

THE GENDER RATIO OF CHILDREN OF AUSTRALIAN VIETNAM VETERANS

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Introduction

One of the health effects that was noted at Seveso was that the children of men who were exposed to 2,3,7,8-tetrachlorodibenzo-*p*-dioxin had an excess of girls (or an deficit of boys)¹.

Several other studies have noted similar effects^{2,3}, although some studies have found an absence of this effect⁴, and one study of individuals exposed to a combination of dioxins and PCBs showed an excess of boys in the children of the exposed population⁵.

At Dioxin 2002, Ikeda *et al* reported a mouse model that showed a significant decrease in the number of male offspring of young male mice exposed to dioxin⁶. This adds weight to the view that exposure of young mammalian males reduces their ability to father boys.

Methods and Materials

We have previously described our methods and materials⁷. Briefly, we conducted a census of the surviving 49,944 then known Australian Vietnam male veterans for whom an address could be found. Of these, 40,030 veterans returned a questionnaire.

Among the questions asked was the gender and year of birth of each child fathered since the father's return from their first service in Vietnam. We analysed the gender of the offspring by Branch of Service (Army, Air Force, Navy) and by the age of the veteran when the veteran first served in Vietnam. The veterans fathered 69,646 children after returning from Vietnam. This represents 35,767 boys and 33,879 girls.

Results and Discussion

At Seveso, the excess of girls occurred among the children of men who were young at the time of exposure. We also felt that it was possible that there may have been a difference in the exposure experienced by each of the different services. We therefore decided to undertake an analysis by age when first exposed and by branch of service. The following table (see Table 1) outlines the number of boys, number of girls, sex ratio of the children of Australian Vietnam veterans, and the male rate (that is the number of male children divided by the total number of children).

We also felt that a change in sex ratio might be more obvious closer to the period of possible exposure. In Australia, for the period 1963 to 1998, the Male Rate for the whole population was 0.514. The Male Rate for Australian Vietnam veterans seems similar to this ratio. This is outlined in Table 2, 3, and 4. Thus, we analysed each service by age of service in Vietnam and by the number of years after service in Vietnam the child was born, for those veterans aged 15-19 on service.

Table 1. Gender of Children of Australia Servicemen.

Service	Age first served in Vietnam	Male births	Female births	Sex ratio	Male Rate
Army	<20	5635	5300	106.3208	0.515
Army	20-24	19107	18162	105.2032	0.513
Army	25-29	1640	1565	104.7923	0.512
Army	30 and over	696	663	104.9774	0.512
Navy	<20	3701	3457	107.0581	0.517
Navy	20-24	2325	2251	103.2874	0.508
Navy	25-29	518	488	106.1475	0.515
Navy	30 and over	161	148	108.7838	0.521
Air Force	<20	473	447	105.8166	0.514
Air Force	20-24	950	870	109.1954	0.522
Air Force	25-29	400	383	104.4386	0.511
Air Force	30 and over	161	145	111.0345	0.526

Table 2. Gender of Children of Army Veterans, by age of service in Vietnam, and duration after service, age 15-19 on service.

Age in Vietnam	Number of years after service	Male births	Female births	Sex ratio of births	Male Rate	95% Confidence Intervals
15-19	0-4 years	822	754	109.02	0.522	0.489 - 0.546
15-19	5-9 years	933	858	108.74	0.521	0.490 - 0.544
15-19	10-14 years	468	421	111.16	0.526	0.483 - 0.559
15-19	15+ years	348	313	111.18	0.526	0.476 - 0.565

Table 3. Gender of Children of Air Force Veterans, by age of service in Vietnam, and duration after service, age 15-19 on service.

Age in Vietnam	Number of years after service	Male births	Female births	Sex ratio of births	MaleRate	95% Confidence Intervals
15-19	0-4 years	47	54	87.04	0.465	0.337 - 0.563
15-19	5-9 years	84	57	147.37	0.596	0.489 - 0.677
15-19	10-14 years	42	34	123.53	0.553	0.405 - 0.664
15-19	15+ years	27	25	108.00	0.519	0.340 - 0.655

Table 4. Gender of Children of Navy Veterans, by age of service in Vietnam, and duration after service, age 15-19 on service.

Age in Vietnam	Number of years after service	Male births	Female births	Sex ratio of births	MaleRate	95% Confidence Intervals
15-19	0-4 years	586	544	107.72	0.519	0.480 - 0.548
15-19	5-9 years	976	888	109.91	0.524	0.494 - 0.546
15-19	10-14 years	670	650	103.08	0.508	0.472 - 0.535
15-19	15+ years	515	459	112.20	0.529	0.487 - 0.560

As can be seen, there is no statistically significant excess of boys or girls in any of the sub-populations. In each case, the 95% CI includes the Australian norm of 0.514. The gender ratio does vary from sub-population to sub-population, but this appears to be inconsistent, and is most likely a chance effect.

There are several possible reasons why the children of Australian Vietnam veterans would have an absence of an alteration in gender. Perhaps paternal exposure to dioxin does not alter the gender ratio of human offspring. However, the evidence from Seveso is strong, and the work by Ikeda *et al* provides an animal model that supports this finding.

Another reason is that the level of exposure for Australian Vietnam veterans is likely to have been less, and probably substantially so, than at Seveso.

An alternate reason is that these veterans were perhaps too old at the time of exposure for an effect on their developing reproductive system. While we did have veterans below the age of 20, most were only just, being 19 when they first served, and turning 20 when they were in Vietnam.

Another possible reason is that after wars there is usually (but not always) an increase in the number of male children⁸. It is not certain that this is a result of veterans fathering more boys, or if it is a community-wide phenomenon, affecting both veterans and those who did not participate in war. If it affects primarily veterans, then possibly there are two competing effects at work on this population. The first effect is a propensity for veterans to father more boys. The second is that male populations exposed to dioxins seem to father fewer boys. Perhaps these two effects cancel each other out, leaving a population of children with a normal gender ratio. There may even be a third factor operating in this population. An Australian study from 1977 suggested that environmental exposure to arsenic resulted in an increase in male children⁹. In Vietnam, there was also a vast amount of arsenic-based herbicide used, and while this was an organic arsenical, this may be a factor acting to increase the number of boys.

For whatever reason, Australian male veterans of the Vietnam War father children with a gender ratio that does not differ from the expected rate.

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