

## HEALTH RELATED WAR DIOXIN IN VIETNAM TODAY, METHODOLOGICAL APPROACH IN EVALUATION

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### Introduction

The Chemical war, that lasted for more than 10 years (1961-1971) had ended 30 years ago, but its severe outcomes on exposed human health seem to be far from ending. By the newest calculations, there should be more than 80 million of herbicides<sup>1</sup>, including no less than 500 kg of Dioxin - 2,3,7,8-TCDD have been sprayed over land of South Vietnam<sup>2</sup>.

Dioxin the most ecotoxic agent, that human knows to now, and have been researched by many scientists over the world. The studies conducted in experimental animals and partly in human tissues, have demonstrated, that dioxin cause the toxicity for many biofunctions, especially for systems like: nervous<sup>3</sup>, digestive<sup>4</sup>, immunoresponses<sup>5,6</sup>, reproductive health<sup>7</sup>, skin disorders<sup>8</sup>, and carcinogenicity<sup>9,10</sup>...

It seems to be, that Viet nam have become a “biggest laboratory” of dioxin testing and its effects studying over the world. Many research into human health have been done, but the opinions of health outcomes, related to dioxin exposure still cause the debates. A lot of studies conducted on nature and man in Viet nam also, unfortunately there is not yet the overview general, concerning the methodological as epidemiological criteria.

This report sum up the health, especially the reproductive outcomes, based strictly on the epidemiological disciplines

### Materials and Methods

Subjects of studies:

- Exposed:
- North veterans, who served in the South during wartime, after the war returned to live in the North, ended the exposure
  - Population living in sprayed areas of South Vietnam, still exposed to
- Unexposed:
- Veterans, served in wartime only in the North
  - Population of North Vietnam

Level of exposure have been regarded by the time of serving, the exposure type, and the place of serving.

Method: epidemiological cohort studies.

## DIOXIN IN VIETNAM: CHARACTERISATION, MONITORING, REMEDIATION AND EFFECTS

The data of the studies have been processed and analyzed by EPIINFO 6.04, SPSS 10.0, STATA 7.0, the results evaluated and interpreted in correspondence with the epidemiological disciplines, as follow:

- The statistical relation between Agent Orange/Dioxin Exposure and the Health Outcomes, rely on the strength of the evidence: RR/OR; CI; p value.
- Errors removing/or restricting (chance, bias, and confounding)
- Cause-effect relationship verifying, giving the overtop for Strength of Association (RD, Fe...) Temporally Correct Association, Consistency of Association, Biologic Plausibility, and Considering the other hypothesis or interpretation

### Results and Discussion

Taking into account the strength of the scientific evidence and the appropriateness of the used epidemiological methods used to detect the association. The results of the studies are confined and stable, the reunification in conclusion between scientists and researches affirm that, the impacts of Agent Orange are real and severe.

### Diseases structure

*Veterans, serving during wartime in sprayed areas of the South Vietnam, after the war returned to live in the North, ended the exposure*

There are high rates of pathologies, compared to the unexposed veterans, clearly in the rates of nervous system, skin diseases, and cancer in general, the differences are statistically significant, with  $\alpha = 1\%$  ( $p < 0.01$ ) and lower.

The outcomes have sufficient evidence of to be associated to herbicides exposure are: Neurasthenia, Prurigo Dermatitis, Chronic Hepatitis, Spondylosis, Chloracne, Male Infertility.

There is the dose-response relationship between pathology and exposed levels, from light to and heavy

# DIOXIN IN VIETNAM: CHARACTERISATION, MONITORING, REMEDIATION AND EFFECTS

**Table 1:** Relative Frequencies of Diseases by Exposure Level of Veterans<sup>1</sup>

Diseases by System	UNEXPOSED (n=5998)		EXPOSED				$\chi^2$ for trend	<i>p</i>
			LIGHT (n=5897)		MODERATE-HEAVY (n=1945)			
	Freq.	<i>Rel. Freq.</i>	Freq.	<i>Rel. Freq.</i>	Freq.	<i>Rel. Freq.</i>		
	5998	43.3	5897	42.6	1945	14.1		
Circulatory <i>OR</i>	815	13.6	756	12.8	302	15.5	1.29	0.25
	1		0.92		1.17			
Digestive <i>OR</i>	2213	36.9	2338	39.6	799	41.2	12.9	0.0003
	1		1.12		1.17			
Genitourinary <i>OR</i>	251	4.2	252	4.3	113	5.9	6.25	0.012
	1		1.02		1.41			
Skin <i>OR</i>	346	5.8	477	8.1	160	8.2	23.2	0.00001
	1		1.44		1.46			

<sup>1</sup>: Hanoi Veterans

- Circulatory diseases like: Secondary hypertension, Hypotension, Angine pectoris ...
- Digestive diseases like: Gastritis & duodenitis, Intestinal malabsorption, Chronic hepatitis...
- Genitourinary diseases like: Calculus of kidney & ureter, Endometriosis, Male infertility...
- Skin diseases like: Psoriasis, palpulosuamous disorders, disorders of pigmentation, Chloracne...

*Level of exposure assessed in scores, calculated by places, time, and kind of exposure:*

- ✓ light level: 1-14 scores
- ✓ moderate level: 15-29
- ✓ heavy level: 30 and more

## ***In population living in sprayed areas***

There also the high rates of pathology, in comparison of unexposed North population, clearly in diseases of the musculoskeletal system & connective tissue, the genitourinary system, skin diseases, the blood & endocrine system, and infectious diseases, the differences are statistically significant.

The outcomes have sufficient evidence of to be associated to herbicides exposure are: Spondylosis, Chronic Hepatitis, Chloracne, Thyroid disorders.

# DIOXIN IN VIETNAM: CHARACTERISATION, MONITORING, REMEDIATION AND EFFECTS

**Table 2:** Relative Frequencies of Diseases of Exposed population, compared to Unexposed

Diseases	UNEXPOSED (n=3832)	EXPOSED (n=4087)	RR (CI.95%)	P	AFe(%)
Sciatica	1.20	2.30	1.92 (1.35-2.72)	0.0002	47.8
Spondylosis	1.88	3.57	3.13 (1.76-5.56)	0.00004	47.4
Chloracne	0.21	0.51	2.46 (1.1-5.6)	0.02	59.4
Thyroid disorders	0.29	1.69	5.88 (3.12-11.1)	0.00001	83
Liver cancer	0.03	0.20	7.5 ( <b>0.9-3.52</b> )	0.04	

- Exposed: Cam lo - Quang tri: sprayed areas of South
- Unexposed: Cam xuyen- Ha tinh - North province

## Reproductive Health Outcomes

There is a clear relationship between exposure and the reproductive health<sup>11,12</sup>, like: Spontaneous abortion, Hydatidiform mole, Stillbirth, dead-born fetus, death under 1 year<sup>13</sup>, and birth defects delivery. *The differences are high statistically significant* in Spontaneous abortion and Birth defects, the most birth defects are: defects of nervous system like mental retardation of different levels, defects of the musculoskeletal system like deformities of hands, legs, or Spina Bifida<sup>14</sup>.... There is the dose-response relationship between Reproductive Outcomes and exposed levels also

**Table 3:** Reproductive Outcomes by Exposure Levels of Veterans<sup>1</sup>

Reproductive Outcomes	UNEXPOSED (n=5998)		EXPOSED				<i>p</i>
			LIGHT (n=5897)		MODERATE-HEAVY (n=1945)		
	Freq.	<i>Rel. Freq.</i>	Freq.	<i>Rel. Freq.</i>	Freq.	<i>Rel. Freq.</i>	
Spontaneous abortions	178	<i>0.58</i>	1087	<i>4.42</i>	554	<i>6.93</i>	<i>0.0000</i>
<i>OR</i>			<i>7.92</i>		<i>12.76</i>		
Hydatidiform moles	5	<i>0.02</i>	24	<i>0.096</i>	9	<i>0.113</i>	<i>0.00004</i>
<i>OR</i>			<i>5.99</i>		<i>6.93</i>		
Stillbirths	30	<i>0.1</i>	103	<i>0.42</i>	66	<i>0.83</i>	<i>0.0000</i>
<i>OR</i>			<i>4.3</i>		<i>8.51</i>		
Birth Defects	198	<i>0.7</i>	397	<i>1.76</i>	252	<i>3.53</i>	<i>0.0000</i>
<i>OR</i>			<i>2.54</i>		<i>5.21</i>		

<sup>1</sup>: Hanoi Veterans

- Compared to the unexposed veterans, prevalence rates of Reproductive Outcomes increase from light to moderate-heavy level, with statistical significance (OR, p-value).

# DIOXIN IN VIETNAM: CHARACTERISATION, MONITORING, REMEDIATION AND EFFECTS

The mortality of the children under one year is statistically higher, compared to unexposed area

**Table 4:** First Year Infant Mortality

<b>Reproductive</b>	UNEXPOSED (n=1138)	EXPOSED (=2196)	<b>RR</b>	<b>CI. 95<sup>2</sup></b>	<b>P</b>
Total of live births	3306	5609	1.9	1.45– 2.42	<0.001
First Year deads	80	250			
Mortality rates	2.4	4.5			

- Exposed: Can Gio and Tan Uyen villages in South Viet nam - sprayed areas
  - Unexposed: My Thanh village, South Viet nam - unsprayed area
- Among the population living in South spraying areas, especially in some “**hot-spots**”- with high dioxin residuals, like Aluoi from Thua Thien Hue province, it seems to be, that the frequencies of reproductive outcomes are still high. Prevalence rates of abortion and birth defects delivery have not yet the tendency to decrease. Frequencies of birth defects are also proportional with contamination levels inside the "hot sport".

**Table 5:** Birth Defects in relative frequencies by the Levels of Exposure and Contamination

Levels		UNEXPOSED	EXPOSED			<i>p</i>
			LIGHT	MODERATE	HEAVY	
<i>of Exposure<sup>1</sup></i>	<i>Ha bac</i>	1.1	1.9	2.2	5.1	<0.01
	<i>Tay Nguyen</i>	0.59	4.7	5.3		<0.0001
<i>of Contaminatio n<sup>2</sup></i>	<i>A luoi</i>		5.5	5.8	8.4	<0.01

- <sup>1</sup>: Veterans, served during wartime in sprayed areas, after war returned to live in the North.
- <sup>2</sup>: Population, living in spryed area, have been exposed, and now continued to be exposed to.

**Reproductive failures and birth defects appeared among the F2 generation- grandchildren of exposed veterans<sup>15</sup>.** There is a decrease in frequencies of outcomes, in F2 generation, compared to F1 generation. But strength of the evidence in F2 generation is higher, compared to F1 once.

# DIOXIN IN VIETNAM: CHARACTERISATION, MONITORING, REMEDIATION AND EFFECTS

**Table 6 :** Reproductive failures of F2 generation (Grandchildren) of Veterans<sup>1</sup>

Reproductive failures	UNEXPOSED (n=7659)	EXPOSED (n=12369)	RR	CI .95	P
Total of pregnancies	16091	28189			
Total of live births	15307	26878			
Spontaneous abortions	5	79	9.02	3.65-22.26	0.000001
Stillbirths	2	30	8.56	2.05-35.81	0.0004
Birth defects	11	78	4.04	2.15-7.59	0.0000026

<sup>1</sup>: Hanoi Veterans

## Conclusion

The epidemiological studies, well designed and conducted ( on 23,220 veterans of 14,678 exposed versus 8,541 unexposed , and 30,796 persons ( 21,994 exposed versus 8,802 unexposed)., the results of studies have been evaluated and interpreted on basis of modern statistical method, allow to conclude that in exposed populations:

- There are significant differences of pathologies, compared to the unexposed, clearly in the rates of nervous system, musculoskeletal system & connective tissue, genitourinary system, skin diseases, and cancer.
- The outcomes have sufficient evidence of to be associated to herbicides exposure are: Neurasthenia, Prurigo Dermatitis, Chronic Hepatitis, Spondylosis, Chloracne, Thyroid disorders, Male Infertility .
- There is a clear relationship between exposure and the reproductive outcomes, respectively Spontaneous abortion and Birth defects. The often defects are mental retardation of different levels, deformities of hands, legs,....
- Reproductive outcomes have been appeared among the F2 generation- grandchildren. The frequencies of the outcomes are decreased, but the strengths of the evidence is higher , compared to F1 generation.
- There is the dose-response relationship between pathologies and reproductive outcomes and exposed levels.

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