4</b>	<b>7.6</b>	<b>9.79</b>

\* Data adapted from <sup>19</sup>

## Figures

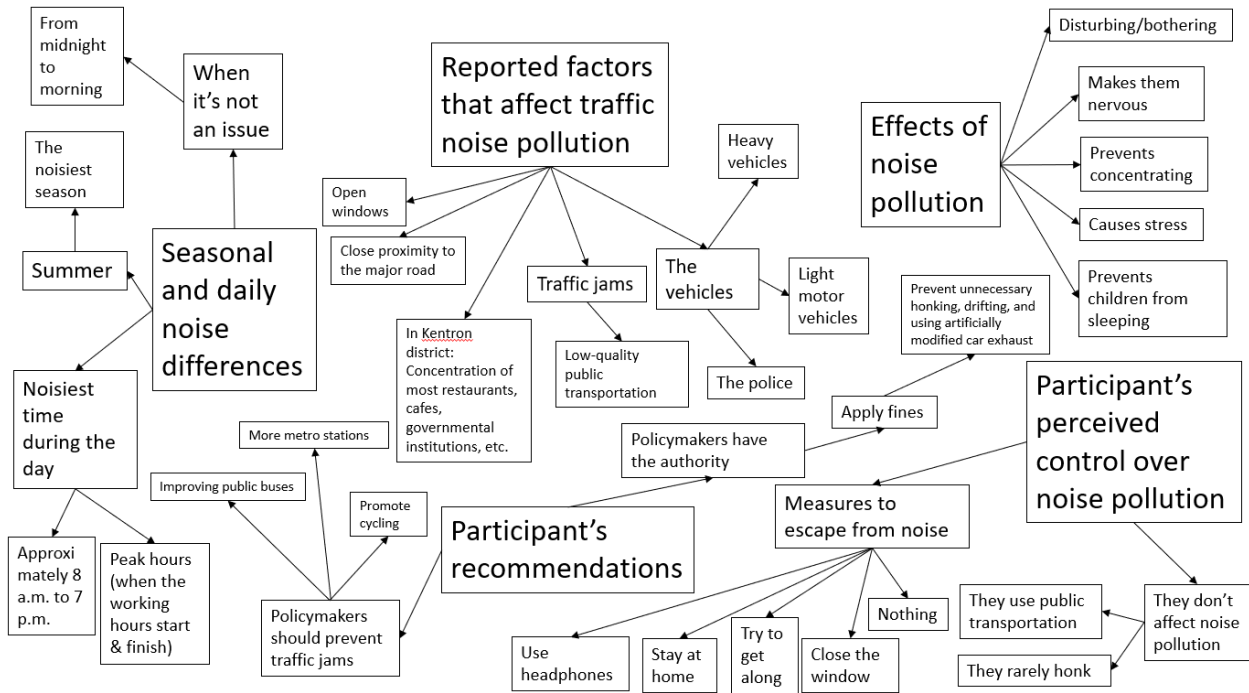
**Figure 1.** Map of Yerevan districts, with red pins in the five most densely populated districts selected for the study.



\* Data adapted from Administrative divisions of Armenia,<sup>25</sup> and Administrative districts of Yerevan<sup>26</sup>

\* The figure shows administrative divisions of Armenia, with number 11 being Yerevan. The inset is a map of districts of Yerevan, and the red pins show the five most densely populated districts selected for the study.

**Figure 2. Thematic map**



\* The figure shows the thematic map with five major themes generated after thematic content analysis. The main themes, written in larger text, are reported factors that affect traffic noise pollution, seasonal and daily noise differences, effects of noise pollution, participant's perceived control over noise pollution, and participant's recommendations. Smaller texts are codes and subcodes.

## **Appendices**

### **Appendix 1**

#### **Demographic data**

**Date:**

**Interview site:**

1. Interviewee ID:
2. How old are you?
3. Do you have hearing difficulties (hearing impairments) diagnosed with a physician?
4. Do you have psychiatric or nervous system disorders diagnosed with a physician?

## Appendix 2

### Interview Guide

**Date:**

**Group/individual ID:**

As you may have noticed, in recent years, noise pollution has increased in Yerevan; We all hear different noises in our surroundings. “The road traffic noise source is determined by combining the noise emission of each individual vehicle forming the traffic flow. These vehicles are grouped into four separate categories with regard to their characteristics of noise emission (light motor vehicles, medium heavy vehicles, heavy vehicles, powered two-wheelers).”<sup>3</sup> I would like to learn more about what you think about the increase in noise pollution in Yerevan.

1. What noises do you hear in your environment (home)?

*Probe:* How different is the noise pollution at different hours during the day?

*Probe:* How different is the noise pollution in summer compared to other seasons?

2. How do they make you feel?
3. What noise do you dislike the most?
4. How does noise pollution affect you in your day-to-day life (compared with other sorts of pollution)?

*Probe:* What do you do to stop noise from affecting you?

*Probe:* Where do you go for a quiet space?

5. How do you feel you have control over the noise in your environment?

*Probe:* Who do you think can affect (mitigate) the noise in your environment (the municipality, politicians, neighbors, or others)?

*Probe:* How do you think they can affect the noise in your environment? Could you give more examples?

6. What changes you would like to see to reduce the environmental noise to a more convenient level?



### Appendix 3

American University of Armenia

Institutional Review Board #1

Oral Consent Form for Participants

Noise Pollution in Yerevan: A qualitative investigation of multiple perspectives from Yerevan

Hello, my name is Arpa Harotounian. I study at the Turpanjian College of Health Sciences at the American University of Armenia, and for conducting my master's thesis project, I am exploring the views, perceptions, and experiences of traffic noise pollution and its health consequences on populations in Yerevan.

I want to invite you to participate in a focus group discussion for this project because you live in Yerevan, and I want to explore your perceptions and experiences on the topic. This interview will be your sole contribution to this study, which will last for approximately 30-60 minutes. I will ask questions regarding environmental noise. There will be approximately 16 study participants apart from you.

All provided information will be remained confidential. We will not write your name in any results, and a summary from the data provided by the interviews will be shown. If you agree, I will record or take notes from this discussion, to make sure that I will capture all the important information you provide. My notes and the recording will be saved without your identifying information and they will be deleted after the project. Your quotes may be used in reporting the final findings but will not link to your name or any type of personal and/or identifiable information.

You will participate in this study voluntarily. You can refuse to answer each question or can stop the discussion whenever you want. No financial compensation will be applied to you, and you will have no personal benefits because of participating in the study. No known risks were identified to you because of your participation. Possibly, the information that you provide, will inform governmental decisions regarding structural and educational interventions in the country, which is a benefit for you and the general Armenian population.

In case you have questions about this project, you can contact Dr. Varduhi Petrosyan, the dean, professor, and director of the Avedisian Onanian Center for Health Services Research and Development at Turpanjian College of Health Sciences of the American University of Armenia +37460 612592.

In case you think someone treated you unfairly or hurt you, you should contact Ms. Varduhi Hayrumyan, the Human Participant Protections administrator of the Institutional Review Board of the American University of Armenia (374-60) 612561.

Do you agree to participate? Thank you. If yes, do you agree to the recording? If YES, I'll continue. If it's not a problem, I'll turn on the audio recorder once we start the discussion. If NO, I can take notes, if you do not mind.

## Appendix 4

### Ժողովրդագրական տվյալներ

Ամսաթիվ:

Հարցազրույցի վայր:

1. Հարցազրույցի մասնակցի նույնականացման համարը :
2. Քանի՞ տարեկան եք:
3. Ունե՞ք լսողական խնդիրներ, որոնք ախտորոշվել են բժշկի կողմից:
4. Ունե՞ք հոգեբանական կամ նյարդային համակարգի խանգարումներ, որոնք ախտորոշվել են բժշկի կողմից:

## Appendix 5

### Հարցաշար

Ամսաթիվ:

Խմբի/անձի նունակ անվան համար:

Ինչպես են կատարվում, վերջին տարիներին Երևանում ավելացել է աղմուկի աղտոտվածությունը: Մենք բոլորս մեր շրջապատում լսում ենք տարբեր աղմուկներ: «Ճանապարհային երթևեկության աղմուկի աղբյուրը որոշվում է երթևեկության հոսքը ձևավորող յուրաքանչյուր առանձին մեքենայի աղմուկի արտանետումների համադրմամբ: Այս տրանսպորտային միջոցները խմբավորված են չորս առանձին կատեգորիաների՝ կապված աղմուկի արտանետման իրենց բնութագրերի հետ (թեթև շարժիչային տրանսպորտային միջոցներ, միջին ծանրության տրանսպորտային միջոցներ, ծանր տրանսպորտային միջոցներ, շարժիչով աշխատող երկանիվ մեքենաներ)»: <sup>3</sup> Ես կցանկանայի ավելին իմանալ, թե ինչ կարծիքի էք Երևանի աղմուկի աղտոտվածության աճի մասին:

1. Ի՞նչ ձայներ էք լսում ձեր շրջակա միջավայրում (տանը):

Հետաքննությունը. Որքան է տարբերվում աղմուկի աղտոտվածությունը օրվա տարբեր ժամերին:

Հե տաք ն ն ռ թ յ ռ լ ն . Որ ք ան ո ՞ վ է տար ք եր ամ ռ ան ը  
աղ մ ռ լ կ ի աղ տո տվ ած ռ լ թ յ ռ լ ն ը մ յ ռ լ ս ս ե գ ռ ն ն եր ի  
հ ամ ե մ աս :

2. Ի ն չ պ ի ս ի ՞ գ գ աց ռ ղ ռ լ թ յ ռ լ ն ն եր ե ն առ աջ աց ն ռ լ մ ն ր ան ք :
3. Ո ՞ ր աղ մ ռ լ կ ը ամ ե ն աշ ատը չ ե ք ս ի ր ռ լ մ :
4. Ի ն չ պ ե ՞ ս է աղ մ ռ լ կ ի աղ տո տվ ած ռ լ թ յ ռ լ ն ը ազ ղ ռ լ մ ձ ե գ վ ր ա  
ձ ե ր առ օ ղ յ ա կ յ ան ք ռ լ մ (հ ամ ե մ ատաձ ա յ լ տե ս ա կ ի  
աղ տո տվ ած ռ լ թ յ ան հ ե տ) :

Հե տաք ն ն ռ թ յ ռ լ ն . Ի ՞ ն չ ե ք ան ռ լ մ , ռ ր պ ե ս գ ի աղ մ ռ լ կ ը  
չ ազ ղ ի ձ ե գ վ ր ա :

Հե տաք ն ն ռ թ յ ռ լ ն . Որ տե ՞ ղ ե ք գ ն ռ լ մ ռ ր պ ե ս հ ան գ ի ս տ  
տաք ած ք ի :

5. Կար ծ ռ լ մ ե ք ի ն չ պ ե ՞ ս ե ք ազ ղ ռ լ մ ձ ե ր մ ի ջ ալ ա յ ր ի աղ մ ռ լ կ ի  
վ ր ա :

Հե տաք ն ն ռ թ յ ռ լ ն . Ձ ե ր կ ար ծ ի ք ռ վ ռ վ ք ե ՞ ր կ ար ռ ղ ե ն  
ազ ղ ե լ (մ ե ղ մ աց ն ե լ ) աղ մ ռ լ կ ը ձ ե ր մ ի ջ ալ ա յ ր ռ լ մ  
(ք աղ աք ապ ե տաք ան ը , ք աղ աք ա կ ան գ ռ թ ի չ ն եր ը ,  
հ ար ն ան ն եր ը կ ամ ա յ լ ք ) :

Հե տաք ն ն ռ թ յ ռ լ ն . Ի ՞ ն չ ե ք կ ար ծ ռ լ մ , ի ն չ պ ե ՞ ս կ ար ռ ղ  
ե ն ն ր ան ք ազ ղ ե լ ձ ե ր մ ի ջ ալ ա յ ր ի աղ մ ռ լ կ ի վ ր ա :

Կար ռ ՞ ղ ե ք ալ ե լ ի շ ատ օ ղ ի ն ա կ ն եր ք եր ե լ :

6. Ի՞նչ փոփոխություններ կցանկանայիք տեսնել 2 րջակա միջավայրի աղմուկը ավելի հարմար մակարդակի իջեցնելու համար:

## Appendix 6

Հայաստանի ամերիկյան համալսարան

Գիտե տազոտական է թիկայի թիվ մեկ հանձնաժողով

Իրագեկ համաձայնությունն

Շրջակամիջավայրի ձայնային աղմուկը և դրա  
ազդեցությունը առողջության վրա. որակական  
հետազոտություն Երևանում

Բարև, իմանունը Արփա Հարությունյան է: Ես սովորում եմ  
Հայաստանի ամերիկյան համալսարանի Թրփան ճեան  
առողջապահական գիտությունների ֆակուլտետում և իմ  
մագիստրոսական թեզի նախագծի շրջանակներում՝ ես  
ունումնասիրում եմ Երևանի բնակիչներին կարծիքները,  
ընկալումները, և փորձառությունները շրջակամիջավայրի  
աղմուկի և դրա առողջական ազդեցություններին վերաբերյալ:

Ես հրավիրում եմ Ձեզ մասնակցելու այս ֆոկուս խմբային  
քննարկմանը, որով հետևյալ քայլում եք Երևանում, և ես  
ցանկանում եմ իմանալ Ձեր ընկալումը և փորձը այդ թեմայի  
վերաբերյալ: Ձեր մասնակցությունը միայն այս հարցազրույցն  
է, որը կարող է տևել մոտավորապես 30-60 րոպե: Ես Ձեզ մի քանի հարց  
կտամ շրջակամիջավայրի ձայնային աղմուկի մասին: Դուք մեկն

էք մոտավորապէս 16 մասնակիցներին, որոնք կ'մասնակցեն այս ծրագրին:

Բոլոր տրամադրված տեղեկությունները կ'պահպանվեն գաղտնի: Մենք Ձեր անունը չենք նշի արդյունքներում, և ինֆորմացիան կ'ներկայացվի միայն ընդհանուր գեկույցի տեսքով: Եթե Դուք համաձայնվեք, ես կ'ձայնագրեմ կամ գրառումներ կ'վերցնեմ հարցազրույցի ընթացքում՝ Ձեր ներկայացրած ինֆորմացիան բաց չթողնելու նպատակով: Ձայնագրությունը և գրառումները կ'պահվի Ձեր անձը չբացահայտող տեղեկություններով և կ'ջնջվեն ծրագրի ավարտելուց հետո: Ձեր մեջբերումները հավանաբար կ'օգտագործվեն ծրագրի վերջնական արդյունքներին գեկույցելիս, բայց դրանք չեն փոխկապագվի Ձեր անվան և/կամ որևէ այլ անձնական տեղեկություններին հետ:

Ձեր մասնակցությունը այս ծրագրին ամբողջությամբ կ'ամավորական է: Դուք կ'արողեք բաց թողնել ցանկացած հարց, կ'ամ կ'արողեք դադարեցնել հարցազրույցը ցանկացած պահի: Ուսումնասիրությունը մասնակցելուց ֆինանսական փոխհատուցում կ'ամ այլ անձնական օգուտներ չկան և Ձեր մասնակցությունը այս հարցազրույցին չի հանգեցնի ռիսկի: Հնարավոր է, որ Ձեզնից ստացված ինֆորմացիան օգտագործվի Հայաստանում շրջակա միջավայրի կ'ամ կ'թոնթոն անվերաբերյալ կ'առավարման միջամտություններ իրականացնելու նպատակով:



Սա օգտավետ կլինի նաև միայն Ձեր համար, այլ և երկրի ընդհանուր բնակչության համար:

Եթե ունեք հարցեր տվյալ ծրագրի հետ կապված կարող եք կապ հաստատել Հայաստանի ամերիկյան համալսարանի Թրփան ճեան առողջապահական գիտությունների ֆակուլտետի դեկան, Ավետիսյան Օնանեան առողջապահական ծառայությունների հետազոտման և զարգացման կենտրոնի տնօրեն, պրոֆեսոր Վարդուհի Պետրոսյանին +37460 612592 հեռախոսահամարով:

Եթե կարծում եք, որ ինչ որ մեկը Ձեր հետանարդար է վարվել այս հետազոտության ընթացքում, կամ վիրավորել է հարցազրույցի ընթացքում, Դուք կարող եք դիմել Հայաստանի ամերիկյան համալսարանի գիտահետազոտական էթիկայի հանձնաժողովի համակարգող՝ Վարդուհի Հայրունյանին +37460 612561 հեռախոսահամարով: Համաձայն էք մասնակցելու: Շնորհակալություն: Եթե այո, ես կշարունակեմ: Եթե խնդիր չէ, ես կմիացնեմ ձայնագրիչը հարցազրույցը սկսելիս: Եթե ոչ, ես գրառումներ կկատարեմ, եթե խնդիր չէ: