

## 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.<sup>1,2</sup>

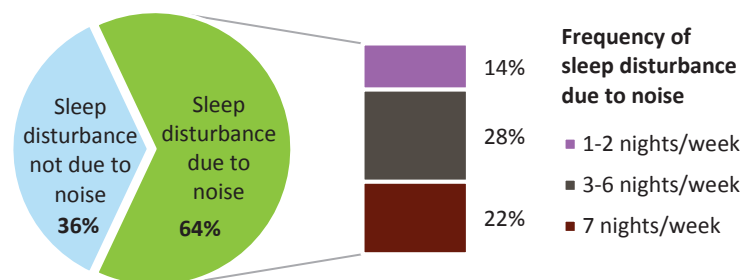
The 2009 New York City (NYC) Community Health Survey found that 20% of adults reported having activities disrupted by noise from outside their homes three or more times per week.<sup>3</sup> In 2016, one in six (18%, or more than 410,000) complaints to 311, the NYC non-emergency services line, were related 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.

### 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

#### 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.

- 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.<sup>4</sup>

#### 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>

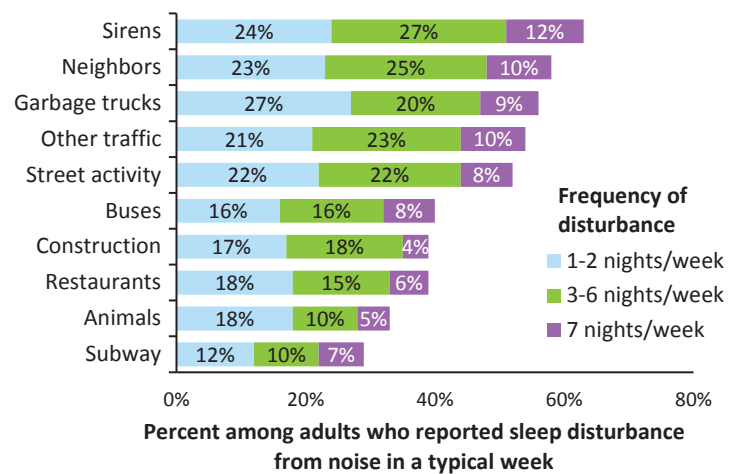
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## Traffic, Neighbors, and Other Noise were the leading sources of noise disturbance

- 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**

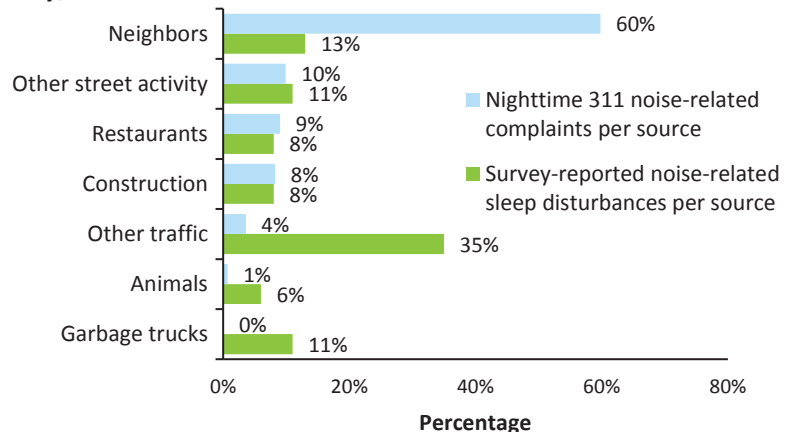


Notes: Respondents could report more than one source of noise disturbance per week. Source: NYC Ambient Noise/Light and Sleep Survey, 2016-2017

## 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.<sup>5</sup>

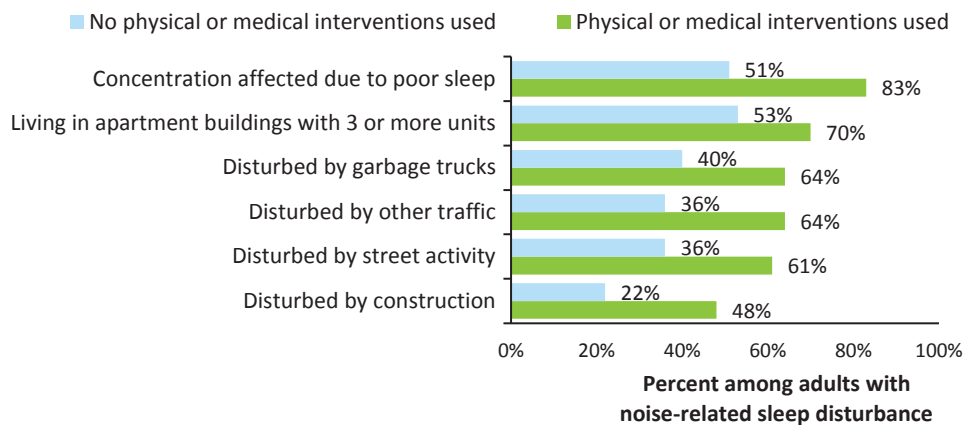
The sample results were weighted using calibration weighting. The sampling weights were adjusted to force the sum of weights in the categories of Borough, Age, Race/Ethnicity, Sex, and Educational Attainment, to equal the 2011-2015 American Community Survey results. Because the Spanish-language version 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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**Acknowledgements:** Christopher D'Andrea, Deborah Deitcher, Anita Geevarughese, Hannah Gould, Charon Gwynn, Calaine Hemans-Henry, Kinjia Hinterland, Iyad Kheirbek, Julien Martinez, Christopher Miller, Corinne Schiff, Hannah Seoh, Ariel Spira-Cohen

**Suggested citation:** Teoh T, Olson C. Effect of Noise and Light on Sleep in New York City. New York City Department of Health and Mental Hygiene: Epi Data Brief (105); September 2018.

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New York City Department of Health and Mental Hygiene





# Epi Data Tables

September 2018, No. 105

## Ambient Noise and Light Affecting Sleep in New York City

### Data Tables

- Table 1.** Demographic characteristics of survey respondents with noise-related sleep disturbance at least once per week, 2016-2017
- Table 2.** Percent of New York City adults who report sleep disturbance due to noise or light, 2016-2017
- Table 3.** Percent of New York City adults with noise-related sleep disturbance by specific sources of noise, 2016-2017
- 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
- 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

### 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<br>population | Percentage | Lower 95%<br>Confidence<br>Interval | Upper 95%<br>Confidence<br>Interval |
|---|-------------------------|------------|-------------------------------------|-------------------------------------|
| <b>Borough</b>                                      |                         |            |                                     |                                     |
| 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                                   |
| <b>Age Category</b>                                 |                         |            |                                     |                                     |
| 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                                  |
| <b>Sex</b>  |                         |            |                                     |                                     |
| Male  | 1,405,000               | 47         | 36                                  | 58                                  |
| Female  | 1,598,000               | 53         | 42                                  | 64                                  |
| <b>Race/ethnicity</b>                               |                         |            |                                     |                                     |
| 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                                  |
| <b>Education</b>                                    |                         |            |                                     |                                     |
| 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                                  |
| <b>Survey Language</b>                              |                         |            |                                     |                                     |
| English   | 2,928,000               | 92         | 86                                  | 97                                  |
| Spanish   | 261,000                 | 8          | 3                                   | 14                                  |
| <b>Type of residence</b>                            |                         |            |                                     |                                     |
| 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                                   |
| <b>Number of nights per week disturbed by noise</b> |                         |            |                                     |                                     |
| 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<br>population | Percent | Lower 95%<br>Confidence<br>Interval | Upper 95%<br>Confidence<br>Interval |
|---|-------------------------|---------|-------------------------------------|-------------------------------------|
| <b>Nights per week disturbed by noise</b> |                         |         |                                     |                                     |
| 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                                  |
| <b>Nights per week disturbed by light</b> |                         |         |                                     |                                     |
| 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 |
|------------------------|----------------------|---------|-------------------------------|-------------------------------|
| <b>Restaurants</b>     |                      |         |                               |                               |
| 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                            |
| <b>Animals</b>         |                      |         |                               |                               |
| 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                            |
| <b>Neighbors</b>       |                      |         |                               |                               |
| 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                            |
| <b>Subway/train</b>    |                      |         |                               |                               |
| 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                            |
| <b>Buses</b>           |                      |         |                               |                               |
| 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                            |
| <b>Sirens</b>          |                      |         |                               |                               |
| 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                            |
| <b>Garbage trucks</b>  |                      |         |                               |                               |
| 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                            |
| <b>Other traffic</b>   |                      |         |                               |                               |
| 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                            |
| <b>Construction</b>    |                      |         |                               |                               |
| 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                             |
| <b>Street activity</b> |                      |         |                               |                               |
| 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<br>Population | Percent | Lower 95%<br>Confidence<br>Interval | Upper 95%<br>Confidence<br>Interval |
|---|-------------------------|---------|-------------------------------------|-------------------------------------|
| <b>Have difficulty concentrating the next day due to poor sleep</b> |                         |         |                                     |                                     |
| 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                                  |
| <b>Use physical interventions due to noise at night</b>             |                         |         |                                     |                                     |
| 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                                  |
| <b>Use sleep aids due to noise at night</b>                         |                         |         |                                     |                                     |
| 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

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| <b>Complaint type</b> | <b>Number of complaints</b> | <b>Percent</b> |
|-----------------------|-----------------------------|----------------|
| 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             |

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