Scientific Reports in Life Sciences 3 (4): 27-52
DOI: http://doi.org/10.5281/zenodo.7332209

Scientific reports in life sciences
http://www.scientific-reports.com

Sound level exposure in the residential and peace zones of Kathmandu valley and its effects on human health

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Received: 15 August 2022 / Revised: 10 November 2022 / Accepted: 18 November 2022/ Published online: 19 December 2022.

How to cite: Chand, P., Joshi. R., Maharjan, A., Joshi, P., Joshi, S. (2022). Sound level exposure in the residential and peace zones of Kathmandu valley and its effects on human health, Scientific Reports in Life Sciences 3(4), 27-52. **DOI:** http://doi.org/10.5281/zenodo.7332209

Abstract

Noise is referred to as an unwanted sound that has been found rapidly increased in Kathmandu as a result of the city's rapid urbanization. This study aims to determine sound level exposure in Kathmandu's residential and silent zones. The noise level was measured from November to December 2021, using a sound level meter at 15 locations in the morning, afternoon, and evening from 9 to 10 a.m., 1 to 2 p.m., and 5 to 6 p.m., respectively. The average noise level in the silent zone was found to be highest in Amrit Campus (80.46 dB (A)) and lowest in Teku Hospital (62.24 dB (A)). Similarly, the average noise level was highest in Banasthali (71.88 dB (A)) and the lowest in Dallu (66.02 dB (A)) of the residential zone. This result showed that the equivalent noise level is above the prescribed national noise level standard and the World Health Organization standard. The survey results show that automobiles and loudspeakers are the main sources of noise pollution. The survey also reflects that the female population is affected by noise from the neighborhood a little more than the male population. The major adverse impacts of noise include interference with communication and annoyance. Generally, a request to reduce or stop is favored by most of the respondents. Public education was found to be the most effective tool to control noise pollution. Therefore, the government should prioritize public awareness as well as a noise barrier to minimize the effect of noise pollution.

Keywords*:* Decibel, Equivalent Noise, noise pollution, residential zone, silent zone

Introduction

The word "noise" is derived from the Latin word "nausea" (Singh & Davar, 2004). Noise may be defined as "the wrong sound in the wrong place at the wrong time." Unwanted sound, i.e., noise, happens to be one of the major pollution problems identified in the past couple of decades in the urban environment. Under the Air Act (Preservation and Control of Pollution, 1981), noise has been notified as a pollutant (Chauhan & Mahavidhalaya, 2008). Compared to the static air pressure (105 Pa), the audible sound pressure variations are very small, ranging from about 20 μPa (20 × 10−6 Pa) to 100 Pa. 20 μPa corresponds to the average person's threshold of hearing. It is therefore called the threshold of hearing. A sound pressure of approximately 100 Pa is so loud that it causes pain and is therefore called the threshold of pain (Olivera et al., 2011). Human activities such as urbanization, transportation, and the celebration of a range of holidays, as well as several industrial and developmental activities, are the primary causes of noise at the global level (Chauhan et al., 2010). The main sources of noise pollution in Kathmandu Valley include traffic (both automotive and air), factories, construction work, power plants, and residential noise (Murthy et al., 2007). Among these, road traffic noise is considered the primary noise source in Kathmandu (Joshi, 2003). With the increasing population, the length of roads, and the number of private and public vehicles are also increased in Kathmandu, more people are exposed to traffic noise (Joshi, 2003; Pradhan, 2004).

The health impact of traffic and industrial noise is being explored more and more (Murthy et al., 2007). Noise is a component of overall pollution. Excessive noise has been proven to harm not only human health but also the health of all living things. Even non-living things are influenced by loud noise (Chauhan & Pande, 2010). Noise has four different effects on human health and comfort, depending on its duration and volume. There are four types of effects: (i) physical effects such as hearing loss; (ii) physiological effects such as increased blood pressure, irregular heart rhythms, and ulcers; (iii) psychological effects such as sleeplessness and going to bed late, irritability, and stress; and (iv) work performance effects such as reduced productivity and misunderstanding what is heard (Hunashal & Patil, 2012).

Noise pollution has been identified as one of the major issues affecting people's quality of life around the world (Ozer et al., 2009). It is the propagation of noise that harms the physiological and psychological well-being of humans and animals. When compared to other types of pollution such as air, water, soil, light, and radioactive contamination, noise or sound pollution is rarely investigated (Oguntunde et al., 2019). Noise pollution in cities is a serious issue that has been steadily worsening over time. People are affected both directly and indirectly, posing a health risk (Joshi, 2003). The noise pollution is increasing day by day, along with the increase in traffic flow. One of the most significant sources of noise pollution in urban areas is traffic noise. In the European common market, 65 percent of the population is exposed to unhealthy levels of transportation noise (Dora & Dora, 1999). An acceptable level of noise has been set by various authorities. According to the World Health Organization (2018), noise pollution ranks second among several environmental stressors linked to adverse public health outcomes. Chronic exposure to sound above 80 decibels, according to the World Health Organization, can affect immune systems, elevate stress hormones, contribute to cardiovascular disease, and impair hearing (Ahmed, 2018). However, the human body's highly developed hearing system is in jeopardy. Noise is a term used to describe a large number of noises that have little or no meaning in today's modern living environment (Sterne, 2003). Noise pollution is caused by equipment, automobiles, electronically inflated music, and loudspeakers, as well as the sounds of living in densely populated cities. Constantly preventing these extraneous sounds from accessing the brain drains a significant portion of mental capacity and produces stress. In addition, the body is unnecessarily agitated to prepare for counteraction. Both mental stress and irrational body responses may have negative consequences for human health and well-being (Ahmed, 2018).

As a result of centralized government policy in the least developed countries like Nepal, people from rural areas migrate rapidly towards urban centers, usually to the capital city, in search of employment, education, and other opportunities for better life careers (Ademola, 2012; Thapa & Murayama, 2010; Raycraft, 2019). Noise pollution from different sources is fast becoming a major problem for the physical and mental health of people in Nepal (NHRC, 2003). Because of the unplanned urbanization of Kathmandu, Nepal’s capital is currently dealing with a slew of environmental issues (Pradhan, 2004). In the last few decades, urbanization in developing nations has resulted in a slew of environmental issues, including noise pollution (Halonen et al., 2017). In different countries, different standards apply to acceptable noise levels, depending on the situation. The Government of Nepal (GON) has established noise level standards for various areas (Table 1).

Table 1. Nepal Ambient Sound Quality Standard (NASQS), 2012

S. N	Area	Noise level (dB (A))	
		Day time	Night time
1	Industrial Area	75	70
2	Commercial Area	65	55
3	Rural Residential Area	45	40
4	Urban Residential Area	55	50
5	Mixed Residential Area	63	55
6	Peace Area	50	40

*The limit in dB denotes the time-weighted average of the level of sound in decibels (dB) in scale A which is relatable to human hearing

Material and methods

The study was carried out in Kathmandu District, located from 27°27′E to 27°49′E longitude and 85°10′N to 85°32′N latitude. The altitude of the district ranges from 1,262 m to 2,732 m above sea level. The climatic pattern ranges from tropical to temperate, with a rainy summer and a dry winter. Temperatures range from below 0 degrees Celsius in the winter to above 30 degrees Celsius in the summer. Kathmandu Valley is located in the foothills of the Himalayas and is bowl-shaped. Kathmandu valley is surrounded by four mountain ranges: Shivapuri Hills (2,732 m), Phulchowki (2,695 m), Nagarjun (2,095 m), and Chandragiri (2,551 m). The Bagmati is the main river that runs through the valley. The valley is made up of the Kathmandu District, Lalitpur District, and Bhaktapur District, covering an area of 899 km^2. The entire study is built around primary and secondary data collection (Fig. 1).

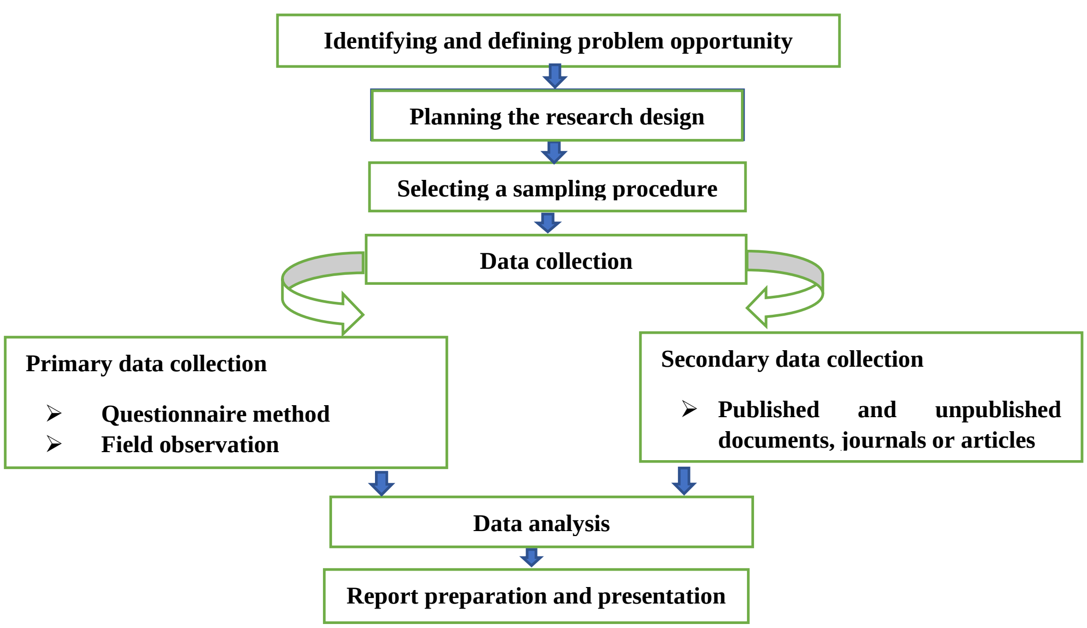

Figure 1. Flow chart of research process

Data collection

Field observation and questionnaire survey was carried out to collect collect the primary data. Based on the settlement density, crowd of people, and traffic flow, Kathmandu was chosen for monitoring noise. The sampling sites for noise assessment were selected by first dividing the study area into two zones, namely, the peace zone and the residential zone. Five residential areas (Budhanilkantha, Banasthali, Kuleshowar, Maharjgunj, and Dallu) and ten peace areas including 4 hospitals and 6 educational institutions (Tri-Chandra Campus, Padma Kanya College, Shankar Dev. Campus, Bir Hospital, Vayoda Hospital, Teaching Hospital, Amrit Campus, Teku Hospital, Siddartha Vanasthali Institute, and Budhanilkantha School) were selected for noise measurement.

The noise levels were measured with the help of a portable precise digital sound level meter (Model SL-4010, made in Taiwan). Measurements for "A" weighting are conducted in November and December 2021, between the hours of 9 a.m. and 10 a.m., 12 a.m. and 1 p.m., and 4 p.m. and 5 p.m., at the specified locations in the peace and residential zone. Sound levels were monitored every 10 seconds for 10 minutes, yielding 60 samples at each sampling site. The sound level meter was held at a height of 1.0–1.5 m and a distance of 15 m from the center on the roadside, along streets in residential areas, and 5 m away from the buildings of hospitals and campuses/colleges.

Additional information was gathered by employing a structured questionnaire along with appropriate closed-ended questions. Altogether, 160 questionnaires were taken for the study. The sampling was taken randomly in fifteen locations in Kathmandu District, and the survey was conducted directly through household visits, school visits, shop visits, etc. The data analysis has been carried out with the help of percentages and cross-classification on noise pollution awareness, perception of environmental noise, source of noise, effect of noise, mostly experienced noise, reaction to noise, and suggestions to control noise in terms of age as well as sex groups. Different published and unpublished documents, journals, or articles were used to collect the secondary source of information.

Data analysis

Primary data was gathered to yield the minimum and maximum sound levels.. According to Oyedepo & Saadu (2010), the equivalent noise level (Leq) was derived from different noise levels measured every 10 seconds for 10 minutes using the following formula:

matrices = 10 log[$1/N \quad \sum_{i=1}^{N} \frac{spli}{10}$]

Where,

Leq = equivalent sound level

N = No. of samples in the reference time interval

$spli$ = sound pressure level in the i^{th} interval

Furthermore, all primary data were compared to secondary data sources, such as journals, articles, and standard guidelines.

Results and discussion

The noise level at a particular location depends upon the distance of the source and surrounding conditions. Along the roadside, it relies upon the density of vehicular flow, types of vehicles, condition of the vehicles, and condition of the road. The smooth and wide road makes less noise than the rough, damaged, and congested road. Noise pollution is severe in the cities of developing countries and is mainly caused by traffic.

The noise level during the morning hour (9 to 10 a.m) in a peaceful and residential zone

Table 2 shows the various noise level indices for the morning hours at various locations throughout the Kathmandu Valley. Figure 2 depicts the Leq in selected locations throughout the Kathmandu district. The silent zone's noise level was found to be highest at Bir Hospital (93 dB A) and lowest at Teaching Hospital (50.5 dB A). Bir Hospital has the highest noise level due to heavy traffic flow and a crowded environment, and it is located at Ratnapark Chowk, which is at Kanti Path in a major traffic junction. The research hospital is located away from the highway, and the surrounding buildings act as barriers, resulting in a low noise level. Similarly, maximum and minimum noise levels were recorded in the residential zone at Maharajgunj at 92 dB (A) and Dallu at 54.1 dB (A) respectively.. Maharajgunj has a high level of noise pollution due to the high flow of vehicles, crowded environment, and congested roads. The noise level in this area is also increased by using pressure horns due to congested roads. Dallu is lying far away from the highway, and the flow of vehicles is very low, due to which it has a minimum noise level. Likewise, the maximum Leq was 79.13 dB (A) at Amrit Campus and the minimum was 62.69 dB (A) at the Teaching Hospital of the silent zone. This is because the Amrit Campus is located near a busy road with a constant flow of vehicles. Furthermore, the maximum and minimum Leq in the residential zone was observed at Maharajgunj at 76.31 dB (A) and Dallu at 64.23 dB (A).

Table 2. Morning noise level indices at various sites of the Kathmandu District

Area/Zone	Location	The morning noise level in dB (A)					
		L_{min}	L_{max}	L_{eq}	L_{10}	L_{50}	L_{90}
Peace (P)	Teaching Hospital	50.5	`73.3	62.69	68.2	55.9	52.7
	Vayoda Hospital	61.6	84.2	70.53	71.3	67.6	64.9
	Teku Hospital	56.7	75.1	64.56	67.9	61.8	58.6
	Bir Hospital	64.2	93	75.88	70.4	66.6	64.7
	Trichandra Campus	66	84.7	75.77	77.5	75.2	70.8
	Amrit Campus	68.4	89.1	79.13	81.8	76.1	72.4
	Shankar Dev Campus	61.6	78.5	68.47	71.2	65.4	63.6
	Padma Kanya Campus	59.4	89.4	74.25	74.6	70.1	65.5
	SiddarthVanasthali Institute	69	91.5	77.75	79.4	72.7	70.5
	Budhanilkantha School	50.7	73.2	64.86	68.5	61.6	55
Residential ®	Dallu	54.1	72.3	64.23	67.2	62.4	56.9
	Maharajgunj	58.5	92	76.31	75.8	71.1	66.5
	Banasthali	58	89.6	74.45	74.7	67.7	63.1
	Kuleshor	60.5	76.7	70.65	74.8	69.4	64.8
	Budhanilkantha	60.8	74.1	67.69	70.1	67.3	63.4

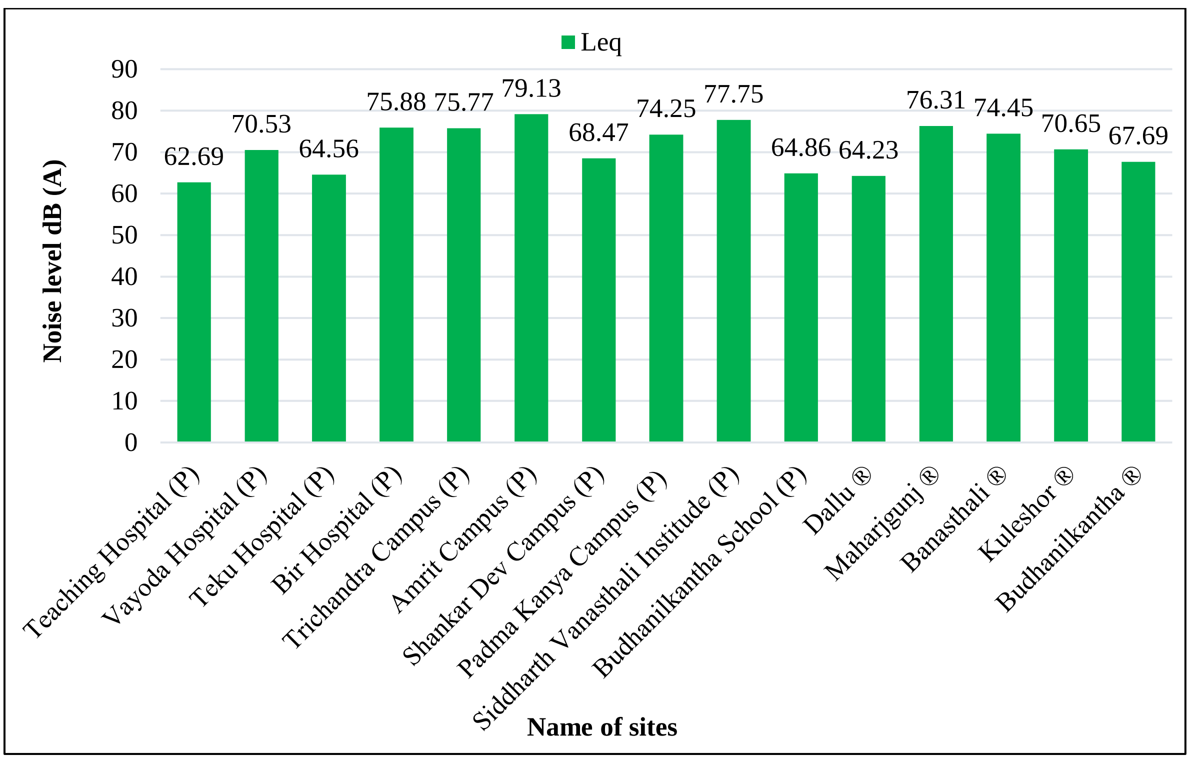

Figure 2. Morning L_{eq} at various sites of Kathmandu District

The noise level during the afternoon hours (1 to 2 p.m) in a peaceful and residential zone

Table 3 shows the various noise level indices for the afternoon hours at various locations throughout the Kathmandu Valley. Figure 3 illustrates the Leq in the selected locations of the Kathmandu District. The noise level was found to be maximum at Trichandra Campus at 101.1 dB (A), and the minimum noise level recorded at Budhanilkantha School was 50.2 dB (A) of the silent zone. Due to heavy traffic jams and the use of pressure horns and ambulance silencers, Trichandra Campus has the highest noise level. Budhanilkantha School has a low level of noise because it is located away from the highway and has building structures that act as a barrier, as well as plants surrounding it. Similarly, in the residential zone, the maximum and minimum noise levels were found to be 80.1 dB (A) and 50.7 dB (A) in Dallu area, respectively. This is due to a congested road and the addition of noise from pressure horns. Likewise, Trichandra Campus has a maximum level of 83.84 dB (A) and Budhanilkantha School of Silent Zone has a minimum level of 60.85 dB (A). Furthermore, in the residential zone, maximum and minimum Leq were observed at Maharajgunj at 68.16 dB (A) and Budhanilkantha at 65.25 dB (A). This is due to the fact that the Budhanilkantha residential area had low traffic flow and plants surrounding it.

Table 3. Afternoon noise level indices at various sites of the Kathmandu District

Area/Zone	Location	Afternoon noise level in dB (A)					
		L_{min}	L_{max}	L_{eq}	L_{10}	L_{50}	L_{90}
Peace (P)	Teaching Hospital	51.4	77.1	65.9	69.9	57.8	53.1
	Vayoda Hospital	59.2	68.5	64.58	67.9	63.6	60.7
	Teku Hospital	57.3	74.1	65.1	67.8	62.9	59.6
	Bir Hospital	65.1	76.5	69.02	70.3	68.2	66.3
	Trichandra Campus	69.3	101.1	83.84	77.7	73.5	70.5
	Amrit Campus	71.1	89.4	78.74	82	76	73.7
	Shankar Dev Campus	58.5	82.2	69.92	71.3	66.3	63.4
	Padma Kanya Campus	62.5	91.4	76.08	77.5	70.3	67.2
	SiddarthVanasthali Institute	66.1	80.9	72.57	74.8	71.3	68.2
	Budhanilkantha School	50.2	69.5	60.85	66.9	60.4	54.2
Residential ®	Dallu	50.7	80.1	65.96	69.2	59	53.2
	Maharajgunj	54.8	78.5	68.16	70.6	67.1	59.9
	Banasthali	53.8	77.6	67.73	71.2	64.1	56.9
	Kuleshor	55.1	77	68.14	70.6	63.8	59.2
	Budhanilkantha	56.2	71.4	65.25	69.8	66.2	61.4

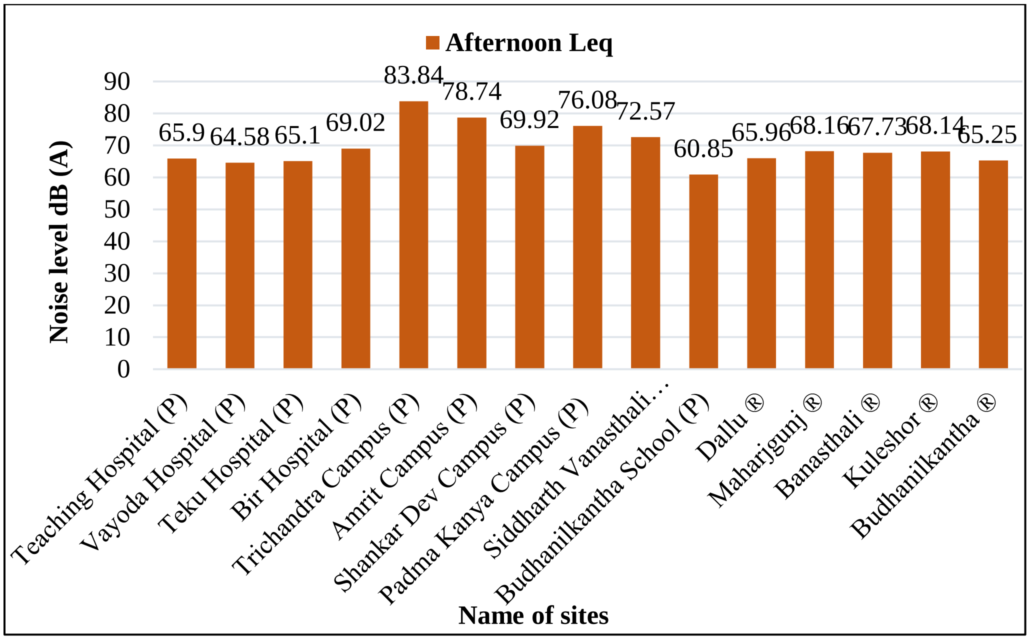

Figure 3. Afternoon L_{eq} at various sites of Kathmandu District.

Noise level during the evening hours (4 to 5 p.m) in a peaceful and residential zone

Table 4 shows the various noise level indices for the evening hours at various locations throughout the Kathmandu Valley. Figure 4 illustrates the Leq in the selected locations of Kathmandu Valley during the evening. In the silent zone, the noise level was found to be highest at Amrit Campus (99.3 dB A) and lowest at Teku Hospital (48.1 dB A). Because of its location away from the highway, Teku Hospital has a low level of noise. Similarly, in the residential zone, maximum and minimum noise levels were recorded at Banasthali (87.4 dB A) and Dallu (52.4 dB A) respectively. This is because the Banasthali area is close to the ring road, where traffic is heavy and the road is congested. Likewise, a maximum Leq of 83.53 dB (A) was observed at the Amrit Campus and a minimum of 57.06 dB (A) at Teku Hospital for the silent zone. Furthermore, in the residential zone, maximum and minimum Leq were observed at Banasthali (73.45 dB A) and Maharajgunj (64.59 dB A). Banasthali has a maximum noise level due to heavy traffic and congested roads. The noise level in this area is also increased by using pressure horns due to the congested road. In comparison to Banasthali, Maharajgung has a low level of traffic flow, due to which it has a minimum noise level.

Table 4. Evening noise level indices at various sites of the Kathmandu District

Area/Zone	Location	The evening noise level in dB (A)					
		L_{min}	L_{max}	L_{eq}	L_{10}	L_{50}	L_{90}
Peace (P)	Teaching Hospital	51	72.7	61.09	65.5	55.3	52.4
	Vayoda Hospital	61	78.5	67.3	69.2	65	62.2
	Teku Hospital	48.1	65.1	57.06	61.4	54.1	49.5
	Bir Hospital	64.5	80	69.56	69.6	67.8	65.9
	Trichandra Campus	70.5	97.6	81.38	79.4	74.7	72.1
	Amrit Campus	71.3	99.3	83.53	82.3	76.3	73.7
	Shankar Dev Campus	61	74.6	68.18	71.8	67.4	62
	Padma Kanya Campus	62.1	76.4	70.51	74.2	69.1	65.6
	SiddarthVanasthali Institute	68.1	82.3	75.79	80.2	74.3	70.9
	Budhanilkantha School	52.7	79.4	65.83	67.8	61.1	56.3
Residential ®	Dallu	52.4	75.6	67.86	71.8	56	57.9
	Maharajgunj	53.5	71.3	64.59	68.6	62.5	58.8
	Banasthali	59.1	87.4	73.45	74.7	70.4	64
	Kuleshor	60.5	78.7	71.25	75.1	68.9	63.6
	Budhanilkantha	59.9	76.8	68.8	71.8	66.9	62.3

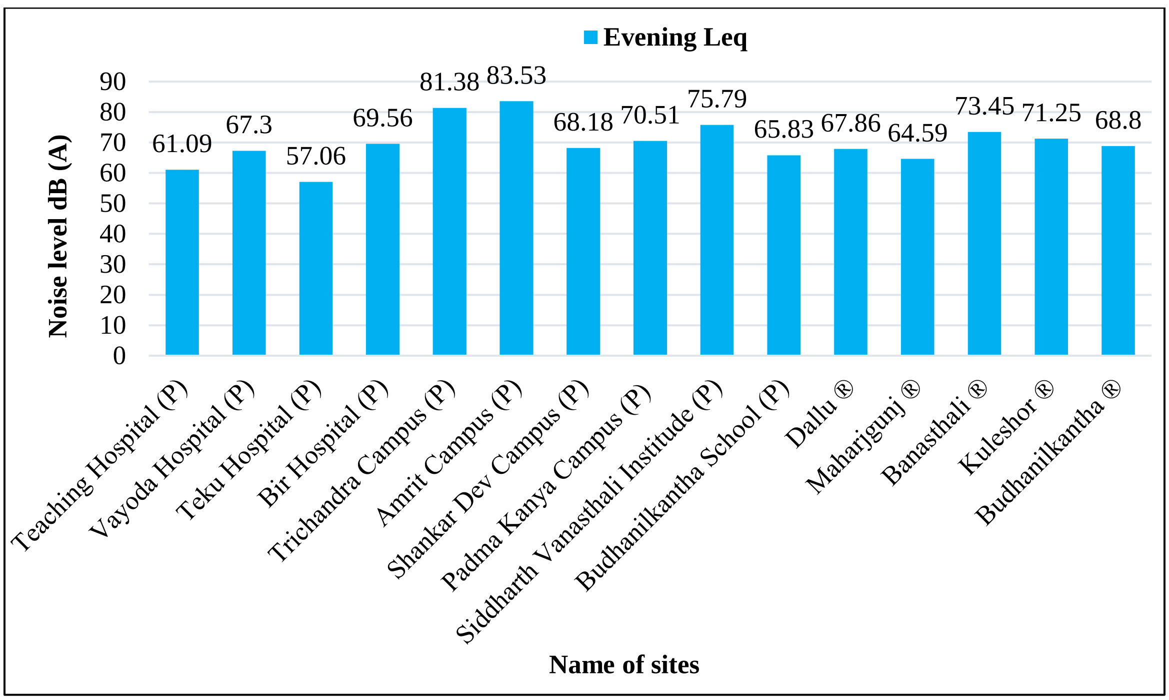

Figure 4. EveningL_{eq} at various sites of Kathmandu District.

Average noise level of morning, afternoon, and evening hours in a peaceful and residential zone

The average noise level indices (morning, afternoon, and evening) were observed at various locations of the study area (Table 5). Figure 5 depicts the average equivalent noise levels (Leq) by zone types. There are altogether 15 locations, 10 of which are in the peace zone and 5 of which are in the residential zone. Out of ten peace zones, maximum and minimum noise levels were observed at Trichandra Campus at 94.47 dB (A) and Education and Research Hospital at 50.96 dB (A). Because of heavy traffic flow and the use of pressure horns and ambulance silencers due to traffic jams, there was more noise, therefore Trichandra Campus has the highest noise level. The educational and research hospital is lying away from the highway and building structures around the premise that act as barriers, due to which it has a minimum noise level. Similarly, out of five residential zones, the maximum and minimum noise levels were observed at Banasthali (84.87 dB (A)) and Dallu (52.57 dB (A)).

The average noise level (Leq) of the silent zone was highest in Amrit Campus (80.46 dB (A)), followed by Trichandra Campus (80.33 dB (A)), Siddharth Vanasthali Institute (75.37 dB (A)), and lowest in Teku Hospital (62.24 dB (A)). This is due to the fact that the Amrit Campus is very close to the road, with a constant flow of vehicles throughout the day. Other studies observed a similar result (Valley, 2019). Because of its location away from the highway, Teku Hospital has a low level of noise. Similarly, in residential zones, the average noise level (Leq) was maximum in Banasthali (71.88 dB (A)) and minimum in Dallu (66.02 dB (A)). The average noise level ranged from 62.24 dB (A) to 80.46 dB (A) in the peace area and 66.02 dB (A) to 76.31 dB (A) in the residential area. Except for the Teku Hospital at ET, all peace zones and residential zones in Kathmandu included in the study had more than 60 dB (A) equivalent noise levels during the morning, afternoon, and evening hours. The results show that, when compared to the National Ambient Quality Standard (2012) and the World Health Organization (2018), the average noise level at each location is above the standards and guidelines for noise levels (WHO, 2018).

Table 5. Average noise level indices at various sites of the Kathmandu District

Area/Zone	Location	Noise level in dB (A)					
		L_{min}	L_{max}	L_{eq}	L_{10}	L_{50}	L_{90}
Peace (P)	Teaching Hospital	50.96	73.83	63.23	67.9	56.3	52.7
	Vayoda Hospital	60.6	77.06	67.47	69.5	65.4	62.6
	Teku Hospital	54.03	71.23	62.24	65.7	59.6	55.9
	Bir Hospital	64.6	82.6	71.49	70.1	67.5	65.6
	Trichandra Campus	68.7	94.47	80.33	78.2	74.5	71.1
	Amrit Campus	70.2	92.6	80.46	82	76.1	73.3
	Shankar Dev Campus	61.06	77.1	68.86	71.4	66.4	63
	Padma Kanya Campus	61.36	81.9	73.61	75.4	69.8	66.1
	SiddarthVanasthali Institute	67.8	84.9	75.37	78.1	72.8	69.9
	Budhanilkantha School	51.2	71.6	63.23	67.7	61	55.2
Residential ®	Dallu	52.57	73.43	66.02	69.4	59.1	56
	Maharajgunj	55.6	80.6	69.69	71.7	66.9	61.7
	Banasthali	58	84.87	71.88	73.5	67.4	61.3
	Kuleshor	58.73	77.23	70.01	73.5	67.4	62.5
	Budhanilkantha	58.96	74.1	67.25	70.6	66.8	62.4

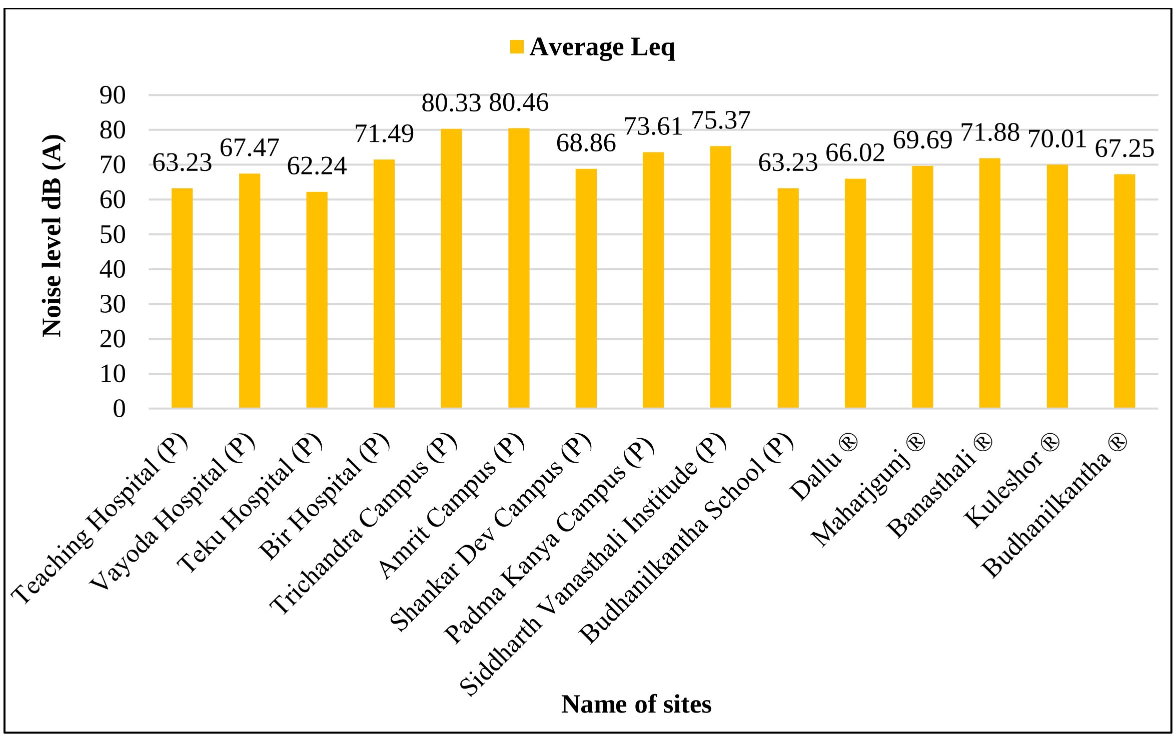

Figure 5. Average L_{eq} at various sites of Kathmandu District.

Comparison of Leq levels in the morning, afternoon, and evening

The noise level (Leq) was highest during the afternoon time (83.84 dB (A)), followed by the evening time (83.53 dB (A)), and the morning time (79.13 dB (A)) of the silent zone (Fig. 6). Because the majority of quiet zones are either hospitals or close to hospitals, ambulance noise may have an impact on them, the afternoon has a higher level of noise than the evening and morning. Similarly, the noise level (Leq) was highest during morning time (76.31 dB (A)), followed by evening time (73.45 dB (A)), and afternoon time (68.16 dB (A)) in the residential zone. In residential zone, the maximum noise at morning time could be due to the office peak hours and contribution of automobiles due to which it has high level of noise as compared to afternoon and evening. This is due to the fact that the afternoon has high traffic jams and that pressure horns add to the maximum noise level. These results suggest that the main sources of noise in Kathmandu Valley are the vehicles running on the roads.

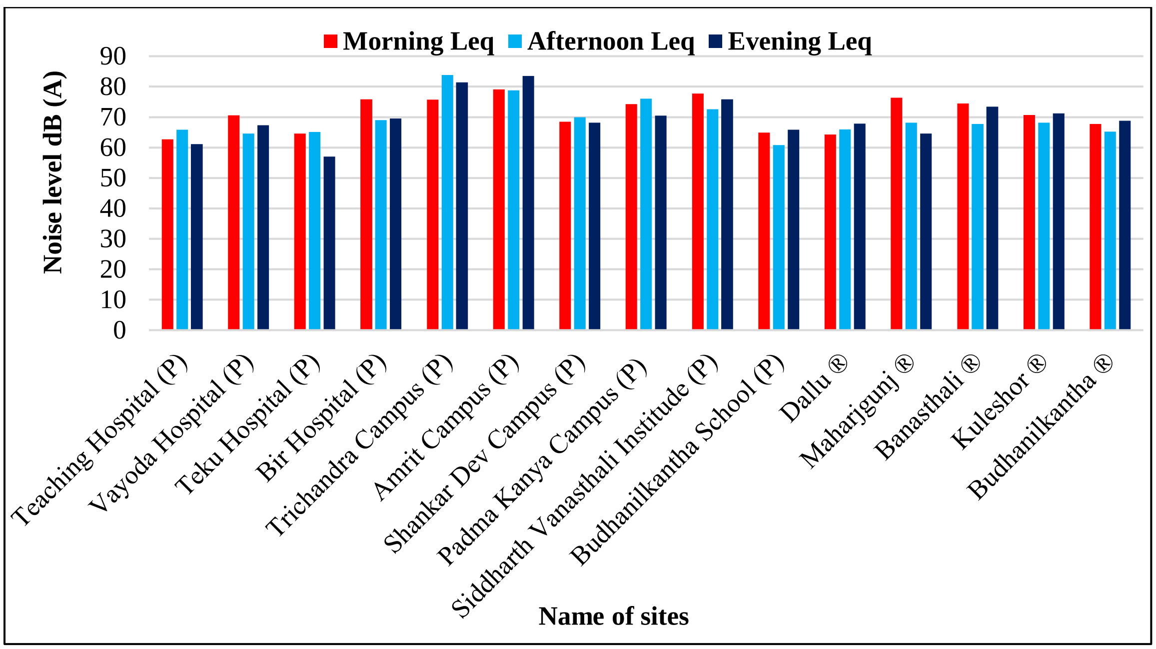

Figure 6. Comparison of Leq during morning vs. afternoon vs. evening time

Out of 160 respondents, 47 were under the age of 20, 82 of respondents between the age of 20-40, 22 of respondents between the age of 40 to 60 and 9 of respondents above the age of 60. Similarly, the number of female respondents is 86, which is more than the male respondent number, which is 74.

Noise pollution awareness among respondents

Figures 7 and 8 summarize the level of awareness of noise pollution among respondents based on age and gender. The results show that 142 (89%) of the total respondents were aware of the problem of noise pollution. The percentage ranges from 56% to 98%, with an overall percentage of 89%. The percentage of such people in the over-60 age group, however, is marginally lower. While 18 (11%) of the respondents were not aware of the problem of noise pollution. The percentage ranges from 2% to 44%, with an overall percentage of 11%. However, the percentage of such people under the age of 20 is relatively low. It means that the majority of respondents were aware of noise as a problem.

Further, we examine whether noise pollution awareness affects the male and female populations differently. Figure 8 depicts the percentage and number of people who are aware of noise pollution by sex group. 90% of females and 88% of males were aware of noise pollution. While 12% of males and 10% of females were unaware of noise pollution.

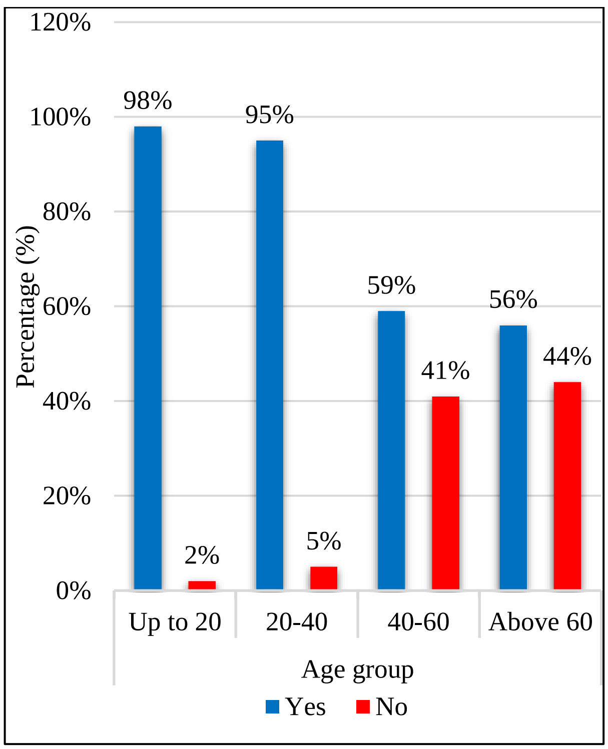

Figure 7. Noise pollution awareness in term of age groups

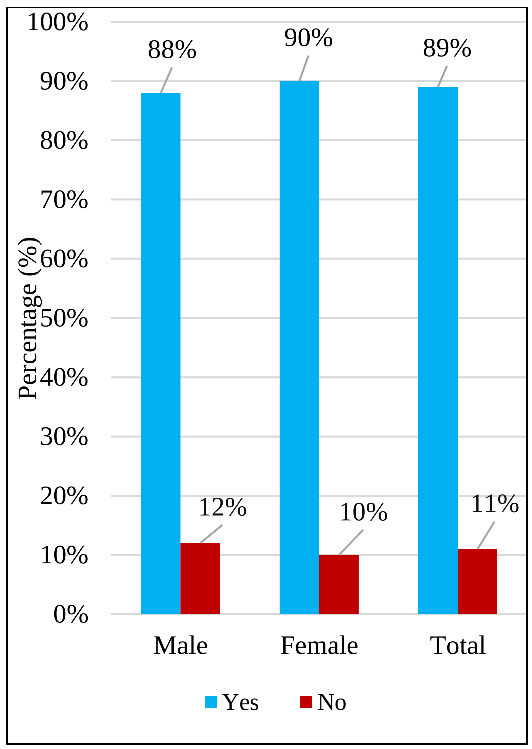

Figure 8. Noise pollution awareness among sex groups

erceptions about environmental noise among respondents

Similarly, Figures 9 and 10 show that the perception of environmental noise pollution varies among age groups and sexes. Out of the total respondents, 139 (87%) said that their environment has noise pollution. The percentage ranges from 67% to 91%, with an overall percentage of 87% (Figure 9). However, the proportion of such people over the age of 60 is marginally lower. While 21 (13%) of the respondents said that their environments do not have noise pollution. The percentage range is 3–10%, for a total of 13%. However, the percentage (%) of such people under the age of 20 is marginally low. Likewise, Figure 10 shows that 89% of males and 85% of females perceive that their environments have noise pollution. While 11% of males and 15% of females perceive that their environment does not have noise pollution.

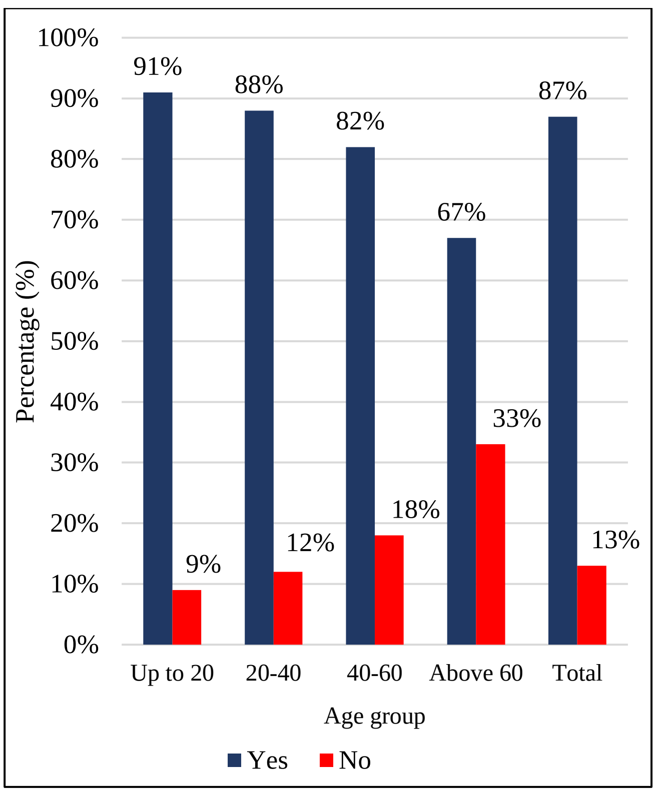

Figure 9. Perception about environmental noise in terms of age groups

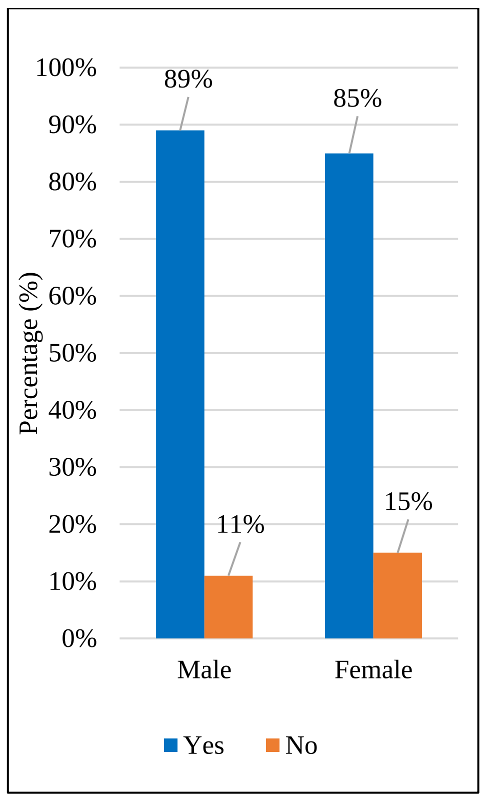

Figure 10. Perception about environmental noise among sex groups

Noise sources

There are various sources of noise pollution, including vehicular traffic, the neighborhood, electrical appliances, TV and music systems, public address systems, railway and air traffic, etc. (Singh & Davar, 2004). Noise affects the majority of people who live in metropolitan cities or large towns, as well as those who work in factories (Atkinson, 2007). The widespread use of loudspeakers for various occasions and religious functions, as well as the indiscriminate use of horns by vehicles, pose a number of health risks to residents. In this modern technological age, road traffic is one of the most significant sources of noise. The speed and exhaust system influence the amount of noise generated by road traffic.

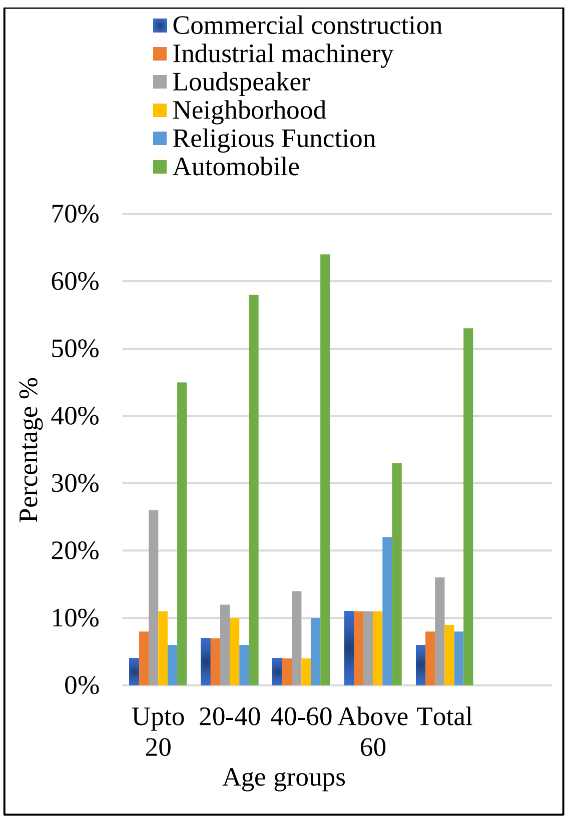

Figure 11. Source of noise in terms of age groups

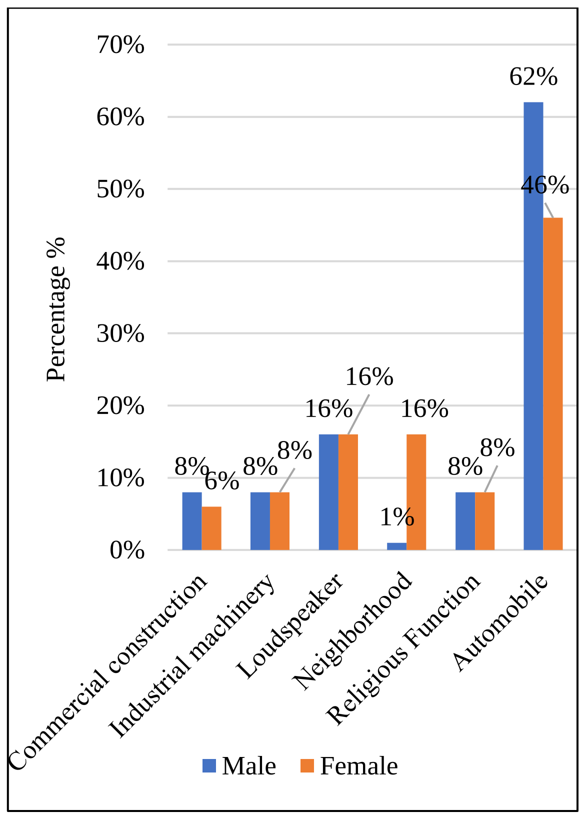

Figure 12. Source of noise among sex groups

The data analysis, as indicated in Figure 11, shows that a very large proportion of respondents in this age group are being affected by noise emanating from automobiles. This source has a range of 36%–64%, with an overall percentage of 53%. However, the proportion of such people over the age of 60 is relatively low. The majority of respondents across different age groups feel that automobiles' noise affects their activities the most. Similarly, 16% of respondents across various age groups acknowledge the adverse effect of noise generated by loudspeakers. An almost equal proportion of respondents (9% and 8%) across different age groups claim that noise originates from neighborhoods, religious functions, and industrial machinery. At last, a small proportion of respondents (6% across different age groups) claim that noise emerging from commercial construction creates problems for them.

From this survey, automobiles are the major source of noise pollution, followed by loudspeakers, neighborhoods, religious functions, industrial machinery, and commercial construction, which also act as significant sources of noise pollution. Figure 12 shows how noise pollution now affects both the male and female populations separately and reveals that different sources of noise affected different percentages of male and female respondents. There are critical differences in population affected by noise from the neighborhood, and according to a survey, women are more affected by it than the male population. When it comes to noise pollution from automobiles, men are slightly more affected than women. In terms of the remaining four sources, there are no marked differences in the percentages of male and female populations. It means that the other sources of noise affect a nearly equal proportion of male and female populations.

Health effect

There is no doubt that noise has a negative impact on human health (Holbraad, 2012). Hearing loss, stress, high blood pressure, sleep loss, productivity loss, and a general decrease in quality of life may all be caused by the noise (Mondelli et al., 2012). Noise has a difficult time being quantified because tolerance levels and types of noise vary greatly among different populations. The widespread use of loudspeakers at various social and religious functions, as well as the excessive use of horns by motor vehicles, causes a variety of health problems for the residents. Mental illness, deafness, high blood pressure, dizziness, nervous breakdown, and insomnia are all possible side effects (Bhargawa, 2001). According to Nagi et al. (1993), the noise level produced by household equipment and appliances can reach 97 dB, which is more than twice the acceptable noise level (45 dB). Excessive noise can cause annoyance, speech interference, sleep disruption, mental stress, headaches, and a lack of concentration, among other things. According to Singh (1984), workers exposed to high noise levels have a higher risk of circulatory problems, cardiac diseases, hypertension, peptic ulcers, and neurosensory and motor impairment.

We can see the general health effects of noise among various age groups. The majority of those exposed to noise pollution (47%) reported irritation and headache (30%) (Figure 13). Noise irritability is a common complaint among respondents of all ages, with the exception of those over 60. As many as 56% reported hypertension, 22% reported stress, and 6% reported no problem. The survey data shows the general effect of noise is not similar among various age groups. In general, increasing age is associated with increased noise pollution. However, the incidence of hypertension and stress effects in the elderly is much higher (above 60 years of age). Furthermore, a glance at the table reveals that in young age groups, hypertension and stress disorders are acknowledged by a smaller proportion of respondents than in older age groups.

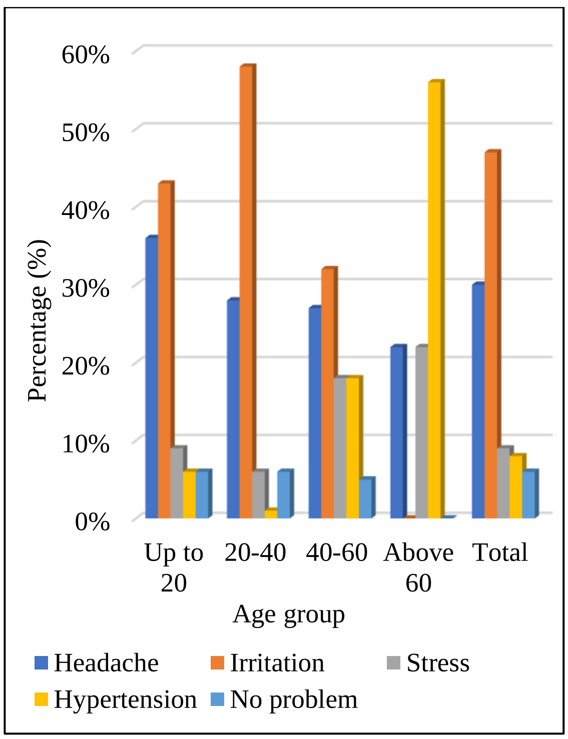

Figure 13. General health effect of noise in term of age groups

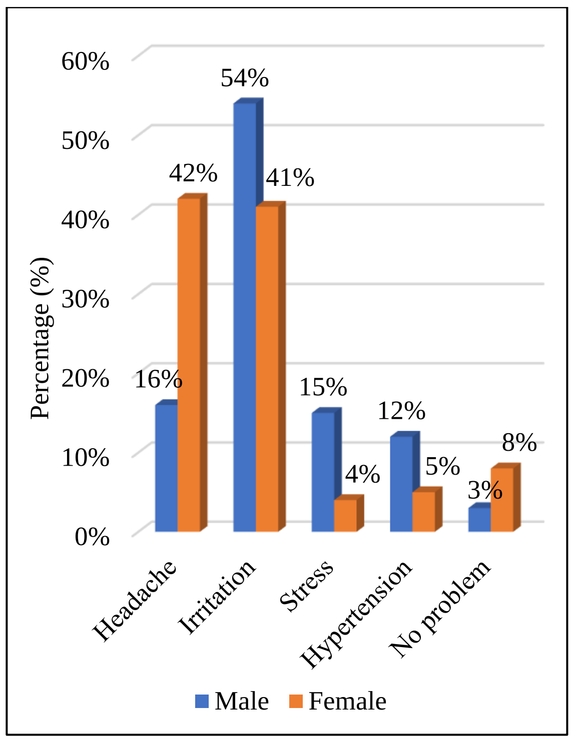

Figure 14. General health effect of noise among sex groups

Figure 14 shows that the perception of male and female populations about the general effects of noise varies. A marginally higher proportion of women feel the general effects of noise on headaches. However, when it comes to other parameters (such as irritation, stress, and hypertension), male respondents feel a greater negative impact than female respondents. At least 8% of females and 3% of males have no problem with the noise. From figure 15, we can see the effect of noise and how it interferes with communication, causes annoyance, affects hearing, and disturbs sleep under its influence. The majority of sample respondents exposed to noise pollution report interference with communication. Interference with communication was reported by 32% of all respondents, followed by cause annoyance at 22%, effect on hearing at 17%, disturbing sleep at 16%, mental health disorder at 9%, and deafness at 4%.

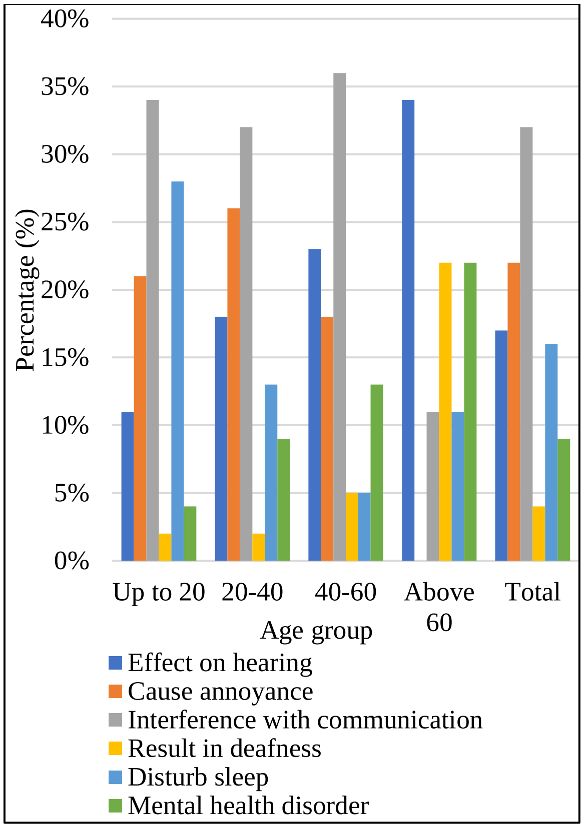

Figure 15. Major health effects of noise in terms of age groups

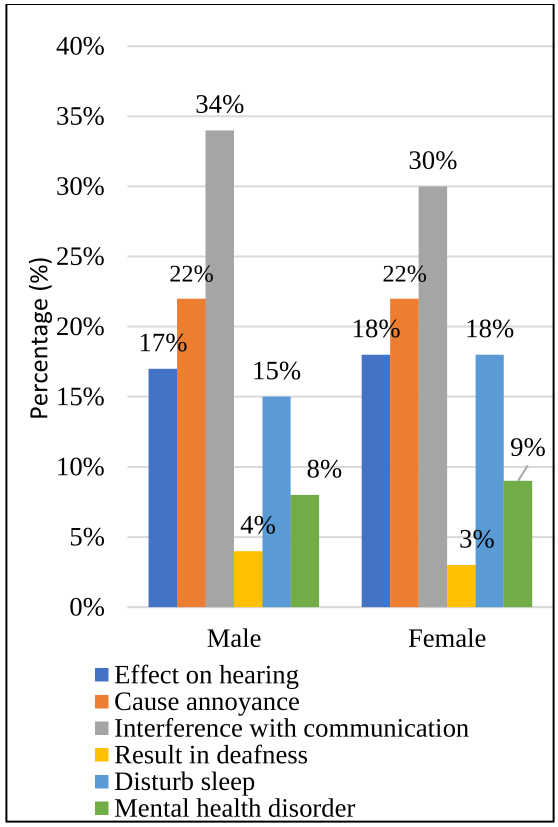

Figure 16. Major health effect of noise among the different age groups

The survey data shows that the effect of noise is not similar among age groups. Generally, growing older bears the brunt of excessive noise pollution. For example, the rising proportion of sample respondents in higher age groups acknowledges depression, sleeplessness, and a deafening effect. However, there is a much higher incidence of deafness, mental health disorders, and hearing loss in older people (over 60 years of age). Further, a general perusal of the table shows that hearing impairment results in deafness and mental health disorders, which are acknowledged by a smaller proportion of respondents in younger age groups as compared to the older population. Figure 16 shows that the perception of the male and female populations about the effect of noise varies. A slightly higher proportion of the male population feels the adverse effects of noise on interference with communication. In terms of other parameters, an almost equal proportion of the male and female population is susceptible to such effects of noise.

Time of maximum noise

Figure 17 shows the respondents' perceptions of noise time based on their age groups. The highest percentage of respondents was exposed to excessive noise in the evening hours (33%), followed by the afternoon hours (29%), the morning hours (18%), and soon after. The respondents from all age groups were the most likely to be exposed to excessive noise in the evening hours. A minimum of 2% of respondents in all age groups were exposed to excessive noise in the morning and afternoon hours. 9 percent of people were exposed to excessive noise during the morning, afternoon, and evening hours. The male and female respondents' perceptions of noise based on time are summarized in figure 18.

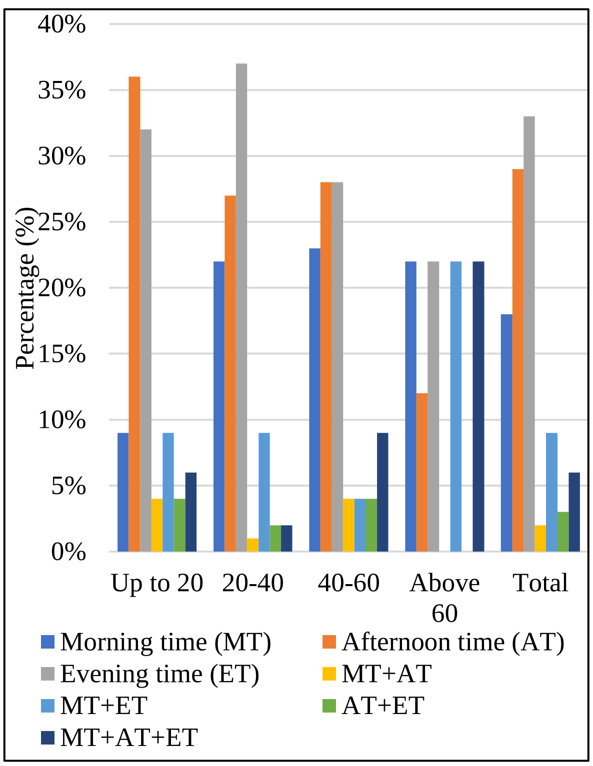

Figure 17. Mostly experienced noise in terms of age groups

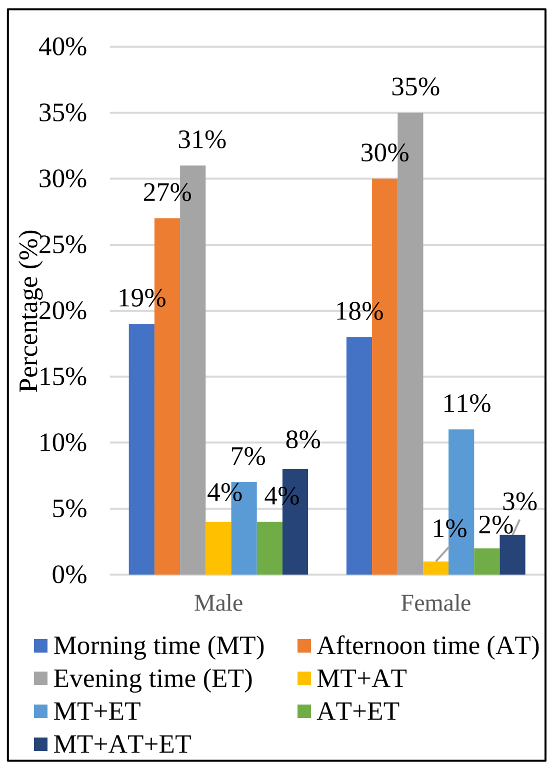

Figure 18. Mostly experienced noise among sex groups

Figure 17 shows the respondents' perceptions of noise time based on their age groups. The highest percentage of respondents was exposed to excessive noise in the evening hours (33%), followed by the afternoon hours (29%), the morning hours (18%), and soon after. The respondents from all age groups were the most likely to be exposed to excessive noise in the evening hours. A minimum of 2% of respondents in all age groups were exposed to excessive noise in the morning and afternoon hours. 9 percent of people were exposed to excessive noise during the morning, afternoon, and evening hours. The male and female respondents' perceptions of noise based on time are summarized in fsigure 18.

According to the survey, male and female groups appear to have similar perceptions of the majority of noise encountered by the respondents. In the total sample, both male and female groups were exposed to excessive levels of noise in the evening hours. This is because the evening hours are the office peak hour, and automobiles, as well as traffic jams, could make things noisier. That’s why people are exposed to excessive levels of noise in the evening hours.

Reactions to noise by the respondents

Figure 19 shows how different respondents react to noise. According to the data, the most common reactions across all age groups include requesting that the source stop or reduce the noise. A significant number of respondents who have been affected by noise seek redress through appropriate authorities. However, 18% of respondents do not take any action to reduce noise. Although arguing with people is a popular reaction to noise control among young people (up to 20 years old), mature people (40-60 years old), and the elderly (above 60 years). People between the ages of 20 and 40 do not engage in arguments. Only a small proportion of the respondents showed any interest in complaining to the police about the noise. Figure 20 shows that there is no major difference in the proportion of male and female populations when it comes to the set of reactions to excessive noise. The method of requesting the source to control excessive noise is generally preferred by both sexes. Figure 20 shows that, in comparison to the male population, the majority of female respondents prefer aggressive reactions (quarrel).

Suggestions for noise reduction by the respondents

Individual responses to a set of possible solutions are shown in figures 21 and 22. According to the findings, the majority of people are concerned about education, government efforts, and technological solutions. The civil administration (authorities), as well as the involvement of empowered INGOs (International non-governmental organizations), could help with noise level monitoring. However, the data suggests that a multidimensional approach is required, as a single measure will not be sufficient to achieve the noise reduction goal. When we look at the overall responses of different age groups, the data analysis confirms that education is the most effective way to reduce noise.

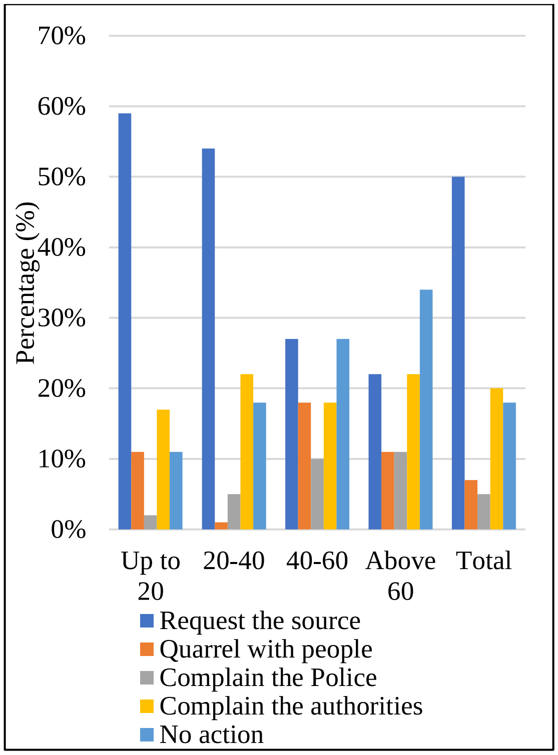

Figure 19. Reaction to noise by different age groups

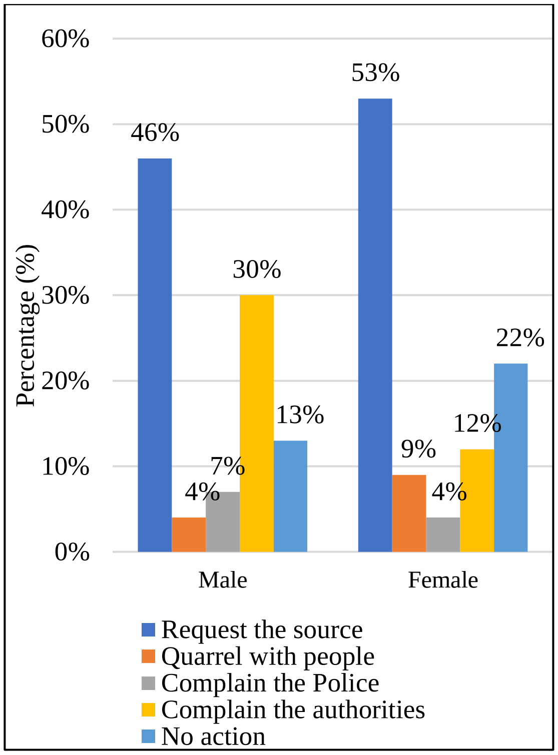

Figure 20. Reaction to noise among sex groups

Education is a means of acquiring knowledge. Because many people are unaware of environmental laws and regulations, there must be a flow of information (in the form of knowledge) about noise pollution among various age groups and individuals. They aren't aware of the noise limits in different areas or the potential harm that excessive noise can cause. As a result, they only need information-based knowledge to control noise pollution. Figure 22 shows that the male and female groups appear to differ in their attitudes toward alternative noise-control methods. According to the survey, the majority of women prefer public education, while the majority of men prefer technological solutions. Empowering the police and INGOs as a tool for noise control with a smaller percentage of the total sample. As a result, government involvement may be able to help us reduce or prevent noise pollution to a certain extent.

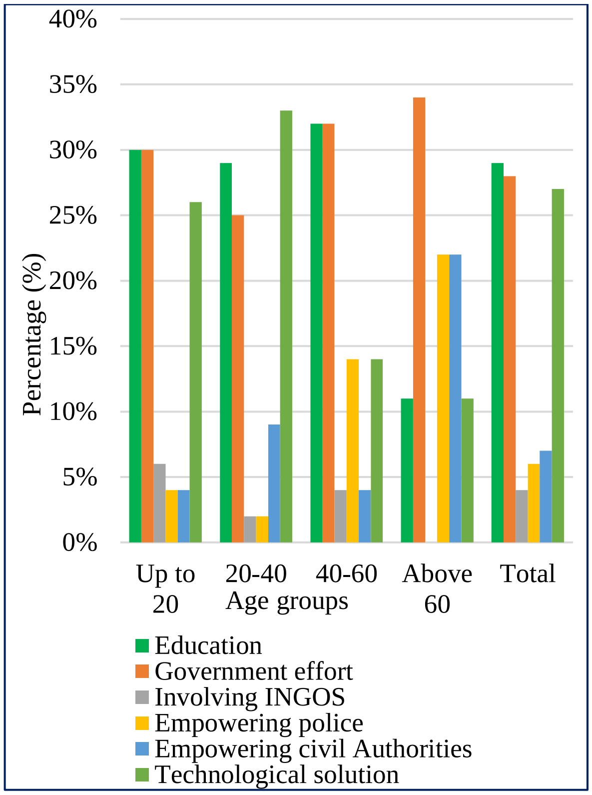

Figure 21. Suggestion by different age groups to control noise

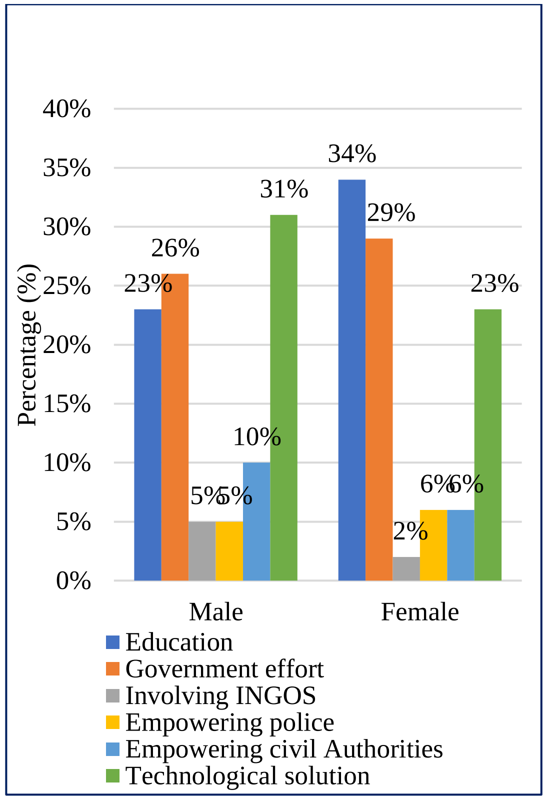

Figure 22. Suggestion by different sex groups to control noise

According to this study, noise pollution is a problem in Kathmandu's residential and peace zones. The study focused on determining the noise level at the selected sites in Kathmandu's two distinct zones. Overall, Amrit Campus is the noisiest place with an average Leq of 80.46 dB (A), and Teku Hospital is the quietest place with an average Leq of 62.24 dB (A) in the silent zone. Similarly, Banasthali is the noisiest place with an average Leq of 71.88 dB (A) and Dallu is the quietest place, with an average Leq of 66.02 dB (A) in the residential zone. The afternoon is the noisiest time, with Leq 83.84 dB (A) from both the silent zone and residential zone. All residential and peaceful zones were found to have noise pollution problems that exceeded established standards and guidelines (WHO 2018). From the site measurements, it is concluded that the main sources of noise in Kathmandu Valley are the vehicles running on the roads.

Out of the total of 100 percent of respondents, 89 percent were aware of noise pollution, while 11 percent were unaware. Similarly, 87% said that their environment has a noise pollution problem, and 13% said that their environment has no noise pollution problem. Automobiles and loudspeakers are the major sources of noise pollution. The survey indicates that the noise pollution level is perceived to be highest in the evening hours. The survey also indicates the different effects of noise on different age groups. It results in improper communication, and can cause annoyance and hearing problems. In the majority of cases, the affected party prefers a request to stop the noise. Public education appears to be the best method, as suggested by respondents. Besides this, the government and technology can also play a significant role in the process of controlling excessive noise.

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