Sex, Health and Australia's Artarmon Triangle

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The Artarmon Triangle in Sydney, Australia is cornered by three large broadcast towers that, over the years, have emitted high levels of radiofrequency radiation. One study of the Artarmon Triangle suggests a link between the incidence of leukemia and proximity to the towers [Ref. 1]. Further, there is a widespread belief within the telecommunications industry that exposure to radiofrequency radiation may cause telecommunication equipment riggers to conceive more female offspring [Ref. 2].

This study tests a hypothesis that telecommunications riggers who have worked on any of the three Artarmon Triangle towers would have an increased frequency of female offspring when compared to telecommunications riggers who have not worked in the Triangle.

Literature Search

Broadcast Towers

An ecological study of the Artarmon Triangle performed in 1996 suggests a link between leukemia incidence and proximity to the towers. The validity of this finding has since been challenged [Ref. 3]. Hence, there continue to be studies supporting and challenging the theory that those residing near broadcast towers have higher levels of cancer risk.

One study showed that the chance of developing childhood leukemia was 2.6-times higher among children residing within 2.6 miles of a radio broadcast tower in Oahu, Hawaii [Ref. 4]. But another study examined 15 years of cancer registry data and could not find any evidence of childhood cancers associated with those living near the Sutro tower in San Francisco, California [Ref. 5].

The Artarmon Triangle

The Artarmon Triangle is shown in Figure 1, where the stars at the triangle corners represent the broadcast towers.

- The star to the top left (Hampden Road) represents the Artarmon tower.
- The star to the mid right (Gore Hill Freeway) represents the Willoughby tower.
- The star to the bottom (Pacific Highway) represents the Gore Hill tower.

Figures 2 and 3 show the height and potential radiofrequency radiation hazards present on the broadcast towers in Sydney's Artarmon Triangle.

General Radiofrequency Radiation Health Effects

The human body is 70% water and

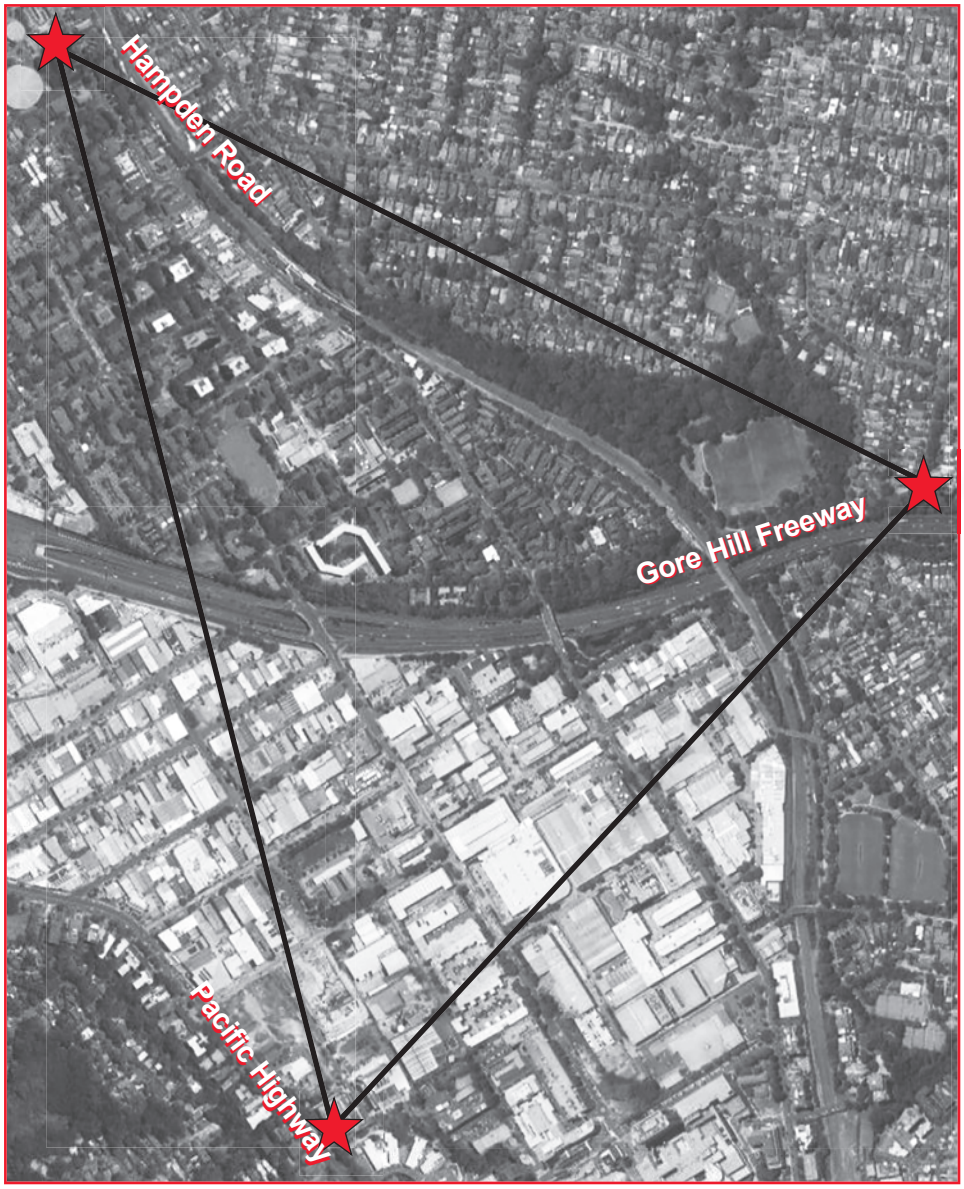

Figure 1 — The Artarmon Triangle in Sydney Australia [Ref. 6].

since radiofrequency radiation results in the vibration of water molecules, injury to the body via a thermal effect can occur [Ref. 7]. Radiofrequency radiation can result in cataracts [Refs. 8 and 9], headaches [Ref. 10], burns [Ref. 11], adverse hearing effects [Ref. 12] and reproductive effects [Refs. 2 and 13]. This radiation can also cause significant issues with medical devices, such as pacemakers [Ref. 14] and insulin pumps [Ref. 15].

Specific Radiofrequency Radiation Reproductive Effects

By design, broadcast towers emit radiofrequency radiation [Refs. 1, 4, 5 and 16]. Several studies support the literature that radiofrequency radiation exposure has potential significant reproductive effects.

According to these studies:

- There was a significant increase in abnormal spermatogonia, as well as changes in seminiferous tubules and DNA damage in albino mice exposed to 902.4 MHz for four and eight hours per day over 35 days [Ref. 17].
- DNA fragmentation increased significantly in human sperm exposed to 850MHz for an hour [Ref. 18].
- DNA fragmentation and non-progressive motility of human sperm increased and there was a reduction in progressive motility of sperm exposed to 900-1800 MHz intermittently every 10 minutes for five hours [Ref. 19].
- Radiofrequency radiation exposure can decrease sperm count, seminiferous diameter, and testicular weight with increases in DNA single-strand break down [Ref. 13].
- There was a significant reduction in sperm motility in rats exposed to radiofrequency radiation, due to oxidative stress, when compared to controls. The study suggested a causal relationship between changes in semen quality and radiofrequency radiation exposure [Ref. 20].
- Radiofrequency radiation from mobile phones can decrease semen quality reducing sperm motility, viability and count. This decrease in sperm parameters was dependent on daily mobile phone exposure [Ref. 21].

Figure 2 — Willoughby tower (with the Gore Hill freeway below). This illustrates the extreme heights at which telecommunications riggers work (Photograph taken by the study researcher).

Figure 3 — The Willoughby tower looking back towardArtarmon Triangle tower. This picture illustrates a series of antennas mounted in just one section of the tower (Photograph taken by the study researcher).

Table 1 — Ratios of Female and Male Offspring (Among Male Telecommunications Riggers Who Had *Worked on Any of the Three Artarmon Triangle Broadcast Towers).*

	No F	F	FF	FFF	FFFF	FFFFF
No M	11	5	3	2	0	0
M	3	16	3	2	1	0
MM	3	3	3	3	0	0
MMM	3	2	2	2	0	0
MMMM	1	0	0	0	0	0
MMMMM	0	0	0	0	0	0
Key: (Female = F) (Male = M)						

Table 2 — Ratios of Female and Male Offspring (Among Male Telecommunications Riggers Who Had Not *Worked on Any of the Three Artarmon Triangle Broadcast Towers).*

	No F	F	FF	FFF	FFFF	FFFFF
No M	13	5	2	1	0	2
M	5	16	3	2	0	0
MM	2	1	2	2	0	0
MMM	4	3	3	2	0	0
MMMM	0	0	0	0	0	0
MMMMM	0	0	0	0	0	0
Key: (Female = F) (Male = M)						

- Radiofrequency radiation exposure may result in infertility and lower ratios of boys to girls in offspring [Ref. 22].
- Analyses of the effect of GSM phone equipment on semen noted an increase in the percentage of sperm cells of abnormal morphology associated with the exposure duration to radiofrequency radiation emitted by a GSM phone [Ref. 23].

There is a belief within the telecommunications industry that telecommunications riggers have more female offspring as a result of exposure to radiofrequency radiation over the years [Refs. 2 and 24]. However, there are few studies focusing on radiofrequency radiation exposure and its potential effects on sperm cells — and whether those effects may result in an increase in female offspring.

Two studies, in 2014 and 2019, interviewed two different target populations of 68 telecommunications riggers and concluded that the outcomes of these studies were comparable to the sex ratios at birth found in the general Australian population [Refs. 2 and 24]. Hence, this study aims to take a similar survey-based approach to these previous studies by comparing telecommunications riggers who have worked in the Artarmon Triangle to riggers who have never worked in the Artarmon Triangle.

Sperm Motility Relationship to Sex of Offspring

In most animals, sperm motility is crucial for the success of fertilization [Ref. 25]. Research has shown that sperm motility correlates with positive fertility outcomes [Ref. 26].

Further, in terms of sex, it has been demonstrated that men with more brothers have faster sperm and that a negative relationship exists between speed of sperm and the number of sisters a man has ($F_{1,124} = 7.14$, $P = 0.009$) [Ref. 27].

Again, there is a widespread belief within the telecommunications industry that riggers conceive more female than male offspring. This researcher speculates that more female offspring may result from sperm exposed to radiofrequency radiation, where motility may be adversely affected.

Methods

Male telecommunications riggers were randomly approached and asked the following questions:

1. If they had children and, if yes, how many and what was the sex of those children?
2. Were they working as a telecommunications rigger at a point before their biological children were conceived?
3. Had they worked on any of the three broadcast towers within Sydney's Artarmon Triangle at a point before their biological children were conceived?

A total of 68 telecommunications riggers had worked at Artarmon Triangle towers before their biological children were conceived and agreed to participate in the brief interview.

The study also found 68 telecommunications riggers who had not worked on Artarmon Triangle towers before their biological children were conceived. They also agreed to participate in the brief interview.

Discussion and Conclusions

Study 1: Ratios of Female and Male Offspring (among male telecommunications riggers who had worked on the Artarmon Triangle broadcast towers).

In this study, 68 male telecommunications riggers were interviewed over a 12-month period regarding the sex of their offspring. It was identified that a total of 80 males and 79 females were conceived at a time when they were working on any of the three Artarmon Triangle towers. These outcomes are presented in Table 1.

According to the Australian Bureau of Statistics, the male/female ratio in Australia was 98.4 males to 100 females at birth. As such, the sex ratio derived here demonstrates little variance from that of the general population [Ref. 28].

Study 2: Ratios of Female and Male Offspring (among male telecommunications riggers who had not worked on the Artarmon Triangle broadcast towers).

In this study, 68 male telecommunications riggers were interviewed over a 12-month period regarding the sex of their offspring. It was identified that a total of 76 males and 76 females were conceived at a time they were working as telecommunications riggers, but were not associated with the Artarmon Triangle towers. These outcomes are presented in Table 2.

According to the Australian Bureau of Statistics, the male/female ratio in Australia was 98.4 males to 100 females at birth. As such, the sex ratio derived demonstrates little variance to that of the general population [Ref. 28].

Potential Exposures

Telecommunications riggers are potentially exposed to silent, invisible and hazardous radiofrequency radiation from the installations on which they work. As the broadcast and telecommunications industry has evolved, so too have risk controls for this hazard, suggesting higher levels of exposure in earlier years. Current risk controls primarily focus on outages (isolating antennas from emitting radiofrequency radiation) and providing radiofrequency radiation monitors (to detect any hazardous levels of radiofrequency radiation). The literature has also described incidents where such risk controls have failed, exposing those working in the vicinity of the antennas to radiofrequency radiation [Refs. 9, 11 and 29].

Recommendations

With the hypothesis suggesting that potential occupational exposure to radiofrequency radiation may result in more female offspring, this overall study has not identified this to be valid,whether the riggers had worked on the Artarmon Triangle or not. No statistical relationship was identified ($p>0.05$) between the telecommunications riggers who have worked on any three of the Artarmon Triangle towers and those who have not.

Future sex ratio studies are recommended within the Artarmon Triangle while any of the three towers continues to emit radiofrequency radiation.

About the Author

Dr. Denis Boulais is an Australian risk management specialist with more than 20 years of industrial experience in occupational health and safety, including a number of years of safety management experience in the telecommunications industry.

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