File # 204

Event history analysis - the Somatization models

DRU:Modeling Nuclear Disaster Risk:
The Effects of Risk Perception and Cumulative External Radiation Exposure to Caesium-137 on post-Chernobyl Psychosocial and Health Behavior Outcomes

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1 Research questions

In this section, we address the issues of whether cumulative external dose and/or perceived Chornobyl health risk are related to psychological somatization. We explore the evidence for somatization and investigate associations with risk factors using basic survival analysis techniques. This work is more exploratory than confirmatory at this stage, although we do endeavor to test the relationships between age, illness, and symptoms of both and to assess the extent to which these may be attributed to psychological effects of the Chornobyl experience. We hope to test the relationship between external dose and perceived Chornobyl health risk, on the one hand, and cured time, on the other to see if there is a relationship that could help explain resistance to somatization or facilitation of recovery from somatization after a nuclear event.

2 Methods

2.1 Sampling

Sampling methods entailed random selection of phone numbers by a computer. We attached these numbers to area codes provided by the Ukrainian telephone company. Those who were contacted and agreed to participate were interviewed. Their responses were recorded and input into a computer. Datasets were maintained in Stata SE and MP editions. Thus our sample was representative in that each individuaL with a landline phone had an equal chance of being called, thus providing the sample with a modicum of external validity. Model-based or sampling design-based analysis was rendered possible. Preliminary analysis was performed with a model-based approach.

2.2 Principal statistical analysis

We employ the Kaplan-Meier analysis with log-rank and Wilcoxon tests for basic associations. From there we move directly to identifying risk factors for the hazard rate of somatization using Cox proportional hazards models. Using population average panel generalized estimating equations we proceed to investigating factors relating to resiliency against such somatization with basic cure models.

3 Sample description

Table 1 display the software configuration for a recurrent events survival analysis using Stata version 13. Once the data were properly input into a panel dataset we transformed that dataset to a statistical survival format, where instead of each record representing a year of recalled obesrvations, it represented a spell or episode of somatization.. This nontrivial transformation meant converting a dataset of more than 43 thousand observations into a smaller one of approximately 624 somatic observations.

4 Somatic survival functions

One method of introducing the reader to the nature of the study is to examine the survival function or hazard rate decomposed by basic sociodemographic characteristics. We begin by examining the overall somatization survival function of the sample as it is broken down by gender in Tables 3 and Table 4. This survival function is the cumulative probability of not experiencing somatization over time.

We can analyze our sample by its resistance to somatization or physical manifestation of discomfort following from the Chornobyl. This temporal pattern may exhibit tell-tale configurations that imply that it followed from what happened at Chornobyl. To what extent is it a direct, an indirect, or a proximate effect of Chornobyl? Unless we observe a direct action and reaction contiguous in space and time, we would not be able to be sure that this phenomenon was isolated from all other events enough to be sure of its genesis. However, when we observe in both and female somatization survival functions drops associated with the occurrence of Chornobyl, we might be more predisposed to suspect that this effect was either a direct, indirect, or proximate effect of that disaster. Both the male and female somatic survival probabilities exhibit such drops in probability of avoidance at the time of Chornobyl.

We illustrate these functions by graphing them in Figure 1 and 2. But if we want to know whether they are significantly different from one another, we would have to turn to Table 5, in which the results of the log-rank and Wilcoxon tests reveal that they are not significantly different from one another at the 0.05 level. Perhaps we might want to examine the survival functions broken down by another variable [3].

Moreover, we can observe this drop in survival probability regardless of age group. It may be reasonable to suspect that Chornobyl had psychological effects that emerged as somatic effects over time.

Table 1: Analytic configuration

```
. stset endate, id(id) failure(event==1) enter(time bgdate) exit(time .)
                id:  id
     failure event:  event == 1
obs. time interval:  (endate[_n-1], endate]
 enter on or after:  time bgdate
 exit on or before:  time .
------------------------------------------------------------------------------
      624  total observations
        0  exclusions
------------------------------------------------------------------------------
      624  observations remaining, representing
      236  subjects
      624  failures in multiple-failure-per-subject data
     8116  total analysis time at risk and under observation
                                                at risk from t =         0
                                     earliest observed entry t =        40
                                          last observed exit t =       100

.
```

Table 2: Sample Description

```
         failure _d:  event == 1
   analysis time _t:  endate
  enter on or after:  time bgdate
  exit on or before:  time .
                 id:  id
```

		per subject			
Category	total	mean	min	median	max
no. of subjects	236				
no. of records	624	2.644068	1	2	8
(first) entry time		40	40	40	40
(final) exit time		74.38983	41	78	100
subjects with gap	0				
time on gap if gap	0	.	.	.	.
time at risk	8116	34.38983	1	38	60
failures	624	2.644068	1	2	8

Table 3: Male Survival Function

```
. sts list if gender==1
```

Time	Beg. Total	Fail	Net Lost	Survivor Function	Std. Error	[95% Conf.	Int.]
40	0	0	-98	1.0000	.	.	.
41	98	4	-2	0.9592	0.0200	0.8949	0.9845
42	96	1	0	0.9492	0.0221	0.8822	0.9785
44	95	2	-2	0.9292	0.0258	0.8573	0.9656
46	95	3	-2	0.8999	0.0300	0.8219	0.9448
48	94	3	-2	0.8711	0.0333	0.7885	0.9230
50	93	4	-4	0.8337	0.0368	0.7463	0.8931
52	93	29	-17	0.5737	0.0474	0.4754	0.6602
54	81	6	-5	0.5312	0.0469	0.4353	0.6181
56	80	12	-8	0.4515	0.0452	0.3615	0.5372
58	76	11	-9	0.3862	0.0427	0.3027	0.4688
60	74	4	-4	0.3653	0.0417	0.2844	0.4464
62	74	7	-4	0.3307	0.0397	0.2544	0.4089
64	71	13	-11	0.2702	0.0358	0.2027	0.3420
66	69	6	-5	0.2467	0.0340	0.1832	0.3153
68	68	3	-2	0.2358	0.0330	0.1743	0.3028
70	67	16	-12	0.1795	0.0280	0.1285	0.2375
72	63	13	-11	0.1425	0.0240	0.0994	0.1931
74	61	8	-4	0.1238	0.0218	0.0851	0.1701
76	57	15	-8	0.0912	0.0176	0.0606	0.1294
78	50	10	-7	0.0730	0.0150	0.0472	0.1060
80	47	18	-12	0.0450	0.0106	0.0274	0.0691
82	41	11	-3	0.0329	0.0084	0.0193	0.0523
84	33	7	-5	0.0260	0.0070	0.0147	0.0424
86	31	9	-5	0.0184	0.0054	0.0099	0.0314
88	27	11	-4	0.0109	0.0036	0.0054	0.0201
90	20	8	-3	0.0065	0.0025	0.0029	0.0131
92	15	8	0	0.0031	0.0014	0.0011	0.0072
94	7	4	0	0.0013	0.0008	0.0003	0.0041
96	3	3	0	0.0000	.	.	.

Table 4: Female Survival Function

Time	Beg. Total	Fail	Net Lost	Survivor Function	Std. Error	[95% Conf. Int.]	
40	0	0	-138	1.0000	.	.	.
41	138	5	-4	0.9638	0.0159	0.9151	0.9848
42	137	2	-1	0.9497	0.0185	0.8974	0.9757
44	136	6	-6	0.9078	0.0244	0.8465	0.9454
45	136	3	-3	0.8878	0.0264	0.8234	0.9297
46	136	8	-7	0.8356	0.0306	0.7649	0.8866
48	135	5	-5	0.8046	0.0325	0.7314	0.8598
50	135	5	-2	0.7748	0.0339	0.6997	0.8334
52	132	37	-24	0.5576	0.0389	0.4780	0.6299
54	119	11	-9	0.5061	0.0383	0.4288	0.5782
56	117	18	-12	0.4282	0.0365	0.3560	0.4984
58	111	13	-7	0.3781	0.0348	0.3101	0.4457
60	105	17	-13	0.3169	0.0322	0.2550	0.3804
62	101	13	-11	0.2761	0.0300	0.2191	0.3359
64	99	16	-13	0.2315	0.0271	0.1805	0.2863
66	96	13	-8	0.2001	0.0248	0.1540	0.2507
68	91	18	-16	0.1605	0.0216	0.1209	0.2052
70	89	9	-8	0.1443	0.0201	0.1077	0.1861
72	88	30	-22	0.0951	0.0151	0.0682	0.1273
73	80	1	0	0.0939	0.0150	0.0673	0.1258
74	79	9	-9	0.0832	0.0137	0.0590	0.1126
76	79	22	-12	0.0600	0.0107	0.0414	0.0834
78	69	18	-14	0.0444	0.0085	0.0297	0.0633
80	65	15	-8	0.0341	0.0070	0.0223	0.0498
82	58	7	-6	0.0300	0.0063	0.0194	0.0442
84	57	19	-9	0.0200	0.0046	0.0124	0.0306
86	47	12	-3	0.0149	0.0037	0.0090	0.0235
88	38	14	-4	0.0094	0.0026	0.0053	0.0156
90	28	15	-1	0.0044	0.0015	0.0021	0.0082
92	14	5	0	0.0028	0.0011	0.0012	0.0058
94	9	6	0	0.0009	0.0006	0.0003	0.0028
96	3	2	0	0.0003	0.0003	0.0000	0.0018
100	1	1	0	0.0000	.	.	.

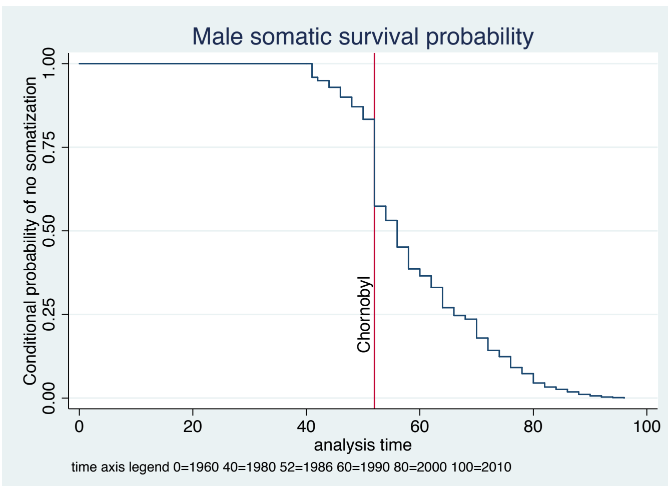

Figure 1: male survival function

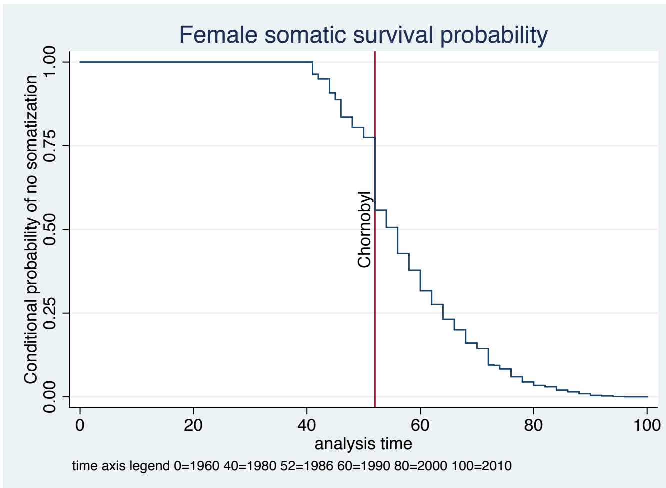

Figure 2: female survival function

We might want to examine the survival functions by gender. To do so, we could look at Figure 3. When we examine the graph, we can see that there appear to be differences for the age groups. With the confidence intervals apparently overlapping, we are not sure whether there is a significant difference between at least one of them, but when we examine the log-rank and Wilcoxon test, we can see that there is at least one statistically significant difference. between them.

Table 5: Log-rank and Wilcoxon tests for gender differences of survival

Log-rank test for equality of survivor functions

gender	Events observed	Events expected
1. male	249	259.79
2. female	375	364.21
Total	624	624.00
	chi2(1) =	0.99
	Pr>chi2 =	0.3193

Wilcoxon (Breslow) test for equality of survivor functions

gender	Events observed	Events expected	Sum of ranks
1. male	249	259.79	-2270
2. female	375	364.21	2270
Total	624	624.00	0
	chi2(1) =	1.60	
	Pr>chi2 =	0.2056	

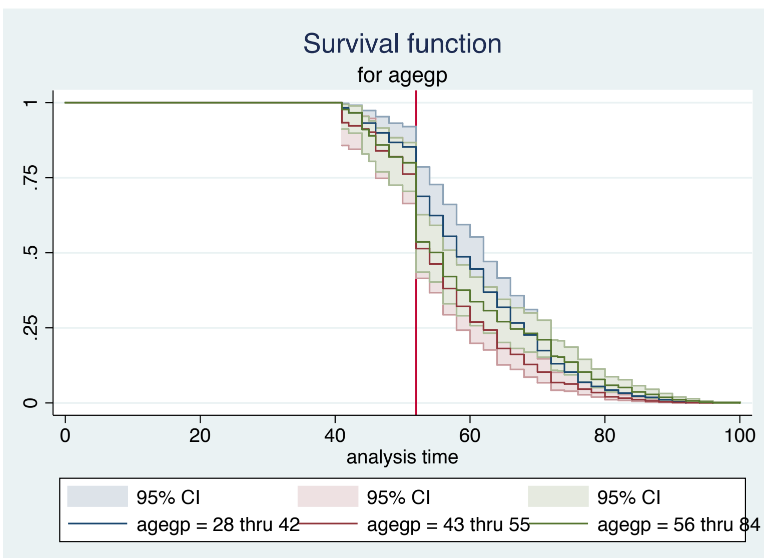

Figure 3: Survival function by age group

Survival differences by age group

Log-rank test for equality of survivor functions

agegp	Events observed	Events expected
28 thru 42	141	142.61
43 thru 55	240	206.36
56 thru 84	243	275.03
Total	624	624.00
	chi2(2) =	12.04
	Pr>chi2 =	0.0024

Wilcoxon (Breslow) test for equality of survivor functions

agegp	Events observed	Events expected	Sum of ranks
28 thru 42	141	142.61	-1390
43 thru 55	240	206.36	5405
56 thru 84	243	275.03	-4015
Total	624	624.00	0
	chi2(2) =	9.94	
	Pr>chi2 =	0.0069	

4.1 The challenge and motivation

One might argue that the emergence of these effects over time may have come about as a natural product of the life-cycle as evidenced by the change of the distributions in accordance with the birth cohort. That this was a period effect that may have happened without the impact of Chornobyl, as evident in Figure 4. Not only do the box plots reveal the median as the bar within the box, but they dislose the shape of the interquartile range as it changes over time by gender.

In that graph, we can observe the emergence of more suffering in the older birth cohorts in the later periods of time. So the challenge is to demystify this puzzle. Is this a natural by-product of the life-cycle or is this a daughter product of Chornobyl or both? And if it is both, to what extent and in what ways does Chornobyl contribute to it? To what extent is this the normal cycle of life? Why do women appear to suffer less over time than men? Note the smaller boxes for the women than for the men? Whey are there outliers on the part of the men more than on the part of the women?

We hope that our model building will provide some answers to this question, perhaps by revealing suggestive patterns over time that could be more attributable to one than to the other.

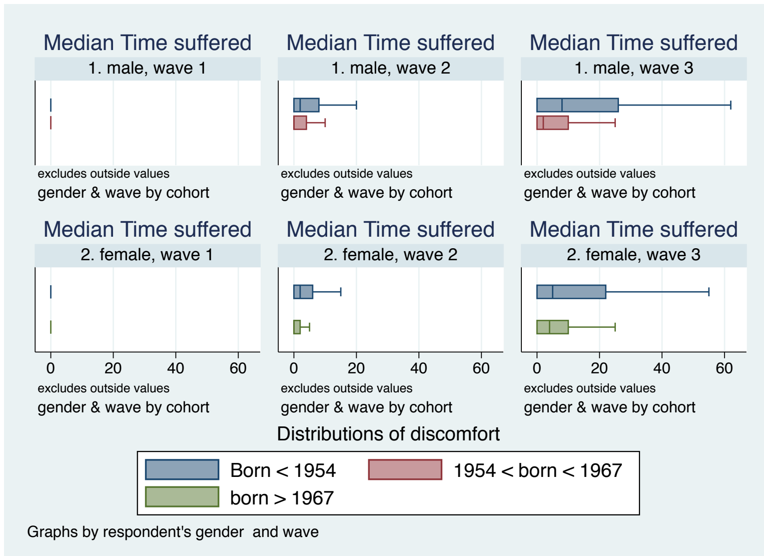

Figure 4: Somatization by gender, wave, and birth cohort

4.2 Is there a cumulative hazard over time?

If we observe that suffering increase over time, is this the result of Chornobyl, the current situation, or both. We observe the men suffering more than the women over time, but is there a difference in danger experienced by different age groups? An examination of the cumulative hazard divided by age group may provide a clue. In Figure 5, we can observe the pre-eminence of the middle aged group expressing a greater hazard over time.

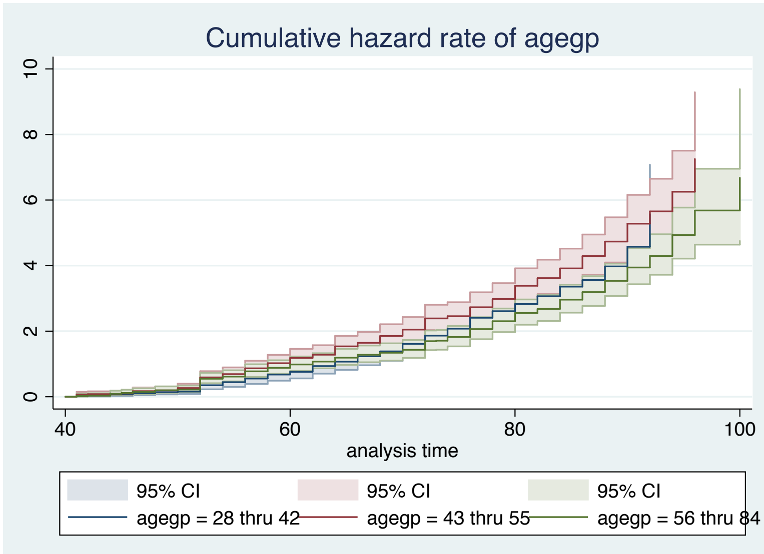

Figure 5: Cumulative hazard by age group

We might ask how much of this stems from Chornobyl and how much comes from economic, political, and social problems? If we examine the relationship of self-reported and medically diagnosed illness over time, Figure 6 suggests that the concern over illness may begin to flatten out somewhat over time, particularly when it pertains to medically diagnosed illnesses, the lowess line for which is colored orange as opposed to that of the self-report colored in cranberry. If the lowess smoother is a more accurate guide to the nonlinear pattern of anxiety over illness, anxiety over the number of medically diagnosed illnesses first increases and then decreases after reaching an apex. The anxiety over self-reported illness tends to exceed this but not decline so much. It appears that the female anxiety may be a little higher than that on the part of the males. In this connection, moderation of anxiety may be associated more with medical management of diagnosis to preclude public panic.

To further investigate these patterns we turn to Cox regression analysis, which has provided a more useful vehicle for our inquiry than the parametric models, the assumptions for which were violated by our data. We turn to the male model first.

5 Models of Recurrent Somatization

In the Cox regression models, we endeavor to identify what risk factors and buffers impact the relative hazard rates over time. Although these processes are recurrent, as shown in Figure 7, the frequency of relapse drops off steeply for both males and females after the first episode. The first episode is the most

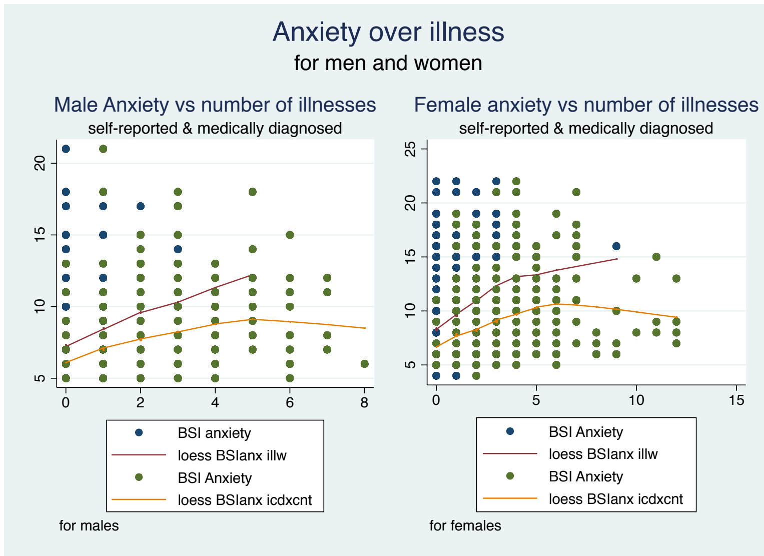

Figure 6: Cumulative hazard by age group

frequent and after that the hazard for them is much diminished. To conserve the power of our analysis, we will focus on the first one or two of these somatic spells [2] [6].

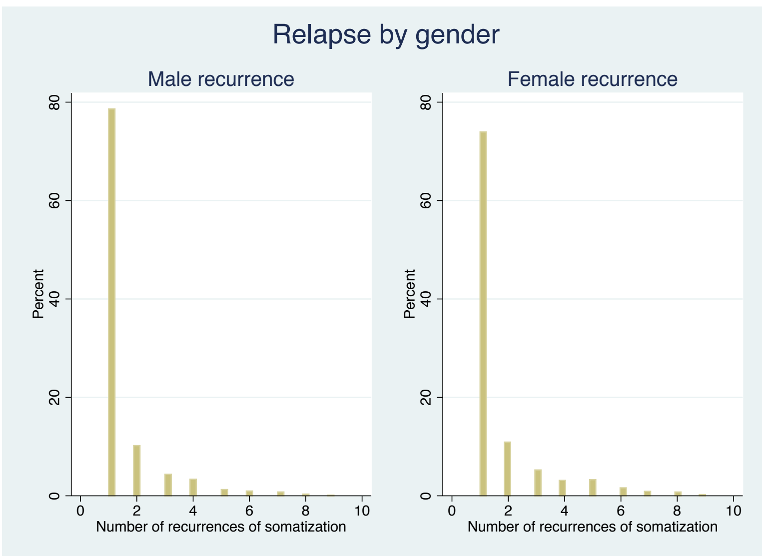

Figure 7: Histograms of relapse for males and females

If we use the default criteria for a Cox proportional hazards regression provided by Stata, we can examine the power we would have for the sample sizes for male and female relapses, respectively, and observe where the power for a two-sided test exceeds 0.80 with an alpha of 0.05 from Table 7. We could be justified in performing an analysis of one male spell and two female spells at most, if we would accept a two-sided hypothesis test estimation. Were we to accept a one-sided test condition, we could be able to squeeze in one extra episode for each gender [12].

5.1 Modeling strategy

The modeling strategy employed was a separate one for each episode with a particular gender. Each episode was analyzed on its own and therefore the model is not a hierarchical one. For this reason, the risk factors identified need not be common to both episodes, although it might seem that the factors in spell two are dependent upon those influencing spell one.

The strategy entailed forming a general unrestricted model that included basic sociodemographic variables, major negative life events, daily stresses and hassles, conditions of mental health measured by the Nottingham health profile along with those of the Brief symptom inventory, beliefs about the social and environmental milieu, including those concerning radiation in general and Chornobyl in particular. Two trims were performed. The first variable pruning was at a p=0.15 level and the second was at a p=0.10 level. The parameter estimates reported are those which remained.

Although there may have been a latent hierarchical relationship in the sequence of episodes, we did not require such a configuration in our models. It is possible that some of these factors may have had delayed or threshold effects that did not surface till later in time, for which reason they might not appear significant precursors until a later episode. Consequently, each episode was modeled separately without a requirement that the variables retained in the trimming maintain a preconceived hierarchical structure. In Tables 8 and 9, we present the results of the analysis of the male episodes one and two, respectively, without any preconceived notion of nesting, whether it be latent or not [4] [1].

5.2 Interpretation

5.2.1 The male model

In these models, positive coefficients represent coefficients in the log-hazard metric explaining the hazard for experiencing the spell of somatization under consideration. In the display below, the first category of the variable is the reference category and therefore is not included in the display of nominal predictors. When interpreting the impact of a dummy representation of a categorical predictor, the effect is always compared to that of the missing lower reference category. As for significant factors, the only significant factor for both spells of male somatization being analyzed is a percent belief in the air and water pol-

Table 6: Relapse by gender crosstabulation

Key
frequency
row percentage
column percentage

Number of recurrences of somatization	respondent´s gender 1. male	2. female	Total
1	98 41.53 39.36	138 58.47 36.80	236 100.00 37.82
2	60 41.10 24.10	86 58.90 22.93	146 100.00 23.40
3	34 38.64 13.65	54 61.36 14.40	88 100.00 14.10
4	20 32.79 8.03	41 67.21 10.93	61 100.00 9.78
5	15 36.59 6.02	26 63.41 6.93	41 100.00 6.57
6	12 42.86 4.82	16 57.14 4.27	28 100.00 4.49
7	7 38.89 2.81	11 61.11 2.93	18 100.00 2.88
8	3 50.00 1.20	3 50.00 0.80	6 100.00 0.96
Total	249 39.90 100.00	375 60.10 100.00	624 100.00 100.00

```
         Pearson chi2(7) =   2.2455   Pr = 0.945
likelihood-ratio chi2(7) =   2.2717   Pr = 0.943
             Cramr´s V =   0.0600
                 gamma =   0.0465  ASE = 0.060
        Kendall´s tau-b =   0.0281  ASE = 0.036
```

Table 7: Power computations for relapse sample sizes with Cox regression

```
*  Power analysis for males
. stpower cox, n(98 60 34) table

Estimated power for male model Cox PH regression
Wald test, log-hazard metric
Ho: [b1, b2, ..., bp] = [0, b2, ..., bp]
```

Power	N	E	B1	SD	Alpha*
.929346	98	98	-.69315	.5	.05
.765646	60	60	-.69315	.5	.05
.524277	34	34	-.69315	.5	.05

```
  * two sided

* Power analysis for females
. stpower cox, n(138 86 54) table

Estimated power for female model Cox PH regression
Wald test, log-hazard metric
Ho: [b1, b2, ..., bp] = [0, b2, ..., bp]
```

Power	N	E	B1	SD	Alpha*
.982629	138	138	-.69315	.5	.05
.895084	86	86	-.69315	.5	.05
.721338	54	54	-.69315	.5	.05

```
  * two sided

*  Power analysis for males
. stpower cox, n(98 60 34) table onesided

Estimated power for male model Cox PH regression
Wald test, log-hazard metric
Ho: [b1, b2, ..., bp] = [0, b2, ..., bp]
```

Power	N	E	B1	SD	Alpha*
.962954	98	98	-.69315	.5	.05
.850759	60	60	-.69315	.5	.05
.646542	34	34	-.69315	.5	.05

```
  * one sided

* Power analysis for females
. stpower cox, n(138 86 54) table onesided

Estimated power for female model Cox PH regression
Wald test, log-hazard metric
Ho: [b1, b2, ..., bp] = [0, b2, ..., bp]
```

Power	N	E	B1	SD	Alpha*
.992377	138	138	-.69315	.5	.05
.941692	86	86	-.69315	.5	.05
.816453	54	54	-.69315	.5	.05

```
  * one sided
```

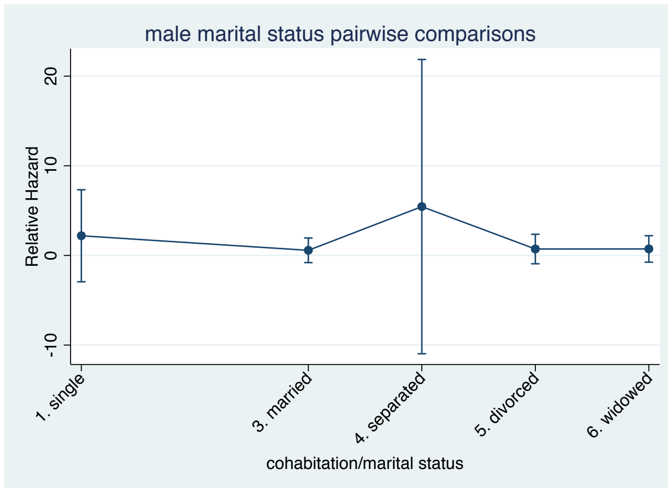

Figure 8: male pairwise marital status comparisons

lution being hazardous to one's health(airw). Because this is an observational study rather than a controlled experiment, this may be an effect rather than a cause in the relationship between the relative hazard and the somatization. Age levels did not play a significant role in the first male spell. But having an M.D.degree (8.educ) was almost significant as was concern a for nutritional deficiencies (defnw). There were no other significant factors apparent in this first male spell analysis.

What emerged as relevant factors in the analysis of the second male spell were appeared to be almost twice as informative, if we are to use the Nagelkerke pseudo-R^2 as a guide. At this stage, the middle age group appeared to be almost significant, but so did marital status considerations. In Figure 8, the categories of marital status with the tight confidence intervals are shown to be those male martial status categories which are significantly different from the others. Being married (3.marrw) appeared to reduce the relative hazard of somatization by 0.137. Being widowed(6.marrw) appears to reduced somatization by 89.05 % and being divorced and being divorced(5.marrw) is associated with a 75% reduction in somatization. Even though being separated appears to have a higher relative hazard than others, the variability of this is such that it is too uncertain that this is a fact. Health effects the family problems at home is also a substantially significant buffering effect (HP2pbfhm).

By the second spell, the percent belief in the hazardous effects of radiation (efradw)appear to have a small but significant effect on the hazard ratio of somatization, while the percent of air and water pollution (airw) appears to be the vector of this somatization among the men. In the first spell this appears to be positive, but in the second spell it turns negative–almost reminiscent of what we have observed in Figure 6 before.

Moreover, the men appear to have significant relationship between somatiza-

Table 8: Male proportional hazard regression models

Cox regression of male recurrent somatization by spell number

	spell1 b/t/p	spell2 b/t/p
1.agegp	-0.025	0.573#
	(-0.09)	(1.69)
	(0.925)	(0.091)
2.agegp	-0.122	0.459
	(-0.48)	(1.08)
	(0.631)	(0.280)
3.educ	-0.098	
	(-0.26)	
	(0.797)	
4.educ	0.066	
	(0.10)	
	(0.917)	
5.educ	-0.228	
	(-0.72)	
	(0.474)	
6.educ	-0.315	
	(-0.99)	
	(0.320)	
8.educ	0.678#	
	(1.83)	
	(0.067)	
trrepw	-0.002	
	(-0.37)	
	(0.712)	
defnw	0.006#	
	(1.75)	
	(0.081)	
airw	0.013**	-0.013**
	(2.59)	(-2.66)
	(0.010)	(0.008)

Continued in the next table ...

Table 9: Male proportional hazard regression model–continued

3.marrw		-1.989***
		(-4.82)
		(0.000)
4.marrw		-0.021
		(-0.05)
		(0.962)
5.marrw		-1.390**
		(-2.96)
		(0.003)
6.marrw		-2.212***
		(-3.82)
		(0.000)
suchrw		0.003
		(1.03)
		(0.304)
efradw		0.010*
		(2.45)
		(0.014)
radw		0.003
		(0.64)
		(0.522)
WHPsleep		0.012*
		(2.38)
		(0.017)
HP2pbfhm		-2.366*
		(-2.31)
		(0.021)
Nagelkerke-R2	0.144***	0.321***
LL_0	-285.604	-164.841
LL	-279.324	-153.623
num_x	10.000	12.000
time_at_risk_half_yrs	1603.000	788.000
n_subjects	81.000	58.000
n_depressed	81.000	58.000

# p<.1, * p<.05, ** p<0.01, *** p<0.001

tion in the second spell from a fear of radiation pollution(efradw). However, any relationship with reconstructed external dose fades from significance is not retained by the male model. Moreover, our index of perceived Chornobyl health risk is not retained by either model. The evidence in support of perceived Chornobyl health risk as somatization is not consistent with our data.

5.2.2 The female model

Somatization among the women provides a different perspective, which can be derived from Tables 10, 11, and 12. When we convert these coefficients to hazard ratios and then percents, we can observe what happens from spell one to spell two. With respect to sociodemographic characteristics, middle-agers appear to have a significant 85.1% hazard ratio in the first spell and but only a quasi-significant 63% relative risk in the second spell. The seniors are almost important in the second spell.

In the both first and second female spells, educational achievement appears to have significant and substantial impact on the relative risk. All categories of education, compared to the unseen non-high school grads, which serves as the reference category, have significant and very substantial impact. High school graduates (educ2) exhibit 475.9% relative risk, while the technical school(educ3) degree holders exhibit a 288.3% relative hazard in the first spell. College graduates (educ3) show a 312.4% relative risk, whereas masters level graduate(educ4) exhibit a 139.4% hazard ratio. Non-MD female doctorates (educ7) exhibit a 183.9% relative hazard in the first episode of somatization.

By spell two, these risk factors continue to have a significant impact, but in most educational categories the magnitude of these educational effects greatly subsides. The high school grads' (educ2) relative risk drops to 10.9% and those who have technical degrees (educ3) had their relative hazard decline to 7.1%. College grads saw their own risk drop down to less than one (0.814) %. The masters grads, like those with a technical degree, had their relative risk drop down about 7.2%, while the female non MD doctorates had their relative risk decline as well to 5.8%.

If we consider martial status, we notice that those who were cohabiting or married had their relative risk decrease ever so slightly, whereas those who became divorced or widowed observed a steep rise in their hazard rates.

In the first female spell, income counts for almost as much as education. Insufficiency for basic needs is associated with a relative hazard of 143.3%, with mere sufficiency is associated with 113.7% relative hazard. Those who just have enough plus a few extras exhibit an 85.5% risk. By female somatic spell two, income does not appear to be statistically significant. Nevertheless, there the second somatic spell appears to exhibit an association with fear of having eaten contaminated food, avoidance coping, and concern about political problems posing a danger to oneself and the relative hazard associated with these matters appear to be from 36.7% (for fear of having eaten some contaminated food) to 39.9% (for avoidance coping)

Table 10: Female proportional hazard regression model

title(Cox regression of female recurrent somatization by spell number)

Cox regression of female recurrent somatization by spell number

	spell1 b/t/p	spell2 b/t/p
agegp2	0.839***	0.875
	(3.84)	(1.41)
	(0.000)	(0.158)
agegp3	0.240	1.090#
	(0.83)	(1.81)
	(0.406)	(0.070)
educ2	2.560***	-1.217***
	(5.19)	(-4.04)
	(0.000)	(0.000)
educ3	2.059***	-1.629***
	(4.92)	(-3.50)
	(0.000)	(0.000)
educ4	2.139***	-3.810***
	(4.53)	(-4.21)
	(0.000)	(0.000)
educ5	1.881***	-1.605**
	(5.17)	(-3.18)
	(0.000)	(0.001)
educ6	1.332**	-1.838***
	(2.78)	(-3.65)
	(0.005)	(0.000)
educ7	1.609**	
	(2.84)	
	(0.004)	
cohabit	-1.566***	-1.743*
	(-4.23)	(-2.06)
	(0.000)	(0.040)
married	-0.533#	-0.566
	(-1.75)	(-0.98)
	(0.079)	(0.327)
separated	omitted	1.185
	(.)	(1.42)
	(.)	(0.155)
divorced	-2.117**	0.011
	(-3.25)	(0.02)
	(0.001)	(0.987)
widowed	-1.530**	-0.461
	(-2.78)	(-0.80)
	(0.005)	(0.426)

Continued in the next table ...

Table 11: Female proportional hazard regression model- part 2

Cox regression of female recurrent somatization by spell number

	spell1 b/t/p	spell2 b/t/p
inc1w	1.360***	
	(3.98)	
	(0.000)	
inc2w	1.128***	
	(3.87)	
	(0.000)	
inc3w	0.844**	
	(2.58)	
	(0.010)	
suchrw	-0.009***	-0.002
	(-4.25)	(-0.52)
	(0.000)	(0.606)
beerw	-0.015*	-0.002
	(-2.32)	(-0.25)
	(0.020)	(0.805)
hospw	-0.006#	-0.004
	(-1.80)	(-0.62)
	(0.073)	(0.535)
percRiskgp2	-1.029***	
	(-3.63)	
	(0.000)	
percRiskgp3	-0.446	
	(-1.57)	
	(0.117)	
cumdosewgp2	-0.451**	
	(-2.59)	
	(0.010)	

# p<.1, * p<.05, ** p<0.01, *** p<0.001

Continued in the next table ...

Table 12: Female proportional hazard regression model- part 3

	spell1 b/t/p	spell2 b/t/p
partime		0.588* (2.51) (0.012)
retired		-1.837*** (-4.66) (0.000)
unemployed		-0.493 (-1.09) (0.277)
deaw		-0.374** (-2.65) (0.008)
fdferw		-0.002 (-0.54) (0.586)
polprw		0.009* (2.48) (0.013)
CSavoid		0.083** (2.84) (0.005)
Nagelkerke-R2	0.451***	0.521***
LL_0	-555.648	-261.551
LL	-514.279	-230.256
num_x	21.000	22.000
time_at_risk_half_yrs	2531.000	1110.000
n_subjects	138.000	85.000
n_depressed	138.000	85.000

# p<.1, * p<.05, ** p<0.01, *** p<0.001

We can observe some trends with respect to concerns with Chornobyl survivor benefits, the number of hospital visits during the period, and beer drinking. All those with these concerns appear to reveal a relatively stable hazard rate from spell one to spell two. Both the number of beers consumed and those with concerns about Chornobyl survivor benefits have about the same level of relative risk from spell one to spell two which is approximately a relative hazard of around 36.7%. That is as far as the trends in somatization spells go.

Otherwise, somatic hazards are spell-specific. We can use these to help us understand the differences between female spell one and female spell two. We can use these to distinguish spell one from spell two. In female spell one, those in the middle level group perceiving Chornobyl health risk exhibited about a 13.1% relative risk. Those in the higher level group for Chornobyl health risk exhibited 23.55 (percRiskgp3) relative hazard, but that was not significant.

Spell one exhibited concerns with income that were not significant in female spell two. Spell one exhibited concerns about cumulative external dose that do not appear to be significant explanatory factors in spell two. In contrast, spell two exhibited concerns with number of deaths experienced, employment status, with those working part time exhibiting a 66.2% relative hazard and those retired only a 5.8 % while those who were unemployed revealing about a 22.4% relative risk. The characteristics were not statistically significant in female somatic spell one, but the concerns about external dose and perception of Chornobyl health risk do not appear to figure significantly in a second somatic relapse, as one can see from the three tables presenting these data.

With respect to our hypothesis about reconstructed external dose, we find that there is evidence of somatization in connection with it only in the first of the female spells. We find no such evidence in the second female spell.

As for perceived Chornobyl health risk, we find although there is evidence in support of middle-range perceived Chornobyl health risk in connection with somatization, but not in the higher range during the first female spell. But this evidence does not persist into the second spell. Therefore, the evidence for a connection between reccurrent spells of somatization and reconstructed external dose and perceived Chornobyl health threat does not persist beyond the first of two spells for males or females. This partial evidence may support the fading of concern and the beginning of recovery on the part of the sample

5.3 Model assessment

These female models explain more of the information than the male models did, as we can observe from the Nagelkerke pseudo-R^2 measures of 0.451 and 0.521. These are both much larger than the ones for the male models, so we can have more faith in their goodness of fit and their ability to explain the information in the dependent variable. However, we have to ask whether they fulfill the the model assumptions sufficiently for us to find them credible. The first of these two female somatic spell models fails to pass the proportional odds assumption test of no interaction with time (global χ^2 test = 71.69, df=21, p-value = 0.000, whereas the second female somatic spell model does fulfill it (global χ^2 test

= 6.11, df=22, p-value=0.9997). When we examine the model we find that many of the covariates are clearly time-dependent by definition so it is normal that they would interact with time. For example, age is by definition time-dependent and so is education. Marital status is generally time dependent also. Income is often time dependent. Cumulative external dose is time dependent as well. Aspects of employment status, such as retirement are time dependent. Often, but not always, the number of deaths experienced may depend on one's age and the age of his or her friends and associates. A model with such time dependent covariates is unlikely to not interact with time without the removal of such significant covariates. This removal would create a problematic situation of substantial specification error, to be sure. The extent to which we can trust such a model would be limited. Such validity would depend on the fulfillment of both the proportional hazards assumption and the linearity assumption [1].

The first female spell model is significantly different from linearity because of the age variable. If we remove the age variable from the model, there is no significant difference by a likelihood ratio test between the linear model and the optimal model recommended by the fractional polynomial program of Royston and Sauerbrei(1999) [10]. Royston and Lambert object to such a violation of the proportional hazards assumption, owing to the nature of the baseline hazard and the ratio that should be maintained throughout the study time for the hazard ratio to be reliable. Therefore, we would argue that this model does not meet that assumption and should not be considered validated [10]. The second female spell linear model is not significantly different from the optimal fit recommended by the program. Therefore, caution must be used in reposing full faith in the first female somatic spell model, but the second spell model appears to be valid insofar as it fulfills the required assumptions [11] [4].

6 Cure models

6.0.1 Objective

The cure models are attempts to explain with panel data the number of years cured of psycho- somatic disorder. Using the traditional definition of exhibiting and reporting no somatic symptoms for a period of two years, we test the repertoire of variables in two generalized estimating equations with exchangeable working correlations in order to identify risk factors and risk buffers conducive to cure of the male and female respondents. In the analysis that follows, we will attempt to find covariates that are directly related as well as those that are inversely related to the length of the time cured. We hope that they will provide the clues that suggest pathways to recovery from the psychological sequelae that follow from the experience of a nuclear event and identification of the risk factors that we can try to avoid or circumvent because they could impede or obstruct such a recovery. Our models are therefore again gender-specific. We now turn to the covariates identified as significant contributors

6.0.2 Modeling Strategy

The modeling strategy was a general-to-specific approach with two trimmings. The first was a simultaneous trim at p=0.15. The model was rerun and all variables not significant on at least the p=0.10 level were trimmed from the model. The resulting model is shown in Table 13 to explain the time cured. We used clustered-robust variance estimators and an exchangeable working correlation matrix to control for autocorrelation between the panels as well as to correct for mild levels of heteroskedasticity between the panels [9, 559-560].

6.0.3 Interpretation

6.0.4 The male model

The male model results, shown in Table 13, reveal what covariates are related to the time the male appears to cured. Having attained a higher level degree, such as a master's degree (b= 1.846, p=0.011), appears to be the only educational status related to male cured time. The relationship is a positive one, suggesting that the attainment of such a degree is associated with the time cured for males.

Among the stressors that appears to be related to the time the male reports that he is cured is the number of self-reported illnesses. The negative coefficient (-1.06 p=0.000) suggests that the more illnesses that reported, the shorter the cured time.

The level of danger posed by the general media (b=.026, p=0.004) is positively related to the time cured. This means that there is a reliance on the media but also a skepticism about what is read. A healthy skepticism appears to be significantly related to the time cured. Although this relationship is positive, the magnitude is not large. The relationship, albeit significant, appears to be small.

Another matter of trust appears to be significantly related to the time cured. There appears to be a suspicion on the part of the government on the part of those who experience more time cured. The significant negative relationship between trust in government (trgovw b = -0.026,p=.032) and the time cured suggests that a skepticism about what the government does may indicate an attitude conducive to being cured.

There is a quasi-significance of a belief in the serious threat posed by the economic problems (ecprw b= .0129, p=0.085) of the time. Although this is not clearly significant, it could be moderated or mediated by myriad other matters. Consistent with this belief is the experience of the great global financial crisis of 2008 (fcrisis2008 b=1.853, p=0.000) and the year 2009 (y2009 b=0.517, p=0.000), when the Russians shut off the gas to the Ukraine, almost crippling the economy for awhile.

Moreover, there is the residuum of Chornobyl, where higher exposure to external dose of ^{137}CS is significantly and positively related to the time cured (cumdosewgp b=0.988, p=0.012). Notwithstanding the statistical significance, the magnitude of the relationship is not large and therefore if this relationship exists, it may be a by-product of people knowing whether or not they may have been in areas where they were exposed or having done things that might have exposed them. But if the level of external dose is below that of biological reactivity, it is difficult to see this as anything other than some sort of epiphenomenon of shifting wind, consumed milk, or other foodstuffs possibly exposed. That notwithstanding, we find a direct significant relationship between reconstructed external dose and the length of cured time for men

We do not find a statistically significant relationship between perceived Chornobyl health risk on the part of men and their cured time, but we do find borderline evidence for it (b= 0.988, p=0.053). We would therefore not want to dismiss the possibility of it altogether.

Hypervigilance may arise when the situation or environment threatens the life, liberty, or wellbeing of people as a normal defense mechanism that characterizes human behavior. The perceived Chornobyl health risk is an index that we constructed to measure this process. The index comprises danger to oneself, one's family, and one's community from Chornobyl (Cronbach's alpha reliability = 0.9047 for males and alpha = 0.91 for females). We collapsed this into three approximately equal categories and named it perceived Risk group, and the higher level, compared to the lowest of three levels, is almost significantly related to the time cured as well (b =1.443, p=0.053)

6.0.5 The female model

The female model parameter estimates can be found in Table 14. We begin our analysis of this model with a view toward finding variables positively related to the length of time that a respondent is cured.

We discover that voluntary work (b=4.200, p=0.012) is strongly related to length of time cured. This focuses attention on things that can be done to help others accomplish their goals. Such social support is conducive to networking and learning about new situations and ways of doing things that could be useful in the future. It is constructive and usually appreciated and sometimes rewarded. It is noteworthy that this activity has the largest significant positive parameter estimate directly relating it to the time cured for all of those in the model.

The second largest significant positive parameter estimate is that of being widowed (b = 3.597, p=0.028). This is not to suggest that the death of a loved one is good for becoming cured.

For some reason, the experience of the great recession (fcrisis2008 b= 3.29, p=0.000) of 2008 appears to be significantly, positively, and strongly related to the time cured. This experience is associated with an increase by a factor of 1.8532 of the length of time cured. Why this is so is open to discussion.

The length of time cured is also significantly, positively, and strongly related to those who happen to be among those who are amongst those in the level level of perceived Chornobyl health risk (PercRskgp (high b=2.322, p=0.000). Even those in the medium risk group of those perceiving themselves to have a Chornobyl related health risk (b = 1.73, b= 0.024) are candidates for Chornobyl survivors benefits and possibly worthy of social support from the community

Table 13: Male population average panel model explaining cured time

GEE population-averaged model		Number of obs =	18814
Group variable:	id	Number of groups =	306
Link:	identity	Obs per group: min =	28
Family:	Gaussian	avg =	61.5
Correlation:	exchangeable	max =	62
		Wald chi2(25) =	58.80
Scale parameter:	31.28645	Prob > chi2 =	0.0002

(Std. Err. adjusted for clustering on id)

curedtime	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
agegp						
43 thru 55	-.0857086	.6133067	-0.14	0.889	-1.287768	1.11635
56 thru 84	.1617121	.7549818	0.21	0.830	-1.318025	1.641449
marrw						
1. single	-.7293201	.6698321	-1.09	0.26	-2.042167	.5835267
2. cohabitating	.0426368	.5198284	0.08	0.935	-.9762083	1.061482
3. married	-.0016057	.7848539	-0.00	0.998	-1.539891	1.53668
4. separated	-.8531811	.7751869	-1.10	0.271	-2.37252	.6661574
5. divorced	-.8989329	.89175	-1.01	0.313	-2.646731	.8488649
6. widowed	.3022	2.151009	0.14	0.888	-3.9137	4.5181
educ						
3. technical degree	1.23293	.5593482	2.20	0.028	.1366272	2.329232
4. did not finish college/bachelor´s	4.589419	1.975436	2.32	0.020	.7176363	8.461202
5. graduated college/bachelor´s	.844628	.6530018	1.29	0.196	-.435232	2.124488
6. finished specialist/master´s degree	1.846743	.7279158	2.54	0.011	.4200542	3.273432
7. doctor of science/phd	5.872193	4.650053	1.26	0.207	-3.241742	14.98613
8. doctor of medicine/md	1.410015	2.440406	0.58	0.563	-3.373092	6.193121
illw	-1.06021	.2829699	-3.75	0.000	-1.614821	-.5055995
shfamw	.0095043	.0069363	1.37	0.171	-.0040905	.0230991
trgovw	-.025643	.0119393	-2.15	0.032	-.0490436	-.0022423
efradw	-.0100545	.0063451	-1.58	0.113	-.0224906	.0023817
ecprw	.0129366	.0075043	1.72	0.085	-.0017715	.0276448
medw	.0262175	.0091204	2.87	0.004	.0083418	.0440931
cumdosewgp						
high	.9875014	.391651	2.52	0.012	.2198795	1.755123
percRiskgp						
medium	.1625371	.5281418	0.31	0.758	-.8726018	1.197676
high	1.442526	.7448995	1.94	0.053	-.0174505	2.902502
fcrisis2008						
experienced	1.853276	.2778737	6.67	0.000	1.308654	2.397899
1.y2009	.5173103	.1161545	4.45	0.000	.2896517	.7449688
_cons	-1.648419	1.206531	-1.37	0.172	-4.013176	.7163377

for their plight.

Being retired (b = 2.038, p=0.036) is also significantly positively associated with length of time cured. It means that the individual is not obligated to follow a work routine and may allocate his time according to his needs. If he needs particular therapy, he probably has a minimum of conflicting obligations that could preclude his devoting the time to such therapy. If a person is retired it usually means that he has the resources with which to retire and therefore need not worry nor want for basic needs. This is consistent with the coping by using social support (CSsocspt b=0.092, p = 0.093), an activity that is also positively related to length of time cured, although not so strongly as being retired. Even part-time work (b = 2.464, p =0.064) provides people with spare time to attend to other needs they might have or to rehabilitation they might need.These activities and situations entail assistance, social support, sympathy, and possible cooperation within the community and they all appear to be related to the length of the cure time.

The factors that appear to be risk factors in this connection are several. Belonging to the senior age group is significantly negatively related to the time cured for females. This factor is among the strongest with a negative relationship to cure time (b= -2.165, p=0.008). Compared to belonging to the youngest age group, the more one belongs to this senor age group, the less the time cured. It is possible that as people age, their recovery period becomes longer.

Perhaps the next largest negative factor is that of poverty and lack of the means for providing for basic necessities. This factor is of quasi-significance (inc1w b = - 1.659, p=0.056), but could account for much difficulty in surviving such a catastrophe. More significant but of half the magnitude is that of the number of self-reported illnesses (illw b = -.890, p=0.001). By definition, illness is the zero-sum challenge for time cured Co-morbidity could only compound the problem and is something to avoid if at all possible.

But there are other risk factors to avoid or circumnavigate if possible. Stresses and hassles from financial problems are almost negatively related to length of time cured (shfincw b=-.023 p=0.066). Length of stay in hospital is also inversely related to length of time curedd (hospw b = -0.045, p=0.000). There appears to be significant but small inverse relationship between length of cure time and the extent to which a person believes that radiation is dangerous to one's health (efradw b=-0.016,p=0.005). For this reason, it might help to educate people about the nature of radiation to preclude people falling prey to misinformation and the deleterious consequences from it.

Among women, there is almost more of a direct relationship to the length of cure with a trust in government (b = 0.018, p=0.054) than there was among the men, with whom the relationship was a negative one. Women trend to rely on neighbors for information (b=0.022, p=0.041) and this is for some reason related to the length of the cure time.

External dose was not quite statistically significant among the women(avcumdosw = .43, p=0.085). But the perceived Chornobyl health risk was significant at both the medium and high level groups for women with their cured time. For women the direct positive relationship between perceived Chornobyl health risk and the

Table 14: Female population average panel model explaining cured time

GEE population-averaged model		Number of obs	=	16568
Group variable:	id	Number of groups	=	272
Link:	identity	Obs per group: min	=	59
Family:	Gaussian	avg	=	60.9
Correlation:	exchangeable	max	=	62
		Wald chi2(29)	=	87.28
Scale parameter:	44.78055	Prob > chi2	=	0.0000

(Std. Err. adjusted for clustering on id)

curedtime	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
agegp						
43 thru 55	-.9285157	.8219829	-1.13	0.259	-2.539573	.6825412
56 thru 84	-2.16527	.8141678	-2.66	0.008	-3.761009	-.5695301
marrw						
2. cohabitating	2.000241	3.710651	0.54	0.590	-5.272501	9.272983
3. married	1.298648	.6562408	1.98	0.048	.0124398	2.584857
4. separated	.5278932	4.096031	0.13	0.897	-7.500181	8.555967
5. divorced	1.487017	1.000152	1.49	0.137	-.4732448	3.447279
6. widowed	3.597464	1.642099	2.19	0.028	.3790103	6.815918
emplw						
2. part time	2.463628	1.328642	1.85	0.064	-.1404629	5.067719
3. voluntary	4.200761	1.677414	2.50	0.012	.9130895	7.488432
4. retired	2.037617	.9733234	2.09	0.036	.1299387	3.945296
5. unemployed	.503545	.748502	0.67	0.501	-.963492	1.970582
inc1w	-1.659422	.8694164	-1.91	0.056	-3.363446	.044603
illw	-.8903498	.257273	-3.46	0.001	-1.394596	-.3861041
shfincw	-.0230765	.0125344	-1.84	0.066	-.0476436	.0014906
phlthw	-.0433138	.0191318	-2.26	0.024	-.0808114	-.0058162
mhlthw	.0456231	.0183426	2.49	0.013	.0096722	.081574
CSsocspt	.0917363	.0545692	1.68	0.093	-.0152174	.19869
CSavoid	-.127457	.0732522	-1.74	0.082	-.2710287	.0161146
hospw	-.045278	.0118937	-3.81	0.000	-.0685891	-.0219668
trgovw	.0180728	.0093938	1.92	0.054	-.0003388	.0364844
efradw	-.0156476	.0055407	-2.82	0.005	-.0265072	-.0047879
radw	.0147608	.0099592	1.48	0.138	-.0047589	.0342805
neiw	.021937	.0107515	2.04	0.041	.0008645	.0430096
avgcumdosew	.4325206	.251139	1.72	0.085	-.0597029	.924744
percRiskgp						
medium	1.17313	.5203283	2.25	0.024	.1533051	2.192954
high	2.321931	.6273219	3.70	0.000	1.092403	3.551459
fcrisis2008						
experienced	3.29209	.3952046	8.33	0.000	2.517503	4.066677
y2009	.7112443	.1557836	4.57	0.000	.4059141	1.016575
MiPTSD	.0361285	.0255037	1.42	0.157	-.0138578	.0861148
_cons	-2.780575	2.39593	-1.16	0.246	-7.476511	1.915361

length of cured time is significant at the 0.05 level.

6.0.6 Discussion

What are the common factors positively related to cure time among both men and women? Anything involving social support appears to be common among men and women. For the men, these factors included the aspects of the importance of education for men, particularly either not finishing college or getting a higher degree. For women, it meant being married or widowed, engaging in voluntary or part time work, whereas for men it meant avoiding illness. For both men and women the global financial crisis experience of 2008 and the year of 2009, when the Russians shut off the gas the resulted in the closure of many factories, were found to be related to the length of cured time. What explains this deserves further investigation than we can give it here, since our focus was on the sequelae of Chornobyl.

Because the relationship between cured time and perceived Chornobyl health risk on the part of women is a direct and positive relationship, education in connection with radiation could be one way in which to improve the cured time. Perhaps education with respect to levels of biological reactivity might allay some of the radio-phobia and mythology concerning exposure to various kinds of radiation.

We also have to address the hypotheses we wanted to test. We were examining in particular the relationship between somatization and external dose in mSV on the one hand, and somatization and perceived Chornobyl health risk, on the other. If hypothesis 2 is that radiation predicts medically diagnosed illnesses and hypothesis 7 is that perceived Chornobyl health threat predicts medically diagnosed illnesses we observe little evidence of that in our somatization Cox Regressions.

In the male model, there is no evidence of such prediction. If that were the case, then the high level of average cumulative dose would directly predict a higher hazard ratio, which it dose not. The coefficient of cumulative external dose in the female model in Table 11 is negative, indicating that the relation is an inverse one rather than a direct positive one which the hypothesis postulates.The findings are therefore inconsistent with hypothesis two.

According to the hypothesis 7 perceived risk predict medically diagnosed illness and if we extend this to somatization, the findings show an inverse relationship between somatization and perceived risk insofar as the higher the level of perceived risk, the less significant the effect in the female model in Table 11. Insofar as the manifestation of somatization would be in the diagnosis of medically diagnosed illnesses, we find no evidence in support of this interpretation.

When findings such as these are counterintuitive, it is likely that other omitted variables are impacting the relationship under consideration and that such specification error is leading to anomalous results.

References

[1] Allison, P. 2010 Survival analysis using SAS, 2nd ed. Cary, N.C.: SAS Institute, Inc., 72, 193-195.

[2] Blossfeld, H-P., Golsch,K., and Rohwer, G. 2007 Event history analysis with Stata Hillsdale, NJ: Lawrence Earlbaum, 109-112,191-195.

[3] Cleves, M., Gould, W., Gutierrez, R.G., and Marchenko, Y.V. 2010 An Introduction to Survival Analysis using Stata College Station, TX: Stata Journal, 14, 41, 60-62, 67, 182-183, 229-331, 360.

[4] Hosmer, D., Lemeshow, S., and May, S. 2007 Applied Survival Analysis New York, NY: John Wiley and Sons, Inc., 94, 122, 124, 145.

[5] Kalbfleisch, J. and Prentice, R.L. 1980 The Statistical Analysis of Failure Time Data New York, NY: Wiley, 30.

[6] Kleinbaum, D. G. and Klein, M. 2011 Survival Analysis A Self-Learning Text New York, NY: Springer, 3rd ed., 298, 366-367.

[7] Gutierrez, R. G. 2002 Parametric frailty and shared frailty survival models College Station, TX: Stata Journal, 22-44.

[8] Rabe-Hesketh, S. and Skrondal, A. 2006 Multilevel and Longitudinal Modeling using Stata, Vol.1, 3rd ed. College Station, TX:, Stata Press, 242.

[9] Rabe-Hesketh, S. and Skrondal, A. 2006 Multilevel and Longitudinal Modeling using Stata, Vol.2, 3rd ed. College Station, TX:, Stata Press, 559-560, 747-795.

[10] Royston, P. and Lambert, P.C. 2011 Flexible Parametric Survival Analysis Using Stata: Beyond the Cox Model College Station, TX: Stata Press, 296-299.

[11] Singer, J.D. and Willet,J.B. 2003 Applied Longitudinal Data Analysis New York: John Wiley and Sons, Inc., 334-495.

[12] StataCorp. 2011 Survival Analysis and Epidemiological Tables, Release 12 College Station, TX: Stata Press, 280-291.