

Effect of Noise and Light on Sleep in New York City

Disrupted sleep can be harmful to health. Sleep disturbances from noise and light can lead to shorter sleep duration, increased daytime fatigue, and poorer daytime cognitive performance.^{1,2}

The 2009 New York City (NYC) Community Health Survey found that 20% of adults reported having activities disrupted by noise from outside their homes three or more times per week.³ In 2016, one in six (18%, or more than 410,000) complaints to 311, the NYC non-emergency services line, were related to noise. However, the majority (66%) of those complaints were either not in violation of the NYC noise code, which sets decibel limits and other types of noise control techniques, or the noise could not be observed or measured at the time of the response.

In 2016-2017, the NYC Ambient Noise/Light and Sleep Survey examined: the frequency and sources of ambient noise and light that cause sleep disturbance, measures taken to mitigate exposure to disruptive noise, and effect on concentration due to tiredness from poor sleep.

Definitions:

Ambient Noise is defined in this report as any noise from outside the home except from the industrial workplace.

Ambient Light is defined in this report as any light from outside the home.

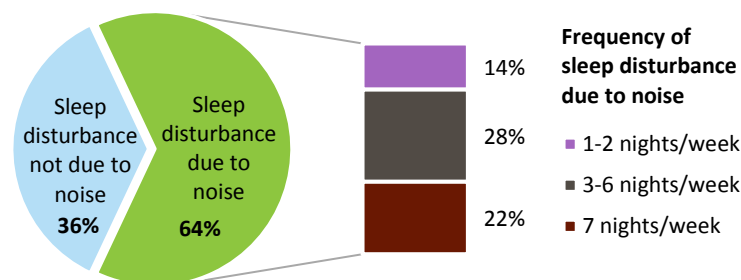
Race/ethnicity: For the purpose of this publication, Latino includes persons of Hispanic or Latino origin, as identified by the survey question “Are you Hispanic or Latino?” and regardless of reported race. Black and White race categories exclude those who identified as Latino. Due to low sample size, Asian population estimates could not be reliably calculated; Asians were combined with those in the Other race category.

Frequent noise-related sleep disturbance is defined as sleep disturbed by noise three or more nights per week.

Almost two in five New Yorkers had their sleep frequently disturbed by noise

- In 2016-2017, most adult New Yorkers (82%) reported sleep disturbance of any type at least once per week. Within that group, 64% — an estimated 3,189,000 adults — reported noise as a cause of their poor sleep.

Sleep disturbance due to noise among adults with sleep disturbed at least once per week, New York City, 2016-2017



Source: NYC Ambient Noise/Light and Sleep Survey, 2016-2017

- More than one third of New Yorkers (39% or an estimated 2,494,000 adults) had frequent noise-related sleep disturbances (sleep disturbed by noise three or more nights per week).
- Black and Latino New Yorkers were more likely to report having their sleep frequently disturbed by noise than White New Yorkers (37% Black and 48% Hispanic, vs. 28% White), consistent with findings of racial/ethnic differences in exposure to noise pollution.⁴

Data Sources:

NYC Ambient Noise/Light and Sleep Survey, 2016-2017: The NYC DOHMH administered an automated telephone survey to 1,532 adults, using a Redirected Inbound Call Sampling (RICS) method (see description on page 2). Inclusion criteria were being 18 years or older and living in one of the NYC boroughs. Imputation was used for missing demographic variables and for missing or “prefer not to answer” responses.

311 Service Requests, 2016-2017: 311 is NYC’s non-emergency services line, where all complaints are recorded. For more information, visit: <http://www.nyc.gov/311>

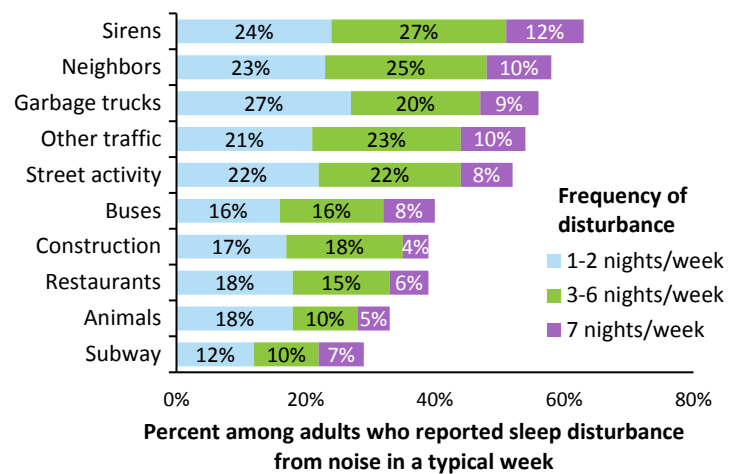
References:

- 1 Janssen S, Basner M, Griefahn B, Miedema H, Kim R. Environmental Noise and Sleep Disturbance. In: *Burden of Disease from Environmental Noise: Quantification of Healthy Life Years Lost in Europe*. Copenhagen, Denmark: WHO Regional Office for Europe; 2011:55-70.
- 2 Ohayon MM, Milesi C. Artificial Outdoor Nighttime Lights Associate with Altered Sleep Behavior in the American General Population. *SLEEP*. 2016;39(6):1311-1320.
- 3 Rodriguez-Lopez. Ambient Noise Disruption in New York City. New York City Department of Health and Mental Hygiene: Epi Data Brief (45); April 2014.
- 4 Casey JA, Morello-Frosch R, Mennitt D, et al. Race/Ethnicity, Socioeconomic Status, Residential Segregation, and Spatial Variation in Noise Exposure in the Contiguous United States. *Environmental Health Perspectives*. 2017;125(7):077017-1–077017-10.
- 5 Levine B, Krotki K, Lavrakas PJ. RICS—Telephone Surveying via a New Survey Sampling Paradigm. *Manuscript submitted for publication*.

Traffic, Neighbors, and Other Noise were the leading sources of noise disturbance

- In 2016-2017 the sources of noise that most commonly caused frequent (three or more nights per week) sleep disturbance were traffic, including garbage trucks and buses (50% of all adults with noise-related sleep disturbance), sirens (39%), and neighbors (35%). The same noise sources were also cited as the most frequent cause of seven-night-a-week sleep disturbance.
- Fifty-two percent of those who had frequent sleep disturbance from noise reported that it was due to five or more sources of noise.
- When asked to name the one noise source perceived as most disruptive to sleep, traffic (32%), neighbors (24%), and other sources of noise not listed in the survey (11%) were chosen by those reporting any noise-related sleep disturbance.

Specific sources of noise in a typical week among New York City adults with noise-related sleep disturbance, 2016-2017

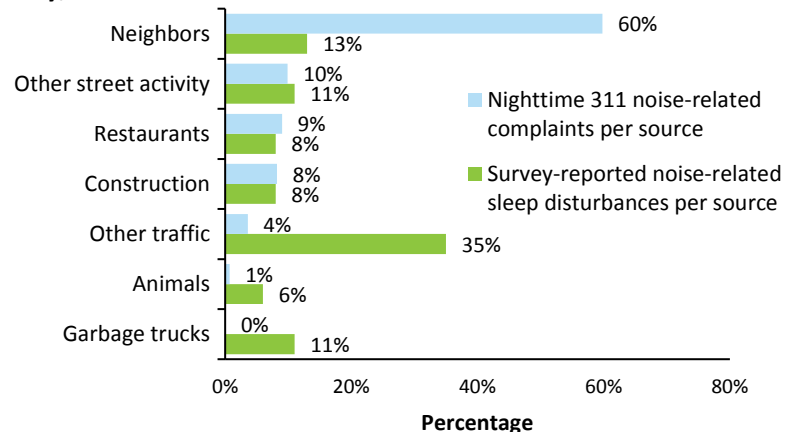


Notes: Respondents could report more than one source of noise disturbance per week. Source: NYC Ambient Noise/Light and Sleep Survey, 2016-2017

More 311 complaints focus on neighbors than traffic

- Nearly half (47%) of all noise-related 311 complaints during the 2016-2017 survey period occurred during nighttime hours. Sixty percent of nighttime 311 complaints related to noise were about neighbors. In contrast, 13% of adults with noise-related sleep disturbance in the NYC Noise/Light and Sleep Survey reported neighbors as a noise source.
- Only 4% of 311 complaints for noise were about traffic, while 35% of survey-reported nights of noise-related sleep disturbance were due to traffic. Similarly, there were fewer 311 complaints regarding noise from garbage trucks and animals when comparing them as sources of noise-related sleep disturbances in the survey.

Sources of noise named in nighttime 311 complaints compared with sources of survey-reported sleep disturbances, New York City, 2016-2017



Notes: Other Traffic in the survey-reported results includes Buses and Sirens. Sources: NYC Ambient Noise/Light and Sleep Survey, 2016-2017; 311 Service Requests from 10:30pm-6:59am, Nov. 18-29, 2016 and Jan 25-Mar 31, 2017

Redirected Inbound Call Sampling (RICS) is a non-probability sampling method developed by Research Triangle Institute, who partnered with Reconnect Research. Telephone calls that failed to connect due to being misdialed, incomplete, or disconnected inbound were routed to the survey, which was operated by an Interactive Voice Response system.⁵

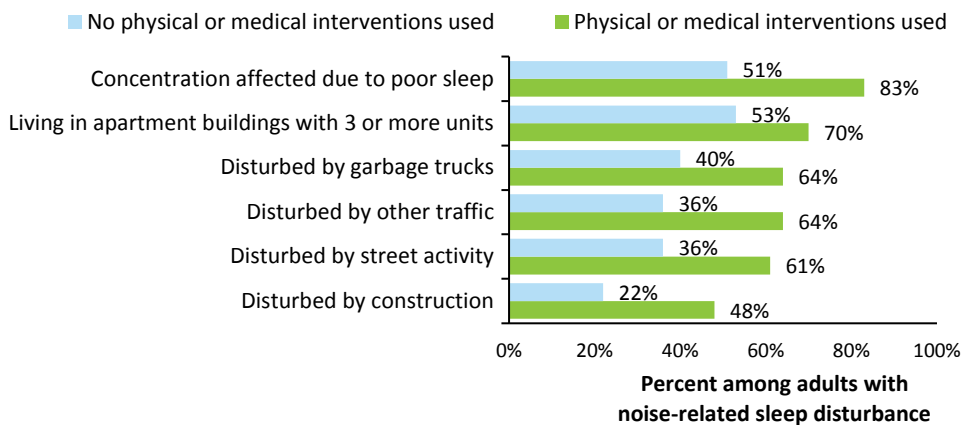
The sample results were weighted using calibration weighting. The sampling weights were adjusted to force the sum of weights in the categories of Borough, Age, Race/Ethnicity, Sex, and Educational Attainment, to equal the 2011-2015 American Community Survey results. Because the Spanish-language version was not available during the November period of the survey, nonresponse of the Spanish language speakers was accounted for by forcing the sum of the weights of the respondents who answered the Spanish-language version to be the same percent of the total weight of the survey when it was available.

Because this was a nonprobability sample, the 95% CI was calculated with larger margins of error. The simple random sample formula with adjustment for the approximate design effect was used. The margin of error was multiplied by an inflation factor to reflect an unequal weighting effect of 2, which is typical for traditional inbound calling surveys.

Three in four New Yorkers with noise-related sleep disturbance also had difficulty concentrating due to poor sleep

- In 2016-2017, 55% of adults reported difficulty concentrating due to poor sleep at least once per week.
- Among those reporting three or more nights of noise-related sleep disturbance per week, three quarters (75%, or 1,872,000 New Yorkers) also had difficulty concentrating due to poor sleep.
- Thirty-nine percent of people with any noise-related sleep disturbance, or an estimated 1,245,000 adults, used physical interventions (e.g., wearing earplugs or using a white noise machine) three or more nights per week to mitigate noise from outside their home.

Characteristics of adult New Yorkers who reported noise-related sleep disturbance, by use of physical or medical interventions, 2016-2017



Notes: Sources of noise with greatest differences between the two groups represented in this graph.

Source: NYC Ambient Noise/Light Survey, 2016-2017

- Twenty-three percent of people with any noise-related sleep disturbance, or an estimated 749,000 adults, reported using medical interventions (e.g., sleeping pills) because of noise outside their home on three or more nights per week.
- Use of physical or medical interventions due to noise outside their home did not vary by age group, sex, or education level.
- Data suggest that Manhattan residents with noise-related sleep disturbance were more likely to use interventions to mitigate noise than in other boroughs (71% vs 61%).
- However, those with any noise-related sleep disturbance who used any interventions were more likely than those who did not use interventions to report: being disturbed by all sources of noise, having their concentration affected due to poor sleep, and living in an apartment building with three or more units.

Almost one in seven New Yorkers had sleep disturbed by light at least three days per week

- In 2016-2017, thirty-one percent of New Yorkers with any sleep disturbance, an estimated 1,538,000 adults, reported that at least one night of disturbance was due to light. Nineteen percent were disturbed by light three or more days per week.
- Among those reporting light-disturbed sleep, daytime sunlight (25%), street lights (25%), and other light (19%) were the sources most disruptive to sleep.
- Twenty-three percent of those whose concentration was affected due to poor sleep reported sleep disturbed by light three or more times per week.

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Epi Data Tables

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Ambient Noise and Light Affecting Sleep in New York City

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Data Sources

NYC Ambient Noise/Light and Sleep Survey, 2016-2017: The NYC DOHMH administered an automated telephone survey to 1,532 adults, using a Redirected Inbound Call Sampling (RICS) method. RICS is a non-probability sampling method developed by Research Triangle Institute, who partnered with Reconnect Research. Telephone calls that failed to connect due to being misdialed, incomplete, or disconnected inbound were routed to the survey, which was operated by an Interactive Voice Response system. Participants were screened to be 18 years and older and live in one of the NYC boroughs. Frequency numbers are weighted using calibration weighting, where sampling weights were adjusted to force the sum of weights in the categories of Borough, Age Category, Race/Ethnicity, Sex, Educational Attainment to the 2011-2015 American Community Survey, as well as to the usage of the Spanish-language version of the survey when it was available. Imputed values used for missing or "prefer not to answer" responses. Remaining missing or "prefer not to answer" responses were omitted.

311 Service Requests, 2016-2017: 311 is NYC's non-emergency services line, where all complaints are recorded. For more information, visit: <http://www.nyc.gov/311>

Table 1. Demographic characteristics of survey respondents with noise-related sleep disturbance at least once per week, 2016-2017

Source: NYC Ambient Noise/Light and Sleep Survey, 2016-2017

Frequency numbers are weighted using calibration weighting, where sampling weights were adjusted to force the sum of weights in the categories of Borough, Age Category, Race/Ethnicity, Sex, Educational Attainment to equal the 2011-2015 American Community Survey, as well as to the Spanish-language version of the survey when it was available.

	Estimated population	Percentage	Lower 95% Confidence Interval	Upper 95% Confidence Interval
Borough				
Brooklyn	897,000	28	19	37
Queens	898,000	28	18	38
Bronx	597,000	19	11	26
Manhattan	656,000	21	12	30
Staten Island	141,000	4	0	9
Age Category				
18-24	450,000	14	7	22
25-34	771,000	24	15	34
35-44	565,000	18	10	26
45-54	550,000	17	10	25
55-64	402,000	13	7	19
65 or older	417,000	13	7	20
Sex				
Male	1,405,000	47	36	58
Female	1,598,000	53	42	64
Race/ethnicity				
White non-Latino	777,000	27	17	37
Black non-Latino	625,000	22	14	30
Latino	961,000	33	23	44
Other race non-Latino	512,000	18	9	27
Education				
Did not graduate high school	670,000	23	13	32
High school graduate or G.E.D.	728,000	25	16	33
Some college, technical school, or 2-year degree	700,000	24	15	32
Bachelor's degree or higher	852,000	29	18	40
Survey Language				
English	2,928,000	92	86	97
Spanish	261,000	8	3	14
Type of residence				
50 or more apartments	966,000	30	21	40
20-49 apartments	516,000	16	9	24
3-19 apartments	560,000	18	10	25
2 apartments	375,000	12	5	18
Single-family home	620,000	19	11	28
Don't know	152,000	5	0	9
Number of nights per week disturbed by noise				
1-2	695,000	22	13	31
3-6	1,410,000	44	34	55
7	1,084,000	34	24	44

Notes: The 95% confidence intervals were calculated using the simple random sample formula with adjustment for the approximate design effect method, where the margin of error was multiplied to reflect an unequal weighting effect of 2, as typical for traditional inbound calling surveys. Percents rounded to nearest whole number. Population estimates rounded to the nearest 1,000.

Race/ethnicity: For the purpose of this publication, Latino includes persons of Hispanic or Latino origin, as identified by the survey question "Are you Hispanic or Latino?" and regardless of reported race. Black and White race categories exclude those who identified as Latino. Due to low sample size, Asian population estimates could not be reliably calculated; Asians were combined with those in the Other race category.

Table 2. Percent of New York City adults who report sleep disturbance due to noise or light, 2016-2017*Source: NYC Ambient Noise/Light Sleep Survey, 2016-2017*

Frequency numbers are weighted using calibration weighting, where sampling weights were adjusted to force the sum of weights in the categories of Borough, Age Category, Race/Ethnicity, Sex, Educational Attainment to equal the 2011-2015 American Community Survey, as well as to the Spanish-language version of the survey when it was available.

	Estimated population	Percent	Lower 95% Confidence Interval	Upper 95% Confidence Interval
Nights per week disturbed by noise				
0 nights per week	3,283,000	51	43	58
1-2 nights per week	695,000	11	6	15
3-6 nights per week	1,410,000	22	16	28
7 nights per week	1,084,000	17	11	22
Nights per week disturbed by light				
0 nights per week	4,954,000	76	70	83
1-2 nights per week	613,000	9	5	14
3-6 nights per week	496,000	8	4	12
7 nights per week	429,000	7	3	10

Notes: The 95% confidence intervals were calculated using the simple random sample formula with adjustment for the approximate design effect method, where the margin of error was multiplied to reflect an unequal weighting effect of 2, as typical for traditional inbound calling surveys. Percents rounded to nearest whole number. Population estimates rounded to the nearest 1,000.

Table 3. Percent of New York City adults with noise-related sleep disturbance by specific sources of noise, 2016-2017

Source: NYC Ambient Noise/Light Sleep Survey, 2016-2017

Frequency numbers are weighted using calibration weighting, where sampling weights were adjusted to force the sum of weights in the categories of Borough, Age Category, Race/Ethnicity, Sex, Educational Attainment to equal the 2011-2015 American Community Survey, as well as to the Spanish-language version of the survey when it was available.

	Estimated Population	Percent	Lower 95% Confidence Interval	Upper 95% Confidence Interval
Restaurants				
0 nights/week	1,914,000	61	51	72
1-2 nights/week	556,000	18	9	26
3-6 nights/week	455,000	15	7	22
7 nights/week	201,000	6	1	11
Animals				
0 nights/week	2,089,000	67	57	77
1-2 nights/week	552,000	18	9	26
3-6 nights/week	319,000	10	4	16
7 nights/week	166,000	5	0	10
Neighbors				
0 nights/week	1,306,000	42	31	52
1-2 nights/week	726,000	23	14	32
3-6 nights/week	784,000	25	16	34
7 nights/week	320,000	10	4	17
Subway/train				
0 nights/week	2,200,000	70	60	80
1-2 nights/week	390,000	12	5	20
3-6 nights/week	314,000	10	4	17
7 nights/week	232,000	7	2	13
Buses				
0 nights/week	1,908,000	61	51	71
1-2 nights/week	493,000	16	8	24
3-6 nights/week	488,000	16	8	23
7 nights/week	243,000	8	2	13
Sirens				
0 nights/week	1,123,000	36	26	46
1-2 nights/week	762,000	24	15	33
3-6 nights/week	855,000	27	18	37
7 nights/week	387,000	12	5	19
Garbage trucks				
0 nights/week	1,400,000	45	34	55
1-2 nights/week	837,000	27	17	36
3-6 nights/week	633,000	20	12	29
7 nights/week	275,000	9	3	15
Other traffic				
0 nights/week	1,458,000	46	36	57
1-2 nights/week	658,000	21	12	30
3-6 nights/week	709,000	23	14	31
7 nights/week	316,000	10	4	16
Construction				
0 nights/week	1,912,000	61	51	71
1-2 nights/week	520,000	17	9	25
3-6 nights/week	569,000	18	10	26
7 nights/week	131,000	4	0	8
Street activity				
0 nights/week	1,496,000	48	37	58
1-2 nights/week	689,000	22	13	31
3-6 nights/week	694,000	22	13	31
7 nights/week	246,000	8	2	14

Notes: The 95% confidence intervals were calculated using the simple random sample formula with adjustment for the approximate design effect method, where the margin of error was multiplied to reflect an unequal weighting effect of 2, as typical for traditional inbound calling surveys. Percents rounded to nearest whole number. Population estimates rounded to the nearest 1,000.

Table 4. Percent who have difficulty concentrating, use physical interventions, or use medical aids among New York City adults who have sleep disturbed due to noise, 2016-2017

Source: NYC Ambient Noise/Light Sleep Survey, 2016-2017

Frequency numbers are weighted using calibration weighting, where sampling weights were adjusted to force the sum of weights in the categories of Borough, Age Category, Race/Ethnicity, Sex, Educational Attainment to equal the 2011-2015 American Community Survey, as well as to the Spanish-language version of the survey when it was available.

	Estimated Population	Percent	Lower 95% Confidence Interval	Upper 95% Confidence Interval
Have difficulty concentrating the next day due to poor sleep				
0 nights per week	915,000	29	19	38
1-2 nights per week	584,000	18	10	27
3-6 nights per week	1,276,000	40	30	50
7 nights per week	415,000	13	6	20
Use physical interventions due to noise at night				
0 nights per week	1,447,000	45	35	56
1-2 nights per week	496,000	16	8	23
3-6 nights per week	738,000	23	14	32
7 nights per week	507,000	16	8	24
Use sleep aids due to noise at night				
0 nights per week	2,052,000	64	54	74
1-2 nights per week	387,000	12	5	19
3-6 nights per week	392,000	12	6	19
7 nights per week	357,000	11	4	18

Notes: The 95% confidence intervals were calculated using the simple random sample formula with adjustment for the approximate design effect method, where the margin of error was multiplied to reflect an unequal weighting effect of 2, as typical for traditional inbound calling surveys. Percents rounded to nearest whole number. Population estimates are rounded to the nearest 1,000. Examples of physical interventions are wearing earplugs, using a white noise machine, turning on a fan, or closing windows. Examples of sleep aids are prescription sleeping pills, melatonin, or herbal remedies like valerian.

Table 5. Frequency of 311 complaints related to noise received November 2016 and January to March 2017 during 10:30PM-6:59AM, New York City

Source: 311 Service Requests from 10:30PM-6:59AM, Nov. 18-29, 2016 and Jan 25-Mar 31, 2017

Complaint type	Number of complaints	Percent
Neighbors	21,000	60
Other Street Activity	3,000	10
Restaurants	3,000	9
Other Noise	3,000	8
Construction	3,000	8
Other Traffic	1,000	4
Animals	<1,000	1
Garbage Trucks	<1,000	<1

Notes: Percents rounded to nearest whole number. Number of calls rounded to the nearest 1,000.