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High-Rise Living: Impacts of Living on Higher Floors

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High-rise buildings are becoming a primary choice among those people living in urban areas as they provide a more economical option for a proportion of the population who cannot afford the rising costs of traditional semi-detached or detached homes in major cities like Vancouver, Calgary and Toronto.

Worldwide, high-rise buildings are increasing both in number and in height as major city urban developers look for affordable and profitable options as land space becomes sparse. Not surprisingly, New York City has the greatest number of total high-rises among cities worldwide, with 6069 (see Table 1). The Greater Toronto Area (GTA) in 2014 led North American cities with 130 high-rise building projects, most of which were condominiums. The GTA is also a leader in terms of the percentage of high-rises (buildings that are at least 12 stories in height) in the city that are residential in nature.¹

TABLE 1. List of high-rises (12 stories or greater) in major cities as of 2014

City	Number of High-rises	City Population
New York City	6069	8,175,000
Toronto	2005	2,615,000
Shanghai	1202	13,523,000
Tokyo	1185	8,583,000
Chicago	1150	2,833,000
Kiev	970	6,994,500
Mexico City	762	8,694,753
Vancouver	664	616,537
Montreal	619	1,649,519

What is largely unknown are the health effects, if any, of living in these high-rise buildings, some of which can be 40 or more stories in height.² This review aims to summarize the current literature that explores these health effects.

Housing is an important determinant of health, and has attracted considerable interest in public health research and policy. The World Health Organization (WHO) has identified inadequate housing conditions as an important factor contributing to injuries and preventable diseases such as respiratory, nervous system and cardiovascular diseases and other chronic conditions, including cancer.³ Housing conditions may affect health both directly and indirectly. Direct effects on health might operate through the biological, chemical or physical characteristics of buildings such as the presence of radon, asbestos or pests, unsafe heating systems, overcrowding or indoor pollution.^{4,5} Indirect effects might act through individual characteristics and exposures related to the socioeconomic position of those living in a building and neighborhood.

If the GTA is taken as an example of the population boom occurring in some major cities — the GTA population is expected to increase by more than 44 percent (to 9.2 million people in the next 25 years) — cities are looking for more sustainable housing planning.⁶ Currently, it is estimated that about 70 percent of those living in high-rise buildings are in structures that are at least 13 stories in height.⁶ Ultimately more patients that naturopathic doctors see will be living in these buildings, and it may aid us to understand the health effects of living in these structures and how doing so may contribute to illness.

The Switzerland Study

A review of research databases reveals that there are few articles published on the health effects of living in high-rises. Most studies of high-rise housing and health have focused on structural features of high-rise buildings or characteristics of their neighborhoods.

A team of researchers conducted an interesting study in Switzerland that was published in in 2013 in the European Journal of Epidemiology.⁷

Panczak et al utilized information from the Swiss National Cohort (SNC), a longitudinal study based on the linkage of the December 2000 census with mortality and emigration records from 2001-2008, to examine the association of the floor of residence in high-

risers on all-cause and cause specific mortality in Switzerland. The SNC includes more than 7.2 million people who participated in the 2000 census.

For the analysis the researchers excluded 858,843 (11.8 %) persons younger than 30 years and 1,247 (0.02 %) individuals older than 95 years at the time of census. 4,081,484 (56.1 %) residents of buildings with fewer than four floors and 357,971 (4.9 %) individuals with missing information on the floor of residence were also excluded. The study population ultimately consisted of 1,500,015 persons.

Upon analysis, the researchers discovered that the floor of residence was associated with all-cause and cause-specific mortality. Table 2 shows fully adjusted hazard ratios (HR) of death from all causes comparing residents of the eighth floor or higher with residents living on lower floors. Mortality decreased with increasing floor: residents on the ground floor had a 22% greater hazard of death from any cause compared to residents on the eighth floor and above. Interestingly, the gradient was steepest between ground floor and fourth floor and leveled off from the fourth floor upwards.

TABLE 1. List of high-rises (12 stories or greater) in major cities as of 2014

Cause	No. of Deaths	Hazard Ratio and 95% CI
All causes	6069	8,175,000
Cardiovascular diseases	2005	2,615,000
Myocardial infarction	1202	13,523,000
Stroke	1185	8,583,000
Respiratory diseases	1150	2,833,000
Stomach cancer	970	6,994,500
Lung cancer	762	8,694,753
Breast Cancer	664	616,537
Prostate cancer	619	1,649,519

The association was strongest with respiratory diseases (HR 1.40; 95 % CI 1.11–1.77), stroke (HR 1.36; 95 % CI 1.07–1.74), cardiovascular diseases (HR 1.35; 95 % CI 1.22–1.49) and lung cancer (HR 1.22; 95% CI 0.99–1.50). There was little evidence of an association with other causes of death. The HR was 0.41 (95 % CI 0.17–0.98) overall.

An association with floor of residence was evident with causes associated with specific behaviors, such as smoking. The association

of floor of residence with causes of death such as stroke or lung cancer may be explained by differences in health-related lifestyles and behaviors. A limitation in this study is insufficient data comparing lifestyle habits of those living on higher floors to ground floor residents. Panczak et al commented that those living on higher floors may have consumed diets higher in fruits and vegetables, consisted of more non-smokers, had higher levels of physical activity and higher income (which was not included in the SNC).

Environmental exposures may also play a role, for example the higher levels of airborne pollutants, including particulate matter, polycyclic aromatic hydrocarbons or carbon monoxide at lower floor levels.⁸ There is research to support that residents of low-floor apartments are exposed to elevated levels of vehicle exhaust and their volatile organic compounds compared to high-floor apartment residents.⁹

Aside from this Swiss study, few other studies report on the effects that floor of residence has on health outcomes. We can expect as greater numbers of people reside in high-rises in the future, that we see more research investigating these issues.

Radon Exposure

Radon is an invisible, odourless radioactive gas that is produced with the natural process of uranium decay. It is found in soil and rock in all parts of North America. Radon can be found in all types of housing and buildings throughout the United States and Canada. If radon is present in the soil or rocks of the buildings foundation, it can seep into the building. Radon commonly is introduced through homes through cracks or drains in the foundation. The Environmental Protection Agency (EPA) recommends testing all homes below the third floor for radon.¹⁰ As most indoor radon is produced from naturally occurring radon in the foundations soil and rocks, the highest indoor levels are most likely to exist below the third floor. However, in the cases of high-rise buildings, radon has been found at floors above the third floor, possibly due to radon movement through elevators or airshafts in the building.

Radon exposure can have a significant impact on overall health. Studies have demonstrated that residential radon exposure is the second most important risk factor for lung cancer and the first among never-smokers.¹¹ The damaging effects may be greater in current and past smokers. The province of Nova Scotia surveyed 719 homes in 75 communities, finding average radon concentrations of 2.9 pCi/L (picocuries/litre). Four pCi/L is the American standard for radon above which remediation may be recommended. The Canadian standard is 20 pCi/L, and 22 homes out of the 719 surveyed exceeded that standard.¹²

Homeowners or tenants can test for radon with a variety of radon measuring devices that can be purchased. A professional can also be hired to test your living space. If high radon levels are discovered, improving the exposure typically involves repairs to the building. The building owner/tenant should be informed.

Electromagnetic Fields

Electromagnetic fields (EMF) of all frequencies represent one of the most common and fastest growing environmental influences, on which much research is now being focused.¹³ Electric fields are strongest close to a charge or charged conductor, and their strength rapidly diminishes with distance from it. Conductors such as metal block EMFs very effectively, however, building materials are less effective. In contrast to electric fields, a magnetic field is only produced once a device is switched on and current flows. Magnetic fields are strongest closer to their origin and rapidly decrease at greater distances from the source. Common materials such as the walls of buildings do not block magnetic fields.¹⁴

Environmental exposure to man-made electromagnetic fields has been steadily increasing with growing electricity demand and ever-advancing technologies, which have created more and more artificial sources. Higher levels of EMF exposure has been found in high-rise buildings when compared to other types of homes.¹⁴ This is most likely due to the proximity to other units and being exposed to the EMFs from nearby high-rise buildings.

Canada has no national guidelines for occupational or residential exposure to EMFs.¹⁵ The Federal Provincial Territorial Radiation Protection Committee (FPTRPC) that met to review the literature concluded that epidemiological studies have not provided sufficient evidence to provide an association between exposure to EMF and development of cancer in adults. In contrast to this, the European Council recommends that member countries adopt exposure limits to EMFs. Countries that have adopted some precautionary elements include Italy, Netherlands, Switzerland, and Slovenia.¹⁵ The focus in these countries has been on 'sensitive areas' where people may be exposed for a prolonged duration to EMFs: schools, hospitals, workplaces and high-rises.

It is not disputed that electromagnetic fields above certain levels can trigger biological effects. Experiments with healthy volunteers indicate that short-term exposure at the levels present in the environment or in the home do not cause any apparent detrimental effects.¹⁵ Exposures to higher levels that might be harmful are restricted by national and international guidelines. The current debate is centered on whether long-term low-level exposure can evoke biological responses and influence people's well being. Large-scale studies are currently underway in several countries and may hopefully help resolve these questions.

Conclusion

With high-rise buildings becoming a primary choice for housing in major cities across North America, it is likely that many more patients we see will be living in these buildings. A review of the current available literature does not provide strong evidence of direct harm to inhabitants of these structures in the short-term, although radon exposure and electromagnetic field exposure are important factors to consider. As the Switzerland study examined, living on

higher floors may even be protective against the development of several conditions. More research is required at this time to specify exact health effects, if any, of living in high-rise buildings for a prolonged period of time. ☀

About the Author

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