



FAMILY HISTORY PROTOCOL STUDY REPORT

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+ New Zealand Nuclear Tests Veterans Association

October 2000

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PART ONE
Family History Protocol Study Report



FAMILY HISTORY PROTOCOL STUDY REPORT

*Roff S, * Preece P, +McKenzie R, +Sefton R

*Dundee University Medical School
+ New Zealand Nuclear Tests Veterans Association
October 2000

Background

A self-reported morbidity study of 235 members of the New Zealand Nuclear Tests Veterans Association was reported in 1999 (Roff 1999) together with data on the health of their children and grandchildren. The 235 men were part of the 528-strong crews of two ships deployed to follow the mushroom clouds after the detonation of nuclear devices. To refine our understanding about which of this reported morbidity might be familial and which is more likely to have been induced by the men's participation in the Grapple series of UK nuclear weapons tests at Christmas Island in 1957 we undertook a follow up study consisting of telephone interviews of respondents. Funding was secured by Roy Sefton QSM of the NZNTVA from the New Zealand War Pensions Medical Research Trust.

Methods

The protocol for the interviews comprised 74 questions concerning the health of the proband and his immediate blood relatives. The protocol was based on models reported in Abramson et al 1996; Blatter et al 1997; Bratt et al 1997 and 1999; Curhan et al 1997; Matsui et al 1997; Mayer et al 1997; Mussio et al 1998; Page et al 1997; Romitti et al 1997; Schultz, Diepgen and Svensson 1996; Welborn, Reid and Marriott 1997; Yang et al 1998.

Data collection was managed by Ruth McKenzie RN with 2 assistants. Data entry was also managed and cross checked by this team. Interview techniques and procedures were agreed in a meeting between McKenzie and Roff in Dundee in August, 1999.

Auckland Ethics Committees permission was received in October 1999 and data were collected from December 1999 through September 2000. Members of the NZNTVA were approached by mail with an invitation to make a telephone appointment at their convenience and advised of the inventory of questions.

Data were collected on 110 veterans and 1999 relatives, an average of 18 relatives per proband (range 2-62). The average length of interview was 40-50 minutes. The data were sent to Dundee where they were analysed by Roff, a medical sociologist, and Preece, a clinician.

Results

One aim of the study was to identify those men whose cancers were more likely to have been induced by presence at the nuclear weapons tests than by familial cancer predisposition. 27 (25%) of the 109 men reported parents or siblings who had died from cancer. 14 (52%) of these men also reported themselves as suffering from cancer, of which 3 cases were skin cancer and 1 cases malignant melanoma. In all 37 (34%) men reported cancers, of which 17 were skin cancers or malignant melanomas. There were 4 cases of bowel cancer, 6 of prostate cancer and 2 cases of leukemia. There was one case of each of malignant meningioma, liver cancer, tongue cancer, stomach cancer and two cases of bladder cancer. There was one case of lung cancer, one of lung and bladder cancer and one of lung and bowel. There was one case of oesophageal cancer. Most of these cancers are considered to be presumptively radiogenic for US nuclear test veterans.

The enquiry extended beyond malignant diseases incidences. Only 2 (2%) of the men reported no morbidity. The remaining 107 reported, as well as the cancers above, a range of symptoms which are consistent with the SAPHO syndrome postulated in the 1999 report.

More than half of the families reported morbidity in the children fathered by veterans. This morbidity mirrored the skin, skeletal, arthritic, respiratory, cardiovascular and blood disorders reported in 1999 for the 324 children of the 235 veterans in the primary study. The incidence of morbidity in the offspring of the 109 veterans in this follow up study is markedly higher than that in the nieces and nephews of the probands and their wives.

As well as the co-morbidity that may be symptomatic of connective tissue diseases such as the SAPHO syndrome, one family reports a daughter born in 1960 suffering from multiconnective tissue disease and two families in the present study report children and/or grandchildren suffering from Marfan Syndrome.

In one family (Case A) two sons out of 4 children had died of cardiac arrests and been diagnosed as Marfan syndrome sufferers.

The veteran in the second family (Case B) had served at Hiroshima clearing up rubble etc. after the atomic bomb before serving on both the HMNZS *Pukaki* and HMNZS *Rotoiti* during two tours to the UK nuclear tests at Christmas Island. His first two daughters and first son were born before the father went to Christmas Island and all three suffered joint problems and mitral valve incompetence. His second son born in 1957 suffers from Marfan syndrome, ulcerative colitis and asthma. His third son born

in 1959 suffers from ulcerative colitis and cardiac dysrhythmia. His third daughter born in 1963 suffers from asthma and is suspected of suffering from Marfan syndrome. The fourth son, born in 1962, suffers from diabetes and ulcerative colitis. A fifth son was still born in 1965. The fourth daughter of this veteran was miscarried in 1964. His fifth daughter, born in 1966, suffers from ulcerative colitis and asthma.

The first daughter (born 1950) has four sons, born in 1969, 1970, 1973 and 1985, all of whom suffer from Marfan syndrome, mitral valve incompetence and ulcerative colitis as does her daughter born in 1983. The paternal grandfather of these children also served at Hiroshima after the detonation.

The second daughter (born 1952) has one son (born 1977) and one daughter (born 1975) with severe palate deformities and one daughter (born 1990) who has no reported conditions.

The first son (born 1954) has a son (born 1977) with Marfan syndrome and two other children with no reported conditions.

The first daughter (born 1950) has a grandchild born 1993 (child of her son born 1969 with Marfan syndrome) who also has Marfan.

Data were reported for 33 relatives of both the veteran and his wife with no incidence of Marfan syndrome or connective tissue disease.

According to the March of Dimes patient information literature Marfan syndrome is thought to affect about 1 in 10,000 Americans. It is a variable pattern of abnormalities that may affect the heart, blood vessels, lungs, eyes, bones and ligaments and is one of more than 100 inherited disorders of connective tissue. Affected individuals are often tall, slender and loose-jointed. Arms and legs may be unusually long in proportion to the torso. The spine may be curved (scoliosis), and the breastbone may protrude or be caved in. The face may be long and narrow, with a high roof of the mouth and crowded teeth. Heart and blood vessels are nearly always affected. Heart valves are usually oversized and floppy. Their motion during heart function may allow brief reverse blood flow which results in a heart murmur. The aorta is nearly always affected to some extent. A weak aorta gradually dilates and can split in places, sometimes resulting in death. In some 50% of persons with Marfan syndrome, the lens of the eye is displaced. Near-sightedness is another common symptom, whether the lens is in place or not. The retina may also become detached.

Recommendations

1.1 It is recommended that the New Zealand government follow the US guidelines for presumptive radiogenic cancers in developing its pension and compensation policies for nuclear test veterans.

1.2 This should be accompanied by access to regular monitoring for the surviving New Zealand nuclear test veterans for the early detection of both cancer and non-cancer morbidity such as diabetes.

1.3 A longitudinal study should be instituted to investigate the relationships between non-cancerous and pre-cancerous conditions in the surviving New Zealand veterans. This study should not only be epidemiological in nature but also access the latest radiobiological techniques for detection and evaluation.

2.1 Since approximately half the families in this follow up study report conditions for their children in the skeletal, ocular and cardiovascular systems and many of these families report conditions in two or more of the systems in the one child, it is suggested that this population should be screened for Marfan syndrome and other connective tissue disorders.

2.2 This is all the more important because it is generally agreed that early diagnosis permits management which can extend life expectancy (Child 1997; Tsipouras and Silverman 1999; Gott et al 1999; Mottes et al 2000; Iseri, Jondeau, Sidi and Kachaner 1997). Gott (1998) notes that "It is critical to make an early diagnosis of Marfan aneurysm because there is a high frequency of dissection and rupture once the aortic diameter reaches 6cm... Elective aortic-root replacement has a low operative mortality. In contrast, emergency repair, usually for acute aortic dissection, is associated with a much higher early mortality." Tsipouras and Silverman (1999) note that pregnancies of Marfan sufferers with severe cardiovascular disease should be closely monitored and delivered by caesarean section with antibiotic prophylaxis for endocarditis where indicated. Child (1997) recommends Caesarean section at 38 weeks gestation if the aortic root diameter is greater than 4.5cm.

2.3 Equally important in a population which is still conceiving families, together with the emergence of the grandchildren into their reproductive years, prenatal diagnosis should be offered (Tsipouras and Silverman 1999; Mottes et al 2000; Gott et al 1999). It is important in this connection to note that it is currently hypothesised that Marfan syndrome is associated with mutations in Chromosome 15 (Montgomery et al 1998; Liu et al 1997; Chikumi et al 2000; Ng et al 1999; Collod-Beroud G et al 1997). Gott et al (1999) comment:

"Much is still to be learned about the pathogenesis of the condition - for instance, how it is that the mutation of allele of the fibrillin-1 gene (often so small as to affect only 1 nucleotide out of 10,000 in the coding sequence in a specific patient adversely affects the extracellular matrix in diverse organs and tissues. Knowledge of the mutation in a patient can allow the identification of relative at risk for cardiovascular problems before the diagnosis could be established on the basis of clinical criteria. Similarly, molecular testing may identify a relative who does not have the mutation and is therefore at low risk for aortic problems; with this information that person can avoid the expense and inconvenience of repeated evaluation."

The same researchers also note that "Until more effective methods are developed, patients and their families should understand that cardiovascular complications of Marfan's syndrome can be managed effectively in most cases by moderate restriction of physical activity, beta-adrenergic blockade, routine imaging of the aorta, and prophylactic replacement of the aortic root before the diameter exceeds 5.5 to 6.0 cm."

- 3 Since 4 cases of spina bifida have been reported (Roff 1999) among the children and grandchildren of these 235 New Zealand nuclear test veterans it is also recommended that monitoring and pre-natal screening for neural tube defects be offered this population as a matter of urgency.

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NEW ZEALAND NUCLEAR TEST VETERANS ASSOCIATION

Ref NZC 14680
13th July 2000

Sue Rabbit Roff
Medical School
University of Dundee
DUNDEE

Jessie Gunn
Secretary of War pensions
Defence HQ
Private Bag
WELLINGTON

CHAIRMAN

Roy Sefton QSM

45 Newcastle St
Palmerston North
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Ph/Fax 06 358-4841
E-mail: roy_sefton@clear.net.nz



VICE CHAIRMAN

Tere Tahī

24 Flower St
Bulls
New Zealand
Ph/Fax 06 322-1720

Dear Sue & Jessie,

Ref:- WPMRT funded Family Health Protocol Study NZNTVA/Dundee University.

To date two batches of data, the first containing information on 50 subjects and the second 30 subjects, have been forwarded on disc, to Dundee. Presently the research team is entering the data on a further 34 subjects and that information will be forwarded to Dundee soon. That will give a total of 114 subjects.

The original intent was to publish the findings of the study at about this time but there has been some difficulty in obtaining the data and this in turn has delayed the completion of obtaining the information.

For general information and in the interests of further research, the following may be of value.

The FHPS questionnaire contains 80 questions involving the immediate families of the veteran and his wife and their blood relatives. That is a somewhat daunting task for even the most willing of subjects. The reasons that we have not been able to obtain all, or even part of the information includes.

- a. The questions overall are too personal.
- b. Information pertaining to the vet and his family is available but the subject considers the material to be too personal to ask relatives.
- c. Due to marriage break-ups ex-wives and children, or a combination of both, they have lost contact.
- d. Deaths of a veteran or his spouse has resulted in a loss of contact.
- e. Some subjects are alone and too sick to be involved.
- f. Alcohol affects the ability of the subject to obtain the information.
- g. With some Maori families in particular, the family structure is large and confused by half brothers, adoptions, etc.
Some see their relatives only at hui's and as no in-depth personal information is exchanged, they are considered in to be good health.
- h. Some just cannot be bothered at all.

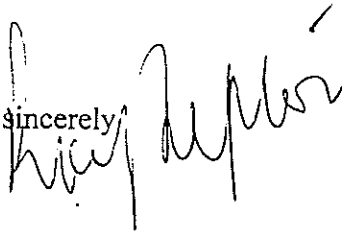
i. Families overall are just too fragmented and have no contact with each other.

The collection and processing of the data by Ruth McKenzie and her team involves a lot of work and time. More we believe, that was considered at the beginning of the study.

Unfortunately some of the most valuable information lays with some that are not willing or able to co-operate. We believe however, that after the third batch has been sent to Dundee, that a further programme of direct targeting MAY result in obtaining further useful information. With that in mind I believe it would be in our best interests not to close the study until we are satisfied that all reasonable efforts have been made to obtain worthwhile data. I would be pleased if Dundee/WPMRTF Board would therefore approve of extending the data collection time.

Best regards

Yours sincerely

A handwritten signature in black ink, appearing to read 'Roy Sefton', written over the typed name 'Roy Sefton QSM'.

Roy Sefton QSM
Chairman

14691

OFFICE OF VETERANS' AFFAIRS
 Headquarters New Zealand Defence Force
 Private Bag
 WELLINGTON

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From: Jessie Gunn Director, Office of Veterans' Affairs Secretary for War Pensions	Telephone: 04 495-2071 Facsimile: 04 495-2076
To: Roy Sefton NZNTVA	Fax No: 06 358 4841
Date: 17 July 2000	No of Pages (including cover):

WPMRT FUNDED FAMILY HEALTH PROTOCOL STUDY

In response to your fax NZC 14680 of 13 July 2000, I am pleased to advise that members of the WPMRTF have given out of session clearance for an open ended extension to the data collection time for the Family Health Protocol Study.

Regards
 Jessie Gunn

PART TWO
Ethics Committee Submission and Approval

University Of Dundee



CENTRE FOR MEDICAL EDUCATION

September 4, 1999

The Secretary
Auckland Ethics Committees
Private Bag 92522
Wellesley Street
Auckland, New Zealand

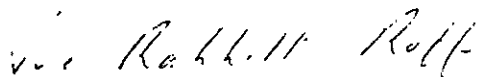
Dear Sir/Madam,

Please find enclosed the required number of copies of the National Application Form for Ethical Approval of a Research Project. As this is a national telephone survey of 200 members of the New Zealand Nuclear Tests Veterans Association, the application is being simultaneously submitted to all the local committees. The project is a social science survey and is funded by the New Zealand War Pensions Medical Research Trust Fund.

The New Zealand-based researcher is Ruth McKenzie, RN who can be reached at 09 372 7430, who will be in Scotland to discuss the research agenda in the first week of September.

The data will be analysed by myself and Mr Paul Preece MBBCH, MD(Wales) FRCS(Edinburgh) FRCS (England) and reported to the New Zealand Nuclear Tests Veterans Association and the War Pensions Medical Research Trust Fund.

Yours faithfully,



Sue Rabbitt Roff
Cookson Senior Research Fellow

Director, Professor R M Harden

NEW ZEALAND NUCLEAR TEST VETERANS ASSOCIATION

CHAIRMAN

Roy Sefton QSM

45 Newcastle St
Palmerston North
New Zealand
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VICE CHAIRMAN

Tere Tahi

24 Flower St
Bulls
New Zealand
Ph 06 322-1720

Ref NZC 11305
15th October 1999

Sue Rabbitt Roff
Medical School
University of Dundee
DUNDEE

VIA FAX

Dear Sue

Ruth received a telephone call from the Auckland Ethics Committee Secretary advising her that our application to proceed with the FHPS has been approved. I am unsure if yourself or Ruth will be advised direct by mail.

Best regards,

Roy Sefton
Chair

A handwritten signature in black ink, appearing to read 'Roy Sefton', written over a dotted line. The signature is cursive and somewhat stylized.

NATIONAL APPLICATION FORM FOR ETHICAL APPROVAL OF A RESEARCH PROJECT

PART I : BASIC INFORMATION

Protocol number and date
received (for office use only)

1. Full project title

Development of a Family History Protocol for Veterans of Nuclear Weapons Tests

2. Short project title (lay title)

Family History Protocol Study

3. Lead Principal Investigator's name and position

Sue Rabbitt Roff, Senior Research Fellow, Dundee University Medical School, Scotland

4. Address of lead Investigator

484 Perth Road	Work ph	44 01382 631958
Dundee DD2 1LR	Home ph	44 01333 312131
Scotland	Fax	44 01382 645748
UK	E-mail	s.l.roff@dundee.ac.uk

5. Lead investigator's qualifications and experience in past 5 years (relevant to proposed research)

I have a MA degree from the University of Melbourne 1972. For longer than the past five years I have been teaching social sciences and medical sociology at the University of Dundee Medical School with extensive postgraduate research supervision and internal examination responsibilities for the Masters degree in Medical Education. During this period I have developed a validated Educational Environment Measure for health professions institutions using a 100-person Delphi panel, and also conducted a self-reported morbidity and mortality survey of members of the British Nuclear Tests Veterans Association and the New Zealand Nuclear Tests Veterans Association.

6. Co-investigators' name(s) and position(s)

A	Paul Preece MBBCH, MD (Wales) FRCS (Edinburgh) FRCS (England)
B	Ruth McKenzie, RN
C	
D	

7. Address of co-investigator A

Centre for Medical Education	Work ph	44 01382 632563
Dundee University Medical School	Home ph	44 01382 668126
484 Perth Road, Dundee DD2 1LR	Fax	44 01382 645748
Scotland, UK	E-mail	p.e.preece@dundee.ac.uk

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8. Address of co-investigator B

Ruth McKenzie	Work ph	09 372 7430
4 Hauraki Road	Home ph	
Waiheke Is	Fax	
	E-mail	

9. Address of co-investigator C

	Work ph	
	Home ph	
	Fax	
	E-mail	

10. Address of co-investigator D

	Work ph	
	Home ph	
	Fax	
	E-mail	

11. Where this is supervised work

11.1 Supervisor's name	Sue Rabbitt Roff
Position	Senior Research Fellow, Dundee University Medical School
Day time phone number	44 01382 631958

11.2 Signature of supervisor (where relevant)

Declaration: I take responsibility for all ethical aspects of the project

--

12. List any other New Zealand Ethics Committees to which this project has been submitted and attach their letters of approval where available

Simultaneously submitted to all NZ Ecs
--

13. I wish the protocol to be heard in a closed meeting (If yes the reason should be given in a covering letter) Yes No

14. I request a fast track procedure Yes No

15. Proposed starting date (dd/mm/yy)	1/10/ 1999
16. Proposed finishing date (dd/mm/yy)	30/6/1999
17. Duration of project (mm/yy)	9/12
18. Proposed final report date (mm/yy)	30/6/1999

PART II : PROJECT SUMMARY

1. Multicentre proposals

(Important: read the guidelines, Appendix 1)

	Yes	No
1.1 Is this a multicentre study? (if no, go to question 2)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
1.2 Is this committee the primary ethics committee?	<input type="checkbox"/>	<input type="checkbox"/>
If no, name the primary ethics committee	Auckland	
1.3 Has the protocol been submitted to any other ethics committees in New Zealand? (If yes, attach copies of relevant correspondence)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
1.4 Who is the lead investigator or institution in New Zealand?	Ruth McKenzie, RN	
1.5 List the other New Zealand centres involved, and the Principal Investigator for each centre	This is a national study for which the Principal Investigators are Sue Rabbitt Roff and Paul Preece of Dundee University, UK	
1.6 If the study is based overseas, what other countries are involved?		

2. Scientific Assessment

Has this project been scientifically assessed by independent review? Yes No

If yes, by whom? (name and position) A copy of the report should also be attached

If no, is it intended to have the project scientifically assessed, and by whom?

The project is funded by the NZ War Pensions Medical Research Trust which assessed it positively

3. Data and Safety Monitoring Board (DSMB)

3.1 Is the trial being reviewed by a data and safety monitoring board? Yes No

If yes, who is the funder of the DSMB? Sponsor HRC

4. Summary

Give a brief summary of the study (not more than 200 words, in lay language)

Following an initial self-reported morbidity and mortality study conducted by the present researchers in which 235 of New Zealand's 528 nuclear veterans reported an apparently heavy health burden in the families of the men as well as among the men themselves, this project is intended to develop a Family History Protocol by conducting 200 telephone interviews with these families in order to understand the genetic background of the families. This work is intended to explore the hypothesis that the men's participation in the nuclear weapons tests adversely affected their own health and that of their children and grandchildren by seeking to identify possible confounding factors and outline the genetic history of the families concerned.

PART III : PROJECT DETAILS

SCIENTIFIC BASIS

1. Aims of Project

1.1 What is the hypothesis/research question(s)? (state briefly)

1 That irradiation of young men, particularly on their spines, triggers a variant of the SAPHO syndrome - synovitis, acne, pustulosis, hyperostosis and osteitic syndrome and premature ageing particular in relation to cancer

and

2 that preconceptual paternal irradiation contributes to the health burden of offspring of males who have participated in nuclear weapons tests.

1.2 What are the specific aims of the project?

To identify possible confounding factors in the attribution of health burden of men and their children/grandchildren to radiogenesis by developing a protocol to elaborate and analyse family health profiles.

2. Scientific Background of the Research

Describe the scientific basis of the project (300 words maximum) Where this space is inadequate, continue on a separate sheet of paper. *Do not* delete page breaks or renumber pages.

The preliminary study MORTALITY AND MORBIDITY OF MEMBERS OF THE BRITISH NUCLEAR TESTS VETERANS ASSOCIATION AND NEW ZEALAND NUCLEAR TESTS VETERANS ASSOCIATION AS OF DECEMBER 1997 *Medicine, Conflict and Survival* Supp July-September 1999 vol.15:3 reports the results of a self-reported paper questionnaire survey of 1041 UK and 238 NZ veterans. It indicates a heavy burden of ill health among the men and their families. The present project is intended to identify possible confounding factors that may lead to mis-attribution of the role of ionising radiation in causing ill health among these men and their families by delineating the health burdens of first degree relatives in these families. Several studies have attested to the relatively high accuracy of self-reported morbidity studies; others attest to the accuracy of reports for first degree relatives, but not for second degree relatives. A structured interview protocol will be developed based on precedents reported for similar studies; it will be piloted on a small group of NZ participants who have been recruited through their members of the NZ Nuclear Tests Veterans Association; the refined protocol will then be administered to the full 200 families. Data will be input to a correlational data base program and a descriptive report will be produced. Confirmation of reported ill health will be undertaken subsequently by the NZ government authorities if they proceed with plans to offer nuclear veterans and their families a special program of medical care. It is expected that the present project will identify families who should be considered for such a special program as well as developing a protocol for use with other nuclear veteran cohorts internationally.

3. Participants

3.1 How many participants is it intended to recruit?

200 family representatives

3.2 How will potential participants be identified?

Through the membership files of the New Zealand Nuclear Tests Veterans Association

3.3 How will participants be recruited? (e.g. advertisements, notices)

By written letters inviting them to arrange a telephone date and submitting a consent form.

3.3.1 Where will potential participants be approached? (e.g. outpatient clinic) If appropriate, describe by type (e.g. students)

By letter through a membership list by the NZNTVA researcher, a qualified nurse.

3.3.2 Who will make the initial approach to potential participants?

Mrs Ruth McKenzie, a nurse who collected the data for the preliminary study and is a senior member of the NZNTVA

3.3.3 Is there any special relationship between the participants and the researchers? e.g. doctor/patient, student/teacher

Yes - as above

3.4 Briefly describe the inclusion/ exclusion criteria and include the relevant page number(s) of the protocol or investigator's brochure

The 200 subjects have been identified from the preliminary study; all are members of the NZNTVA and voluntarily participated in the preliminary study.

3.5 If randomisation is used, explain how this will be done

NA - this project is concerned to describe the family health history of a specific membership group.

4. Study Design

4.1 Describe the study design. Where this space is inadequate, continue on a separate sheet of paper. *Do not delete page breaks or renumber pages.*

The preliminary study of 235 members of the New Zealand Nuclear Tests Veterans Association collected self-reported morbidity data and mortality information on the men and their families. The present study is designed to expand and elaborate that information by telephone interviews on a structured protocol with 200 of this sample. It is hypothesised that some families will demonstrate confounding factors which will nullify the attribution of particular health burdens to radiation exposure. Other families will report a health burden which will not be readily attributable to inherited factors. These families will then be invited to participate in confirmatory studies if they wish to avail themselves of the recent decision to develop a special medical care package for families of nuclear veterans. The present project is a social science qualitative survey in which only simple descriptive statistics will be used. The data will be reported in numerical form only and any liaison between the individual families and the Office of Veterans Affairs or other government agencies will only be undertaken with the express written permission of the families supplying the information.

Several studies have been undertaken of the validity and reliability of self-reported health status studies and of reports collected from first degree relatives. This is a widely used strategy in health status research and has been shown to have a high rate of accuracy. It has been agreed that formal confirmation of the claimed conditions is not a part of this stage of the research, but will rest on the individuals if they choose to liaise with the New Zealand government subsequent to the report of the results of this research. This is reflected in the modest budget for the present research, two thirds of which (\$20,000) will be spent in data collection in New Zealand under the Lead Investigator (Mrs. McKenzie) in a form analysable by the Principal Researchers in Dundee (Mrs. Roff and Mr. Preece).

4.2 How many visits/admissions of participants will this project involve? Give also an estimate of total time involved for participants.

This is a telephone interview survey and it is estimated that the interviews will last 30-40 minutes.

4.3 Describe any methods for obtaining information. Attach questionnaires and interview guidelines.

The interview protocol is currently being developed at the University of Dundee Medical School and will be discussed with the Lead Investigator during her visit to the UK in September.

4.4 Who will carry out the research procedures?

The Lead Investigator with research assistants.

4.5 Where will the research procedures take place?

Throughout New Zealand.

4.6 If blood, tissue or body fluid samples are to be obtained, state type, use, access to, frequency, number of samples, total volume, means of storage and labelling, length of proposed storage and method of disposal.

N/A

4.7 Will data or other information be stored for later use in a future study?

Yes No

If yes, explain how

A correlational database will be built from the data and the information will be available to e.g. the Office of Veterans Affairs if written permission is given by the subject.

4.8 Will any samples go out of New Zealand?

Yes No

If so where, and for what purpose?

5. Research Methods and Procedures

5.1 Is the method of analysis quantitative or qualitative? (If the method of analysis is qualitative, go to question 5.2)

If the method of analysis is wholly or partly quantitative, complete the following:

5.1.1 Describe the statistical method that will be used

5.1.2 Has specialist statistical advice been obtained? Yes No
If yes, from whom?

(A brief statistical report should be included if appropriate)

5.1.3 Give a justification for the number of research participants proposed, using appropriate power calculations.

5.1.4 What are the criteria for terminating the study?

5.2 If the method of analysis is **wholly or partly qualitative**, briefly describe the analysis. If interviews are to be used include the general areas around which they will be based. Copies of any questionnaires that will be used should be appended.

The interview protocol is being developed from precedents reported in the literature. It will cover inter alia family structure of proband through first degree relatives; health history of proband and first degree relatives; occupational history of proband and first degree relatives; environmental factors thought to be relevant.

6. Risks and benefits

6.1 What are the benefits to research participants of taking part?

Opportunity to locate their family health burden in the context of other veterans of nuclear weapons tests and relative to the general New Zealand population.

6.2 How do the research procedures differ from standard treatment procedures?

This research does not involve treatment but is a social science health survey.

6.3 What are the physical or psychological risks, or side effects to participants or third parties? Describe what action will be taken to minimise any such risks or side effects.

Some families experience anxiety in discussing these matters and the interviewers will be trained to offer termination of the interview if appropriate. Individuals will only be interviewed if they have accepted a written invitation to do so. Since this sample has already volunteered information on their health burden to the Lead Investigator, it is not expected that there will be a high refusal rate on these grounds.

6.4 What arrangements will be made for monitoring and detecting adverse outcomes?

As above.

6.5 Will any potential toxins, mutagens or teratogens be used? Yes x No
If yes, specify and outline the justification for their use

6.6 Will any radiation or radioactive substances be used? Yes x No

Note: If any form of radiation is being used please answer the following. If no, go to question 6.8

6.6.1 Under whose license is the radiation being used?

6.6.2 Has the National Radiation Laboratory (NRL) risk assessment been completed? Yes No

If yes, please enclose a copy of the risk assessment, and the contact name and phone number

If no, please explain why

6.7 What facilities/procedures and personnel are there for dealing with emergencies?

6.8 Will any drugs be administered for the purposes of this study? Yes x No

If yes is SCOTT approval required? Yes x No

Has SCOTT approval been given? (please attach) Yes X No

7. Expected outcomes or impacts of research

7.1 What is the potential significance of this project for improved health care for Maori and non Maori, and for the advancement of knowledge?

Since both Maori and non Maori men were involved in the nuclear weapons tests, the impacts will be the same as above. The Vice Chairman of the New Zealand Nuclear Tests Veterans Association is a Maori.

7.2 What steps will be taken to disseminate the research results?

The results will be submitted to the New Zealand Nuclear Tests Veterans Association by the Principal Researchers in Dundee. The NZNTVA will report them to their membership and the War Pensions Medical Research Trust and be responsible for their dissemination in the media if that is thought appropriate. The Principal Researchers in Dundee retain the full right to publish the results in professional journals and meetings in the usual manner.

PART IV: BUDGET AND USE OF RESOURCES

8. Budget

8.1 How will the project be funded?

\$30,000 from the New Zealand War Pensions Medical Research Trust to the New Zealand Nuclear Tests Veterans Association and Dundee University

8.2 Does the researcher, the host department or the host institution, have any financial interest in the outcome of this research? Please give details.

The data collection will be undertaken by members of the NZNTVA under the supervision of a qualified nurse who is a member of the NZNTVA and the lead researcher; Dundee University and its Principal Investigators have no financial interest in the outcome of the research.

8.3 Will the researcher personally receive payment according to the number of participants recruited, or a lump sum payment, or any other benefit to conduct the study? If so, please specify:

The lead researcher and her team will be paid a stipend to collect the data.

8.4 What other research studies is the lead investigator currently involved with?

None

9. Resource Implications

9.1 Does the study involve the use of healthcare resources? Yes No
If yes, please specify:

9.2 What effect will this use of resources have on waiting list times for patients ie., for diagnostic tests or for standard treatments?

The research will identify families who may become eligible for the special medical care announced by the NZ Office of Veterans' Affairs.

10. Financial Costs and Payments to Participants

10.1 Will there be any financial cost to the participant? Give examples including travel.

None. The cost of the telephone interview will be borne by the research project.

10.2 Will the study drug/treatment continue to be available to the participant after the study ends? Yes No X N/a
If yes, will there be a cost, and how will this be met?

10.3 Will any payments be made to participants or will they gain materially in other ways from participating in this project? Yes x No
If yes, please supply details
Except for possible eligibility as above.

11. Compensation for Harm Suffered by Participants

Is this a clinical trial under Accident Rehabilitation and Compensation Insurance Corporation Guidelines? (see form guidelines) Yes x No

If yes, please answer the following:

11.1 Is the trial being carried out principally for the benefit of a manufacturer or distributor of the drug or item in respect of which the trial is taking place? Yes No

(a) If the answer to 11.1 is yes, please complete **Statutory Declaration Form B** and answer questions 11.2, 11.3 and 11.4

(b) If the answer to 11.1 is no please complete **Statutory Declaration Form A**

11.2 What type of injury/adverse consequence resulting from participation in the trial has the manufacturer or distributor undertaken to cover? (please tick the appropriate box/es) Yes No

- a) any injury (mental or physical)
- b) only serious or disabling injuries.
- c) only physical injuries
- d) only physical injuries resulting from the trial drug or item, but not from any other aspect of the trial
- e) physical and mental injury resulting from the trial drug or item, but not from any other aspect of the trial.
- f) any other qualification (explain)

11.3 What type of compensation has the manufacturer or distributor agreed to pay? Yes No

- a) medical expenses
- b) pain and suffering
- c) loss of earnings
- d) loss of earning capacity
- e) loss of potential earnings
- f) any other financial loss or expenses
- g) funeral costs
- h) dependants' allowances

11.4 Exclusion clauses:

- a) Has the manufacturer or distributor limited or excluded liability if the injury is attributable to the negligence of someone other than the manufacturer or distributor? (such as negligence by the investigator, research staff, the hospital or institution, or the participant). Yes No
- b) Has the manufacturer or distributor limited or excluded liability if the injury resulted from a deviation from the study protocol by someone other than the manufacturer or distributor?
- c) Is company liability limited in any other way?
If yes, please specify

14. Treaty of Waitangi

- 14.1 Have you read the HRC booklet, "Guidelines for Researchers on Health Research involving Maori"? X Yes No
- 14.2 Does the proposed research project impact on Maori people in any way? X Yes No
- 14.3 Explain how the intended research process is consistent with the provisions of the Treaty of Waitangi

There are Maori members of the NZNTVA and their written consent to participate in the study will be obtained before the telephone interviews are undertaken.

- 14.4 Identify the group(s) with whom consultation has taken place, and attach evidence of their support

The Vice Chairman of the NZNTVA is a Maori, Mr Tere Tahī.

- 14.5 Describe the consultation process that has been undertaken prior to the project's development

This project relates from an extended public debate within and without the NZNTVA.

- 14.6 Describe any ongoing involvement the group consulted has in the project

The Vice Chairman is party to the decisions of the Executive Committee of NZNTVA.

14.7 Describe how information will be disseminated to participants and the group consulted at the end of the project

The results will be made available through the newsletter of the NZNTVA with individual copies available to members upon written request.

15. Other Issues

15.1 Are there any aspects of the research which might raise specific cultural issues? Yes x No
If yes, please explain

15.1.1 What ethnic or cultural group(s) does your research involve? Maori
Describe what consultation has taken place with the group prior to the project's development

As above, the study is conducted under the auspices of the NZNTVA whose Vice Chairman is Maori.

15.1.2 Identify the group(s) with whom consultation has taken place and attach evidence of their support

As above.

15.1.3 Describe any ongoing involvement the group consulted has in the project

As above.

15.1.4 Describe how you intend to disseminate information to participants and the group consulted at the end of the project

As above,through the newsletter of the NZNTVA.

16. Ethical Issues

16.1 Describe and discuss any ethical issues arising from this project, other than those already dealt with in your answers?

None

Thank you for your assistance in helping us assess your project fully

Please now complete:

- the declarations (Part V)
- a drug administration form (if applicable)
- an Accident Rehabilitation and Compensation Insurance Corporation form A or B

PART V: DECLARATIONS

1. **DECLARATION BY PRINCIPAL INVESTIGATOR**

The information supplied in this application is, to the best of my knowledge and belief, accurate. I have considered the ethical issues involved in this research and believe that I have adequately addressed them in this application. I understand that if the protocol for this research changes in any way I must inform the Ethics Committee.

NAME OF PRINCIPAL INVESTIGATOR (PLEASE PRINT):
SUE RABBITT ROFF

SIGNATURE OF PRINCIPAL INVESTIGATOR:

Sue Rabbitt Roff

DATE: *25/8/99*

2. **DECLARATION BY THE HEAD OF THE DEPARTMENT IN WHICH THE PRINCIPAL INVESTIGATOR IS LOCATED OR APPROPRIATE DEAN OR OTHER SENIOR MANAGER ****

I have read the application and it is appropriate for this research to be conducted in this department I give my consent for the application to be forwarded to the Ethics Committee.

NAME AND DESIGNATION (PLEASE PRINT):
PROFESSOR RM HARDEN, DIRECTOR CENTRE FOR MEDICAL EDUCATION, DUNDEE UNIVERSITY

SIGNATURE: *Rm Harden*

DATE: *25/8/99*

DESIGNATION: *Director CME*

** (NOTE: WHERE THE HEAD OF DEPARTMENT IS ALSO ONE OF THE INVESTIGATORS, THE HEAD OF DEPARTMENT DECLARATION MUST BE SIGNED BY THE APPROPRIATE DEAN, OR OTHER SENIOR MANAGER.

IF THE APPLICATION IS FOR A STUDENT PROJECT, THE SUPERVISOR SHOULD SIGN HERE).

3. **DECLARATION BY THE GENERAL MANAGER OF THE HEALTH SERVICE IN WHICH THE RESEARCH IS BEING UNDERTAKEN (IF APPLICABLE)**

I have reviewed the proposal for cost, resources, and administrative aspects and issues regarding patient participation and staff involvement. The proposal has my approval subject to the consent of the Ethics Committee.

NAME OF GENERAL MANAGER (PLEASE PRINT):

SIGNATURE:

OUTLINE PROTOCOL FOR FAMILY HEALTH HISTORY TELEPHONE INTERVIEW STUDY OF NZ NUCLEAR VETERANS

Subject – Nuclear Veteran

1. Name of Subject – i.e. nuclear veteran
2. Is Subject alive or deceased?
3. Year of birth of Subject
4. Year of death of Subject

Informant

5. Name of Informant
6. Relationship of Informant to Nuclear Veteran Subject
7. Address/telephone number

Health of Subject

8. What illnesses has/does the Subject suffer from?
9. What was the cause of death of the Subject if deceased?
10. How many times was the Subject married? Years

Father and children

11. How many children did the subject father before he went to the nuclear tests?
Years of birth/death/gender
12. Have any of those children been diagnosed with illnesses/susceptibilities or deformities?
13. Have any of those children died? What causes of death?
14. How many children did the subject father after he went to the nuclear tests?
Years of birth/death/gender
15. Have any of those children been diagnosed with illnesses/susceptibilities or deformities?
16. Have any of those children died? What causes of death?

Wives/mothers of children

17. What are the ages of birth/death of the wife/s of the nuclear veteran?
18. Has the wife/wives of the nuclear veteran been diagnosed with any illnesses?
19. If any wife/s are deceased, what was the cause of death?

Parents of nuclear veteran

20. Has his mother been diagnosed with any illnesses/susceptibilities or deformities?
21. Has his father been diagnosed with any illnesses/susceptibilities or deformities?
22. If his mother is deceased what was the cause of death?
23. If his father is deceased what was the cause of death?

Siblings of nuclear veteran

24. Does the nuclear veteran have any brothers?

25. What are their years of birth/death/gender?
26. Have these brothers been diagnosed with any illnesses/susceptibilities or deformities?
27. What were the causes of death of any deceased brothers?
28. Does the nuclear veteran have any sisters?
29. What are their years of birth/death?
30. Have these sisters been diagnosed with any illnesses/susceptibilities or deformities?
31. What were the causes of death of any deceased sisters?

Brothers-in-law of veteran

32. Has the wife/s of the veteran any brothers?
33. What are their years of birth/death?
34. Have these brothers been diagnosed with any illnesses/susceptibilities or deformities?
35. What were the causes of death of any deceased brothers?

Sisters-in-law of veteran

36. Has the wife/s of the veteran any sisters?
37. What are the years of their birth/death/gender?
38. Have these sisters been diagnosed with any illnesses/susceptibilities or deformities?
39. What were the causes of death of any deceased sisters?

Nephews of veteran

40. Has the veteran any nephews from his own siblings (brothers/sisters)
41. What are the years of their birth/death/gender?
42. Have any of these nephews been diagnosed with any illnesses/susceptibilities or deformities?
43. What were the causes of death of any deceased nephews?
44. Has the veteran any nephews from his wife's siblings (brothers-in-law, sisters-in-law)?
45. What are the years of their birth/death/gender?
46. Have any of these nephews been diagnosed with any illnesses/susceptibilities or deformities?
47. What were the causes of death of any deceased nephews?

Nieces of veteran

48. Has the veteran any nieces from his own siblings (brothers/sisters)
49. What are the years of their birth/death/gender?
50. Have any of these nieces been diagnosed with any illnesses/susceptibilities or deformities?
51. What were the causes of death of any deceased nieces?
52. Has the veteran any nieces from his wife's siblings (brothers-in-law, sisters-in-law)?
53. What are the years of their birth/death/gender?
54. Have any of these nieces been diagnosed with any illnesses/susceptibilities or deformities?
55. What were the causes of death of any deceased nieces?

Grandchildren of veteran

56. Has the veteran any grandchildren?
57. What are the years of their birth/death/gender?
58. Have any of these grandchildren been diagnosed with any illnesses/susceptibilities or deformities?
59. What were the causes of death of any deceased grandchildren?

Greatgrandchildren of veteran

60. Has the veteran any greatgrandchildren What are the years of their birth/death/gender?
61. Have any of these greatgrandchildren been diagnosed with any illnesses/susceptibilities or deformities?
62. What were the causes of death of any deceased greatgrandchildren?

Partners of children/parents of grandchildren

63. Are there health problems in the partner and/or his/her family of the child/children who have given the nuclear veteran grandchildren?

Partners of grandchildren/parents of greatgrandchildren

64. Are there health problems in the partner and/or his/her family of the child/children who have given the nuclear veteran greatgrandchildren?

Work and General History of Subject –Nuclear Veteran

65. What sort of work did the nuclear veteran do before the nuclear tests?
66. What sort of work did the nuclear veteran do at the nuclear tests?
67. What sort of work did the nuclear veteran do after the tests?
68. Is the nuclear veteran still working? When ceased?
69. Where has the nuclear veteran lived over the years? City/rural/exNZ
70. Has the nuclear veteran been likely to be exposed to any poisons over the years at work or in his home environment?
71. Have the veterans' family been likely to be exposed to any poisons over the years at their work or in their home environments?
72. Does/did the nuclear veteran smoke? How much?
73. Does/did the nuclear veteran drink alcohol? How much?

Based on *inter alia*

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Bratt O, Kristoffersson U, Lundgren R, And Olsson H, Familial and Hereditary Prostate Cancer in Southern Sweden A Population-based Case Control Study, *European Journal of Cancer* 1999 35:2 272-77

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Schultz F, Diepgen T, Svensson A The occurrence of atopic dermatitis in North Europe: An international questionnaire study *J Am Acas Dermatol* 1996; 34: 760-4

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Yang Q, Khoury MJ, Rodriguez C, Calle EE, Tatham LM and Flanders WD, Family History Score as a Predictor of Breast Cancer Mortality: Prospective Data from the Cancer Prevention Study II, United States, 1982-1991 *Am J Epidemiology* 1998 147;7:652-658

NEW ZEALAND NUCLEAR TEST VETERANS ASSOCIATION

CHAIRMAN
ROY SEFTON QSM
45 Newcastle Street
Palmerston North
New Zealand
Ph/Fax 06 358-4841

VICE CHAIRMAN
TERE TAHI
24 Flower Street
Bulls New Zealand
Ph. 06322-1720

Patient Information Sheet

DEVELOPMENT OF A FAMILY HISTORY FOR VETERANS OF NEW ZEALAND VETERANS OF NUCLEAR WEAPONS TESTS 99/190

Principal Investigators: Mrs Sue Rabbitt Roff MA, Dundee University Medical School, Scotland

Mr Paul Preece, MBBCH (Wales), FRCS (Edinburgh),
FRCS (England), Dundee University Medical School, Scotland

Co-Investigator: Mrs Ruth McKenzie RN, New Zealand Nuclear Tests Veterans Association

Purpose of Study

This is a follow-up to the questionnaire survey conducted by Mrs Ruth McKenzie for the New Zealand Nuclear Tests Veterans Association in 1997/8 which was analysed and reported by researchers at Dundee University in Scotland. That study aroused considerable concern about the possibility that families of men who served on the HMNZ Ships *Pukaki* and *Rotoiti* may have suffered ill health because of radiation exposure.

Procedures/Duration of Study

We are now conducting telephone interviews with representatives of 200 families from this first study to explore further the range and types of illnesses in these families. This work is funded by the New Zealand War Pensions Medical Research Trust and the results will help to inform government policy on access to medical care, pensions and possibly compensation for families and individuals who are identified as likely to have been injured. However NO personal, identifying information will be released to any person or agency outside the NZNTVA and the researchers at Dundee University without the written permission of the persons concerned.

In the first instance, a letter will be written to each of the 200 families inviting their participation in the telephone interviews at a convenient time. You will be asked to return this form signed to indicate that you have read and understood it, together with a Consent Form.

Confidentiality

Although the results of the study may be published, confidentiality of the participants will be maintained. No material which could personally identify you will be used in any reports on this study.

Statement of Approval

This study has approval from the Auckland Ethics Committee.

Copy of Results

You may request a copy of the results of the study during or after the completion of the research.

Advocacy Contacts:

You are free to discuss this study with the researchers and with :

- Health Advocate Trust (Northland to Franklin tel. 0800 205 555
- Advocacy Network Services (below Franklin to Wellington) tel 0800 423 638
- Advocacy Services South Island Trust (South Island) tel 0800 377 766 or 377 7501 within Christchurch.

Please feel free to contact the investigators if you have any questions about the study:

- the New Zealand-based researchers are led by Ruth McKenzie RN who can be reached at 4 Hauraki Road, Waiheke Island 1240 tel 93727430 or Mr Roy Sefton QSM, Chairman of the NZNTVA who can be reached at 45 Newcastle Street, Palmerston North tel 63584841;
- the Dundee University researchers are Sue Rabbitt Roff MA and Paul Preece MBBCH, MD (Wales), FRCS (Edinburgh), FRCS (England) who can be reached at UK fax no 44 1382 645748. /Tel 044 1382 631958 email: s.l.roff@dundee.ac.uk or p.e.preece @dundee.ac.uk.

**DEVELOPMENT OF A FAMILY HISTORY FOR VETERANS OF NEW
ZEALAND VETERANS OF NUCLEAR WEAPONS TESTS 99/190**

CONSENT FORM

REQUEST FOR INTERPRETER			
English	I wish to have an interpreter	Yes	No
Maori	E hiahia ana ahau ki tetahi kaiwhakamaori/kaiwhaka pakeha korero Ae	Ae	Kao
Samoan	Oute mana'o ia iai se fa'amatala upu	Ioe	Leai
Tongan	Oku ou fiema'u ha fakatonulea.	Io	Ikai
Cook Island	Ka inangaro au I tetai tangata uri reo.	Ae	Kare
Niuean	Fia manako au ke fakaago e taha tagata fakahokohoko kupu.	E	Nakai

1. I, hereby indicate that I have read and understood the Information Sheet for the **Family History Protocol Study** to be conducted by the New Zealand Nuclear Tests Veterans Association and Dundee University, Scotland with funding from the New Zealand War Pensions Medical Research Trust. I have had an opportunity to contact the researchers to discuss this study and its implications and am satisfied with the answers.

2. I understand that taking part in this study is voluntary (my choice) and that I may withdraw from the study at any time and this will in no way affect my right to apply for special services, pensions and/or compensation related to the nuclear weapons tests.

3. I understand that my participation in this study is confidential and that no material which could identify me will be used in any reports on this study or be released outside the NZNTVA/Dundee University unless I give my express written permission.

4. I have had time to consider the implications of taking part in this telephone study and am ready to agree a time for it to take place. I understand it may take 30-40 minutes and cover aspects of my immediate family's health history.

3 I know that if I have any questions about the study I should contact

- the New Zealand-based researchers led by Ruth McKenzie RN who can be reached at 4 Hauraki Road, Waiheke Island 1240 tel 93727430 or Mr Roy Sefton QSM, Chairman

of the NZNTVA who can be reached at 45 Newcastle Street, Palmerston North tel 63584841;

- the Dundee University researchers are Sue Rabbitt Roff MA and Paul Preece MBBCH, MD (Wales), FRCS (Edinburgh), FRCS (England) who can be reached at UK fax no 44 1382 645748. /Tel 044 1382 631958 email: s.l.roff@dundee.ac.uk or p.e.preece @ dundee.ac.uk or 484 Perth Road, Dundee DD2 1LR UK.

4. I wish to receive a copy of the results. I understand that it may take some time after collection of the information before the results are available. YES/NO

5. I understand that I do not have to answer all the questions and that I may stop the interview at any time.

6. I understand that this study has received ethical approval from the Auckland Ethics Committees for a national study.

I.....(full name) hereby consent to take part in this study.

Signed:..... Date:

In my opinion, consent was freely given and the subject understands what is involved in this study.

Name:.....Signature:.....

Position/Relationship.....Date:.....

I have explained the study to the subject and in my opinion they understand what is involved and consent was freely given.

Signed:..... Date:.....

IMPORTANT: Please return this form to Mrs Ruth McKenzie

**4 Hauraki Road,
Waiheke Island NZ
Tel/fax 09 372 7430**

PROTOCOL FOR FAMILY HEALTH HISTORY STUDY OF NZ NUCLEAR VETERANS

Subject – Nuclear Veteran

1. Name of Subject – i.e. nuclear veteran
2. Is Subject alive or deceased?
3. Year of birth of Subject
4. Year of death of Subject

Informant

5. Name of Informant
6. Relationship of Informant to Nuclear Veteran Subject
7. Address/telephone number

Health of Subject

8. What illnesses has/does the Subject suffer from?
9. What was the cause of death of the Subject if deceased?
10. How many times was the Subject married? Years

Father and children

11. How many children did the subject father before he went to the nuclear tests?
Years of birth/death/gender
12. Have any of those children been diagnosed with illnesses?
13. Have any of those children died? What causes of death?
14. How many children did the subject father after he went to the nuclear tests?
Years of birth/death/gender
15. Have any of those children been diagnosed with illnesses?
16. Have any of those children died? What causes of death?

Wives/mothers of children

17. What are the ages of birth/death of the wife/s of the nuclear veteran?
18. Has the wife/wives of the nuclear veteran been diagnosed with any illnesses?
19. If any wife/s are deceased, what was the cause of death?

Siblings of nuclear veteran

20. Does the nuclear veteran have any brothers?
21. What are their years of birth/death/gender?
22. Have these brothers been diagnosed with any illnesses?
23. What were the causes of death of any deceased brothers?
24. Does the nuclear veteran have any sisters?
25. What are their years of birth/death?
26. Have these sisters been diagnosed with any illnesses?
27. What were the causes of death of any deceased sisters?

Brothers-in-law of veteran

28. Has the wife/s of the veteran any brothers?
29. What are their years of birth/death?

30. Have these brothers been diagnosed with any illnesses?
31. What were the causes of death of any deceased brothers?

Sisters-in-law of veteran

32. Has the wife/s of the veteran any sisters?
33. What are the years of their birth/death/gender?
34. Have these sisters been diagnosed with any illnesses?
35. What were the causes of death of any deceased sisters?

Nephews of veteran

36. Has the veteran any nephews from his own siblings (brothers/sisters)?
37. What are the years of their birth/death/gender?
38. Have any of these nephews been diagnosed with any illnesses?
39. What were the causes of death of any deceased nephews?
40. Has the veteran any nephews from his wife's siblings (brothers-in-law, sisters-in-law)?
41. What are the years of their birth/death/gender?
42. Have any of these nephews been diagnosed with any illnesses?
43. What were the causes of death of any deceased nephews?

Nieces of veteran

44. Has the veteran any nieces from his own siblings (brothers/sisters)?
45. What are the years of their birth/death/gender?
46. Have any of these nieces been diagnosed with any illnesses?
47. What were the causes of death of any deceased nieces?
48. Has the veteran any nieces from his wife's siblings (brothers-in-law, sisters-in-law)?
49. What are the years of their birth/death/gender?
50. Have any of these nieces been diagnosed with any illnesses?
51. What were the causes of death of any deceased nieces?

Grandchildren of veteran

52. Has the veteran any grandchildren from his own siblings (brothers/sisters)?
53. What are the years of their birth/death/gender?
54. Have any of these grandchildren been diagnosed with any illnesses?
55. What were the causes of death of any deceased grandchildren?
56. Has the veteran any grandchildren from his wife's siblings (brothers-in-law, sisters-in-law)?
57. What are the years of their birth/death/gender?
58. Have any of these grandchildren been diagnosed with any illnesses?
59. What were the causes of death of any deceased grandchildren?

Greatgrandchildren of veteran

60. Has the veteran any greatgrandchildren from his own siblings (brothers/sisters)?
61. What are the years of their birth/death/gender?
62. Have any of these greatgrandchildren been diagnosed with any illnesses?
63. What were the causes of death of any deceased greatgrandchildren?
64. Has the veteran any greatgrandchildren from his wife's siblings (brothers-in-law, sisters-in-law)?

65. What are the years of their birth/death/gender?
66. Have any of these greatgrandchildren been diagnosed with any illnesses?
67. What were the causes of death of any deceased greatgrandchildren?

Partners of children/parents of grandchildren

68. Are there health problems in the partner and/or his/her family of the child/children who have given the nuclear veteran grandchildren?

Partners of grandchildren/parents of greatgrandchildren

69. Are there health problems in the partner and/or his/her family of the child/children who have given the nuclear veteran greatgrandchildren?

Work and General History of Subject –Nuclear Veteran

70. What sort of work did the nuclear veteran do before the nuclear tests?
71. What sort of work did the nuclear veteran do at the nuclear tests?
72. What sort of work did the nuclear veteran do after the tests?
73. Is the nuclear veteran still working? When ceased?
74. Where has the nuclear veteran lived over the years? City/rural/exNZ
75. Has the nuclear veteran been likely to be exposed to any poisons over the years at work or in his home environment?
76. Have the veterans' family been likely to be exposed to any poisons over the years at their work or in their home environments?
77. Does/did the nuclear veteran smoke? How much?
78. Does/did the nuclear veteran drink alcohol? How much?

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PART THREE
Application to New Zealand War Pensions
Medical Research Trust

APPLICATION TO THE NEW ZEALAND WAR PENSIONS RESEARCH TRUST FUND

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STATEMENT OF RESEARCH

BACKGROUND TO THE PROJECT

Self-reported morbidity studies have been undertaken on ten percent of the 22,000 UK men who participated in the UK nuclear weapons tests in Australia and Christmas Island and 45% of the 528 NZ men who were at the Christmas Island tests. A consistent pattern of morbidity was reported by this sample, which may be a variant of the the SAPHO - synovitis, acne, pustulosis, hyperostosis and osteitic - syndrome. The musculoskeletal, gastrological and dermatological conditions reported by the men are also apparent in their children and even their grandchildren. The incidence of spina bifida/hydrocephalus among the children and grandchildren was five times the expected UK rate for live births. There are informal reports of the same pattern of co-morbidity among the 16,000 Australian veterans of the UK nuclear tests. A small study of 30 health report forms (most prepared by military doctors) of the Fijian contingent at the tests reported similar findings.

OBJECTIVES AND DESIRED OUTCOMES OF THE RESEARCH

The present project therefore is concerned to develop a Family History Protocol and pilot it on up to 200 veterans' families in each of New Zealand, Australia and the UK. The present request is support for the New Zealand component of this study.

A Clinical Assessment Programme is now being developed at Dundee University Medical School based on the preliminary findings of the self-reported morbidity study, and the Family History Protocols will be potentially used as gateway documentation for the clinical studies and management.

The hypotheses to be explored in this research are:

- The male-mediated hypothesis of preconceptual teratogenic radiation outcomes;
- The hypothesis that the irradiation of young men, particularly on their spines, triggers a variant of the SAPHO syndrome;

- That the teratogenic hazards of paternal preconceptual irradiation include the musculoskeletal, gastrological and dermatological conditions of the SAPHO syndrome;
- and the neural tube defects, particularly Spina bifida and hydrocephalus.

RELEVANCE OF PROJECT TO THE NZ WAR PENSIONS MEDICAL RESEARCH TRUST FUND OBJECTIVES

This project is a component of the ongoing programme of research to establish the long-term effects of participation in the UK nuclear weapons tests in Australia and Christmas Island. The Ministry of Defence of the UK has acknowledged that the findings of the initial self-reported morbidity studies, especially in regard to multiple myeloma, may require a change in the Statements of Principle governing access to medical care and pensions for nuclear veterans. The New Zealand Government has initiated policy changes based on the results which presume eligibility for compensation for veterans and their children. The present project will refine both the medical understanding of the long term and multigenerational sequelae and the parameters of health care required by the veterans and their families in all the countries from which participants in the UK tests were drawn - Australia, New Zealand, Fiji and Canada as well as the UK. No pensions have been awarded in the UK to veterans of nuclear weapons tests since 1992.

RESEARCH PLAN

Phase A:

- A Family History Protocol will be developed from internationally reported instruments and reviewed by a panel of potential clinicians and geneticists in the Clinical Assessment Programme and international researchers who have conducted similar studies;
- The computer programme and database for analysis of the data will be adapted from existing models at Dundee University Medical School;
- Data collectors will be trained in the use of the instrument in New Zealand, Australia and the UK.

Phase B:

- Data collection from up to 200 families in each of New Zealand, Australia and the UK who have 'self-reported' what they consider to be radiogenic injuries stemming from the father's participation in the UK nuclear weapons tests
- Data analysis and report writing.

Sample Selection:

The families will be drawn from those who have participated in a self-reported questionnaire study initiated by a legal firm in Melbourne for the Australian sample; from the 238 member families of the New Zealand Nuclear Tests Veterans Association who have participated in an earlier self-reported morbidity study; and from the members of the British Nuclear Tests Veterans Association who have participated in the self-reported morbidity study. Participation of those families which report birth defects, particularly spina bifida and hydrocephalus, will be sought in particular.

Methods:

Trained interviewers will conduct telephone and/or face to face interviews with the families. The protocols will be databased and analysed.

Ethical Safeguards:

The UK studies to date have been conducted with the consent of the Multi Centre Ethics Committee and similar clearances will be sought in Australia and New Zealand. All participants will be drawn from membership/client lists to which they have voluntarily subscribed.

BUDGET

The present request for funding to the New Zealand War Pensions Medical Research Trust Fund is for the NZ component of the project. Separate applications have been made to Australian and UK for those components. The budget for data collection in New Zealand for 200 families is estimated at \$NZ100 per family (trained interviewer stipend/telephone/photocopy/fax etc costs) and for data analysis in Dundee at \$NZ50 per family (data inputter/analysis runs/report writing) or a total budget of \$NZ150 per family x 200 families = \$NZ30.000. It is envisaged that the research would be undertaken as a formal contract with the University of Dundee, Scotland.

Automatic data processing and statistical requirements:

These will be determined by the structure of the protocol, and will be adapted from systems which have already been used in internationally reported research.

Mr Paul Preece

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Deputy Director of Postgraduate Medical Education 1989-1998

Reader and Honorary Consultant Surgeon, University of Dundee, Department of Surgery, 1978-1998.

Lecturer and Honorary Senior Registrar, University Hospital of Wales, 1975-77.

Research Fellow, Tenovus and Medical Research Council, Welsh National School of Medicine, 1973-74.

House/Senior House Officer, Registrar, various hospitals, England and Wales, 1966-72.

Recent publications

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Research Activities

My research activity is centred on breast cancer with particular reference to familial incidence. With the increasing case throughput in 1995 and 1996. I contributed to the recruitment to the multicentre trials (which now number eight) which topped the Scottish League table. In 1995 with Professor Michael Steel, I completed a project entitled "Anthropometric Factors in Breast Disease". I also commenced a project with Dr Andrew Ritchies at St Andrews "Radiation Sensitivity in the blood of

patients with Breast Cancer and Control". To date, the preliminary results indicate increased predisposition to permanent DNA damage in white cells of breast cancer patients compared with controls.

At a joint meeting of the British Oncology Association and the British Association of Surgical Oncology, I read a paper entitled "Significant Detection of Operable Breast Cancers Results from Regular Review of Women with a Positive Family History".

Recent Grants Received

- TP Gunton for £10K towards a Specialist Genetics Associate.
- CRC for £35K looking at group peer therapy for women with advanced breast cancer.
- Chief Scientist Office "Funding for Data Manager for Scottish and Northern Irish Family History Clinic" (awarded £2K for 5 years)
- Tenovus Scotland "Molecular Epidemiology of Familial Breast Cancer in the Dundee Catchment Area " (awarded £95K over 3 years)

I have submitted the following applications for grants:

- US Army "Proposed National multicentre Trial of MRI as a Method of Screening for Breast Cancer.
- NHS R&D Programme "Evidence Gathering from Network of Cancer Family Clinics in Promoting Best Practice for Management of Early Onset Breast Cancer.
- MRC "The RCA 1 Detection in Biopsy Material from Familial Breast Cancer Patients"
- Tenovus Scotland "Migration Stimulation Factor (MSF) as a Prognostic Indicator in Breast Cancer".
- Chief Scientist "MSF: Initial Assessment of its Potential as Prognostic Indicator in Breast Cancer".
- SHERT "Differential Allele Expression as an Indicator of Metastatic Potential in Breast Cancer"
- NHS R&D Programme "NHS Implications of BrCa1 Mutations, Clinical, Laboratory and Psychosocial Consequences."
- DTH NHS Trust "Establishment of Breast Cancer Family Database in Tayside" (awarded)
- Association of International Cancer Research "Differential Allele Expression as an Indicator of Metastatic Potential in Breast Cancer".

I served on the Scottish Office Committee for Inherited Cancer Services 1994-1996. I convened Gastro Intestinal System Steering Group and Medical Ethics Theme in the Undergraduate Curriculum

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PART FOUR

Extracts from Roff SR Mortality and Morbidity of
Members of the British Nuclear Tests Veterans
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Conflict and Survival* vol 15 Suppl 1 1999

Medicine Conflict and Survival

Volume 15: Supplement 1

Mortality and Morbidity of Members of the British Nuclear Tests Veterans Association and the New Zealand Nuclear Tests Veterans Association and their Families

SUE RABBITT ROFF

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..because no disease is uniquely attributable to radiation, scientists must rely on statistical methods to detect its biological effects. By the time of the Salt Lake City hearings scientists had firm evidence that high doses of radiation caused serious forms of cancer, but even the most sophisticated statistical methods still left great uncertainty about the effects of exposure as low as those attributed to fallout from weapons tests. Statistics however, were cold and impersonal indicators of human suffering and tragedy.

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Medicine, Conflict and Survival

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Foreword

As this report was being prepared for publication, papers appeared in US and UK journals confirming what servicemen who had served in the 1991 Gulf war, and their relatives, had long been saying in the face of official denials: that they were suffering more ill-health than would have been expected from their age and previous health record. Sue Rabbitt Roff believes that the health of servicemen who attended the UK nuclear tests in the Pacific between 1956 and 1964 was affected by their presence at the tests, which up to now has been officially denied. She calls for a full enquiry into the health of the survivors as a matter of urgency: up to a third of the attenders at the tests may already be dead, so that vital evidence is already lost.

It is already established that several cancers are more frequent in the survivors of the Hiroshima and Nagasaki A-bombings. Roff's findings, if confirmed, remind us that mortality and morbidity from nuclear explosions are not confined to a few kilometres from ground zero or a few months after the detonation. They appear as negotiations to eliminate nuclear weapons, to which the nuclear weapon states are committed under Article VI of the Non-Proliferation Treaty, are at a standstill. The acquisition of nuclear weapons by India and Pakistan are a warning that unless progress towards elimination continues, the non-proliferation process will break-up, making it more likely that nuclear weapons will be used again sometime somewhere. The aftermath of a nuclear exchange between India and Pakistan could dwarf the experiences described here. Over and above its formal recommendations, this report adds to the calls for the global elimination of nuclear weapons as a priority for the new millennium.

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(April 1999)

Abstract

More than 20,000 British servicemen – most of them on their National Service, few of them volunteering for the tests, and most in their early twenties, some still boy soldiers in their teens – were required to 'participate' in the United Kingdom nuclear tests in Australia and Christmas Island in the 1950s and 1960s. 528 members of the New Zealand Navy were also present for one series of tests. There was also a Fijian Army contingent, which has been variously numbered between 100 and 500 men. An estimated 16,000 Australian servicemen and civilians were also involved in the tests at Maralinga and other sites.

The men performed a wide range of duties, from highly technical preparations for the detonations to catering and clerical jobs. But whatever their role, they were all required to witness the detonations as part of their 'indoctrination' for the possibility of nuclear war. Most of them were required to line up on the beach, with their backs to the detonations and their hands over their eyes for the first minute or so. They were then allowed to turn around and look at the awesome sight as the mushroom cloud plumed thousands of feet into the air. Very few wore more than shorts and sandals during their time at the tests; only those who were thought to be at risk from radiation injury were issued with protective clothing and radiation dose badges. The UK government was sure that the troops, most of whom were standing within 20 km of the detonations and some of whom were present for 25 nuclear bomb blasts in as many weeks on Christmas Island, were not irradiated. The Ministry of Defence still routinely issues a document to nuclear veterans who feel that their illnesses were caused by the radiation they encountered when they were young men which states:

The background [radiation] dose received by civilians and members of HM Forces serving at or off Christmas Island in the years 1956 to 1964 was only about 35% of that which they would have received on average had they remained, for that period of their lives, in the United Kingdom – that is, some 100 microsieverts per calendar month less at Christmas Island than in the United Kingdom.

This sanguine view of the health burden borne by nuclear veterans and their families is not borne out by the data reported in this study of the health outcomes of the 2500 men (2200 UK, 238 New Zealand and 62 Fijian) on whom data is available to the present researcher.

Thirty per cent of the men in this sample have already died, mostly in their fifties. Two-thirds of them died from cancers that are pensionable in the United States as presumptively radiogenic among nuclear veterans. About one in seven of the men in the sample of 1014 who responded to the questionnaire circulated in late 1997 did not father any children after they returned from the weapons tests. Among the nearly 5000 children and grandchildren of this group of more than a thousand veterans, there are 26 cases of spina bifida alone – more than five times the usual rate for live births in the UK.

Nearly half the health problems among the offspring of the nuclear weapons tests veterans reported in this study consist of the same dermatological, musculoskeletal and gastrointestinal conditions from which many of the men have also suffered. Among the 2261 children of 1041 veterans, more than 200 skeletal abnormalities were reported, including more than 30 cases of short stature and 18 spinal problems, mostly curvature and scoliosis. More than 100 skin conditions were reported, mostly eczema and dermatitis, in many cases described as congenital. Over 50 of the children are already suffering from arthritis and similar conditions, although they are only now entering their thirties. Hip deformities were reported for 19 children and kneecap deformities for 14. More than a hundred of the veterans' children reported reproductive difficulties; 24 women reported problems with their ovaries. This pattern of morbidity was repeated in the grandchildren, though there seems to some diminution of the effect.

A similar pattern is evident in the health of the men, their children and grandchildren of the 235 New Zealand veterans on whom data were collected separately. The data on the 62 Fijians is not reported here. It is currently submitted as evidence to the European Court of Human Rights.

Any bias in the respondents from the UK nuclear veterans organisation for which data are reported here is in fact towards amore youthful, healthier group than the full cohort, on whom

standardised mortality studies were undertaken up to December 1990 by the National Radiological Protection Board. The data in this study points to an accelerated rate of death for the UK nuclear veterans at precisely the moment the NRPB studies terminated, and the UK Ministry of Defence acknowledged in late 1998 that the finding in relation to multiple myeloma alone compels a re-analysis and updating of the NRPB studies. But radiobiological tests are now available which can detect evidence of past radiation exposure. It is a major recommendation of this study that research henceforth proceed beyond the epidemiological to the clinical and pathological levels. Then at least medical science can learn from this forty-year-old tragedy with its cast of thousands.

PART FOUR

Mortality and Morbidity in Crews of Two Royal New Zealand Naval Frigates Present for Grapple Tests off Christmas Island 1957-58

Background

Mortality and morbidity studies of particular crews who were in service at US nuclear weapons tests are about to be undertaken for the Operation Crossroads series in response to anxieties raised by surviving crewmembers. This present study reports data from a sample of the 528 men who were in service with the New Zealand Navy, stationed on the frigates HMNZ *Pukaki* and HMNZ *Rotoiti* as weather ships in the vicinity of the 1957-58 Grapple series of UK nuclear weapons tests off Christmas Island. More information about New Zealanders' experience of these tests is given in Part 5.

Methods

Ruth McKenzie, a registered nurse and member of the NZNTVA, distributed a questionnaire in 1997 to three hundred and eighty servicemen or their families who are members of the New Zealand Nuclear Tests Veterans Association. The raw data was provided on disc to the present researcher who is responsible for the coding and the interpretations placed on the results. Roy Sefton, Chairman of the New Zealand Nuclear Tests Veterans Association, was responsible for negotiating the inclusion of the New Zealand data into the present study. Neither of them, however, bears any responsibility for the interpretations placed upon the data by the researcher.

Results

Mortality

Responses were received from 235 (62% of the 380 questionnaires; 45% of the 528 servicemen) of whom 97 were from families of deceased veterans (41% of the 235 responses). The NZNTVA have information that a further 48 men are deceased, or 145 (27%) of the 528 servicemen. The responses provided information on causes of death for 73 men, of which 57 were from cancer (78% of deaths for which data is available). In addition to the 57 cancer deaths, the 235 NZNTVA responses reported 10 cardiovascular deaths, 2 deaths from diabetes, and 4 deaths from strokes, a total of 73 deaths or 31% of the sample of 235 men.

Cancer deaths

Of the fatal cancers, eight were of the lung, five leukaemias, three lymphoma and two multiple myelomas. Fifteen were unspecified. A complete list of the cancers, together with a comparison with two previous surveys of NZ nuclear test veterans, can be obtained from the author.

Other illnesses

The 235 men reported a total of 299 conditions, including 47 cardiovascular, 22 respiratory, and 17 gastrointestinal. There were 49 skin, 20 arthritic and 16 other skeletal disorders. Ten reported bilateral cataracts and 18 infertility. A complete list is available from the author.

Conceptions

There were 443 conceptions reported for the 235 men. Of these, 99 (22%) were miscarriages and 16 (3.6%) stillborn; 2 fetuses were aborted. Of these 117 prenatal and stillborn deaths, a large number were reported as severely deformed. Thus 26.4 % of the conceptions did not result in live births. Eight families accounted for 48 of the miscarriages with 4-9 per family. Of the 324 live born children, 2 were so severely deformed that they died perinatally and a further 25 children died in early childhood. For the grandchildren, 230 conceptions were reported in this sample, 28 resulted in miscarriages (12.1%) of which half were experienced by 3 families; 2 fetuses were aborted, one for anencephaly and the other for gross deformity; there were 2 perinatal deaths and 198 live births

Children and grandchildren

Respondents to the survey reported 231 conditions in 324 children, and 66 in 198 grandchildren (full list from author). In the children, there were 33 skin, 29 respiratory, 20 cardiovascular (including congenital heart disease), 14 blood, 20 arthritic and 24 other skeletal disorders. There were two cases of spina bifida. Nine reported infertility. There was one case of leukaemia and four of melanoma.

In the grandchildren, there were 22 respiratory conditions, 13 skeletal disorders and one other case of arthritis, and two cases of spina bifida.

Discussion

The cancer mortality reported by this sample of 235 men, which is only 44.5% of the full cohort of 528 men, shows an acceleration in the 1990s comparable to that reported in the Death Certificate Study of members of the British Nuclear Tests Veterans Association (Part One above). In the full cohort, an incidence of 33 cancer cases with 26 deaths were reported up to 1987,⁷⁵ with an incidence of 49 cases and 36 deaths by 1996.⁷⁶

These studies surveyed the 528 men known to have participated in the tests and a group of 1504 men who were in the Royal New Zealand Navy during the same period but did not participate in the tests. It is however, possible that these controls, or some of them, may have served at a later time aboard the Royal New Zealand Navy ships that were present at several of the Grapple tests of 1957-8 so could have been subject to residual or induced radiation. Despite making no correction for the Healthy Soldier bias, they reported a relative risk of death from cancer of 1.38 and of the incidence of cancer 1.12 for the test participants. The risk was particularly elevated for the hematological cancers: a 3.25 risk of mortality and 1.94 risk of incidence, with the risk for leukaemia reaching 5.58. The authors noted that three of the leukaemias in the test participants as well as both leukaemias in the controls occurred more than 25 years after the tests, and only one occurred less than 15 years after the tests. The latency period for leukaemia has been regarded as up to 25 years, although it is noted that longer latency periods have been observed in Hiroshima survivors aged 35 years or less at the time of exposure.

The later study⁷⁶ showed that the test participants had nearly four times the risk of developing haematological cancers as the controls by the end of 1992, and their risk of dying from leukaemia or non-Hodgkins lymphoma was nearly 6 times that of the controls. It states

From this further follow-up to the end of 1992, we concluded that the evidence is still consistent that some haematological cancers (including some leukaemias and some non-Hodgkin's lymphoma) may have been caused by participation in the nuclear weapons tests programme. However, this further follow-up strengthens the evidence that there is no

increased risk for non-haematological cancers or for causes of death other than cancer in the test participants.

There is still no correction for the healthy soldier bias.

The SAPHO-type syndrome accounts for at least 40% of morbidity in all three generations in this New Zealand sample. The incidence of neural defects is far higher than in the study of New Zealand chemical applicators, ⁶⁹ which reported congenital defects and miscarriages among the offspring of 989 New Zealand 2,4,5-T sprayers, including two cases of spina bifida in 2294 births. The overall birth defect rates were 20 per 1000 among the chemical applicators and 16 per 1000 among the agricultural contractors, 'close to those reported in three previous New Zealand studies.' The miscarriage rates for their New Zealand sample were similar for the two groups, with a rate of 86 miscarriages per 1000 births for the chemical applicators and 93 per 1000 births for the agricultural contractors. There were 3 stillbirths reported, or 7 per 1000 live-births, which was lower than the NZ rate for 1969-1978 of 8.9 per 1000.

Ruth McKenzie, the nurse who collected the present data, comments:

An interesting link has been noted between the condition of the father and those problems experienced by his offspring. A father has cancer and his child may have cancer too. A father who has a skin condition may well have a heavily birth-marked child or one who has rashes of moles over a whole limb or part of the body, or who in one case presents with an unusual follicular condition. A father who has an unusual painful joint condition may have a child suffering exactly the same conditions: 'Just like your father's' says the perplexed doctor. A father who has severe premature ageing (noted in a Russian paper to be a secondary immune dysfunction) may have a child with an immune dysfunction. A father with a lung problem can have every descendant suffer with a baffling lung conditions 'asthma just like whooping cough but not whooping cough' which confounds the experts.

PART FIVE

General Discussion

The National Radiological Protection Board Survey²

Sample construction

The NRPB report claims to have identified 85% of the men who were sent to the UK nuclear weapons tests through data linkage of various sources. These included government records and those of ex-servicemen's organisations such as the Royal British Legion and the British Nuclear Tests Veterans Association. The present research, using the BNTVA records constituting 10% of the NRPB survey, acts as a cross-check on the NRPB study.

According to the NRPB:

For the study to be definitive, either all the participants needed to be included or the authors needed to be able to show that those who were included were fully representative of all those who had participated. At the time of the test programme, no comprehensive list of participants was compiled, and this made it unlikely that after so many years the authors could be certain to identify every person eligible for the study. Therefore, names and identifying details of participants were sought from many sources other than MOD. People identified in this way include individuals who notified themselves as test participants, or who were notified by a third party. The identification may have been made by contacting a government department or some other public body (for example, NRPB, the BBC or the University of Birmingham) or through one of the organisations of test veterans who have assisted NRPB.

Assumptions about exposure

The NRPB researchers had access to exposure records for some men but they were a small minority of those who were present at the tests. There are many anecdotal reports of the dosimetry badges that were issued not being properly collected or recorded. These badges in any case only monitored small areas of the body; they were not capable of recording alpha, internal or committed doses. Caution should therefore be exercised in deducing health hazards from such scanty reconstructed dosimetry; it is more important to look at the outcome endpoints of potentially radiogenic illness in the men and then consider the role of long term chronic exposure to residual, induced and resuspended radionuclides.

On p.4 of the NRPB report, it is stated that 'Men were not included if they had been involved only with peripheral activities associated with the test programme, such as weather forecasting or the handling of non-radioactive stores and supplies, at other locations' [that is, excluding RAAF Pearce in Western Australia and RAAF Edinburgh Field in South Australia].

Later, subgroups regarded as at some risk of radiation exposure are listed (pp. 8-9):

At the start of the study NRPB was informed by MOD that only a small proportion of test participants were likely to have been exposed to radiation as a consequence of their test participation. The relevant groups of personnel were:

- (i) the members of the crew of HMS *Diana* which sailed through the fallout plumes in Operation Mosaic
 - (ii) the members of the Buffalo Indoctrinee Force, a group of volunteer officers assembled to observe at first-hand the effects of a nuclear explosion;
 - (iii) RAF aircrews involved in radioactive sampling from the clouds of the explosions;
 - (iv) the RAF active handling flight, who decontaminated aircraft used in cloud sampling;
- and
- (v) individuals not in groups (i)-(iv) but who had recorded radiation doses greater than zero.

This resulted in the identification of 22,347 'test participants' who formed the sample for the NRPB studies. 'Of 22,347 test participants included in the study, only 1804 (8%) are believed by the MOD to have been liable to exposure to radiation. The proportion was much higher for AWRE personnel, 409 (50%) of whom were included in a special group (p. 9).

The NRPB report² (p.76) concludes that:

There was no increase in risk with measured external dose and no special accumulation of cases in men identified by MOD as liable to be exposed to radiation, in men employed by AWRE or involved with the minor trials at Maralinga, or in men present at one or other of the tests, or specifically at the tests at Christmas and Malden Islands, who include any men known to have been exposed to neutrons or thought by MOD to be the ones likely to have ingested or inhaled any radionuclides that would have escaped measurement on the dosimeters. Indeed, the greatest (or equal greatest) RR, the most highly

significant difference from the controls, and the highest SMRs for both leukaemia and multiple myeloma were all found in the group of 'other test participants' after excluding the small number who, on any assumption, were unlikely to have been exposed to more radiation than the general public. These 'other' men had been involved in the test programme in a variety of ways: just under 60% of them had visited Christmas Island, but not during one of the operations listed in Table 3.1, and just over 30% had visited Maralinga, but were not known to have been involved in the programme of minor trials or to have been present during one of the major tests. Most of the remaining visits had been to the Monte Bello Islands either before or after tests in the Mosaic series. According to MOD, the experience of men in this group... is, on all counts, likely to be less than for groups A and B in the same table. A comparison of the 11 men who developed leukaemia (other than chronic lymphatic leukaemia) or multiple myeloma with unaffected participants in the same group, failed, however, to highlight any characteristics that distinguished them.

Reservations about Completeness of Cohort

The authors of this cohort study⁷⁷ of mortality in test veterans, using the UK National Health Service (NHS) Central Register, discuss the completeness of follow-up. The details of men for whom follow up was achieved but unsatisfactory using the NHS Central Registers were submitted to the Department of Social Security (DSS) for further tracing. Information on men born before 1916 and reported by the NHS Central Registers as currently registered with a general practitioner, and a 1% sample of remaining men born in or after 1916, were also submitted. The additional follow up increased the number of deaths fully identified in the cohort by 6.5%. Mortality among those untraced on the NHS Central Registers was substantially greater than in the cohort as a whole (10.2% compared with 6.9%). Among those reported by the NHS Central Registers as not currently registered with a general practitioner, 2.7% were found to have died, as were 1.1% of men born before 1916 and currently reported to be registered with a general practitioner. There was clear evidence that information about emigrations supplied by both the NHS Central Registers and DSS is far from complete. The authors concluded that standardised mortality ratios based on follow up via the NHS Central Registers alone are likely to be somewhat low, and this should be borne in mind when interpreting the data.

The report itself notes (p 72) that there were particular problems with locating the records of precisely those individuals who made claims for ill health arising out of their participation in the nuclear weapons programme.

Reservations about Standardised Mortality Ratio methodology

In evaluating radiation hazards, analytic studies have utilised either the cohort type of investigation (where persons exposed and not exposed to radiation are followed forward in time for outcome in respect of disease), or the case-control approach (persons with and without a specific disease are evaluated for previous exposure to radiation).⁷⁸ Most radiation studies have evaluated cohorts (such as radiologists), although important case-control studies have been conducted (for example, childhood leukaemia as related to prenatal X ray). At its best, according to one senior US researcher, epidemiology is capable of evaluating relative risks (RR) on the order of 1.4 (i.e., a 40% relative excess). However, the RRs of interest following low doses of radiation (0.01gray) are on the order of 1.02-1.002. Thus, not much should be anticipated from direct observations at this level, and indirect approaches must be taken to estimate low-dose effects. Such indirect approaches include the study of:

- populations exposed to a range of doses, both low and high, where interpolation models can be reasonably applied to estimate low-dose effects; and
- populations exposed to fractionated doses over a long period of time where the resulting dose-effect relationship theoretically should be linear and the estimation of low-level health effects facilitated.

Proportionality mortality analyses are traditionally considered to be unreliable because they lack information on persons at risk.⁷⁹ Standardised mortality ratios based on follow-up through the United Kingdom National Health Service central registers alone are likely to be somewhat low,² and this should be borne in mind when interpreting the data. No reduction in proportionate mortality from cancer among members of the Vegetarian Society was found, even when allowing for the possibility that individuals joined that society because of ill health, and those with cancer might be especially likely to do so.¹ As the authors point out:

The proportionate method of analysis has obvious limitations, for since the proportions must add up to unity, any 'real' deficiency of a major cause of death will tend to inflate the values for other diseases, and vice versa. If vegetarians differed from the general population in having, say, an appreciably reduced mortality from one disease (or one group of diseases), then this should be detectable by the

present method. However, if vegetarians experience an altered mortality from several major diseases [for example the radiogenic cancers], this would probably not be evident using this method.

Correction for 'healthy soldier' effect

The NRPB report² acknowledged the strength of the 'healthy soldier' effect (p.74):

Another reason for the low mortality rates observed in the study is that all ranks who served in the tropics and sub-tropics were selected for physical fitness. This might have had an effect throughout the study, but it would certainly have had a substantial effect on the mortality from neoplasms and from all non-violent causes of death in the early years. It provides an explanation for the fact that the SMRs for neoplasms rose (for participants and controls combined) from 65 in the first 5 years after the start of the observation, through 72 from 5-15 years after the start, to 86 for subsequent years and for all non-violent causes of death from 55 through 65 to 76.

But the conclusions precisely do not correct for this potential bias:

The difference between the two groups in the mortality from leukaemia and multiple myeloma (22 deaths from leukaemia and 6 from multiple myeloma in participants, against 6 from leukaemia and 0 from multiple myeloma in controls) was largely due to extraordinarily low rates from these diseases in the controls (SMRs, respectively, of 32 and 0), while the mortality in the participants was only slightly greater than expected from national rates (SMRs, respectively, of 113 and 111) and much of these differences seems likely to have been due to chance... It is concluded that small hazards of leukaemia and multiple myeloma may well have been associated with participation in the nuclear weapons programme, but that such participation has not otherwise had a detectable effect on the participants' expectation of life or on their total risk of developing cancer. [Abstract]

The four disease categories of Hodgkin's disease, non-Hodgkin's lymphoma, multiple myeloma, and leukaemia... together constitute the broad group of 'cancers of lymphatic and haematopoietic tissue.' Altogether there were 51 deaths from this group of cancers in the test participants and 28 in the controls, and the relative risk was estimated to be 1.65, which is significantly increased ($p=0.02$; 90% confidence interval 1.08 to 2.51). The difference was not, however, due to a high mortality in the test participants in whom the number of deaths was equal to that expected from national rates (SMR100)

but to a low mortality in the controls in whom the number was only just over half that expected (SMR 56, $p > 0.001$). [p 48]

In effect, instead of correcting for the 'healthy soldier' effect (which has been shown to be capable of halving the relative risks for some occupational groups) the interpretation of the findings of NRPB-R214 rests, in effect, on dividing the hazard by the healthy soldier effect rather than multiplying it. This was compounded by the initial comparison of two veterans groups in the construction of the sample and the control, then calculating the SMRs against the general population to reach the Relative Risks. It should be noted that even so, the RRs for leukaemia and multiple myeloma were markedly heightened for the sample group. At the same time, in another study,⁸⁰ an increased mortality in the younger age groups from multiple myeloma during the period 1950-79 was reported.

New Zealanders' Experience of UK Tests

An account⁷⁵ of the Grapple test notes that HMNZS *Pukaki* and HMNZS *Rotoiti*, the New Zealand ships present, 'were stationed at varying distances of 20 to 150 miles from ground zero throughout the series of tests' and 'visited Christmas island after the tests, and it has been hypothesised that rainout into the lagoon and concentration in the food chain could have occurred.... Thus although currently available data indicate that the RNZN personnel in Operation Grapple probably received very low doses of gamma radiation, the possibility cannot be excluded that there could have been significant external exposure to neutron radiation or internal exposure due to inhalation or ingestion.' It is further commented that 'The strongest reason for concluding that the leukaemia findings may reflect a causal relation is that a similar excess risk was found in the previously published study of British participants in the same nuclear weapons testing programme.'

Techniques for data collection

Information for the later survey⁷⁶ was obtained from electoral rolls, driver's licence or car registration, and hospital discharges as well as mortality records and the Cancer Registry, and supplemented by a postal questionnaire. Identification of subjects in the earlier report⁷⁵ had utilised the resources of the Ministry of Defence, the Returned Services Association, and the general practitioner who had first raised the need for the study. This was supplemented by press advertisement and led to identification of 536 test participants. It is not

clear how many subjects responded to the postal questionnaire. The authors do not seem to consider that the publicity surrounding the construction of the sample confounded the results or attracted a selective sample.

Exposure reconstruction

HMNZS *Pukaki* and HMNZS *Rotoiti* were under the command at the UK Royal Navy at the 'Grapple' hydrogen bomb tests at Malden and Christmas Island in 1957 and 1958. They served as weather ships, with as secondary tasks Air Sea Rescue, anti-submarine watch, thermal flash measuring and water sampling. Roy Sefton, Chairman of the NZNTVA, testified in September 1997:

The Test procedures aboard RNZN frigates were basically the same as those aboard the UK Royal Navy ships. At each test explosion only an absolute minimum of men (6) were left internally to run the ship. *As many men as possible were required to be on deck to observe the explosions during the 'line up' procedures. Initially the procedure was quite rigid with men being appointed 'Blast Stations' on the side of the ship facing detonation.*

Protective clothing was worn at Grapple 1 and 2. No protective clothing was worn at Grapple 3. Only goggles were worn at Grapple X. At Grapple Y no protective clothing, but crew were instructed to face away from the blast. At Grapple Z1 *Pukaki* was 28 nautical miles from ground zero, no protective clothing was worn. At Grapple Z2 Conventional Anti Flash gear was worn (35 Naut miles from ground Zero). At Z3 Conventional Anti flash gear was worn (35 Naut miles from Ground Zero) At Z4 20 nautical miles from Ground Zero there is no record of protective clothing being worn.

Both *Pukaki* and *Rotoiti* were to alternate as 'close in observer ship'. The distances from ground zero ranged from 150 to 20 nautical miles..... On the 28th of April 1958 when Grapple 'Y' was exploded, ships' company wore NO protective clothing, the only precaution taken was to face away from the blast with eyes closed until 15 seconds after detonation. It is officially reported and remembered by crewmen, that the resulting bomb cloud had spread and drifted across the whole sky and was clearly distinguishable OVERHEAD at sunset.

Pukaki's captain, Lt CDR Elliot, is recorded to have remarked 'I hope it does not rain.' Elliot was clearly aware of the dangers posed by rain out. At 910 hour during her return to Christmas Island,

Pukaki sailed through Ground Zero. No protective clothing was worn. Sea water monitored from the boiler room inlets detected levels of radiation. Lt Cdr Elliot described later in an Auckland newspaper that *Pukaki* had sailed under the detonation cloud for 23 hours before returning to Christmas Island and sailing through Ground Zero en route.

Because of a lack of fresh water on board both frigates, rain squalls on the horizon were often chased so that crewmen could shower in them and wash clothes. There is no record or recollection of such water being tested for radiation. This rainwater may have been purposely drunk, or accidentally ingested during showering. Seawater was distilled for domestic purposes, including drinking and cooking aboard the frigates. As such there was an obvious risk of irradiation through ingestion if this water was contaminated.

Generally after each test the frigates would return to Christmas Island. Every effort was made to afford leave to crewmen to go ashore. The general activities were recreational, swimming catching and eating fish, competitive sport, socialising etc. There was also a fish and chip shop ashore. This shop was popular with our seamen. The fish were caught locally. Exploring the island, which had no restricted areas or warning signs of no entry or no fishing, was popular also.

Grant Howard⁸¹ quotes Commander Hale of the *Pukaki* describing the events of 15 May 1957:

I then opened my eyes, stood up and faced the burst. And then I removed my goggles. The fireball was just starting to grow in size, easily visible and well above the horizon. At plus two to three minutes the blast wave brought double pressure on the eardrums, and it was followed closely by the double rumble of the explosion.

For the first two or three minutes, the fire ball grew in size, shaped like a turbulent cauliflower and changing from an angry, deep red streaked with grey, to a larger smouldering ball of cloud with a glowing centre. Evidence of the intense heat remained visible for seven to eight minutes. Between the second and third minutes a terrific updraft of air and cloud soon became apparent by what seemed to be a strikingly white water spout being sucked up into the centre of the fireball. This rising mass increased in volume until the more familiar but equally fantastic shape of the mushroom was evident to everyone.

The mushroom did not stay for long. After six or seven minutes the upper atmosphere winds began to blow the top of the cloud flat. Then the stalk fell away and was lost to sight. Between the eleventh and twelfth minutes a speck of blue sky was seen in the midst of the nuclear cloud. Finally, the deadly cloud formed a huge smoke ring, which hung in the sky until about four o'clock in the afternoon, when it slowly dispersed.... More bomb tests followed. The second was larger than the first but the weather not as good for observation.

Nothing was seen on board the *Pukaki* until about 11 minutes after the blast, and Commander Hale recorded that there was 'little character' to the mushroom cloud that followed. Conditions for watching this (third) bomb test were better than for the second, although on this occasion the *Pukaki* was 150 nautical miles east of the bomb zone. The flash of the exploding H-bomb was seen to cover the horizon 'like red-tinted sheet lightning', and approximately three minutes later the mushroom was seen towering above the other clouds. 'On leaving the bridge twenty or more minutes later, I clearly felt the pressure wave on my ears in my cabin,' Commander Hale noted. 'It was followed by the noise of the explosion.'

Another veteran remembered:

Grapple Y, 28th April 1958 the Bomb in question went wrong. A megaton explosion, about 18 of them as far as I can make out, was supposed to be air burst. The RAF pilot of a Lysander assigned to duty that day pointed out the lower two to three hundred feet of the fireball was missing. Instead of detonating at 8000 feet she had gone off at about 1200, sucking sand water and general radioactive debris into the cloud core and throwing it into the atmosphere. On Christmas Island rain clouds gathered and a heavy downpour began. At sea the RNZN frigate *Pukaki* continued with the day's drill and scaled down its crew's ABCD status.

In December 1997, the NZ War Pensions Agency accepted the opinion of Dr John C Probert, Associate Professor of Radiation Oncology at Auckland University, that the malignant meningioma presenting 26 years after a *Pukaki* veteran's presence at the Grapple tests and causing his death in 1995, was probably induced by exposure to ionising radiation at that time. In his opinion 'there is a strong probability that [the malignant tumour] was caused by ionising radiation from the nuclear detonations. This opinion is held because of the rarity

of the tumour, its strong association with low dose ionising radiation, the two decades before it presented clinically, and the presumption that Mr X received low dose radiation while on the HMNZS *Pukaki*'. Dr Probert cited the report¹² of the high incidence of meningioma in Hiroshima and Nagasaki survivors.

Radiation and Ill Health

Hiroshima and Nagasaki

Recent studies of the survivors of the bombings of Hiroshima and Nagasaki are revealing a similar pattern of morbidity and mortality to that reported in this study. One report shows an increase of malignant disease and also of anaemia, hypertension, heart and cerebro-vascular disease, gastrointestinal disorders, including diseases of the gallbladder and pancreas.⁸² The authors note that the Radiation Effects Research Council found, in the statistics of the confined survivor group in 1966-1987, a higher excess relative risk of circulatory diseases (cerebro-vascular and cardiac diseases) and gastrointestinal diseases (especially hepatic cirrhosis) in those who were young (below 40 years) at the time of the atomic bombings and whose radiation dose was more than 200 rem. They postulate the existence of a *Genbaku Bura-Bura* syndrome, which is difficult to explain by a single mechanism. The syndrome is considered to result from complex interactions subsequent to multiple changes in the body after radiation exposure:

- Damage to stem cells: decreased immunological activity, anaemia, skin disorders and gastro-intestinal dysfunction
- Injury to the central and autonomic nervous system: gastro-intestinal dysfunction, circulatory symptoms, dysfunction of the autonomic nervous system
- Injuries to the bone: symptoms of damage to the motor system, such as lumbago
- Others.

A Japanese group⁸³⁻⁸⁶ has pointed out that the pattern of appearance over time of radiation-induced cancer other than leukaemia differs from that of leukaemia. In general, radiation-induced solid cancer begins to appear after attaining the age at which the cancer is normally prone to develop (so-called cancer age), and continues to increase proportionately with the increase in mortality of the control group as it ages. Sensitivity to radiation, in terms of cancer induction, is in general higher for those who were young at the time of the bomb than for older persons.

There have been several reports of cardiovascular disease among the subjects of the Life Span Study of Hiroshima and Nagasaki,⁸⁷⁻⁹⁰ especially among those who were younger than 40 years old at the time of the bombing. Wong and co-workers⁹¹ have reported that the incidence of myocardial infarction has been increasing recently among the younger heavily exposed Japanese survivors. Other recent studies⁹²⁻⁹⁷ have also shown that irradiation can induce cardiovascular disease, including aortic calcification, and pulmonary fibrosis.

Spinal radiotherapy for ankylosing spondylitis

Review of the long-term mortality after a single treatment course with X-rays of patients with ankylosing spondylitis indicates an increased incidence of leukaemia and of colon cancer associated with ulcerative colitis. There appears to be about a 50% increase in mortality for a wide range of diseases, including cardiovascular, cerebrovascular and gastrointestinal conditions similar to those reported for the present sample of nuclear veterans.⁹⁸⁻¹⁰⁵ A review¹⁰⁶ commented that 'In the spondylitis patients multiple myeloma and cancers of the bladder and liver were among the few types of cancer for which higher relative risks were observed more than 25 years after exposure than in the earlier period', and noted that there is increasing evidence of 'different temporal patterns of radiogenic risk between the different cancer types as well as for leukemia'.

Soviet nuclear workers

A 'chronic radiation sickness / haematopoietic syndrome' reported¹⁰⁷⁻¹¹² for workers in the Mayak nuclear complex between 1948 and 1958 seems similar to the long-term sequelae experienced by the UK veterans: the Mayak region has been described as the most radiation-polluted area on the globe.¹¹³ The incidence of thyroid cancer has increased in the area irradiated after the Chernobyl accident,^{114,115} and studies are in progress on the health of the clean-up workers.¹⁷⁻¹⁹

Radiobiology

Newer radiobiological techniques can detect at the cellular level, effects of radiation which could predispose to malignancy,^{116,117} perhaps some time after exposure. These techniques are applicable to individuals who have been exposed to radiation in the past.

RECOMMENDATIONS

- It is recommended that a full longitudinal prospective family and clinical follow-up study be undertaken for at least the ten per cent sub-sample of veterans of UK nuclear weapons tests for whom contact addresses are available. A ten per cent sample is used for provisional estimates of mortality for selected causes of death by the US National Center for Health Statistics in their monthly forecasts,²¹ and the use of such samples is widespread in clinical audit.¹¹⁸⁻¹¹⁹ The sample of more than 2,000 men and their families would permit comparisons with, among others, the study of the causes of death among 2,068 patients treated with X-irradiation for metropathia haemorrhagica in Scotland.^{13,14}
- This study has shown an increased incidence of multiple myeloma (further cases have been notified since the study was closed). The incidence of multiple myeloma is raised in both the SAPHO syndrome and after spinal irradiation for ankylosing spondylitis. The occurrence of multiple myeloma among veterans of nuclear weapons tests must therefore be explored more fully. This would increase the understanding of the induction and course of multiple myeloma, especially when triggered by radiation exposure. The role of bone marrow depression in the possible progression from the SAPHO-type syndrome and multiple myeloma should also be examined.
- The sample of UK nuclear tests veterans should be compared with those patients who were treated by spinal irradiation for ankylosing spondylitis.⁹⁸⁻¹⁰⁵
- The UK nuclear veterans for whom contact addresses are held - or the full cohort - should be compared with the survivors of the bombings of Hiroshima and Nagasaki, in whom longstanding longitudinal studies are now reporting a very similar mortality and morbidity pattern.⁸³⁻⁸⁶ The findings should also be compared with observations of the mortality and morbidity of Soviet nuclear workers and Chernobyl liquidators.^{17-19.}

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- The 75 cases of cataract reported in the UK and NZ veterans provide an opportunity to extend studies of radiation-induced cataracts already begun by the National Radiological Protection Board.
- The biological mechanisms of the postulated SAPHO-type syndrome should be examined together with the possibility that they have been triggered by exposure to ionising radiation. The role of ingested or inhaled alpha irradiation should be particularly examined; the Ministry of Defence acknowledges that the veterans were never monitored for this or other forms of internal radiation of any type. This study should take into account the carcinogenetic potential of alpha-particles.^{120,121}
- Given the incidence of spina bifida and other neural tube defects, the present sub-sample, and indeed the full cohort, should be studied for the possibility of radiation-induced genomic instability with its cytogenetic implications.
- An independent tissue and body depository should be established as soon as possible to respond to the present sample's willingness to donate their remains to medical science.
- Now that there are radiobiological techniques^{116,117} available which can assess radiation-induced cytogenetic changes, including genomic instability, samples should be drawn from the present study population to investigate further the possibility of a radiogenic basis for the health burden reported here.

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