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NOISE AND YOUR HEALTH



reported by
SHEELA BASRUR

from a research paper submitted by SIU
FONT and MARINA JOHNSTON

In June 2008, at the age of 51, Dr. Sheela Basrur died of a rare form of cancer. She was East York's Medical Officer of Health. She is best known for being the voice of health authority during Toronto's SARS crisis in 2003. She was appointed Chief Medical Officer of Health for Ontario in 2004.

Noise, which is often referred to as unwanted sound, is typically characterized by the intensity, frequency, periodicity (continuous or intermittent) and duration of sound. Sound is the result of pressure changes in the air caused by vibration. Unwanted sound to some may be considered wanted sound by others, as in the case of loud music.

More people are affected by noise exposure than any other environmental stressor. However, because its associated health effects are not as life-threatening as those for air, water and hazardous waste, noise has been on the bottom of most environmental



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priority lists.

Traditionally, much of the scientific evidence has been based on studies of occupational exposures. These noise exposures tend to be of greater intensity over longer periods of time as compared with exposures to community noise. In earlier research, investigators also tended to assume that noise produced direct health effects, such as hearing loss with noise exposures above 90 decibels, and paid little attention to individual differences in response to noise, and noise as a stressor.

More recently, research has focused on noise as an auditory stressor that can produce both direct and indirect health effects. The direct health effect known to be attributable to noise is hearing loss (resulting from damage to the inner hair cells of the organ of corti) with noise exposure higher than 90 decibels. There are several non-auditory physiological effects of noise exposure including a possible increase in cardiovascular disease from elevated blood pressure and physiological reactions involving the cardiovascular endocrine system. In addition, community noise has been shown to adversely affect sleep, communication, performance and behaviour, reading and memory acquisition, and mental health.

Noise affects millions of people worldwide on a daily basis. Highway noise alone affects more than 18 million people in the United States and 100 million people worldwide. It is estimated that community noise levels in the United States have increased over 11 % during the last decade, with aviation noise projected to rise at an even more



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rapid rate. Most urban noise stems from automobile traffic. Motor vehicle use worldwide continues to climb despite campaigns to encourage reliance on public transportation. Increasing population densities, especially in urban areas, have also resulted in escalating noise levels. This has serious impending health implications for all cities worldwide. Internationally, the issue of noise is gaining more attention as countries set their own national standards regarding noise control.

In the Greater Toronto Area, it has been estimated that the population will increase by 40% in the next 20 years and that automobile ownership is estimated to increase by 60%. The expansion of the Pearson Airport is currently being projected to increase air traffic from approximately 27 million passengers to 50 million passengers over the next decade. Further, the former City of Toronto area is becoming known as a center for music festivals on city streets, parks and public areas. This increase in public leisure activities will likely add to noise levels in the city.

It is evident that reducing noise levels in homes and the community at large requires a multiplicity of actions by all levels of government, the private sector and the general public. Within the City of Toronto, the Public Health Division has a unique role to play in reviewing the latest research on noise. This information may assist city officials and the public in preventing or reducing excess noise levels where reasonable and possible.

The World Health Organization (WHO) defines “health as . . . a state

of complete physical, mental and social well-being. Governments have responsibility for the health of their people which can be fulfilled only by the provision of adequate health and social measures.”

In Canada, the Working Group on Environmental Noise of the Federal/Provincial Advisory Committee on Environmental and Occupational Health acknowledged that:

Noise is more than just a nuisance since it constitutes a real and present danger to people’s health. Day and night, at work and at play, noise can produce serious physical and psychological stress. No one is immune to this stress. People appear to adjust to noise by ignoring it but the ear, in fact, never closes.

Data on the health costs associated with exposure to excessive noise is limited. Research in Germany has estimated that the annual cost of noise on public health is approximately \$500 to \$1900 million ECU (726.4 million dollars to 2.76 billion US dollars) per year for road noise, and \$100 million ECU (1.45 million US dollars) per year for rail noise.

The evidence that people show negative subjective responses to noise (e.g., annoyance, dissatisfaction and disturbance) is strong. However, there is no clear noise level threshold for measuring community reaction. This is likely due to the considerable variation in people’s tolerance to noise levels and the different types of noise,

making it difficult to quantify direct health effects.

The potential adverse health effects are usually classified according to the type of noise. Sudden or impulsive noise appears to create substantially more reaction than non-impulsive noise , and intermittent noise has greater effect than louder, more continuous noise . Predictability and controllability are clearly influencing factors in individual reactions to noise.

Individual physiological and psychological responses to noise are also influenced by susceptibility. For example, noise sensitive people attend more to noises, discriminate between noises, find more noises threatening and out of their control, and react to, and adapt to noises more slowly than less noise sensitive people. There may be a small risk amongst some people that exposure to the stress of high noise levels increases susceptibility to disease and infection and can be a complicating factor in heart problems and other diseases.

While there are reasonable indicators of a casual connection between noise exposure and health effects, the exact nature of this causal relationship is not known. There is a relationship between sleep loss and stress with possible causal connections in both directions. It is less understood how reaction modifiers, including attitude to the noise source, noise sensitivity, and perceived control over the noise consciously or unconsciously influence an individual's reaction to noise

DEMONSTRATED HEALTH EFFECTS RELATED TO NOISE

Hearing Loss. The evidence for a cause-effect relationship between noise and hearing loss is considered sufficient in the scientific community. There is consensus that sound levels less than 75 dB(A) are unlikely to cause permanent hearing loss and that sound levels about 85 dB(A) with exposures of eight hours per day will produce permanent hearing loss after many years.

Annoyance. Annoyance can be defined as “the expression of negative feelings resulting from interference with activities, as well as disruption of one’s peace of mind and the enjoyment of one’s environment.” Evidence has shown that unexpected or impulse noise is more annoying than continuous noise of equivalent energy.

Annoyance in the workplace has been studied and may yield useful insights into annoyance caused by ambient urban noise. The Health Council of the Netherlands found no association between noise level in the workplace and annoyance. The Council, however, identified five non-acoustic variables that have a greater effect on annoyance than noise level: meaningfulness and information content of the noise; predictability, avoidability, and controllability of the noise; attitude of workers to the noise; task demand; and susceptibility.

Noise-induced cardiovascular effects have been extensively studied in occupational settings. The Health Council of the Netherlands concluded that prolonged exposure to occupational noise may contribute to increased blood pressure and hypertension. These effects were shown to occur at sound levels of 85 dB(A). Other

noise-induced cardiovascular effects include: abnormalities in the electrocardiogram; more heart beat irregularities; faster pulse rate; and slower recovery of vascular constriction.

It has been more difficult to determine the effects of noise in the urban environment. Most studies have focused on the effects of air and road traffic noise on people in their own homes. A complicating factor has been to distinguish exposure to traffic noise versus other, often even louder noises, from other sources. Housing features, as well as personal habits and proximity of sleep areas to the noise source (e.g., road) affect the actual noise exposure. There is some evidence that suggests an increased risk of hypertension and ischaemic heart disease for people living in areas with road or air traffic noise at outdoor equivalent sound levels above 70 dB(A) based on exposure between 6:00 a.m. and 10:00 p.m.

Some studies have found that kindergarten children had significantly higher systolic and diastolic blood pressures when exposed to noisy or very noisy environments (kindergarten and home) as compared to quiet environments. However, these effects appear to be of temporary nature.

Sleep Disturbance. Noise has been reported to lessen the quality and the duration of sleep. Epidemiological studies have focused on the impact of noise on individuals such as patients in hospital and the impact of particular sources of noise (e.g., aircraft) on sleep. The Health Council of the Netherlands has considered the

evidence to be sufficient for a causal relationship between the long-term effects of noise-related sleep disturbances, with changes in sleep patterns, awakening, sleep stages, and subjective sleep quality. Susceptible persons may be affected by noise occurring during sleep, as well as the waking state, with day and night noise being a significant problem for night workers, mothers with babies, elderly persons, persons who are especially vulnerable to physical or mental disorders, and other individuals who experience sleeping difficulty.

Immune Effects. There appears to be an association between sleep and the immune response. Thus, it would follow that further study is required on the immune responses of people exposed to noise during sleep, especially those exposed to intermittent transportation noise. For example, nocturnal noise has been indicated as a health risk because of the disturbance to the distribution of sleep stages resulting in direct immunosuppressive effects, specifically inhibition of eosinophils and basophils which usually proliferate during sleep.

The Caerphilly and Speedwell Study found an increased concentration of leucocytes in the blood of persons exposed to high levels of traffic noise. Although no studies have reported a causal relationship between noise and compromised immunity, increased concentration of leucocytes in blood might lead to increased prevalence of diseases such as influenza.

Biochemical Effects. Noise-induced biochemical changes (specific hormones and metal ions such as

magnesium) have been found in persons exposed to very high environmental or occupational noise, suggesting noise acts as a stressor. Several studies also show biochemical changes indicating an increased risk of ischaemic disease. However, limited data on the causal relationship is currently available.

Reproductive Effects. There is limited evidence to suggest a relationship between air traffic noise exposure of pregnant women in the living environment and low birthweight. There is virtually no data to suggest an increased risk of congenital anomalies.

Performance Effects. Very little research has focused on the effect of noise on human productivity in community situations. Most studies have occurred in the laboratory and work settings. Noise has been shown in test subjects to increase alertness, affect task strategy, and decrease attention to the task. Performance on simple tasks, however, especially those that are monotonous, may actually be improved by noise, presumably by elevating the subject's alertness. There are consistent after-effects of noise on tasks requiring higher cognitive performance (e.g., proofreading, completing a puzzle). Some accidents may also be a result of the effects of noise on performance.

Susceptible Groups. There may be some populations at greater risk for the harmful effects of noise. These groups include: the elderly, those with a mental health disorder, the blind, possibly fetuses, and young children. For example, children appear to be particularly susceptible to noise-induced health effects including: interference with speech

acquisition and language development (which can create frustration and impair social interaction), inattention and impaired task performance, lower reading scores, and delayed motor reflex reactions. According to Berglund and Lindvall, classrooms and day care facilities often surpass the recommended sound pressure level (e.g., 35 dB(A) during teaching sessions), compromising the optimum learning environment for children. For hearing impaired children, it is suggested that the sound level needs to be even lower.

Youth and young adults appear to be at greater risk for noise-induced hearing loss due to their exposure to very high levels of noise during leisure activities including concerts and bars, use of personal cassette players, car stereos, firearms (including pellet guns and toy cap guns), fireworks, arcade games and motor sports such as racing cars.

The Health Council of the Netherlands suggests that susceptible populations to the adverse health effects of noise can also include: people that are highly annoyed by low levels of road traffic noise (for hypertension); men exposed to high levels of road traffic noise at home as well as occupational noise (for ischaemic heart disease); and pregnant women who are exposed to occupational noise (for hypertension). Further, people with sleep disturbances have an increased risk of hypertension and ischaemic heart disease compared to people who live in the same environment that do not experience sleep disturbance. Finally, exposure of hospitalized patients to relatively high levels of noise from sources inside or outside the hospital delays recovery

and wound healing.

CONCLUSIONS

Noise is an important health issue that affects more than hearing. The scientific research demonstrates that health effects occur at noise levels below those that impair hearing. Some of these health effects include increased risk for cardiovascular disease, negative effects on sleep, communication, performance and behaviour, reading and memory acquisition, and mental health.

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