

CANCER IN BURNHAM ON SEA NORTH
RESULTS OF THE PCAH QUESTIONNAIRE

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Abstract

This paper addresses the results of a unique local cancer prevalence questionnaire survey in the small coastal town of Burnham on Sea, Somerset, near Hinkley Point nuclear power station, undertaken in Spring 2002 and examines the reported cancer risk in Burnham North ward over the periods 1998-2001 and 1996-2001. Volunteers from 'Parents Concerned About Hinkley' (PCAH) called at houses in the ward and gave out questionnaire forms which asked for information about the people living at the addresses and any cancers that had been diagnosed at the address in the last ten years. In addition, the ages, sex and numbers of people living at each address was asked for and this gave a base population which could be used to determine the expected number of cases of different cancer types using England and Wales national incidence data for 1997. 750 completed survey forms were returned defining a base population of about 1500 persons.

Results were calculated as Relative Risk or RR which is observed cases divided by the expected numbers based on the national data. Statistical significance was estimated using cumulative Poisson probability. These showed that there was roughly double the breast cancer risk in both periods. (1998-2001: RR = 1.86 10 cases, 5.39 expected; $p = .05$, 1996-2001: RR = 1.98 16 observed, 8.1 expected, $p = .01$). This supports earlier work carried out by this group (2000) using mortality data from the office for National Statistics which showed approximately double the national risk. In addition, the data indicated significant excess risks from leukemia (1998-2001: RR=4.1; $p = .01$; 1996-2001: RR= 2.73, $p = .05$, 4 observed, 1.46 expected), kidney cancer (1998-2001: RR 4.76 4 observed .84 expected $p = .01$, 1996-2001: RR = 3.96, 5 observed, 1.26 expected. $P = .01$), cervical cancer (1998-2001 RR = 5.6, 2 observed 0.36 expected, $p = .01$; 1996-2001: RR = 5.6, 3 observed, 0.54 expected, $p = .01$). Reported prevalence of cancer of the colon and prostate were below expectation and for cancer of the lung the prevalence was very low. For all malignancies combined, risk was slightly lower than expected. However, owing to population leakage and early deaths, the true risks are likely to be much higher. On the basis of the year 2001 only, 17 cases were reported with 11 expected, RR =1.55, $p = .06$.

Other questions asked about lifestyle and behaviour in the cancer sufferers. Smoking more than 10 cigarettes per day occurred in 23% of the cancer sufferers compared with 27% in national statistics for all persons and 35% in cancer patients in Irish hospitals in 1996, suggesting that smoking was not a cause of the effect. The most interesting pointer was that 61% of cancer sufferers had hobbies or activities that regularly placed them on the beach or near the sea.

The results support the hypothesis that radioactive particles and materials originating from Hinkley Point and other sources which are present in the intertidal sediment have become transferred into the air and become inhaled or ingested by sea coast populations and that the high local dose to tissues is a cause of the effect. Other possible causes cannot be ruled out.

The questionnaire study is the first of its kind in the UK and starts a process which will enable communities local to a putative source of risk to bypass the perceived secrecy of the cancer registries and discover the levels of ill health in their neighbourhood.

Background

The question of the health effects of radioactive releases from nuclear sites and other sources remains an area of considerable debate. In the last five years there has been new evidence emerging that internal irradiation by the novel substances produced by fission processes e.g. Caesium-137, Plutonium-239, Strontium-90 etc is not adequately addressed by the conven-

tional model. The UK government have recently (July 2001) set up a new committee, CERRIE, to report on the issue. As a part of our research into this area we have previously reported the results of an analysis of cancer mortality data from wards in Somerset in order to examine the effects of proximity to the large offshore mud banks and the tidal regions of the River Parrett which are contaminated by radioactive material from Hinkley Point nuclear power station and also material from other sources such as Sellafield, La Hague, Chernobyl and global weapons fallout. Our results, based on mortality data from the Office for National Statistics (ONS) for 1995-1999 were published in 2000 [Busby et al 2000] and elicited considerable criticism from the Somerset Health Authority (SHA) and the operators of Hinkley Point, British Nuclear Fuels (BNF). Our prior hypothesis was based on a very large study of Irish Sea coastal populations, both in Wales and Ireland, which we conducted in the period 1997-1999 and which had showed the existence of a 'sea coast effect' on cancer. People living near the coast in areas where there were offshore mud banks, estuaries or inlets contaminated by material from Sellafield showed sharp and significant excess risks of cancer of most types which fell off rapidly with distance from the coast or river estuary. Results from Somerset showed the same effect and in particular showed significantly raised breast cancer mortality risk in the town of Burnham on Sea, the largest concentration of population close to the contaminated mud flats. The Standardised Mortality Ratio (SMR) over the period 1995-2000 was about 2, i.e risk of dying from breast cancer was about twice the national average after adjustment for age and social class. The study had been commissioned by Stop Hinkley, and the results were reported in the local media. Somerset Health Authority were dismissive: we had used the wrong populations, they said and the correct populations showed no effects. However, when they supplied us with their correct populations, the effect remained. Later, SHA agreed that there was indeed an excess breast cancer risk but now they argued that it was not caused by the nuclear site and could have occurred by chance alone. They were dismissive and offensive and entirely unhelpful.

Recently, we have paid to obtain electronic data and emails written from within SHA on the issue and these have been illuminating, establishing the level of anxiety within SHA and their attempts to minimise the problem. They deny that there is a problem and refuse to discuss the issue. Meanwhile, people continue to die.

Small area cancer data: secrecy and cover-up

In Somerset, as in all areas where we have tried to establish the effects of nuclear pollution, we have asked the authorities for small-area cancer incidence data to analyse. We were only able to examine the Welsh data because we were given the entire database 1974-1989 by the Wales Cancer Registry (WCR) following the orders of the then Director of Health Dr Deirdre Hine to whom we addressed our concerns. This amazing leak resulted in the immediate closure of WCR and its replacement by a new organisation, Wales Cancer Intelligence Unit whose Director, Dr John Steward, moved swiftly to remove large numbers of cancer cases from the inherited database. More than 15% of all the childhood cancer cases recorded by Wales Cancer registry were wiped off the record without explanation. Shortly after this, all the cancer registries in the UK agreed to refuse small area data on the grounds of confidentiality, and ours and other groups requests for such data are now automatically refused. This includes data on incidence produced to the same level of aggregation (e.g. ward level) as the ONS data on mortality(which is available) showing a difference in application of confidentiality considerations which is hard to explain. No amount of pressure will produce the data: it has been refused in Court following a formal request from a judge and has been refused to the Minister of the Environment. The reason given for the secrecy is that it may be possible for

someone to be identified if the number of cases of say breast cancer in a ward population of say 1000 women is given out. We are thus asked to believe that the knowledge that there were 6 new cases of breast cancer in Burnham-on-Sea North ward in 1998 would enable us to identify a particular person and for this reason the data must be kept secret.

Whatever the reason for this secrecy, it is clearly important to be able to examine the effects of environmental pollution, and as a way around the cancer registries we devised a procedure to obtain the numbers of cancer cases in an area. This simply involved knocking on doors and asking if anyone in the house had been diagnosed with cancer. The method was used for the first time in Carlingford and Greenore on the East Coast of Ireland in 1999 [Busby and Rowe, 2000]. The questionnaire method devised and used successfully in Carlingford enabled us to establish that the sea coast effect in that area was remarkably local with high cancer risk within a few hundred metres of the high water line.

Following a meeting in Burnham on Sea in 2000, where these issues were discussed, a local group, Parents Concerned about Hinkley (PCAH) decided to organise a questionnaire-based study of Burnham North ward based on the Carlingford questionnaire. Although this approach has some shortcomings, which will be discussed, it has the great merit of obtaining data that has not been filtered through official channels and can therefore be believed, and at base, there will exist a list of people with cancer in a small area and the numbers of cases can be analysed with regard to a base population which is also exactly known. In addition, a questionnaire can ask people about their lifestyle and what they think about the issues involved. This approach breaks through the secrecy surrounding small area cancer risk and has the added advantage of being able to obtain numbers of cancers for the more rare sites e.g. leukemia, where mortality data from ONS is not published or to see if there are any links with activities that might prove epidemiological pointers to the cause of the disease. A version of the Carlingford questionnaire was devised and distributed in Burnham North in the Spring of 2002. It is the results of the analysis of the 750 returned questionnaires that will be reported.

The PCAH/Green Audit questionnaire

The questionnaire (see Appendix B) was given by a volunteer from PCAH to each of the houses in Burnham North and the project was explained. It was intended to be filled in for each household on the electoral list by the head of or some responsible person in the household, with the assistance of an interviewer. The questionnaire asked for the sex and age of all persons living at the address. It then asked if any person at that address has been diagnosed with cancer in the previous ten years. Details of this person were then asked for, such as the type of cancer (site), their sex, the age at diagnosis and the year of diagnosis. This data enabled the direct calculation of relative risk in the sample population, relative to the national population. In addition to the fundamental questions above, the questionnaire also asked about the lifestyle of the cancer cases, whether they smoked, whether their habits put them in proximity to the beaches or the sea, whether they ate fish or shellfish regularly and other questions that might throw light on the cause of the cancer.

In the event, difficulties obtaining enough volunteers and other factors resulted in 749 households returning completed questionnaires. Where there were clear ambiguities in some questionnaires, the house was re-visited. The questionnaires also asked people to indicate whether recipients would be prepared to help further, through interviews or with providing other information. There was also a space on the form for comments.

The population at risk

The 1991 census population of Burnham North is given in Table 1. The project was set up

assuming a 50% response rate and total ward coverage. In the event about 750 questionnaires were returned which gave a base population-at-risk of approximately 1500 persons. The age breakdown of the respondents is also given in Table 1. It is clear that about one third of the census population of the ward are included in the survey.

ages	Males	Females	Survey males	Survey females
0 to 4	76	101	28	18
5 to 9	93	113	50	36
10 to 14	119	131	40	39
15 to 19	120	127	45	29
20 to 24	80	83	28	20
25 to 29	89	106	15	16
30 to 34	94	117	21	36
35 to 39	126	122	43	46
40 to 44	168	163	58	48
45 to 49	130	136	45	49
50 to 54	109	122	56	65
55 to 59	125	145	50	54
60 to 64	160	175	59	60
65 to 69	211	237	52	60
70 to 74	186	237	57	67
75 to 79	132	176	47	42
80 to 84	102	181	28	34
85 to 89	48	137	16	17
90+	26	81	6	7
all	2194	2690	744	743

Table 1: 1991 census population of Burnham North compared with population included in the PCAH questionnaire survey.

Population leakage

The questionnaire asked for details of cancer incidence in the ‘last ten years’. In the event, respondents gave cancer details back as far as the late 1970s. However, it is clear that the inclusion of cancer cases diagnosed in the area for earlier periods runs the risk of missing cancer cases or deaths for any early year because the owner died of cancer (and no one else could report this) or because the house where they lived was sold and new people live there who are not aware of the cancer case and therefore did not report it. This is a problem with such a retrospective study. We call loss of cases from earlier years ‘population leakage’ and it may be examined by looking at the trend in Relative Risk by different period of time prior to the survey. Information may also be obtained by examining Relative Risk by age group since older people are more likely to leak out of the study population because they are more likely to die of cancer and their houses will pass into other hands. Table 2 gives the prevalence of reported cancer cases by year of reported diagnosis. It is clear that there is an apparent fall off in prevalence with time and this must be due to a population leakage effect. Therefore the apparent risks shown by the data will be less than the true risk. For this reason, the analysis has to consider a trade off between accuracy and statistical power. Two periods of time were used for the analysis, 1998-2001 and 1996-2001. For the six year period, there were 64 reported cases of cancer with 66 expected on the basis of the national average; however, the number of cases for the most recent year was 17 and if this year is representative, there would have been 102 cases in the six years 1996-2001. This latter is more in line with the results obtained by mortality analysis using the ONS national data. Thus the relative risks found on analysis of the questionnaires were adjusted for this effect, they would increase by about 54

percent; however, we cannot reasonably apply such a correction to any particular type of cancer since we do not know the distribution of the leaked (i.e. missing) cases.

Year	Cases	Year	Cases
2001	17	1991	3
2000	12	1990	1
1999	8	1989	3
1998	8	1988	0
1997	10	1987	3
1996	9	1986	1
1995	6	1971-1986	4
1994	4	Others	(4)
1993	2		
1992	4		

Table 2: Cases of cancer reported by year in PCAH survey results

Confidentiality

The survey interviewers gave an assurance of confidentiality. Each questionnaire was devised to be returned to the analysis team with the postcode reference only. However, in the event, some were returned with an address. There was space on the questionnaire to ask if the person filling out the questionnaire was prepared to give further help or be interviewed: and a number of people gave their name and address and telephone number. This report will not identify any person or any address and this data will remain confidential.

Method

The sample of the population of the study area who were reported in the questionnaire forms were assumed to be the population at risk. The total numbers of cancer cases expected in one year was calculated by multiplying the population at risk in each sex and 5-year age group by the 1997 average national rate for the cancer type or site calculated from the latest (1997) ONS national data [ONS, 2001]. The total numbers expected over 4-year and 6-year period were then obtained by simply multiplying the annual expectation by the appropriate number. This was then compared with the observed number of cases over the same period. The resulting O/E was defined as a Relative Risk and the probability of this result being a chance occurrence was obtained from Cumulative Poisson statistical tables. This p-value represents the probability of the number of cases observed, or less, being found by chance alone given an expectation based on the population in the sample and the national rates. There was no adjustment for Social Class, as this is not possible given the data; however, such an adjustment

would not change the risks by more than 10 percent.

Results

The cases are given in Table 3.

Cancer	sex (m=1)	age diag.	year diag.
Bowel	1	61	1991
Skin	1	57	1992
Bladder	1	70	1998
Cervical	2	35	1989
Ovarian	2	62	1999
Breast	2	35	1999
Colon	1	72	1999
Lymphoma	1	70	not given
Kidney	1	61	2001
Breast	2	56	1999
Melanoma	2	47	1995
Kidney	2	64	2001
Testicular	1	15	2001
Breast	2	60	1997
Kidney	2	72	1996
Breast	2	72	1998
Prostate	1	77	2001
Bowel	2	53	2001
not known yet	2	80	2001
Bowel	2	50	1993
Leukaemia	1	14	1999
Cancer	1	76	1996
Colon	1	61	1995
Leukaemia	1	74	1998
Prostate	1	82	1997
Lymphoma	2	not given	1993
Lymphoma	2	not given	2000
Lymphoma	2	32	1986
Intestine	2	71	1997
Liver	1	72	2000
Prostate	1	74	2000
Cervix	2	54	1990
Kidney	2	77	1998
Prostate	1	79	1996
Lung	2	85	2000
Bowel	1	62	not given
Leukaemia	2	68	2000
Lymphoma	1	75	not given
Breast	2	61	1992
Pancreas	2	73	1994
Lung	1	73	1992
Leukemia	1	57	1994
Breast	2	63	1996
Pancreas	1	58	2000
Stomach lung	1	79	2001
Oesophagus	1	78	2001
Liver	2	68	1987
Cervical	2	35	2000
renal cell	1	38	2001

Pancreas	1	56	1995
Bowel, bones, prostate, lung	1	65	1991
Cervical	2	58	1989
Breast	2	66	1981
Breast	2	49	1997
Abdominal	2	51	1994
Breast	2	41	1987
Breast	2	36	2001
Throat	2	76	1973
Melanoma	2	50	1970
Colon	2	76	1996
Breast	2	75	2000
Cervical	2	43	1996
Bowel	2	73	1999
Cervical	2	39	1999
Skin	2	70	2000
Leukaemia	2	60	1983
Breast	2	47	1997
Breast	2	81	1998
Skin	2	81	1997
Lung	2	77	1987
Breast	2	39	1971
Prostate	1	85	1998
Colon	1	59	1995
Pancreatic	2	84	2000
Lung	1	74	not given
Breast	2	71	2001
Lung	1	80	2001
Skin	2	72	not given
Lymphoma	2	80	1996
Bowel	1	67	1994
Prostate	1	84	1989
lung & liver	1	62	2001
Stomach	2	92	1991
Testicular	1	not given	1990
not given	2	45	1996
Breast	2	65	1995
Breast	2	75	2001
Bowel	2	63	1998
Breast	2	89	2002
Stomach&oesophagus	1	62	1998
Prostate	1	91	1997
Breast	2	63	1997
Skin	1	49	2001
Breast	2	60	1999
not given	1	80	1997
Leukemia	not given	67	2000
Breast	2	48	1997
Liver	1	53	2000
Cancer	1	not given	1995
Breast	2	not given	1989
Prostate	1	84	2001
Leukemia	2	4	1967
Kidney	2	72	1996

Table 3: Cancer cases reported in PCAH survey, with sex and age and year of diagnosis.

Tables 4 and 5 give the Relative Risks calculated by us for the cancers where there was some evidence of statistically significant excess risk and also for some common cancers for the two periods 1996-2001 and 1998-2001. For other cancer sites reported, the risk could not be calculated either because the numbers were too small or the data was too poor (the questions on the form having been vaguely or incompletely answered).

Cancer	Observed	Expected	RR	Poisson p-value
All malignancy	45	44	1.02	NS
Female breast	10	5.39	1.86	0.05
Kidney	4	0.84	4.76	0.01
Leukemia	4	0.976	4.1	0.02
Cervix uteri	2	0.36	5.6	0.01
Colon	5	5.2	0.96	NS
Prostate	4	4.8	0.83	NS
Lung	4			Low

Table 4: Relative Risk (see text) for cancer in Burnham North from 1998-2001 indicated by PCAH survey (based on England and Wales rates for 1997).

Cancer	Observed	Expected	RR	Poisson p-value
All malignancy	64	66	0.97	NS
Female breast	16	8.09	1.98	0.01
Kidney	5	1.26	3.96	0.01
Leukemia	4	1.46	2.73	0.05
Cervix uteri	3	0.54	5.55	0.01
Colon	6	7.8	0.77	NS
Prostate	7	7.2	0.97	NS
Lung	4			Low

Table 5: Relative Risk (see text) for cancer in Burnham North from 1996-2001 indicated by PCAH survey (based on England and Wales rates for 1997).

Questions were also asked about whether the cancer sufferer was a smoker, whether they had a job that kept them mostly outdoors and whether they were regularly on or close to the beach/sea. No internal controls were available for answers to these questions since it was considered that this would make the questionnaire too complicated. However, the information could be compared with national data in the case of smoking and it was considered that the answers to the other questions could be informative and possibly followed up through a separate survey if necessary. The lifestyle/behaviour of the cancer cases, as reported, are given in Table 6.

	Yes	No	Not given	% of replied
Smoker	21	69	13	23%
Sea/Beach	49	31	23	61%
Outdoor/in	14	44	45	32%
Sea or outdoor	53	27	19	66%
Local fish	12	59	32	17%

Table 6: Behaviour of all cancer sufferers as shown by answers on questionnaire.

Comments in the replies

The Cancer Registries claim that people do not want to be identified as cancer sufferers or as the family of a cancer sufferer. This is the rationale behind the Cancer Registries’ refusal to release small area data. However, comments given in the survey (Appendix A) were almost entirely positive and showed that people were concerned and wanted to discover whether there was a problem or not and were very willing to help. A number of replies suggested that there was a degree of suspicion over the impact of radioactivity from Hinkley Point. One old gentleman (age 87) wrote at some length. Since his comments were very relevant, we reproduce them here:

I, (name) was born and bred at (a farm) in Highbridge and lived in Burnham on Sea all my life apart from the war years (1939-45). Regarding Hinkley, a normal schoolchild knows that our winds are normally South Westerly, both at sea level to altitude. It is also a known fact that hot air rises. I imagine output from Hinkley is in the form of hot air and dust particles into the atmosphere. This air is carried away from the Hinkley area until it cools enough to be brought by cooling to the ground, away from Hinkley (being deposited in the Bridgwater-Burnham basin area formed naturally by the Quantock/Pouden Hill semi-circle. With the Severn by virtue of its banks forming a natural funnel I suggest this radioactivity is carried as far as the Stroud area. Why was Burnham area scanned nightly for radioactivity especially the copper roof of the RC church? Is this still done? The tail end of October we had at this area a cement like dust on the cars, supposedly Sahara dust with the wind at the time West-erly???

This response goes to show that people are quite able to draw their own conclusions about cause and effect and are not gulled by anodyne statements from the nuclear plant operators.

Discussion

Results show consistently and significantly elevated risks for female breast cancer, and thus support the earlier finding of about double the expected breast cancer mortality [Busby et al 2000]. The effects were there in both the four year and six year periods. In addition, there were significantly high levels of kidney cancer, leukemia and cervical cancer. Leukemia is the most commonly assumed outcome of radiation exposure although kidney and cervical cancer are also caused by radiation exposure. Although the numbers were small, the risks were quite high and were statistically significant in all cases and time periods. The real levels of cancer would certainly have been higher than these figures show due to population leakage and deaths. Lung cancer prevalence, generally low in Somerset, was apparently very low in the ward according to the questionnaire. Prostate and Colon cancer seemed slightly low.

The answers to the question about smoking showed that 23% of those who answered were smokers. The figure for smokers in the general population is 27% (Action on Smoking and Health) and the Irish Cancer Registry has found that for cancer patients in hospital in Ireland, the figure is about 35%. So first, we can say that the cause of the elevated cancer is not primarily smoking. The radiological protection agencies assume that the main dose to locals from the operation of sea-discharging nuclear power stations or reprocessing sites is through eating fish and shellfish. The cancer sufferers in this survey did not seem to eat a great deal of fish, but we have no controls for this so cannot be certain. However, there was a large percentage of the cancer group who either had a hobby involving being regularly on the beach or in the sea or an outdoor job. The main factor in determining inclusion in the group was the sea hobby connection, and although we do not have a control for this, it would be possible to obtain one fairly simply.

What is the origin of the apparent cancer excess? Could there be some artefactual origin? Is the method biased? We will address these questions briefly.

Is the method biased?

The survey is not the most accurate way of obtaining the cancer incidence in a small area. The preferred way would be to obtain the data from the Bristol or South West Cancer Registry or Somerset Health Authority. However, this data has been refused by both the registry and the health authority. And in any case, research we have done in Wales has shown that data from Cancer Registries is often questionable. For example, following our discovery of various cancer excess risks in Wales, using the Wales Cancer Registry data which we obtained in 1996, WCR was closed down and the new agency, Wales Cancer Intelligence and Surveillance Unit, wiped a significant number of cases from the database and then denied any increases existed. We can prove this and have all the relevant paperwork. So the PCAH survey was the best way to see if there was indeed a problem, as the official mortality data had suggested. And even the mortality data is questionable. In 1997 we received a copy of a death certificate of a little girl who lived near the Atomic Weapons plant at Aldermaston, who died of leukemia but was registered as having died of pneumonia. At least, with a survey, we know we are closest to the source of the data and can revisit. We know the locations and names of the cases.

Given all this, there are still some problems. The first is that dead people don't fill in questionnaires, and that survivors or spouses may move away after a death. This will only bias the result in the direction of lower apparent risks. The second is that someone will say they have cancer when they do not. It is hard to see why anyone should do this. Our evidence from this and the other survey we have carried out (in Ireland), is that the opposite (Type II error) problem, saying they do not have cancer when they do, is more common. We had two people

in this survey who refused to become involved because they were too upset by a recent loss to discuss the issue or fill in a questionnaire. The overall trend in these two possible problems is to lower apparent risk.

What is the apparent origin of the cancer increases?

The results show that there is something about Burnham on Sea that is associated with elevated risks of breast cancer, leukemia, kidney cancer and cervical cancer. The hypothesis that underpinned the original Hinkley mortality study (Busby et al 2000) was that internal exposure to man-made radioactive particles originating in the power station and other sources on the Severn Estuary was a cause of cancer in populations living close to the sea. This hypothesis was advanced originally as an explanation for the sea-coast effect found in Wales and Ireland's east coast, where particulate radioactive material from Sellafield exists. The material is resuspended by wave action and has its highest concentration in the air inside the 1km strip. Radioactive particles of the alpha emitter Plutonium-239 and Americium-241 of 1 micron diameter or less are common sea to land transfer particles and have been measured in sheep droppings, human lung and lymph node tissue, children's teeth and grassland across the whole of the UK. The evidence for this was given at some length in Busby et al 2000 and in several of our papers on the Wales and Irish coast effect which have been presented to CERRIE and are part of that process.

There may be an alternative explanation for the findings or indeed for the sea coast effect, but evidence in its entirety points to radiation exposure. In Ireland, we found cancer increases on the East Coast but not on the West coast, where there are no nuclear sites or pollution. On the East Coast, besides analysing the official data, we employed a similar health survey to the present Burnham on Sea survey in the wards of Carlingford and Greenore, close to radioactively contaminated mudbanks. In this study we were able to divide the population into three groups by distance from the sea, at 0-100 metres, 100-1000 metres and 1000-2000 metres. By this means, (and by inspection of the cases on the map) we were able to show that the risk increased four fold on moving from the most distant group to the coastal group. In Burnham on Sea, since it was a town survey, we were unable to examine effects by distance from the seashore. However, the high percentage of cancer sufferers who had hobbies which put them close to the sea and the sediment suggests that this is the source of the disease. The idea that the contaminated sediment may cause leukemia or cancer is not new. It was the hypothesis of the Leukemia Research Fund study [Alexander et al 1990] where the research confirmed an Association between estuaries and leukaemia. It was also the finding of the Viel et al case control study of childhood leukemia near the French reprocessing site at Cap de la Hague. [Viel et al, 1997].

What of the spectrum of cancers found? Why are the increases apparently in breast cancer, but not prostate cancer or lung cancer. Why are kidney cancer, cervical cancer and leukaemia elevated? We cannot say. We can speculate that particles may become trapped in the kidney and irradiate local cells, that leukaemia (or indeed most cancers) may result from sub micron diameter hot particles trapped in tissue. One problem is that there are many factors which influence the time it takes between the genetic damage and the final expression of the cancer, and this period is different for different cancer sites, owing to the variation in the natural replication rates of the constituent cells. We must realise that the exposures that lead to the expression of cancer in this population are mostly in the past, maybe ten or more years ago, and that we are seeing a 'snapshot' filtered result of a population where some have had cancer (of some type) and died and been removed from the population.

And finally, we cannot say for certain that it is exposure to radioactivity that is the cause of

the effect: all we can say is that in all the studies where we have looked at coastal population of some density living near areas where there are large areas of contaminated sediment, there is a sea coast enhancement of cancer risk which falls off rapidly as we look inland. We will make one final point. The time is now long overdue for the release, by the cancer registries, of small area data on cancer so that people living near a putative source of risk can examine the data for themselves. It is no longer acceptable for the authorities to say, 'trust us'. There have been too many situations (Sellafield and the Seascale leukemias, BSE, Dr Harold Shipman) where it has become clear that health authorities, government science advice committees and those who are paid to look after the public have failed to do that. The cancer survey which PCAH have carried out is a very important breakthrough in this area, since it has shown that local people can, if they are concerned, examine the situation for themselves. Although there are disadvantages to this, at least they can trust the results and will, finally, act politically on what they discover.

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Appendix A: Responses to the questionnaire

Cancer Comment

- Yes Since the early 60's I had been a regular walker on the beach mostly at low tide in the muddier levels, also metal detecting and digging for wartime relics. I often wonder now if there could be a higher radiation level in the mud, and if my finds be affected
- No We have lived here for 11 mnths. I had a breast scan this year & all was O.K.
- Yes To get a balance you really need to know how many healthy births to smokers & non-smokers.
- Yes F - breast cancer - 1985 - probably oestrogen related - still alive
- No son born prematurely(6 weeks), but we had only lived in B.O.S. 12 mnths prior.
- No I have only lived in the area for 3 yrs - but I am very concerned for the younger persons, esp. children, as I feel the higher rate of cancer related illnesses in this area is very worrying and something needs to be done to address this very serious issue
- No Dog contracted cancer of the lymph gland at age 7 - had walked on beach most days.
- No See extract in text
- No Food and smoking? spraying chemicals?
- No My mother died at 45 with C/A breast. this is a subject close to my heart even though it is not related to this survey.
- Yes When my wife was terminally ill with cancer, she received excellent support from our family doctor and other doctors and nurses from the B.O.S. medical centre.
- No Is the survey taking account of naturally occurring environmental factors, e.g. radon gas, as on the Somerset levels? Industrial pollution from S. Wales? Is Berrow included in this survey?
- No Only lived in Burnham 6 mths
- No Only lived at this address 2 mths.
- No 1 male, 1 female both retired (no ages given). We are not happy with nuclear power. And very concerned about the transporting of nuclear waste throughout this area by train, etc.
- No we have only lived here for 2.5 yrs, so perhaps do not fit the criteria very well.
- No My family has been fortunate so far including our daughter who now lives in London. but we know of at least 3 neighbours have died of cancer in the last 10yrs. we support what you are trying to do.
- Yes family history of colonic cancer.
- No My first wife died of lung cancer 4.1.96. age 74. both of my neighbours died of cancer, one, liver, 2000 aged 53, one leukaemia, 2000, aged 67
- Yes lived at an address on beach at Alandale
- Yes Male swam in sea until 1970's frequently.
- No My mother, 20yrs ago, died two yrs later.
- No we have lived in B.O.S only a few mnths and are not representative of the long term pop.
- No a) has any research been carried out about alternative sources of energy in the area e.g. windmill groups in part of Bristol Channel etc? b) The format of the questionnaire worries me. Elderly people living alone can be identified. Who might see these forms?
- No All screening for cancer for men and women should have been done from early twenties.
- Yes My sister died from cancer in 1995 after living here 11 yrs
- Yes My daughter died of breast cancer in 1997. She used to water ski at Comwich and always felt there was a connection.
- Yes XXXX was my 2nd husband, we were only together the 4 yrs 1991-1995 - all of this time we lived in Maddocks Slade - 50yrds from the beach.
- Yes Was a farmer, ate local conger eels
- No after the events of sept 11th I would have thought we should be equally concerned of the dangers from a terrorist attack for ourselves our children and our grandchildren.
- No miscarriage in 1998
- No our neighbour lived on the Berrow Road for many years and walked his dog on the beach everyday for years. last year he was diagnosed with bowel cancer and previously has never suffered a days illness in his life. he is convinced there is a link to B.O.S.
- Yes husband died liver cancer 15yrs ago, lived in high st, north burnham

Yes husband worked at Hinckley point and fished river Parrett
 No miscarriage 7 yrs ago
 No not independent nor unbiased (underlined: 'stop Hinkley')
 No every person I have ever met who had cancer, other than children with leukemia, was a smoker or had been a smoker. I believe this is the greatest threat.
 No I was a water skier for approx 14 yrs, and did this all year round, and spent plenty of time in the water. also as a lad I used to swim in the sea.
 Yes we don't live here but have a holiday home which we have used for 12- 14 yrs
 Yes I hope this information will be useful for your research
 No I worked at hinkley point for 32 yrs have two healthy children and no problems myself or my wife
 No we only moved here 2 mths ago, but, like yourselves, we find the statistics on local cancer rates very alarming! please keep up the good work!
 No have only lived here for 4 yrs, so feel there is nothing I can add. but I wish you well in your endeavours
 Yes Walked on beach every day
 Yes Have you considered the chemical that settled over Burnham 13 yrs ago from a fire near Bristol
 Yes I do not think these questions apply to me as I was diagnosed in 1992, I was told that I had probably had this condition for a number of years previously.
 No Please keep on with your campaign.
 Yes No, (no help), because it was my mother who died and it was very painful nursing her at home.
 No We have only been in the area 7mths. my husband worked at Hinkley for 30yrs and also at Berkeley. Thankfully we had 2 healthy children, and now have 4 healthy grandchildren.
 Yes My husband had 4 major operations for cancer of the bowel at Weston Hospital, from 1994 until he died. I was always surprised how many of the patients were from Burnham, and most had bowel cancer, quite a no. who lived near here, died as a result.
 Yes My mother had breast cancer 12 yrs ago. They live 100yrs from the river bank(the one that runs through the sea down to Dunball).
 No I am doubtful whether this questionnaire is scientifically acceptable, unless you also know how many people haven't had the listed health problems go on or near the beach regularly.

 No very interested. at least 4 friends lost/diagnosed with cancer
 Yes cancer case(husband), worked at berkley, hinkley and oldbury.
 No last year father-in-law died of prostate cancer
 No information from locals that a resident at clarendon way worked at hinkley and fished in the 'ponds' and found deformed fish, 3 eyes, big head and extra fin. it was the outfall. would like iodine tabs, fears that h.p will go critical or be attacked
 No enthusiast. when I first moved to b.o.s. I lived with a family, both girls swam regularly in the sea. both died of cancer. I would like to see past surveys.
 No more dentists
 No would like to know if there is a health problem with 'H'.
 No ate fish from the wicker putts.
 Yes too upset to discuss
 No keen and enthusiastic about survey
 Yes do not want to talk about cancer
 Yes Man built the caisson for the sea defence & water intake prior to operations at hinkley.

 No I'm sorry, this is 'pseudo-science'. for a start, what pop are you going to compare it with? there will be significant bias etc, etc.
 Yes my mother is 89 yrs old, has breast cancer which is responding to pills. we believe this type many older ladies get.
 Yes Daughter high risk of skin cancer, under monthly checks.
 No are you aware that a coal fired power station produces higher radio-active emissions than a nuclear power station? also local brick houses emit radioactivity.
 No we want the present two hinkleys closed and no new ones. nor any other nuclear installa-

tions.

No have lived here for 26yrs. prior to that we had a caravan here for 16 yrs and our 6 children and ourselves went into the sea regularly. I walk the dog on the beach most days. we did lose our last dog, however, with lymphoma and she swam regularly.

Yes my father died of lung cancer in 2000. had lived in b.o.s. for 30+ yrs. worked indoors 100yds from seafront. smoked 20 cigarettes+ from 1960-1985. did not regularly eat local fish.

No cannot really contribute anything tangible to this matter.

Appendix B

The PCAH Survey Questions

Section A

Is your home within 500 yards or walking distance from the sea? Yes/no

How many males live at your address? Number? Ages?

How many females live at your address? Number? Ages?

Section B

Has anyone including yourself been diagnosed with cancer or lymphoma in the last ten years?
Yes/no

If yes, then Sex? Age at diagnosis? Year diagnosed?

Type of cancer/leukaemia/lymphoma diagnosed?

How long has this person lived in the Burnham area?

Where did they live before Burnham?

Did/does the person receive treatment or surgery?

Name of GP or doctor?

Did/does the person smoke more than 10 cigarettes a day before the diagnosis?

Is the person still alive?

Has anyone in your household has:

A stillbirth birth defects infant death (if yes, how long after birth?)

If so, in what year did this occur

How long had the mother lived in the Burnham area?

Where had she lived before Burnham?

Did the mother smoke more than 10 cigarettes a day prior to having the baby?

Section D

Please answer these questions if you have said Yes to any of the questions in sections B and C.

Had the person regularly eaten fish caught locally?

Are they regularly on or close to the beach/sea at Burnham for hobbies/pleasure?

Is their job mostly indoors or outdoors?

If their job is outdoors, are they regularly close to the beach/sea?

Would you be prepared to help by answering further questions if necessary?

If Yes, please leave your name address and telephone below.

Please add anything you feel relevant to the information on the questionnaire.

Thank you for your time!

Someone will collect your completed survey within the next few days. If you have any queries please ring XXXXX on XXXXXXXXXX.

Research by Green Audit - Commissioned by Stop Hinkley