A robust path analysis of anxiety and depression among Ukrainian residents of Kiev and Zhitomyr Oblasts after Chornobyl

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2 Introduction

In this analysis we examine some plausible causal etiological paths of Depression, Anxiety, and PTSD among residents of Zhitomyr and Kiev Oblasts in the years since Chornobyl. We will focus on omnibus measures of fit, as well as statistically significant paths, broken down into direct, indirect, and total effects. We employ path analysis to allow us to find out which variables are mediating ones and which have direct effects. The path analysis permits us to decompose total into direct, indirect, and spurious effects. After a short introduction to path analysis, we begin with an analysis of our depression models for men and women. We guard against selection bias by a random generation of phone numbers from a computer and the attachment of those phone numbers to the area codes provided by the telephone company.

In this report, we address hypotheses postulated in hypothesis 4, 5, and 8. Hypothesis 4 refer to direct effects of radiation on the radiation on measures of the Brief Symptom Inventory (BSI) measures of psychological health (e.g., anxiety and depression for men and Positive symptoms, anxiety, and depression for women). Hypothesis 5 pertains to direct effects of perceived exposure risk on BSI measures of psychological health, whereas hypothesis 8 refers to direct effects of perceived exposure on Nottingham measures of physical health (e.g., sleep for males and energy level, sleep, and physical ability for women).

These hypotheses were tested with our path models to facilitate distinction between direct and mediating effects on a representative sample of the population in the Kiev and Zhitomyr Oblasts. We discuss our findings in the passages that follow.

3 Structural path analysis

3.1 Nomenclature

Although we may refer to these models as causal, they are really only models of association. Causality requires an invariable space-time relationship between two phenomena that may be likened to a logical and probabilistic chain of events, where an effect temporally follows a cause, when the two these phenomena are spatially contiguous to one another, conditional upon specified conditions affecting these phenomena. For the time being, we exclude matters of quantum entanglement as being beyond the scope of this analysis.

To determine that the relationship between these two phenomena may be causal, we would have to be able to conduct a controlled experiment to demon-

strate that the cause is proximate, facilitating, necessary and/or sufficient for the effect to occur, given specific circumstances. Without such circumstances, we cannot know whether models are causal[4, 56-78]. In a sense, we are statistically analyzing what David Hume in his Enquiry Concerning Human Understanding (1748) referred to as an association and the models which we develop are to be construed only as reflections of a possible causal path.

3.2 Path effect specification

In path analysis, we endeavor to model reflections of a possible causal paths among variables. The coefficients in such a system are called path coefficients. Although some practitioners standardize these coefficients, we do not, lest we lose the sense of scale and mean location of the metric being used when interpreting the effects of different equations.

When all effects are in a regression model, the regression coefficients are called direct path coefficients. When a variable y intervenes between w and z, the indirect effect is computed by the product of the regression coefficients in each of the component paths from w to y and from y to z. The sum of all of the indirect paths plus the direct effect is called the total effect.

The *spurious or unmeasured effect* is that difference between the total effect and the zero-order effect (correlation if standardization is employed or regression coefficient if variables are not standardized) between the exogenous and the endogenous variable, where the zero-order correlation is the bivariate correlation between the exogenous and endogenous variable with 0 controls for other variables to hold them constant to partial out other effects [**?** , 359-360].

We use a robust path model, by controlling for the serial correlation across the waves by applying a cluster control of id across the waves of the study.

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3.3 Model structure

Because we make the working assumption that variables are fixed effects, we rely on the submodel structural equation formulation of Joreskog and Sorbom for observed variables, except that we adopt Sorbom's formulation of mean structures.

If and only there are no feedback loops, our models will be simplified to

$$y = \alpha + \gamma x + \zeta \tag{1}$$

with ϕ = covariance matrix among observed variables [2, 9,136-137], [5, 210].

However, in the event that our model is nonrecursive, we rely on their formulation of it as

$$y = \alpha + \beta y + \gamma x + \zeta \tag{2}$$

where α is a px1 vector of constants, β is an pxp matrix of parameter estimates for those endogenous observed variables, ξ is a nxq matrix of exogenous observed variables, and ζ= px1 vector of equation errors, with n= number of observations.

The mean of the vector is

$$y = (I - \beta)^{-1}(\alpha + \gamma\kappa) \tag{3}$$

The mean of vector ξ is denoted by vector, κ, which has an order of nx1.

3.4 Assumptions

Because the building blocks of path analysis consist of covariance structure analysis and regression analysis, the assumptions of linear structural equation modeling are are essential to assure statistical conclusion validity. The uncorrelated errors assumption ($E(\xi\zeta) = 0$) is an essential assumption. According to this principle, the errors of the equations are uncorrelated with the explanatory variables in the model. Otherwise, the equation errors could be driving both the explanatory and endogenous variable, rendering the explanatory variable endogenous rather than exogenous and rendering the model spurious.

What is not modeled is in the error term and if there are important omitted variables correlated with the explanatory variables, the errors will be correlated with the explanatory variables, allowing for omitted variable bias or specification error that can engender the same spurious result.

For these reasons, the optimal model building strategy of choice is one of a general-to-specific nature. There is no other way to minimize the probability of omitted variable bias assumption violations.

We make a working assumption of linearity of functional form. We have used basis functions to linearize nonlinear function forms and assume that these transformations will capture delayed effects or threshold effects sufficiently, even though this may never totally accomplished.

Any model that is to be estimated must be identified. Without adequate identification the model cannot be estimated with unique solutions for its variables. If the model is non-recursive, it contains feedback loops or cyclical effects. There must be enough variables from outside the loop to allow that loop to be estimated. The rank condition which is necessary and sufficient for this condition to hold should be tested for a model to be proposed.

Hidden in the the feedback loop is the assumption of a dynamic equilibrium. The dynamic equilibrium is otherwise known as covariance stationarity, which is necessary if the model is to be estimated by non-Bayesian methods. Covariance stationarity requires stability of the mean, the variance, and the autocovariance. From the stability of the variance derives the requirement of residual homoskedasticity. For this condition of stability of the mean to obtain, level shifts in the middle of a dataset being estimated by a model of the equations are not to be tolerated without proper modeling of those effects. If feedback loops obtain within the model, we assume that the moduli (absolute value) of the eigenvalues are all within the unit circle so that the system is stable in the

long run. Without such stability, variances could not be properly estimated. Also, without such just or over-identification, the variables in the system would not be estimable.

Although we construct our summary measures of Chornobyl related health threat from factor scores, in waves one though three, with alpha reliability coefficients in excess of 0.78, we make a simplifying working assumption in our exploratory mode that these variables are fixed effects without measurement error. This permits us to eschew use of the measurement equations of the structural equation modeling system and to rely on the submodel of Joreskog and Sorbom, plus Sorbom's formulation of mean structures [2, 9,136-137].

Regression models presume a causal direction from the exogenous to the endogenous variable variable and then from one to another endogenous variable. We assume that multicollinearity is not a problem in controlling for the effects of other variables. We also assume that our cluster control is robust enough to attend to issues that otherwise may have derived from serial correlation of our residuals and deviations from homoskedasticity. Finally, we assume that all models are stationary, lest we be unable to rely on the consistency of our statistical analysis.

In order for our models to accommodate a substantial number of variables simultaneously, we make a working assumption that our variables are fixed in that they are not subject to measurement error.

Linear structural equation models in general assume independence of observations and multivariate normality of the observed and latent variables. Sometimes joint normality is too restrictive and conditional normality or general symmetry may suffice. If too many of the variables appear to be ski jumps without clear modes or maxima, the models may not converge at all. However, there are estimation algorithms that such as asymptotic distribution free (ADF) or quasi-maximum likelihood (QML) which relax this assumption. When we request ADF, we obtain a kind of weighted least square which can correct for heteroskedasticity. WHen we request cluster robust estimates, the estimation method becomes QML, which relaxes the independence of observations by allowing clustering (correlation among id) across the waves, while requiring independence of the clustered observations [5, 57].

3.5 Maximum likelihood estimation

When models have a single target endogenous variable and there are no feedback loops contained within the models, they can be estimated with hierarchical ordinary least squares (OLS) [1]. When there are feedback loops within the models, and many of our models contain them, OLS estimation leads to inconsistent results. We therefore use maximum likelihood estimation to assure that the consistent estimation. Although there are goodness of fit indices for the model, they do not refer to each of the regression models; they refer to the overall model, which consists of many regression analysis. Given the nature of most of models, this form of estimation, is more optimal. Of course, we could use asymptotic distribution free weighted least squares, but the results would be

similar to those we have now. Therefore, we do not supply R^2 for each regression analysis, nor do we belabor the assessment of spurious effects for each regression. We focus on the amount and types of information instead.

If we want to trim the model, we sometimes bootstrap it to see which of the paths are fragile and can be dropped. Otherwise, we settle for what we get if the model fits and the parameter estimates are statistically significant. If the parameter estimates of a path are borderline or almost statistically significant, and the path makes logical sense and appears to be a reasonable one, we may leave the path in the model. For the most part, we trim out all paths that are not statistically significant at the 0.05 level.

3.6 Model-fitting

We use the standard variances to fit the model but clustered robust variances and standard errors to control for any heteroskedasticity and autocorrelation between waves with a working assumption that the larger robust variances do not preclude the model fit.

3.7 Advantages of path analysis

Structural equation modeling permits a full-information maximum likelihood analysis, which in a confirmatory mode, estimates linear models well, if the target endogenous variables, have a symmetrical mode, mean, or maximum value. They are excellent at handling linear, additive variables, whose models have Gaussian residuals. They are excellent at decomposing effects into direct, indirect, and total effects as long as those effects are linear and additive. We use standardized coefficients to avoid problems with different metrics when dealing with indirect and total effects. We refer to the standardized path coefficients, estimated with clustered robust variances, as *stdized* β in our analysis.

3.8 Disadvantages of path analysis

These algorithms generally cannot handle endogenous variables that are nonlinear and non-Gaussian, which often appear to be zero-inflated or appear to have a ski-jump distribution. Nor do they estimate interactions well, without some form of conditional estimation. Without special modifications found in M-Plus or Prelis 2, they they cannot handle dichotomous variables, ordinal variables, or categorical variables.

This form of model is not designed for variable selection and model-building where the models must be developed from data-mining. They fall prey to specification error and omitted variable bias under those circumstances.

4 Dose-Anxiety and Depression Physical response path models

4.1 The male model

We are interested in the paths that originate in exposure to radiation and/or perceived risk of exposure and find there way to depression, as defined by the BSI, and/or anxiety, also defined by the BSI. We are also interested in the paths that lead to health behaviors as defined by the Nottingham health profile. The ones we focus on in this paper include sleep, energy level, and physical ability. In focusing on these direct, indirect, and total effects stemming from actual and/or perceived exposure to radiation, we test aspects of hypotheses 4, 5, and 8. In Figure 1, we see a path diagram of findings that illustrates the complexity of our findings. However, a careful explanation will reveal the highlights of this diagram and show that it is not a confused as a first glance might suggest. In Table 2 we present the output of our analysis. For us to understand the either the table or the figure, we must be familiar with the variable names, which we list in the table below.

Table 1

variable name			variable label
age	byte	%8.0g	* Respondent´s age
airw1	byte	%8.0g	consider hazardous (in percent) - air and water pollution in 1986
cumdose1	float	%9.0g	cumulative external dose in mGys in wave 1
cumdose2	float	%9.0g	cumulative external dose in mGys in wave 2
cumdose3	float	%9.0g	cumulative external dose in mGys in wave 3
radchw1	byte	%8.0g	believed % of polution related to chornobyl in 1986
radchw2	byte	%8.0g	believed % of polution related to chornobyl in 1996
radchw3	byte	%8.0g	believed % of polution related to chornobyl NOW
crhtw1	float	%9.0g	Chornobyl related health threat: wave 1 alpha = .835
crhtw2	float	%9.0g	Chornobyl related health threat in wave 2 alpha=.822
crhtw3	float	%9.0g	Chornobyl rleated health threat in wave 3 alpha=0.833
fdferw1	byte	%8.0g	* Level (in %) of fear of eating radioactively contaminated food in 1986
BSIanx	byte	%9.0g	Brief symptom inventory anxiety subscale score
BSIdep	byte	%9.0g	Brief symptom inventory depression subscale score
whppa	float	%9.0g	Nottingham physical ability subscale
whpsleep	float	%9.0g	Nottingham sleep subscale

From the bottom of the output of Table 2, we find that there is a good fit between the data and the model.($LR\chi^2 = 237.10, df = 218, p > \chi^2 = 0.1796$ Notwithstanding a few feedback loops within the data, the stability index remains below unity (stability index= 0.4950), indicating that all the eigenvalues reside within the unit circle, suggesting that the model is stable. Table 2 lists the parameter estimates depicted in Figure 1.

In the path diagram in Figure 1, the reader will find numbers on the right hand side of the boxes that represent observed variables. The upper right hand number is the mean and the lower right hand number is the variance when the variables are exogenous. When the variables are endogenous, the numbers represent the constant in the regression model. The reader will also note that the errors are represented by circles and the number attached to the circle represents the error variance of the equation. The numbers along side the arrows represent the path coefficient of that path.

On the right hand side of the diagram, he will find BSI variables relating to anxiety and depression as well as Nottingham physical health variable of sleep. The number suffixes indicate the respective wave of the variable, as in cumdose1 or or perceived Chornobyl health threat or risk as in crhtw1(or crhrw1).

Figure 1 is color-coded to aid interpretation. Both arrows and variables boxes are colored to help the reader interpret the path diagram. The red arrows designate the links among cumulative external dose. Purple arrows indicate the links among perceived risk of exposure as well as direct effects projecting from them. Red arrows represent direct effects of external radiation dose. The blue arrows indicate the links between the depression variables, along with direct effects emanating from them. The forest green arrows represent the direct effects from the illness count variables.

Red boxes are Chornobyl related health risk at different waves. The light green box is the Nottingham weighted health profile subscale for energy level. Pale yellow boxes are medical conditions with black arrows coming from them. The Nottingham physical ability subscale has a gold filling. The injury from Chornobyl variables is colored with a rose fill and the arrows stemming from it have the same color. Illness count variables have a light khaki fill and a forest green border. Fear of consuming contaminated food is cyan colored, as are the arrows coming from it. The depression variables are blue with a medium blue border. The BSI depression is blue with a black order. The Nottingham sleep scale is a darker blue with medium blue order. Anxiety variables are colored orange and their arrows emanating from them are dark orange. The BSI positive symptom scale is a dark blue, whereas the cumulative external dose variables are yellow with a red outline, and the arrows coming from them are red as well. This color coding should greatly help the reader follow these paths when he wants to do so.

However, the version of the model that we present contains cluster robust variance estimates to accommodate the autocorrelation between our temporal waves of data. We use these parameter estimates from otherwise the same model to test our hypotheses 4, 5, and 8 relating to the direct relationships between radiation and BSI measures of psychological health – for example, positive symptoms, anxiety, and depression (4), perceived risk of exposure and BSI measures of psychological health (5), and perceived risk of exposure and Nottingham measures of physical health–for example, measures of sleep, energy level, and physical ability. For radiation, we use our reconstructed cumulative external dose measures (cumdose1, cumdose2, and cumdose3) representing the accumulated dose for the respective wave under consideration. For the perceived risk of exposure we use our factor scores of self-perceived Chornobyl health threat (crhrw1, crhrw2, crhrw3), perceived Chornobyl health threat to the family, and the number of cancer cases in Kiev and Zhitomyr Oblasts believed to be due to Chornobyl. The alpha reliability coefficients for these scores extended from 0.726 to 0.833, which are sufficiently high to warrant their application as summary scores for their respective waves.

Table 2 lists the parameter estimates in Figure 1 and Table 3 lists the direct effects with which we test hypotheses 4,5, and 8 pertaining to direct effects. We now turn our attention to those hypotheses and our tests of them.

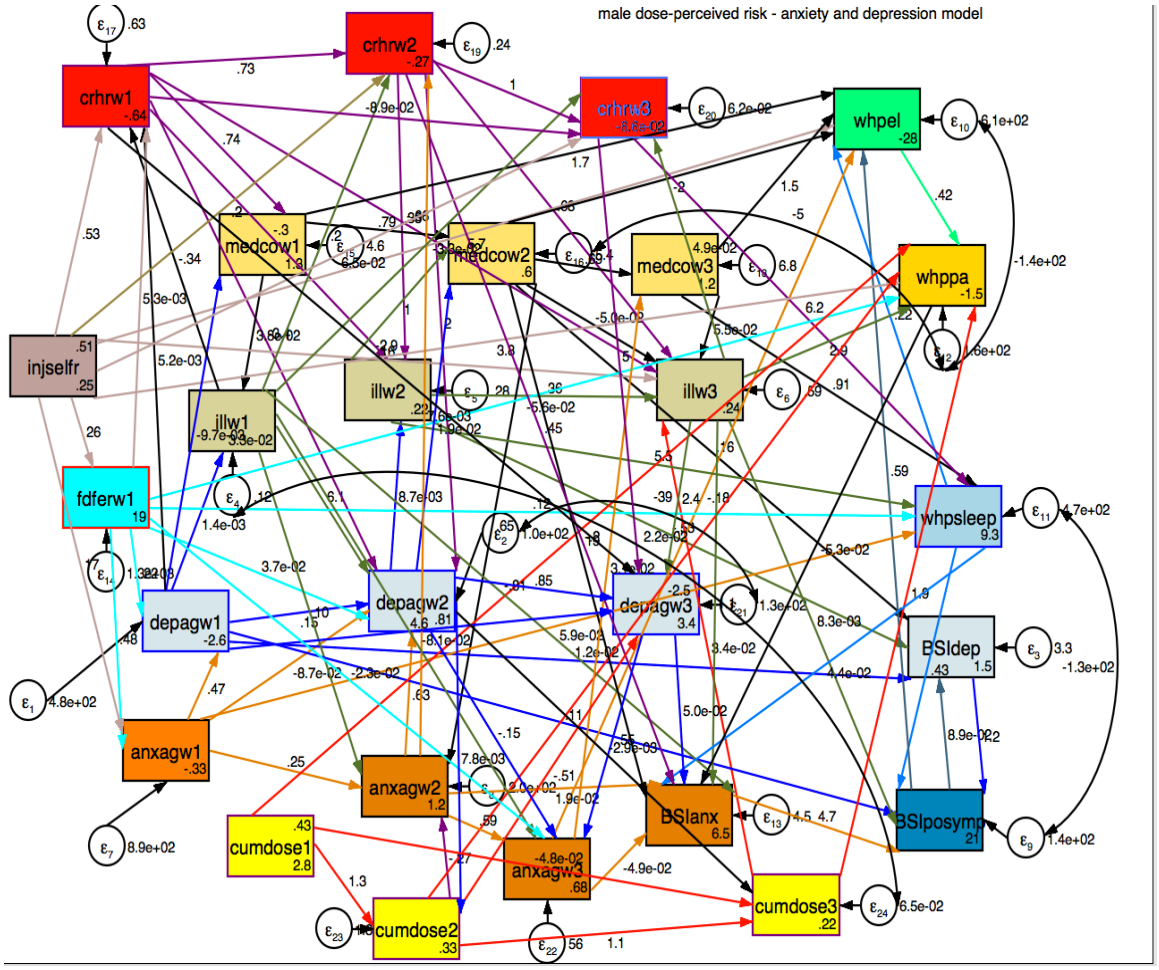

Figure 1: Dose-depression robust path diagram for males

Table 2 Male robust path model across three waves

Endogenous variables

Observed: depagw1 depagw2 BSIdep illw1 BSIposymp medcow1 crhrw1 depagw3 illw2 medcow2 anxagw3 cumdose2 cumdose3 anxagw2 BSIanx crhrw2 crhrw3 illw3 whpsleep whppa anxagw1 whpel fdferw1 medcow3

Exogenous variables

Observed: injselfr cumdose1

Structural equation model Number of obs = 337
Estimation method = ml
Log likelihood = -22103.854

	OIM Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Structural						
depagw1 <-						
anxagw1	.4656653	.038785	12.01	0.000	.389648	.5416825
fdferw1	.221002	.0373915	5.91	0.000	.1477159	.2942881
_cons	-2.642323	1.571464	-1.68	0.093	-5.722335	.4376891
depagw2 <-						
depagw1	.1487322	.0250064	5.95	0.000	.0997205	.1977439
illw1	6.080252	1.535141	3.96	0.000	3.07143	9.089074
crhrw1	-3.386895	1.061813	-3.19	0.001	-5.468009	-1.305781
anxagw2	.6306183	.0391735	16.10	0.000	.5538396	.707397
crhrw2	2.037551	1.103758	1.85	0.065	-.1257749	4.200876
anxagw1	-.0874851	.0220336	-3.97	0.000	-.1306702	-.0443001
fdferw1	.036976	.0178217	2.07	0.038	.0020461	.0719058
_cons	.8092437	.8361265	0.97	0.333	-.8295342	2.448022
BSIdep <-						
depagw1	-.012358	.003587	-3.45	0.001	-.0193884	-.0053276
BSIposymp	.0886065	.0061862	14.32	0.000	.0764817	.1007313
illw2	-.5295742	.1807309	-2.93	0.003	-.8838003	-.1753481
medcow2	.156662	.0363643	4.31	0.000	.0853892	.2279347
_cons	1.544855	.4211444	3.67	0.000	.719427	2.370283
illw1 <-						
depagw1	.0013721	.000584	2.35	0.019	.0002274	.0025168
medcow1	.0382453	.0088848	4.30	0.000	.0208314	.0556592
_cons	.0325941	.0231136	1.41	0.158	-.0127078	.0778959
BSIpo~p <-						
depagw1	.1101832	.0222601	4.95	0.000	.0665542	.1538122
BSIdep	1.162413	.3091475	3.76	0.000	.5564947	1.768331
BSIanx	4.654188	.3056497	15.23	0.000	4.055126	5.253251
illw3	.0082818	.6654817	0.01	0.990	-1.296038	1.312602
whpsleep	.430809	.0702742	6.13	0.000	.2930741	.568544
_cons	20.77652	2.222844	9.35	0.000	16.41982	25.13321

Continued...

Table 2 continued...

medcow1 <-						
depagw1	-.0097412	.0039309	-2.48	0.013	-.0174457	-.0020367
crhrw1	.7378275	.1412034	5.23	0.000	.4610739	1.014581
_cons	1.253832	.1367854	9.17	0.000	.9857371	1.521926
crhrw1 <-						
depagw1	.0052091	.0016688	3.12	0.002	.0019383	.0084798
illw1	-.3355756	.1284777	-2.61	0.009	-.5873873	-.0837639
fdferw1	.0053201	.0013856	3.84	0.000	.0026043	.0080358
injselfr	.5265579	.0928868	5.67	0.000	.344503	.7086127
_cons	-.635711	.0659172	-9.64	0.000	-.7649064	-.5065157
depagw3 <-						
depagw1	-.0808368	.0260342	-3.11	0.002	-.1318628	-.0298108
depagw2	.8545069	.0632176	13.52	0.000	.7306026	.9784111
crhrw1	-2.868767	1.168725	-2.45	0.014	-5.159425	-.5781081
cumdose2	-.5119753	.2410415	-2.12	0.034	-.984408	-.0395426
crhrw3	4.962363	1.233915	4.02	0.000	2.543935	7.380792
illw3	2.380201	.7498707	3.17	0.002	.9104819	3.849921
_cons	3.416534	.9275615	3.68	0.000	1.598547	5.234522
illw2 <-						
depagw2	.0086586	.001825	4.74	0.000	.0050816	.0122355
crhrw1	-.300316	.0543824	-5.52	0.000	-.4069036	-.1937284
crhrw2	.3268756	.0568675	5.75	0.000	.2154173	.4383339
_cons	.2228604	.0341586	6.52	0.000	.1559108	.2898099
medcow2 <-						
depagw2	.0188049	.0086629	2.17	0.030	.0018258	.0357839
medcow1	.7900784	.0571204	13.83	0.000	.6781244	.9020325
illw2	1.020291	.224627	4.54	0.000	.5800305	1.460552
_cons	.6037542	.1562121	3.86	0.000	.2975841	.9099243
anxagw3 <-						
depagw2	-.151756	.0418372	-3.63	0.000	-.2337555	-.0697565
illw1	4.625316	1.20634	3.83	0.000	2.260932	6.989699
depagw3	.547125	.0338606	16.16	0.000	.4807594	.6134907
anxagw2	.5875296	.0352472	16.67	0.000	.5184463	.6566129
fdferw1	-.0227886	.0111718	-2.04	0.041	-.0446849	-.0008923
_cons	.68458	.5506032	1.24	0.214	-.3945824	1.763742
cumdo~2 <-						
depagw2	.0077812	.0037447	2.08	0.038	.0004418	.0151207
cumdose1	1.335932	.0366442	36.46	0.000	1.264111	1.407753
_cons	.3250672	.0705308	4.61	0.000	.1868293	.463305
cumdo~3 <-						
depagw2	-.0029316	.0008374	-3.50	0.000	-.0045729	-.0012904
cumdose2	1.090185	.0119697	91.08	0.000	1.066724	1.113645
cumdose1	-.0480528	.0179132	-2.68	0.007	-.083162	-.0129437
_cons	.2164652	.0163878	13.21	0.000	.1843458	.2485846

Continued...

Table 2 - continued:

anxagw2 <-						
illw1	10.47204	2.164142	4.84	0.000	6.230397	14.71368
medcow2	.6482045	.2861303	2.27	0.023	.0873995	1.209009
cumdose2	-.2686022	.3190389	-0.84	0.400	-.8939069	.3567025
anxagw1	.2455488	.0206835	11.87	0.000	.2050098	.2860878
_cons	1.150379	1.075844	1.07	0.285	-.9582363	3.258995
BSIanx <-						
illw1	-.8103314	.3478046	-2.33	0.020	-1.492016	-.1286469
depagw3	.0497931	.0119458	4.17	0.000	.0263798	.0732063
medcow2	.1857208	.039794	4.67	0.000	.1077259	.2637157
anxagw3	-.0485756	.0152596	-3.18	0.001	-.0784839	-.0186673
anxagw2	.0189287	.0116181	1.63	0.103	-.0038425	.0416998
crhrw2	.4511425	.150507	3.00	0.003	.1561541	.7461309
illw3	1.050721	.1452175	7.24	0.000	.7661	1.335342
whpsleep	.0438481	.0055438	7.91	0.000	.0329824	.0547137
whppa	-.0530394	.011847	-4.48	0.000	-.076259	-.0298198
_cons	6.491549	.1948559	33.31	0.000	6.109638	6.87346
crhrw2 <-						
illw1	.1994248	.0773416	2.58	0.010	.0478381	.3510115
crhrw1	.7300735	.0321988	22.67	0.000	.6669651	.7931819
anxagw2	.0075591	.0016352	4.62	0.000	.0043542	.010764
injselfr	.1979594	.0596857	3.32	0.001	.0809775	.3149412
_cons	-.2675533	.04281	-6.25	0.000	-.3514594	-.1836472
crhrw3 <-						
illw1	-.0325263	.0385049	-0.84	0.398	-.1079945	.0429418
crhrw1	-.0888601	.0288373	-3.08	0.002	-.1453801	-.0323401
crhrw2	1.004691	.0299939	33.50	0.000	.9459039	1.063478
illw3	.048677	.0167445	2.91	0.004	.0158584	.0814956
injselfr	.0648296	.0306705	2.11	0.035	.0047165	.1249426
_cons	-.0656841	.0230685	-2.85	0.004	-.1108975	-.0204708
illw3 <-						
crhrw1	-.6626401	.0825767	-8.02	0.000	-.8244875	-.5007928
illw2	.3645234	.0792141	4.60	0.000	.2092665	.5197802
medcow2	-.0504486	.0183305	-2.75	0.006	-.0863757	-.0145216
cumdose3	.0338875	.0158201	2.14	0.032	.0028807	.0648943
crhrw2	.6826067	.0866224	7.88	0.000	.5128298	.8523835
medcow3	.0547458	.0158008	3.46	0.001	.0237769	.0857147
injselfr	.1629327	.0949665	1.72	0.086	-.0231982	.3490636
_cons	.2382241	.077343	3.08	0.002	.0866345	.3898137
whpsl~p <-						
illw2	5.46723	1.811319	3.02	0.003	1.917111	9.017349
crhrw3	6.172321	1.309173	4.71	0.000	3.606388	8.738253
anxagw1	.0587582	.0345017	1.70	0.089	-.0088638	.1263803
fdferw1	.120017	.0328531	3.65	0.000	.0556261	.1844079
medcow3	.9063692	.3091576	2.93	0.003	.3004315	1.512307
_cons	9.250741	1.932497	4.79	0.000	5.463115	13.03837

Cotinued...

Table 2 continued:

whppa <-						
cumdose2	-2.464111	2.717922	-0.91	0.365	-7.791141	2.862919
cumdose3	1.861966	2.443554	0.76	0.446	-2.927312	6.651243
illw3	2.925224	.7240669	4.04	0.000	1.506079	4.344369
whpel	.4150516	.0515961	8.04	0.000	.3139251	.5161781
fdferw1	-.0556639	.0189202	-2.94	0.003	-.0927469	-.0185809
injselfr	3.768502	1.540567	2.45	0.014	.7490451	6.787959
cumdose1	-.2028255	.8438909	-0.24	0.810	-1.856821	1.45117
_cons	-1.532686	1.304228	-1.18	0.240	-4.088926	1.023553
anxagw1 <-						
fdferw1	.476768	.0441856	10.79	0.000	.3901659	.5633701
injselfr	17.19816	3.450221	4.98	0.000	10.43585	23.96047
_cons	-.3293233	2.458456	-0.13	0.893	-5.147809	4.489162
whpel <-						
BSIposymp	.5858353	.0819895	7.15	0.000	.4251389	.7465317
medcow1	1.655453	.721277	2.30	0.022	.2417762	3.06913
medcow2	-1.971815	.6731024	-2.93	0.003	-3.291072	-.6525586
anxagw3	-.1833858	.0750121	-2.44	0.014	-.3304069	-.0363647
whpsleep	.2225837	.0665461	3.34	0.001	.0921557	.3530117
medcow3	1.47441	.4836956	3.05	0.002	.5263844	2.422436
injselfr	5.704205	2.82774	2.02	0.044	.161936	11.24647
_cons	-27.63459	5.426166	-5.09	0.000	-38.26968	-16.9995
fdferw1 <-						
injselfr	26.44194	4.002247	6.61	0.000	18.59768	34.2862
_cons	18.88554	2.850933	6.62	0.000	13.29782	24.47327
medcow3 <-						
medcow2	.6878779	.047691	14.42	0.000	.5944053	.7813505
anxagw3	.0307144	.0080572	3.81	0.000	.0149225	.0465063
_cons	1.178233	.1758234	6.70	0.000	.8336251	1.52284

Continued...

Table 2 continued:

Variance						
e.depagw1	483.1982	37.2242			415.481	561.9523
e.depagw2	103.6516	7.990537			89.11622	120.5579
e.BSIdep	3.313651	.2600849			2.841168	3.864708
e.illw1	.1243324	.0095958			.1068783	.1446369
e.BSIpos~p	138.7717	22.61546			100.8281	190.9942
e.medcow1	4.560483	.3517078			3.920717	5.304643
e.crhrw1	.6276486	.048562			.5393343	.7304241
e.depagw3	134.4602	11.45694			113.7799	158.8993
e.illw2	.2786289	.0214688			.239574	.3240505
e.medcow2	5.368882	.4156143			4.613079	6.248515
e.anxagw3	55.65276	4.287361			47.85332	64.7234
e.cumdose2	1.264669	.0974406			1.08741	1.470823
e.cumdose3	.064792	.0050129			.0556755	.0754011
e.anxagw2	201.3584	15.7084			172.8088	234.6248
e.BSIanx	4.537515	.3719578			3.864042	5.328371
e.crhrw2	.2428525	.0187097			.2088165	.2824362
e.crhrw3	.061948	.0047723			.0532664	.0720446
e.illw3	.5884159	.0453373			.5059406	.6843359
e.whpsleep	465.6555	35.90016			400.3507	541.6128
e.whppa	163.9245	20.28351			128.623	208.9147
e.anxagw1	887.7132	68.38687			763.3058	1032.397
e.whpel	612.5691	47.70664			525.8524	713.586
e.fdferw1	1349.218	103.9399			1160.134	1569.12
e.medcow3	6.834291	.5265655			5.876388	7.948341
Covariance						
e.depagw2						
e.depagw3	-38.7363	9.46069	-4.09	0.000	-57.27891	-20.19369
e.illw1						
e.cumdose3	.0218235	.0052092	4.19	0.000	.0116136	.0320334
e.BSIpos~p						
e.whpsleep	-134.507	35.56823	-3.78	0.000	-204.2195	-64.79457
e.medcow2						
e.whppa	-5.00205	1.647205	-3.04	0.002	-8.230512	-1.773588
e.whppa						
e.whpel	-135.6901	36.17668	-3.75	0.000	-206.5951	-64.78511

LR test of model vs. saturated: chi2(218) = 237.10, Prob > chi2 = 0.1786

4.1.1 Findings regarding direct effects

Table 3 contains the direct effects. The target variable has an arrow pointing to it. Beneath it is the panel of direct effects, organized in according to the point of origin. The variable of origin or starting point of the path is listed below the arrow.

4.1.2 Hypothesis 4

Hypothesis 4, 5 and 8 (part 1 and 2) refer to direct effects. Hypothesis 4 refers to the direct effects of radiation (cumdose1, cumdose2, cumdose3 for waves 1, 2, and 3) on the BSI measures of depression, anxiety, and positive symptoms. Hypothesis 5 refers to Chornobyl related health risk for each of three waves–respectively,crhrw1, crhrw2, and crhrw3, on such measures. Hypothesis 8 refers to direct effects of perceived exposure on Nottingham measures of physical health of sleep, energy level, and physical ability.

Although hypothesis 4 suggests a test of the relationship between external dose and BSI depression, our findings listed on page 17, table 3 reveal no direct path from any of the cumulative dose variables to BSI depression among males, so we find no empirical basis in support of hypothesis 4 with respect to male BSI depression.

Nor do we find in the BSIanx panel of Table 3 (page 21) any empirical evidence of statistically significant paths between the reconstructed cumulative external dose variable at any wave and BSI measured anxiety, for which reason we infer that hypothesis 4 with respect to anxiety measured by the BSI is not supported by our data.

Even if we broaden the scope to any psychological symptoms contained in the BSI positive symptom subscale, we do not find any empirical evidence of a relationship consistent with the hypothesis in the BSIposymp panel of Table 3 on page 18.

4.1.3 Evidence of other radiation effects

There are however effects emanating from radiation. There is a path, going from cumulative external dose to self-reported anxiety symptoms in wave 2. But this was not part of our hypotheses. We also find evidence of significant effects from cumulative external dose to physical ability, measured by the Nottingham, in all waves. However, in waves 1 and 2 the sign of the relationship is negative, suggesting an inverse relationship. Only in wave 3 is the sign of the relationship positive (page 25, Table 3).

4.1.4 Hypothesis 5

Hypothesis 5 posits significant direct effects of the perception of exposure associated with the BSI measures. These paths are colored lavender in Figure 1.

When we examine the Table 3 male BSI positive symptoms panel on page 18, we observe no evidence of a statistically significant relationship between perceived exposure and positive symptoms, as measured by the BSI (for crhrw1, crhrw2, and crhrw3 have no direct path extending to BSI positive symptoms).

When we examine the BSIdep panel for males (Table 3, page 17), we again find no direct path from perceived risk of exposure at any wave to depression, measured by the BSI.

Although we find no evidence of a direct relationship between perceived exposure in waves 1 or 2, we do find a statistically significant direct relationship between perceived exposure in wave 2 and BSI anxiety ($stdized\ \beta = 0.451\ z = 3.00\ p = 0.003$). However, direct effects do not tell the whole story.

4.1.5 Evidence of similar effects

There is evidence for some similar effects about which we posed no hypotheses. Injury due to Chornobyl and fear of eating contaminated food have statistically significant direct effects on self-reported anxiety symptoms in wave 1. This anxiety significantly directly impacts anxiety in wave 2, where illness in wave 1 and a medical condition in wave 2 also directly and significantly impact self-reported anxiety symptoms in wave 2, which directly and significantly is linked to self-expressed anxiety in wave3 (page 20, Table 3).

4.1.6 Hypothesis 8

Hypothesis eight posits significant direct effects from perceived risk of exposure to Nottingham health behaviors–including sleep, energy level, and physical ability. Table 3, page 23 lists the findings. We find no path from wave 1 or wave 2 perceived risk of exposure to sleep, measured by the Nottingham. However, a statistically significant direct effect from wave 3 perceived risk $crhrw3\ stdized\ \beta = .228,\ z = 4.71,\ p = 0.003$) is found, so we have some evidence in support of this hypothesis.

If we examine the Nottingham energy level panel in Table 3, page 25, we find no evidence in support of the hypothesis that there is a statistically significant direct effect between perceived risk of exposure and energy level. Nor do we find any evidence in support of a direct effect from perceived risk and physical ability.

4.1.7 Evidence of other perceived exposure effects

There are some interesting other direct effects not mentioned in the hypotheses. Perceived exposure and medical condition in wave 1 appear to be directly related. In waves 2 and 3, we notice significant relationships between perceived exposure, illness counts, and self-reported depressive symptoms. In wave 3, we also find a significant positive direct relationship between perceived risk of exposure and sleep, which then impacts anxiety, as measured by the BSI.

Fear of eating contaminated food is very similar to fear of having been exposed, except this fear may have stemmed from previous exposure, fear of it, or fear of current or future exposure. Nevertheless, fear of eating contaminated food is related to having injured yourself as a result of Chornobyl, Nottingham physical ability, sleep, self-expressed depressive symptoms in waves 1 and 2, which in turn is linked to anxiety. This fear of consuming contaminated food, which may be based in milk consumption in the days after Chornobyl, appears to be more interrelated that many other variables of interest. In the

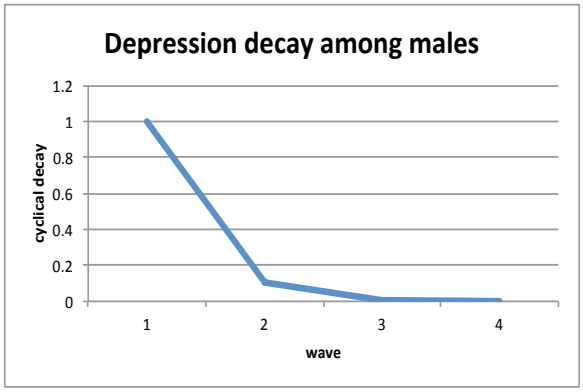

Figure 2: Depression decay for males

male model, the only variable that is directly explains this fear of eating contaminated food is the variable that asks whether the respondent was injured as a result of Chornobyl.

From the path diagram, we observe a potential for a vicious cycle and traumatic cascade of psychological effects in the feedback loop between BSI positive symptoms and BSI depression. One possibility is that injury from Chornobyl may follow from a fear of having consumed contaminated foods or fluids, possibly because of delayed and/or partial release of information concerning the hazard to humans and animals from the release of radioactivity and the ways through which it could enter the food chain. Conflicting reports of the nature of the danger might also aggravate the situation. If we relax the assumption of temporal equidistance for the waves (because wave 1 = 1 year, and wave 2 = 10 years, and wave 3 = 12 years) and assume that a standardized input of 1.0 for the initial input, partialled completely from other effects (such as the earlier wave 1 depression) so we are focusing only on the impact of recycled effect, we can observe the approximate BSI positive symptom-BSI depression impact-response function in males as the decay shown in Figure 2.

The computation is not complicated. It follows the $1 + b + b^2 + b^3 \cdots$ that results from $1/(1 - b)$, where b = product of standardized path coefficients of the two variables in the cycle. At wave 1, the standardized coefficients of BSI depression and BSI positive symptom are multiplied by one another to obtain the wave 2 level. For wave 3, the product of this process is multiplied by the result obtained for the previous wave. The process is repeated until the effect is negligible.

This could lead to anxiety in waves 1,2, 3, and BSI anxiety; this could lead to BSI positive symptoms, and then to BSI depression feed back to positive symptoms. From the positive symptoms, there could be an impact on energy level and physical ability. Fear of consumption of contamination could lead to lack of sleep, and from there to anxiety, and from there to positive symptoms

and around again. A sense of injury from Chornobyl could be followed by an increase illness count in wave3 and more anxiety. Having a medical condition could impact sleep rendering one more vulnerable to positive symptoms, which could aggravate the situation. We might find more evidence for this in our study of indirect effects or the PTSD that resulted from this catastrophe.

Table 3 Standardized Male Direct effects

Direct effects

	OIM Coef.	Std. Err.	z	P>|z|	Std. Coef.
Structural					
depagw1 <-					
anxagw1	.4656653	.038785	12.01	0.000	.544041
fdferw1	.221002	.0373915	5.91	0.000	.2678209
injselfr	0	(no path)			0
depagw2 <-					
depagw1	.1487322	.0250064	5.95	0.000	.2841294
depagw2	0	(no path)			0
illw1	6.080252	1.535141	3.96	0.000	.1304622
medcow1	0	(no path)			0
crhrw1	-3.386895	1.061813	-3.19	0.001	-.186601
illw2	0	(no path)			0
medcow2	0	(no path)			0
cumdose2	0	(no path)			0
anxagw2	.6306183	.0391735	16.10	0.000	.6698724
crhrw2	2.037551	1.103758	1.85	0.065	.1105279
anxagw1	-.0874851	.0220336	-3.97	0.000	-.1952555
fdferw1	.036976	.0178217	2.07	0.038	.0856011
injselfr	0	(no path)			0
cumdose1	0	(no path)			0
BSIdep <-					
depagw1	-.012358	.003587	-3.45	0.001	-.139423
depagw2	0	(no path)			0
BSIdep	0	(no path)			0
illw1	0	(no path)			0
BSIposymp	.0886065	.0061862	14.32	0.000	.7116073
medcow1	0	(no path)			0
crhrw1	0	(no path)			0
depagw3	0	(no path)			0
illw2	-.5295742	.1807309	-2.93	0.003	-.1096762
medcow2	.156662	.0363643	4.31	0.000	.1670778
anxagw3	0	(no path)			0
cumdose2	0	(no path)			0
cumdose3	0	(no path)			0
anxagw2	0	(no path)			0
BSIanx	0	(no path)			0
crhrw2	0	(no path)			0
crhrw3	0	(no path)			0
illw3	0	(no path)			0
whpsleep	0	(no path)			0
whppa	0	(no path)			0
anxagw1	0	(no path)			0
whpel	0	(no path)			0
fdferw1	0	(no path)			0
medcow3	0	(no path)			0
injselfr	0	(no path)			0
cumdose1	0	(no path)			0

Continued...

Table 3 Direct effects continued:

illw1 <-					
depagw1	.0013721	.000584	2.35	0.019	.122163
illw1	0	(no path)			0
medcow1	.0382453	.0088848	4.30	0.000	.2334843
crhrw1	0	(no path)			0
anxagw1	0	(no path)			0
fdferw1	0	(no path)			0
injselfr	0	(no path)			0
BSIpo~p <-					
depagw1	.1101832	.0222601	4.95	0.000	.1547842
depagw2	0	(no path)			0
BSIdep	1.162413	.3091475	3.76	0.000	.144739
illw1	0	(no path)			0
BSIposymp	0	(no path)			0
medcow1	0	(no path)			0
crhrw1	0	(no path)			0
depagw3	0	(no path)			0
illw2	0	(no path)			0
medcow2	0	(no path)			0
anxagw3	0	(no path)			0
cumdose2	0	(no path)			0
cumdose3	0	(no path)			0
anxagw2	0	(no path)			0
BSIanx	4.654188	.3056497	15.23	0.000	.5645547
crhrw2	0	(no path)			0
crhrw3	0	(no path)			0
illw3	.0082818	.6654817	0.01	0.990	.0003419
whpsleep	.430809	.0702742	6.13	0.000	.4649516
whppa	0	(no path)			0
anxagw1	0	(no path)			0
whpel	0	(no path)			0
fdferw1	0	(no path)			0
medcow3	0	(no path)			0
injselfr	0	(no path)			0
cumdose1	0	(no path)			0
medcow1 <-					
depagw1	-.0097412	.0039309	-2.48	0.013	-.1420625
illw1	0	(no path)			0
medcow1	0	(no path)			0
crhrw1	.7378275	.1412034	5.23	0.000	.3103305
anxagw1	0	(no path)			0
fdferw1	0	(no path)			0
injselfr	0	(no path)			0
crhrw1 <-					
depagw1	.0052091	.0016688	3.12	0.002	.180617
illw1	-.3355756	.1284777	-2.61	0.009	-.1306897
medcow1	0	(no path)			0
crhrw1	0	(no path)			0
anxagw1	0	(no path)			0
fdferw1	.0053201	.0013856	3.84	0.000	.2235449
injselfr	.5265579	.0928868	5.67	0.000	.2833524

Contined...

Table 3 Direct effects continued:

depagw3 <-					
depagw1	-.0808368	.0260342	-3.11	0.002	-.1484881
depagw2	.8545069	.0632176	13.52	0.000	.8216501
illw1	0	(no path)			0
medcow1	0	(no path)			0
crhrw1	-2.868767	1.168725	-2.45	0.014	-.1519773
depagw3	0	(no path)			0
illw2	0	(no path)			0
medcow2	0	(no path)			0
anxagw3	0	(no path)			0
cumdose2	-.5119753	.2410415	-2.12	0.034	-.0731263
cumdose3	0	(no path)			0
anxagw2	0	(no path)			0
crhrw2	0	(no path)			0
crhrw3	4.962363	1.233915	4.02	0.000	.2585866
illw3	2.380201	.7498707	3.17	0.002	.1284702
anxagw1	0	(no path)			0
fdferw1	0	(no path)			0
medcow3	0	(no path)			0
injselfr	0	(no path)			0
cumdose1	0	(no path)			0
illw2 <-					
depagw1	0	(no path)			0
depagw2	.0086586	.001825	4.74	0.000	.2469075
illw1	0	(no path)			0
medcow1	0	(no path)			0
crhrw1	-.300316	.0543824	-5.52	0.000	-.4718235
illw2	0	(no path)			0
medcow2	0	(no path)			0
cumdose2	0	(no path)			0
anxagw2	0	(no path)			0
crhrw2	.3268756	.0568675	5.75	0.000	.5056324
anxagw1	0	(no path)			0
fdferw1	0	(no path)			0
injselfr	0	(no path)			0
cumdose1	0	(no path)			0
medcow2 <-					
depagw1	0	(no path)			0
depagw2	.0188049	.0086629	2.17	0.030	.1041334
illw1	0	(no path)			0
medcow1	.7900784	.0571204	13.83	0.000	.5731023
crhrw1	0	(no path)			0
illw2	1.020291	.224627	4.54	0.000	.198132
medcow2	0	(no path)			0
cumdose2	0	(no path)			0
anxagw2	0	(no path)			0
crhrw2	0	(no path)			0
anxagw1	0	(no path)			0
fdferw1	0	(no path)			0
injselfr	0	(no path)			0
cumdose1	0	(no path)			0

Continued:

Table 3 Direct effects continued:

anxagw3 <-					
depagw1	0	(no path)			0
depagw2	-.151756	.0418372	-3.63	0.000	-.1406681
illw1	4.625316	1.20634	3.83	0.000	.0919928
medcow1	0	(no path)			0
crhrw1	0	(no path)			0
depagw3	.547125	.0338606	16.16	0.000	.5274299
illw2	0	(no path)			0
medcow2	0	(no path)			0
anxagw3	0	(no path)			0
cumdose2	0	(no path)			0
cumdose3	0	(no path)			0
anxagw2	.5875296	.0352472	16.67	0.000	.5785019
crhrw2	0	(no path)			0
crhrw3	0	(no path)			0
illw3	0	(no path)			0
anxagw1	0	(no path)			0
fdferw1	-.0227886	.0111718	-2.04	0.041	-.048902
medcow3	0	(no path)			0
injselfr	0	(no path)			0
cumdose1	0	(no path)			0
cumdo~2 <-					
depagw1	0	(no path)			0
depagw2	.0077812	.0037447	2.08	0.038	.0523835
illw1	0	(no path)			0
medcow1	0	(no path)			0
crhrw1	0	(no path)			0
illw2	0	(no path)			0
medcow2	0	(no path)			0
cumdose2	0	(no path)			0
anxagw2	0	(no path)			0
crhrw2	0	(no path)			0
anxagw1	0	(no path)			0
fdferw1	0	(no path)			0
injselfr	0	(no path)			0
cumdose1	1.335932	.0366442	36.46	0.000	.8925045
cumdo~3 <-					
depagw1	0	(no path)			0
depagw2	-.0029316	.0008374	-3.50	0.000	-.0185134
illw1	0	(no path)			0
medcow1	0	(no path)			0
crhrw1	0	(no path)			0
illw2	0	(no path)			0
medcow2	0	(no path)			0
cumdose2	1.090185	.0119697	91.08	0.000	1.022656
anxagw2	0	(no path)			0
crhrw2	0	(no path)			0
anxagw1	0	(no path)			0
fdferw1	0	(no path)			0
injselfr	0	(no path)			0
cumdose1	-.0480528	.0179132	-2.68	0.007	-.0301144

Continued...

Table 3 Direct effects continued:

anxagw2 <-					
depagw1	0	(no path)			0
depagw2	0	(no path)			0
illw1	10.47204	2.164142	4.84	0.000	.2115284
medcow1	0	(no path)			0
crhrw1	0	(no path)			0
illw2	0	(no path)			0
medcow2	.6482045	.2861303	2.27	0.023	.1101963
cumdose2	-.2686022	.3190389	-0.84	0.400	-.037561
anxagw2	0	(no path)			0
crhrw2	0	(no path)			0
anxagw1	.2455488	.0206835	11.87	0.000	.5159186
fdferw1	0	(no path)			0
injselfr	0	(no path)			0
cumdose1	0	(no path)			0
BSIanx <-					
depagw1	0	(no path)			0
depagw2	0	(no path)			0
BSIdep	0	(no path)			0
illw1	-.8103314	.3478046	-2.33	0.020	-.1054056
BSIposymp	0	(no path)			0
medcow1	0	(no path)			0
crhrw1	0	(no path)			0
depagw3	.0497931	.0119458	4.17	0.000	.3139319
illw2	0	(no path)			0
medcow2	.1857208	.039794	4.67	0.000	.2033195
anxagw3	-.0485756	.0152596	-3.18	0.001	-.3176921
cumdose2	0	(no path)			0
cumdose3	0	(no path)			0
anxagw2	.0189287	.0116181	1.63	0.103	.1218944
BSIanx	0	(no path)			0
crhrw2	.4511425	.150507	3.00	0.003	.1483594
crhrw3	0	(no path)			0
illw3	1.050721	.1452175	7.24	0.000	.3575548
whpsleep	.0438481	.0055438	7.91	0.000	.3901318
whppa	-.0530394	.011847	-4.48	0.000	-.2810551
anxagw1	0	(no path)			0
whpel	0	(no path)			0
fdferw1	0	(no path)			0
medcow3	0	(no path)			0
injselfr	0	(no path)			0
cumdose1	0	(no path)			0

Continued...

Table 3 Direct effects continued:

crhrw2 <-					
depagw1	0	(no path)			0
depagw2	0	(no path)			0
illw1	.1994248	.0773416	2.58	0.010	.0788822
medcow1	0	(no path)			0
crhrw1	.7300735	.0321988	22.67	0.000	.741507
illw2	0	(no path)			0
medcow2	0	(no path)			0
cumdose2	0	(no path)			0
anxagw2	.0075591	.0016352	4.62	0.000	.1480244
crhrw2	0	(no path)			0
anxagw1	0	(no path)			0
fdferw1	0	(no path)			0
injselfr	.1979594	.0596857	3.32	0.001	.1081946
cumdose1	0	(no path)			0
crhrw3 <-					
depagw1	0	(no path)			0
depagw2	0	(no path)			0
illw1	-.0325263	.0385049	-0.84	0.398	-.0128781
medcow1	0	(no path)			0
crhrw1	-.0888601	.0288373	-3.08	0.002	-.0903385
depagw3	0	(no path)			0
illw2	0	(no path)			0
medcow2	0	(no path)			0
anxagw3	0	(no path)			0
cumdose2	0	(no path)			0
cumdose3	0	(no path)			0
anxagw2	0	(no path)			0
crhrw2	1.004691	.0299939	33.50	0.000	1.005657
illw3	.048677	.0167445	2.91	0.004	.0504191
anxagw1	0	(no path)			0
fdferw1	0	(no path)			0
medcow3	0	(no path)			0
injselfr	.0648296	.0306705	2.11	0.035	.0354666
cumdose1	0	(no path)			0

Continued on the next page...

Table 3 Direct effects continued:

illw3 <-					
depagw1	0	(no path)			0
depagw2	0	(no path)			0
illw1	0	(no path)			0
medcow1	0	(no path)			0
crhrw1	-.6626401	.0825767	-8.02	0.000	-.6503881
depagw3	0	(no path)			0
illw2	.3645234	.0792141	4.60	0.000	.2277294
medcow2	-.0504486	.0183305	-2.75	0.006	-.1622977
anxagw3	0	(no path)			0
cumdose2	0	(no path)			0
cumdose3	.0338875	.0158201	2.14	0.032	.0955974
anxagw2	0	(no path)			0
crhrw2	.6826067	.0866224	7.88	0.000	.6596548
crhrw3	0	(no path)			0
illw3	0	(no path)			0
anxagw1	0	(no path)			0
fdferw1	0	(no path)			0
medcow3	.0547458	.0158008	3.46	0.001	.2015058
injselfr	.1629327	.0949665	1.72	0.086	.0860565
cumdose1	0	(no path)			0
whpsl~p <-					
depagw1	0	(no path)			0
depagw2	0	(no path)			0
illw1	0	(no path)			0
medcow1	0	(no path)			0
crhrw1	0	(no path)			0
depagw3	0	(no path)			0
illw2	5.46723	1.811319	3.02	0.003	.1306338
medcow2	0	(no path)			0
anxagw3	0	(no path)			0
cumdose2	0	(no path)			0
cumdose3	0	(no path)			0
anxagw2	0	(no path)			0
crhrw2	0	(no path)			0
crhrw3	6.172321	1.309173	4.71	0.000	.2279143
illw3	0	(no path)			0
anxagw1	.0587582	.0345017	1.70	0.089	.0893541
fdferw1	.120017	.0328531	3.65	0.000	.1893125
medcow3	.9063692	.3091576	2.93	0.003	.1275957
injselfr	0	(no path)			0
cumdose1	0	(no path)			0

Continued on the next page...

Table 3 Direct effects continued...

whppa <-					
depagw1	0	(no path)			0
depagw2	0	(no path)			0
BSIdep	0	(no path)			0
illw1	0	(no path)			0
BSIposymp	0	(no path)			0
medcow1	0	(no path)			0
crhrw1	0	(no path)			0
depagw3	0	(no path)			0
illw2	0	(no path)			0
medcow2	0	(no path)			0
anxagw3	0	(no path)			0
cumdose2	-2.464111	2.717922	-0.91	0.365	-.4187537
cumdose3	1.861966	2.443554	0.76	0.446	.3373187
anxagw2	0	(no path)			0
BSIanx	0	(no path)			0
crhrw2	0	(no path)			0
crhrw3	0	(no path)			0
illw3	2.925224	.7240669	4.04	0.000	.1878544
whpsleep	0	(no path)			0
whppa	0	(no path)			0
anxagw1	0	(no path)			0
whpel	.4150516	.0515961	8.04	0.000	.8492033
fdferw1	-.0556639	.0189202	-2.94	0.003	-.1474274
medcow3	0	(no path)			0
injselfr	3.768502	1.540567	2.45	0.014	.1278223
cumdose1	-.2028255	.8438909	-0.24	0.810	-.0230275
anxagw1 <-					
fdferw1	.476768	.0441856	10.79	0.000	.4945357
injselfr	17.19816	3.450221	4.98	0.000	.2284578

Continued on the next page...

Table 3 Direct effects continued...

whpel <-					
depagw1	0	(no path)			0
depagw2	0	(no path)			0
BSIdep	0	(no path)			0
illw1	0	(no path)			0
BSIposymp	.5858353	.0819895	7.15	0.000	.4454624
medcow1	1.655453	.721277	2.30	0.022	.1212536
crhrw1	0	(no path)			0
depagw3	0	(no path)			0
illw2	0	(no path)			0
medcow2	-1.971815	.6731024	-2.93	0.003	-.199105
anxagw3	-.1833858	.0750121	-2.44	0.014	-.1106245
cumdose2	0	(no path)			0
cumdose3	0	(no path)			0
anxagw2	0	(no path)			0
BSIanx	0	(no path)			0
crhrw2	0	(no path)			0
crhrw3	0	(no path)			0
illw3	0	(no path)			0
whpsleep	.2225837	.0665461	3.34	0.001	.1826635
whppa	0	(no path)			0
anxagw1	0	(no path)			0
whpel	0	(no path)			0
fdferw1	0	(no path)			0
medcow3	1.47441	.4836956	3.05	0.002	.1703365
injselfr	5.704205	2.82774	2.02	0.044	.0945635
cumdose1	0	(no path)			0
fdferw1 <-					
injselfr	26.44194	4.002247	6.61	0.000	.3386311
medcow3 <-					
depagw1	0	(no path)			0
depagw2	0	(no path)			0
illw1	0	(no path)			0
medcow1	0	(no path)			0
crhrw1	0	(no path)			0
depagw3	0	(no path)			0
illw2	0	(no path)			0
medcow2	.6878779	.047691	14.42	0.000	.6012264
anxagw3	.0307144	.0080572	3.81	0.000	.1603757
cumdose2	0	(no path)			0
cumdose3	0	(no path)			0
anxagw2	0	(no path)			0
crhrw2	0	(no path)			0
crhrw3	0	(no path)			0
illw3	0	(no path)			0
anxagw1	0	(no path)			0
fdferw1	0	(no path)			0
medcow3	0	(no path)			0
injselfr	0	(no path)			0
cumdose1	0	(no path)			0

4.1.8 Findings regarding indirect effects for males

Table 4 lists the indirect effects. We sort the indirect effects according to the descending size of their standardized coefficients within each of the panels of interest. If we examine the BSI anxiety and BSI depression panels, we can ascertain how much indirect effect originates with either cumulative external dose or perceived exposure risk. We use standardized coefficients because the product of each of the links in the indirect path are measured by different metrics. Standardization puts them all on the same metric, rendering them amenable to comparison. Table 4 lists a path coefficient representing the sum of effects from each of the indirect paths from the point of origin (listed in the panel) to the target endogenous variable on the upper left.

Indirect effects originating from cumulative external dose

We examine the impacts on the BSI, we find no evidence of indirect effects from cumulative external dose on depression measured by the male BSI depression ($cumdose1$ $stdized$ $\beta = 0.152 p = 0.231; cumdose2$ $stdized$ $\beta = 0.013,\ p = 0.754; cumdose3$ $stdized$ $\beta = -0.026.$ $p = 0.551$). As for BSI anxiety, we find no evidence of significant cumulative dose effects either ($cumdose1$ $stdized$ $\beta = 0.036, p = 0.154; cumdose2$ $stdized$ $\beta = 0.031, p = .741; cumdose3$ $stdized$ $\beta = -0.592, p = 0.543$). The same situation holds for exposure to radiation and BSI positive symptom scores ($cumdose1$ $\beta = 0.021,\ p = 0.237; cumdose2$ $\beta = 0.018,\ p = .758; cumdose3$ $\beta = -0.037, p = 0.551$). Therefore, we find no empirical evidence of an indirect effect originating with cumulative dose for males.

Indirect effects on BSI anxiety

After sorting the BSI anxiety panel, we find that the largest standardized indirect effect on BSI anxiety is that of perceived risk of exposure in wave 2 ($stdized$ $\beta = 0.403,\ p = 0.000$) Perceived risk of exposure for wave 3 ranked 7th and that in wave 1 ranked 9th in magnitude. All of these perceived risk indirect path coefficients for BSI anxiety have a positive sign indicating a direct (as opposed to inverse) relationship.

We consider the paramount component paths of the primary indirect effect from perceived risk of exposure in wave 2 to BSI anxiety, we find six different indirect paths that form the total indirect path to BSI anxiety depicted in Figure 1. The indirect standardized path coefficient represents the sum of 6 indirect paths from perceived risk of exposure in wave 2 to anxiety, measured by the BSI. If we examine these six paths, we find that four of them extend from perceived risk of exposure in wave three to a frequency count of illness either in wave 2 or wave 3. Of the two that extend to the count of illness in wave 2, one proceeds to a count of illness in wave 3 and then to BSI anxiety. The other extends from the count in wave 2 to Nottingham sleep, and then to BSI anxiety. Of the two that proceed through the wave 3 illness count at the target of the first link, one goes to self-reported depression symptoms in wave three and then to BSI anxiety. The other proceeds to Nottingham physical ability and then to BSI anxiety. The remaining 2 out of 6 paths link perceived risk of exposure in wave 2 to perceived risk of exposure in wave 3, then to Nottingham measured sleep and then to BSI anxiety. Among these indirect paths are mediators that

include later perceived risk of exposure, illness count, self-reported depression, sleep, and physical ability. The last one links perceived risk of exposure in wave 2 to self-reported depressive symptoms in wave 2 to the same in wave 3 and then to BSI anxiety, so we have to conclude that there are significant indirect effects from perceived risk of exposure, during wave 2, to BSI anxiety,also in support of hypothesis 5.

Indirect effects on BSI depression

Figure 1 contains the component indirect paths of crhrw2 on BSI depression. We can trace the lavender paths to their mediating variables and follow the arrows to BSI depression. If we sort these effects by the size of the sum of their standardized indirect effects, we identify 3 sources of indirect effects from perceived exposure risk. If we rank the 26 effects in descending order of total indirect effect, we find that perceived risk of exposure from wave 2 ranks 3rd ($stdized \ \ \beta \ crhrw2 = 0.323, \ p = 0.000$), from wave 1 ranks 10th, and from wave 3 ranks 11th. The signs of all of these indirect paths are positive. There are seven alternative indirect paths by which perceived Chornobyl health risk in wave 2 can impact BSI depression.

All of these paths, originating with perceived exposure risk in wave 2, are mediated by BSI anxiety and BSI positive symptoms, before reaching BSI anxiety. One goes through the illness frequency count in wave 2 and then to sleep and then to BSI anxiety, and then to BSI depression. Another goes through the illness frequency count in wave 2 to the illness count in wave 3 to BSI anxiety to BSI positive symptoms and from there to BSI depression. A third goes though the illness count in wave 3 to BSI positive symptoms to BSI depression. So the illness count mediates three indirect paths.

Two of the indirect paths begin with wave 2 perceived risk of exposure to the perceived risk of exposure in wave 3. One path goes to self-reported depressive symptoms in wave 3 and the other goes to Nottinghame sleep. From there both paths proceed to BSI anxiety, and then to BSI positive symptoms and from there to BSI anxiety.

As for the two remaining paths, one proceeds from wave 2 perceived risk of exposure to wave2 self-reported depression and then to wave 3 self-reported depression before going to BSI anxiety, BSI positive symptoms and then to BSI depression. The last indirect path goes directly from the source to BSI anxiety, BSI positive symptoms, and BSI depression. Because all indirect paths go through these last three mediating variables, the only question is whether they do it through self-reported depression, an illness count, or a sleep mediating variable. In short, we find significant indirect effects from perceived risk of exposure in wave 2 to BSI depression, complementing hypothesis 5.

Indirect effects on BSI positive symptoms

After sorting the standardized coefficients of indirect effects on BSI positive symptoms, we find that perceived risk of exposure in wave 2 is ranks 3rd in size, after sleep and anxiety, for indirect impact on BSI positive symptoms. We examine some of the pathways from perceived risk to positive symptoms and find 9 indirect paths from perceived exposure risk in wave 2 to the comprehensive positive symptoms. Seven of these paths are mediated by BSI anxiety before

impacting positive symptoms. Two-thirds of the paths project to perceived exposure risk in wave three before proceeding. The same proportion are mediated by Nottingham sleep. Two paths are mediated by the illness count in wave 2 and another two are mediated by a medical condition in wave 3. At least one-third of them are mediated by Nottingham measured energy level. Hence, we have reason to believe that there significant indirect effects on positive symptoms, complementing hypothesis 5.

Indirect effects on Nottingham measures of health behavior

First we look for evidence in support of any radiation indirect effects on sleep and find none (all p-values of cumdose indirect effects exceed 0.19). Neither is there any clear-cut evidence of an indirect radiation effect on energy level, although the wave one effect for cumdose1 is positive it is not quite statistically significant at the 0.05 level ($cumdose1\ stdized\beta = 0.014,\ p = 0.075$). Nor is there any evidence of a statistically significant relationship between physical ability in either wave 1 or 3. However, we do find a statistically significant indirect effect at wave 2 that is positive ($cumdose2\ stdized\ \beta = 0.373\ p = 0.000$). For the most part, we find no empirical evidence supporting a connection between external dose and Nottingham health behavior, but there appears to be some empirical evidence of a possible connection between exposure and physical ability in wave 2.

Other interesting indirect effects on BSI positive symptoms

A review of Figure 1 reveals that injury as a result of Chornobyl and fear of consuming contaminated foods are related. This may be due to the delay in revealing the nature of the Chornobyl accident. These factors had impacts on anxiety, sleep, depression, and positive symptoms. They also impacted energy level and physical ability as well as perceived risk of exposure. It appears that they could be central to the nature of the anxiety and distress over what happened. We will examine them more closely when we examine the male total effects listed in Table 5.

Table 4: Male Indirect effects

(Std. Err. adjusted for 337 clusters in id)

	Coef.	Robust Std. Err.	z	P>|z|	Std. Coef.
Structural					
depagw1 <-					
anxagw1	0	(no path)			0
fdferw1	.2220143	.0239052	9.29	0.000	.2690477
injselfr	19.7228	2.939469	6.71	0.000	.3060908
depagw2 <-					
depagw1	.0053284	.0117265	0.45	0.650	.010179
depagw2	.0103464	.0061625	1.68	0.093	.0103464
illw1	7.786671	2.331712	3.34	0.001	.1670763
medcow1	.865163	.2079178	4.16	0.000	.1133288
crhrw1	2.079586	.1962841	10.59	0.000	.1145748
illw2	.4323774	.101909	4.24	0.000	.0151626
medcow2	.4237784	.3297672	1.29	0.199	.0765278
cumdose2	-.1756048	.1373587	-1.28	0.201	-.0260849
anxagw2	.0231545	.0040272	5.75	0.000	.0245958
crhrw2	.162415	.0441058	3.68	0.000	.0088103
anxagw1	.2313686	.0235278	9.83	0.000	.5163847
fdferw1	.0960743	.011353	8.46	0.000	.2224164
injselfr	5.739769	1.16867	4.91	0.000	.1701717
cumdose1	-.234596	.1894636	-1.24	0.216	-.0232809
BSIdep <-					
depagw1	.0108457	.0031314	3.46	0.001	.1223611
depagw2	.0204556	.0049373	4.14	0.000	.1208057
BSIdep	.1076223	.036152	2.98	0.003	.1076223
illw1	-.0623031	.1516225	-0.41	0.681	-.0078949
BSIposymp	.0039788	.0013525	2.94	0.003	.0319538
medcow1	.2224071	.0508619	4.37	0.000	.1720544
crhrw1	.4132608	.0914802	4.52	0.000	.1344655
depagw3	.0119843	.0048213	2.49	0.013	.0736062
illw2	.7220129	.1672647	4.32	0.000	.1495308
medcow2	.1477302	.0361014	4.09	0.000	.1575522
anxagw3	-.0173124	.0066068	-2.62	0.009	-.1103017
cumdose2	.014895	.0474828	0.31	0.754	.0130668
cumdose3	-.0278104	.0466442	-0.60	0.551	-.0260079
anxagw2	.0184981	.0066343	2.79	0.005	.1160449
BSIanx	.4309094	.0471219	9.14	0.000	.4197809
crhrw2	1.007175	.1119309	9.00	0.000	.3226584
crhrw3	.4092537	.0714324	5.73	0.000	.1309825
illw3	.435122	.1282066	3.39	0.001	.1442457
whpsleep	.0566697	.008718	6.50	0.000	.4911887
whppa	-.0228552	.0069249	-3.30	0.001	-.1179816
anxagw1	.0053782	.0027622	1.95	0.052	.0708891
whpel	-.0094861	.0015537	-6.11	0.000	-.1001903
fdferw1	.0136529	.0025876	5.28	0.000	.1866637
medcow3	.0611984	.0201452	3.04	0.002	.0746738
injselfr	.8276773	.1449983	5.71	0.000	.1449201
cumdose1	.0258707	.0215861	1.20	0.231	.0151622

Continued...

Table 4 male indirect effects continued

illw1 <-					
depagw1	-.0002363	.0001556	-1.52	0.129	-.0210399
illw1	-.0093806	.005375	-1.75	0.081	-.0093806
medcow1	-.0003588	.0001192	-3.01	0.003	-.0021902
crhrw1	.0279537	.0075264	3.71	0.000	.0717776
anxagw1	.0005289	.0000704	7.51	0.000	.0550151
fdferw1	.0006519	.0000762	8.55	0.000	.0703353
injselfr	.0410528	.0161767	2.54	0.011	.0567247
BSIpo~p <-					
depagw1	.0204755	.0127188	1.61	0.107	.0287637
depagw2	.2339359	.0437146	5.35	0.000	.172027
BSIdep	.0521966	.0175336	2.98	0.003	.0064993
illw1	.1431354	1.663109	0.09	0.931	.0022584
BSIposymp	.0449037	.0152637	2.94	0.003	.0449037
medcow1	1.151819	.299909	3.84	0.000	.1109499
crhrw1	3.398165	1.101018	3.09	0.002	.1376755
depagw3	.1352526	.054413	2.49	0.013	.1034365
illw2	6.352737	1.622798	3.91	0.000	.1638219
medcow2	1.675246	.404378	4.14	0.000	.2224636
anxagw3	-.1953851	.0745631	-2.62	0.009	-.1550036
cumdose2	.1647941	.5345244	0.31	0.758	.0180009
cumdose3	-.3138635	.5264197	-0.60	0.551	-.0365481
anxagw2	.2210845	.0759366	2.91	0.004	.1726965
BSIanx	.2089903	.022854	9.14	0.000	.0253506
crhrw2	12.73973	1.408117	9.05	0.000	.5081871
crhrw3	4.618776	.8061758	5.73	0.000	.1840657
illw3	4.902439	1.040634	4.71	0.000	.2023622
whpsleep	.2087564	.0429485	4.86	0.000	.2253009
whppa	-.2579401	.0781533	-3.30	0.001	-.1657959
anxagw1	.132244	.02994	4.42	0.000	.2170426
whpel	-.1070585	.017535	-6.11	0.000	-.1407944
fdferw1	.2142233	.0272888	7.85	0.000	.3646919
medcow3	.6906758	.2273556	3.04	0.002	.1049369
injselfr	11.76693	1.772981	6.64	0.000	.2565406
cumdose1	.2875526	.2432606	1.18	0.237	.0209844
medcow1 <-					
depagw1	.0035622	.0010718	3.32	0.001	.0519497
illw1	-.2452743	.1405395	-1.75	0.081	-.0401766
medcow1	-.0093806	.0031163	-3.01	0.003	-.0093806
crhrw1	-.0069213	.0018635	-3.71	0.000	-.0029111
anxagw1	-.0028773	.0003832	-7.51	0.000	-.0490251
fdferw1	.0011511	.0011109	1.04	0.300	.0203433
injselfr	.3658162	.1185981	3.08	0.002	.0827968

Continued...

Table 4 male indirect effects continued

crhrw1 <-					
depagw1	-.0003811	.0002577	-1.48	0.139	-.0132157
illw1	.0031479	.0018037	1.75	0.081	.0012259
medcow1	-.0127138	.0042236	-3.01	0.003	-.0302277
crhrw1	-.0093806	.0025257	-3.71	0.000	-.0093806
anxagw1	.0022482	.0002994	7.51	0.000	.0910732
fdferw1	.0020889	.0002815	7.42	0.000	.0877755
injselfr	.229634	.0472676	4.86	0.000	.1235711
depagw3 <-					
depagw1	.1337302	.0410537	3.26	0.001	.2456473
depagw2	.0150581	.0082104	1.83	0.067	.0144791
illw1	13.83525	4.252667	3.25	0.001	.2854443
medcow1	.8195785	.202272	4.05	0.000	.1032296
crhrw1	1.638864	1.426364	1.15	0.251	.0868214
depagw3	.0024178	.0003195	7.57	0.000	.0024178
illw2	1.333077	.361092	3.69	0.000	.0449508
medcow2	.3676156	.294815	1.25	0.212	.0638331
anxagw3	.0044191	.0018182	2.43	0.015	.0045841
cumdose2	-.0704075	.1305479	-0.54	0.590	-.0100564
cumdose3	.0890595	.0684447	1.30	0.193	.0135605
anxagw2	.6189859	.0794296	7.79	0.000	.6322337
crhrw2	8.999183	1.452329	6.20	0.000	.4693945
crhrw3	0	(no path)			0
illw3	.247892	.1211297	2.05	0.041	.0133799
anxagw1	.1005478	.0280741	3.58	0.000	.2157809
fdferw1	.0851367	.0203319	4.19	0.000	.1895168
medcow3	.1438771	.0457467	3.15	0.002	.0285836
injselfr	5.864963	1.115509	5.26	0.000	.1671974
cumdose1	-.7823033	.5025009	-1.56	0.120	-.0746494
illw2 <-					
depagw1	.0011375	.0004736	2.40	0.016	.0619659
depagw2	.0001292	.0000769	1.68	0.093	.0036831
illw1	.2311909	.063399	3.65	0.000	.1414565
medcow1	.0130216	.0033042	3.94	0.000	.0486403
crhrw1	.2312272	.0179963	12.85	0.000	.3632788
illw2	.0053975	.0012722	4.24	0.000	.0053975
medcow2	.0052902	.0041166	1.29	0.199	.027242
cumdose2	-.0021921	.0017147	-1.28	0.201	-.0092856
anxagw2	.0081613	.0010888	7.50	0.000	.2472135
crhrw2	.0196697	.0126294	1.56	0.119	.0304264
anxagw1	.0017649	.0003216	5.49	0.000	.1123249
fdferw1	.0010502	.0002462	4.27	0.000	.0693307
injselfr	.0903452	.0317172	2.85	0.004	.0763813
cumdose1	-.0029285	.0024872	-1.18	0.239	-.0082874

Continued...

Table 4 male indirect effects continued

medcow2 <-					
depagw1	-.0008242	.0036939	-0.22	0.823	-.0087191
depagw2	.0091606	.0030811	2.97	0.003	.0507274
illw1	.3028619	.1214002	2.49	0.013	.0359855
medcow1	.0221437	.004965	4.46	0.000	.0160625
crhrw1	.4823988	.1947663	2.48	0.013	.1471763
illw2	.0136378	.0032144	4.24	0.000	.0026484
medcow2	.0133666	.0104014	1.29	0.199	.0133666
cumdose2	-.0055388	.0043325	-1.28	0.201	-.0045561
anxagw2	.020621	.0026588	7.76	0.000	.1212983
crhrw2	.3949473	.1075142	3.67	0.000	.1186375
anxagw1	.0022331	.0009532	2.34	0.019	.0275991
fdferw1	.004483	.0009152	4.90	0.000	.0574703
injselfr	.4891375	.1279112	3.82	0.000	.0803052
cumdose1	-.0073995	.0071544	-1.03	0.301	-.0040663
anxagw3 <-					
depagw1	.0172982	.0300847	0.57	0.565	.0306311
depagw2	.4836003	.0735768	6.57	0.000	.4482663
illw1	11.61506	3.260689	3.56	0.000	.2310118
medcow1	1.033721	.246017	4.20	0.000	.125515
crhrw1	.0120875	1.093408	0.01	0.991	.0006173
depagw3	0	(no path)			0
illw2	1.056974	.2379246	4.44	0.000	.0343578
medcow2	.5222302	.4100289	1.27	0.203	.0874162
anxagw3	.0024178	.0009948	2.43	0.015	.0024178
cumdose2	-.4516926	.2023902	-2.23	0.026	-.0621936
cumdose3	.0487267	.0374478	1.30	0.193	.0071522
anxagw2	.2464992	.0314667	7.83	0.000	.2427116
crhrw2	4.73753	.6118388	7.74	0.000	.2382128
crhrw3	2.721597	1.029341	2.64	0.008	.1367161
illw3	1.437896	.5678753	2.53	0.011	.074816
anxagw1	.1838185	.0272193	6.75	0.000	.3802837
fdferw1	.1037412	.0118102	8.78	0.000	.222618
medcow3	.0787188	.0250292	3.15	0.002	.0150758
injselfr	6.656806	1.336472	4.98	0.000	.1829399
cumdose1	-.605772	.367708	-1.65	0.099	-.0557235
cumdo~2 <-					
depagw1	.0011988	.0003646	3.29	0.001	.0154169
depagw2	.0000805	.000048	1.68	0.093	.000542
illw1	.1079017	.0357358	3.02	0.003	.0155861
medcow1	.006732	.0016179	4.16	0.000	.0059366
crhrw1	-.0101725	.0113136	-0.90	0.369	-.003773
illw2	.0033644	.000793	4.24	0.000	.0007943
medcow2	.0032975	.002566	1.29	0.199	.0040088
cumdose2	-.0013664	.0010688	-1.28	0.201	-.0013664
anxagw2	.0050872	.00067	7.59	0.000	.0363787
crhrw2	.0171184	.0112806	1.52	0.129	.0062514
anxagw1	.0011196	.0002412	4.64	0.000	.0168219
fdferw1	.0010353	.0001934	5.35	0.000	.016135
injselfr	.0446625	.0371938	1.20	0.230	.0089142
cumdose1	-.0018254	.0022123	-0.83	0.409	-.0012195

Continued...

Table 4 male indirect effects continued

cumdo~3 <-					
depagw1	.0008552	.0002601	3.29	0.001	.0103175
depagw2	.0085404	.0072149	1.18	0.237	.0539331
illw1	.0769799	.0254948	3.02	0.003	.0104308
medcow1	.0048028	.0011542	4.16	0.000	.003973
crhrw1	-.0072573	.0080714	-0.90	0.369	-.002525
illw2	.0024003	.0005657	4.24	0.000	.0005316
medcow2	.0023525	.0018306	1.29	0.199	.0026828
cumdose2	-.0009748	.0007625	-1.28	0.201	-.0009145
anxagw2	.0036293	.000478	7.59	0.000	.0243459
crhrw2	.0122127	.0080479	1.52	0.129	.0041836
anxagw1	.0007987	.0001721	4.64	0.000	.0112578
fdferw1	.0007386	.0001379	5.35	0.000	.0107981
injselfr	.0318634	.0369141	0.86	0.388	.0059657
cumdose1	1.45511	.2669609	5.45	0.000	.9119092
anxagw2 <-					
depagw1	.0110379	.0093595	1.18	0.238	.0198505
depagw2	.0160157	.0095392	1.68	0.093	.0150772
illw1	.0690999	.1038015	0.67	0.506	.0013958
medcow1	.9214272	.1950628	4.72	0.000	.1136261
crhrw1	.608158	.1966684	3.09	0.002	.031543
illw2	.6692938	.1577489	4.24	0.000	.0220954
medcow2	.0077786	.006053	1.29	0.199	.0013224
cumdose2	-.0032233	.0025213	-1.28	0.201	-.0004507
anxagw2	.0120002	.001547	7.76	0.000	.0120002
crhrw2	.2514085	.0682731	3.68	0.000	.0128386
anxagw1	.0066855	.000755	8.85	0.000	.0140467
fdferw1	.1265243	.013053	9.69	0.000	.2757451
injselfr	8.053511	1.483652	5.43	0.000	.2247774
cumdose1	-.3631403	.2838336	-1.28	0.201	-.0339257

Continued...

Table 4 male indirect effects continued

BSIanx <-					
depagw1	.0022724	.0017734	1.28	0.200	.0263167
depagw2	.0380601	.0065575	5.80	0.000	.2307321
BSIdep	-.0156644	.0052619	-2.98	0.003	-.0160796
illw1	.6515467	.2524572	2.58	0.010	.0847513
BSIposymp	-.0134757	.0019914	-6.77	0.000	-.111094
medcow1	.1326122	.0416647	3.18	0.001	.1053086
crhrw1	.2693861	.1737459	1.55	0.121	.0899757
depagw3	-.0251664	.0031813	-7.91	0.000	-.1586672
illw2	.732182	.1637119	4.47	0.000	.1556568
medcow2	.0330455	.0267073	1.24	0.216	.0361768
anxagw3	.008286	.0017838	4.65	0.000	.054192
cumdose2	.0344533	.1043479	0.33	0.741	.0310258
cumdose3	-.0616217	.1011978	-0.61	0.543	-.0591555
anxagw2	.0118132	.008048	1.47	0.142	.0760732
BSIanx	-.0627186	.0068586	-9.14	0.000	-.0627186
crhrw2	1.225018	.1897307	6.46	0.000	.4028503
crhrw3	.311696	.0566219	5.50	0.000	.1024036
illw3	-.1376437	.0510532	-2.70	0.007	-.0468394
whpsleep	-.0131482	.0020254	-6.49	0.000	-.1169844
whppa	0	(no path)			0
anxagw1	.007081	.0019742	3.59	0.000	.0958077
whpel	-.0206334	.0033795	-6.11	0.000	-.2237037
fdferw1	.0140885	.0018966	7.43	0.000	.1977254
medcow3	.0473905	.0205854	2.30	0.021	.0593585
injselfr	.8319035	.1920646	4.33	0.000	.1495215
cumdose1	.0590714	.0414445	1.43	0.154	.0355382
crhrw2 <-					
depagw1	.0038347	.0010459	3.67	0.000	.1350444
depagw2	.0001211	.0000721	1.68	0.093	.0022318
illw1	-.1648857	.1529507	-1.08	0.281	-.0652203
medcow1	.0052387	.0010285	5.09	0.000	.0126503
crhrw1	.0033233	.0011686	2.84	0.004	.0033753
illw2	.0050593	.0011924	4.24	0.000	.0032707
medcow2	.0049587	.0038586	1.29	0.199	.0165075
cumdose2	-.0020548	.0016072	-1.28	0.201	-.0056267
anxagw2	.0000907	.0000117	7.76	0.000	.0017763
crhrw2	.0019004	.0005161	3.68	0.000	.0019004
anxagw1	.0036535	.0003486	10.48	0.000	.1503189
fdferw1	.0064955	.0010807	6.01	0.000	.2772114
injselfr	.6211401	.0768476	8.08	0.000	.3394838
cumdose1	-.002745	.0023324	-1.18	0.239	-.0050218

Continued...

Table 4 male indirect effects continued

crhrw3 <-					
depagw1	.0033819	.0009104	3.71	0.000	.1192146
depagw2	.0003006	.0001056	2.85	0.004	.0055465
illw1	.081786	.1034492	0.79	0.429	.0323814
medcow1	.0055628	.0011198	4.97	0.000	.0134458
crhrw1	.7276402	.0415164	17.53	0.000	.7397462
depagw3	.0000449	5.93e-06	7.57	0.000	.0008615
illw2	.0225376	.0065235	3.45	0.001	.0145838
medcow2	.0046563	.003814	1.22	0.222	.0155157
anxagw3	.000082	.0000338	2.43	0.015	.0016333
cumdose2	-.0004084	.0017222	-0.24	0.813	-.0011194
cumdose3	.0016535	.0012708	1.30	0.193	.0048316
anxagw2	.0081461	.0017279	4.71	0.000	.1596727
crhrw2	.0415109	.0086244	4.81	0.000	.0415508
illw3	0	(no path)			0
anxagw1	.0035488	.0003406	10.42	0.000	.1461527
fdferw1	.005847	.0009458	6.18	0.000	.2497726
medcow3	.0026713	.0008494	3.15	0.002	.0101843
injselfr	.7670634	.0855212	8.97	0.000	.4196412
cumdose1	-.000625	.0037984	-0.16	0.869	-.0011446
illw3 <-					
depagw1	-.0000983	.0004479	-0.22	0.826	-.0033467
depagw2	.0036763	.0010032	3.66	0.000	.0654935
illw1	.3541741	.1033631	3.43	0.001	.1353825
medcow1	.0082598	.0042919	1.92	0.054	.019275
crhrw1	.4752574	.0431172	11.02	0.000	.4664701
depagw3	.0009222	.0001219	7.57	0.000	.017086
illw2	-.0059445	.0015936	-3.73	0.000	-.0037137
medcow2	.0437585	.0087149	5.02	0.000	.1407751
anxagw3	.0016855	.0006935	2.43	0.015	.0323948
cumdose2	.0340202	.0033935	10.03	0.000	.0900272
cumdose3	0	(no path)			0
anxagw2	.0094584	.0014339	6.60	0.000	.1789897
crhrw2	.1309496	.0342504	3.82	0.000	.1265466
crhrw3	.0045763	.0017308	2.64	0.008	.0044182
illw3	.0024178	.0009549	2.53	0.011	.0024178
anxagw1	.0019551	.0003096	6.31	0.000	.0777354
fdferw1	.000011	.0002964	0.04	0.970	.0004549
medcow3	0	(no path)			0
injselfr	.0969895	.0606275	1.60	0.110	.0512272
cumdose1	.0438164	.039818	1.10	0.271	.0774638

Continued...

Table 4 male indirect effects continued

whpsl~p <-					
depagw1	.027061	.0071324	3.79	0.000	.0352235
depagw2	.0765735	.0234489	3.27	0.001	.0521742
illw1	2.208955	.8490485	2.60	0.009	.0322944
medcow1	.6407019	.1257723	5.09	0.000	.0571841
crhrw1	3.86613	.7045348	5.49	0.000	.1451328
depagw3	.0155451	.0020542	7.57	0.000	.0110154
illw2	.8426683	.1809365	4.66	0.000	.0201347
medcow2	.7040057	.130409	5.40	0.000	.0866231
anxagw3	.0284123	.0116901	2.43	0.015	.020885
cumdose2	-.0305334	.0274046	-1.11	0.265	-.0030903
cumdose3	.0115626	.0088862	1.30	0.193	.0012475
anxagw2	.1309748	.0168946	7.75	0.000	.0947961
crhrw2	8.73026	.6878785	12.69	0.000	.3226767
crhrw3	.0771404	.0291754	2.64	0.008	.0028484
illw3	.3412057	.153477	2.22	0.026	.01305
anxagw1	.038063	.0045473	8.37	0.000	.0578828
fdferw1	.0748938	.0077492	9.66	0.000	.118136
medcow3	.0186796	.0059393	3.15	0.002	.0026297
injselfr	11.04369	1.520552	7.26	0.000	.2230921
cumdose1	-.0413462	.0486896	-0.85	0.396	-.0027957
whppa <-					
depagw1	.0277112	.0082672	3.35	0.001	.0605637
depagw2	.0356455	.0129157	2.76	0.006	.0407802
BSIdep	.2953345	.0992074	2.98	0.003	.0572117
illw1	-.0674125	.5343702	-0.13	0.900	-.0016548
BSIposymp	.2540703	.0375454	6.77	0.000	.3952746
medcow1	.6543542	.3646984	1.79	0.073	.0980619
crhrw1	.956635	.7000445	1.37	0.172	.0602981
depagw3	.0055844	.0136747	0.41	0.683	.0066443
illw2	2.701191	.7518552	3.59	0.000	.1083706
medcow2	.0163628	.3781466	0.04	0.965	.0033805
anxagw3	-.0974101	.0359334	-2.71	0.007	-.1202263
cumdose2	2.196296	.1823518	12.04	0.000	.373241
cumdose3	.021327	.1667929	0.13	0.898	.0038636
anxagw2	.0317461	.0230706	1.38	0.169	.0385799
BSIanx	1.182491	.1293107	9.14	0.000	.2231541
crhrw2	5.836093	.7768908	7.51	0.000	.3621852
crhrw3	1.557801	.3064201	5.08	0.000	.0965835
illw3	1.150227	.3537458	3.25	0.001	.0738662
whpsleep	.2478953	.0381869	6.49	0.000	.4162328
whppa	-.0627186	.0190031	-3.30	0.001	-.0627186
anxagw1	.0321468	.0110687	2.90	0.004	.0820828
whpel	0	(no path)			0
fdferw1	.0633209	.0103881	6.10	0.000	.167707
medcow3	1.021374	.2350976	4.34	0.000	.2414258
injselfr	5.162075	1.430288	3.61	0.000	.1750904
cumdose1	-.4355592	.6881892	-0.63	0.527	-.0494506

Continued...

Table 4 male indirect effects continued

anxagw1 <-					
fdferw1	0	(no path)			0
injselfr	12.60667	2.552824	4.94	0.000	.1674652
whpel <-					
depagw1	.0707392	.0203424	3.48	0.001	.0755625
depagw2	.0814844	.0257375	3.17	0.002	.0455627
BSIdep	.711561	.2390242	2.98	0.003	.067371
illw1	-2.363329	1.0881	-2.17	0.030	-.0283545
BSIposymp	.0263062	.008942	2.94	0.003	.0200029
medcow1	-.1186845	.0668565	-1.78	0.076	-.008693
crhrw1	3.597669	.6976221	5.16	0.000	.1108329
depagw3	.0069551	.0331747	0.21	0.834	.0040445
illw2	3.990079	1.264279	3.16	0.002	.0782398
medcow2	2.067413	.2275084	9.09	0.000	.208758
anxagw3	-.0631877	.0491355	-1.29	0.198	-.038117
cumdose2	.1574288	.3253449	0.48	0.628	.0130759
cumdose3	-.1880279	.3074453	-0.61	0.541	-.0166487
anxagw2	.0237458	.0515285	0.46	0.645	.0141042
BSIanx	2.849022	.3115534	9.14	0.000	.2627806
crhrw2	8.374142	.8000148	10.47	0.000	.2540032
crhrw3	3.721017	.7392715	5.03	0.000	.1127569
illw3	2.754247	.8533098	3.23	0.001	.0864481
whpsleep	.37468	.0576402	6.50	0.000	.3074815
whppa	-.1511104	.045785	-3.30	0.001	-.0738558
anxagw1	.066737	.0262434	2.54	0.011	.0832858
whpel	-.0627186	.0102726	-6.11	0.000	-.0627186
fdferw1	.1553167	.0252238	6.16	0.000	.2010541
medcow3	.599652	.2049763	2.93	0.003	.0692769
injselfr	8.569517	1.497803	5.72	0.000	.1420642
cumdose1	.2499985	.1405672	1.78	0.075	.0138724
fdferw1 <-					
injselfr	0	(no path)			0
medcow3 <-					
depagw1	-.0000357	.002956	-0.01	0.990	-.0003297
depagw2	.0294292	.0105816	2.78	0.005	.1424377
illw1	.7071453	.1955407	3.62	0.000	.0734375
medcow1	.5904598	.1188191	4.97	0.000	.374351
crhrw1	.3322027	.1441514	2.30	0.021	.0885853
depagw3	.0168452	.002226	7.57	0.000	.0847914
illw2	.7436812	.172403	4.31	0.000	.1262246
medcow2	.0252346	.0197405	1.28	0.201	.0220558
anxagw3	0	(no path)			0
cumdose2	-.0176835	.0087484	-2.02	0.043	-.0127136
cumdose3	.0014966	.0011502	1.30	0.193	.001147
anxagw2	.0398014	.0031231	12.74	0.000	.2046304
crhrw2	.4171858	.0863364	4.83	0.000	.1095315
crhrw3	.0835922	.0316156	2.64	0.008	.0219259
illw3	.0441641	.0174419	2.53	0.011	.0119987
anxagw1	.007182	.0014183	5.06	0.000	.0775815
fdferw1	.0055701	.0009427	5.91	0.000	.0624125
medcow3	.0024178	.0007688	3.15	0.002	.0024178
injselfr	.5409266	.1232026	4.39	0.000	.0776207
cumdose1	-.0236959	.0163282	-1.45	0.147	-.0113815

4.1.9 Findings concerning total effects among males

To be able to add direct and indirect effects to obtain total effects, we have to be able to assume linearity and additivity of effects. Additivity is not a problem if arithmetic rules hold. However, if the rules of psychology dominate the laws of arithmetic, this may be difficult to do. If the sum is be greater than its component parts, particularly when synergy holds or when trauma fixates the mind on an events long ago, there may be when a clash between a positive direct and a negative indirect effects. There may be an asymmetry not accounted for by the addition of direct and indirect effects. The perspectival paradigms may generate cognitive dissonances that may not be easily and happily resolved, leaving the negatives to outweigh the positives among the pessimists and the positives to outweigh the negatives among the optimists, and leaving others to ponder if not brood over how to proceed with their lives. Others may not worry about such things.

Until the psychologists come up with an alternative calculus for total effects, we will make the working assumption of additivity and linearity of effects on the part of male respondents so this problem will not bog us down. To appreciate the total effects of radiation and risk of exposure on anxiety, depression, and sleep, we turn to Table 5 and direct our attention to the relevant panels.

Total effects of cumulative external dose for males on BSI

Are there any total effects of cumulative external dose significantly affecting depression, as measured by the BSI? On page 40 of table 5, we find cumdose1 stdized $\beta = 0.015, p = 0.231$), ($cumdose2$ $stdized$ $\beta = 0.013, p = 0.754$), and ($cumdose3$ $stdized$ $\beta = -0.026, p = 0.551$), for which reason we find that we have no empirical evidence in support of hypothesis 4 as far as the total effects on BSI depression for males are concerned.

Table 5 lists the total effects of cumulative external dose on BSI anxiety on page 45. None of these is statistically significant either (the lowest significance level of cumulative dose during any of the three waves was more than 0.15). For this reason, we find no empirical evidence to support a hypothesis 4 concerning BSI anxiety either.

Nor was the total effect of any of the cumulative dose variables found to be statistically related to the BSI positive symptom scale either (Table 5, p. 41).

Table 5 Male Total effects

(Std. Err. adjusted for 337 clusters in id)

	Coef.	Robust Std. Err.	z	P>|z|	Std. Coef.
Structural					
depagw1 <-					
anxagw1	.4656653	.0620203	7.51	0.000	.544041
fdferw1	.4430163	.058159	7.62	0.000	.5368686
injselfr	19.7228	2.939469	6.71	0.000	.3060908
depagw2 <-					
depagw1	.1540606	.0468583	3.29	0.001	.2943084
depagw2	.0103464	.0061625	1.68	0.093	.0103464
illw1	13.86692	4.592562	3.02	0.003	.2975385
medcow1	.865163	.2079178	4.16	0.000	.1133288
crhrw1	-1.307309	1.453958	-0.90	0.369	-.0720262
illw2	.4323774	.101909	4.24	0.000	.0151626
medcow2	.4237784	.3297672	1.29	0.199	.0765278
cumdose2	-.1756048	.1373587	-1.28	0.201	-.0260849
anxagw2	.6537728	.0861077	7.59	0.000	.6944682
crhrw2	2.199966	1.449722	1.52	0.129	.1193382
anxagw1	.1438835	.0309927	4.64	0.000	.3211293
fdferw1	.1330503	.0248483	5.35	0.000	.3080175
injselfr	5.739769	1.16867	4.91	0.000	.1701717
cumdose1	-.234596	.1894636	-1.24	0.216	-.0232809
BSIdep <-					
depagw1	-.0015123	.0053859	-0.28	0.779	-.0170619
depagw2	.0204556	.0049373	4.14	0.000	.1208057
BSIdep	.1076223	.036152	2.98	0.003	.1076223
illw1	-.0623031	.1516225	-0.41	0.681	-.0078949
BSIposymp	.0925853	.0099577	9.30	0.000	.7435611
medcow1	.2224071	.0508619	4.37	0.000	.1720544
crhrw1	.4132608	.0914802	4.52	0.000	.1344655
depagw3	.0119843	.0048213	2.49	0.013	.0736062
illw2	.1924387	.2278744	0.84	0.398	.0398546
medcow2	.3043922	.1100683	2.77	0.006	.3246299
anxagw3	-.0173124	.0066068	-2.62	0.009	-.1103017
cumdose2	.014895	.0474828	0.31	0.754	.0130668
cumdose3	-.0278104	.0466442	-0.60	0.551	-.0260079
anxagw2	.0184981	.0066343	2.79	0.005	.1160449
BSIanx	.4309094	.0471219	9.14	0.000	.4197809
crhrw2	1.007175	.1119309	9.00	0.000	.3226584
crhrw3	.4092537	.0714324	5.73	0.000	.1309825
illw3	.435122	.1282066	3.39	0.001	.1442457
whpsleep	.0566697	.008718	6.50	0.000	.4911887
whppa	-.0228552	.0069249	-3.30	0.001	-.1179816
anxagw1	.0053782	.0027622	1.95	0.052	.0708891
whpel	-.0094861	.0015537	-6.11	0.000	-.1001903
fdferw1	.0136529	.0025876	5.28	0.000	.1866637
medcow3	.0611984	.0201452	3.04	0.002	.0746738
injselfr	.8276773	.1449983	5.71	0.000	.1449201
cumdose1	.0258707	.0215861	1.20	0.231	.0151622

Continued on the next page...

Table 5 male total effects continued:

illw1 <-					
depagw1	.0011358	.0007679	1.48	0.139	.1011231
illw1	-.0093806	.005375	-1.75	0.081	-.0093806
medcow1	.0378865	.012586	3.01	0.003	.2312941
crhrw1	.0279537	.0075264	3.71	0.000	.0717776
anxagw1	.0005289	.0000704	7.51	0.000	.0550151
fdferw1	.0006519	.0000762	8.55	0.000	.0703353
injselfr	.0410528	.0161767	2.54	0.011	.0567247
BSIpo~p <-					
depagw1	.1306587	.034574	3.78	0.000	.1835479
depagw2	.2339359	.0437146	5.35	0.000	.172027
BSIdep	1.214609	.4080059	2.98	0.003	.1512384
illw1	.1431354	1.663109	0.09	0.931	.0022584
BSIposymp	.0449037	.0152637	2.94	0.003	.0449037
medcow1	1.151819	.299909	3.84	0.000	.1109499
crhrw1	3.398165	1.101018	3.09	0.002	.1376755
depagw3	.1352526	.054413	2.49	0.013	.1034365
illw2	6.352737	1.622798	3.91	0.000	.1638219
medcow2	1.675246	.404378	4.14	0.000	.2224636
anxagw3	-.1953851	.0745631	-2.62	0.009	-.1550036
cumdose2	.1647941	.5345244	0.31	0.758	.0180009
cumdose3	-.3138635	.5264197	-0.60	0.551	-.0365481
anxagw2	.2210845	.0759366	2.91	0.004	.1726965
BSIanx	4.863178	.5318106	9.14	0.000	.5899053
crhrw2	12.73973	1.408117	9.05	0.000	.5081871
crhrw3	4.618776	.8061758	5.73	0.000	.1840657
illw3	4.910721	1.44692	3.39	0.001	.2027041
whpsleep	.6395655	.0983898	6.50	0.000	.6902525
whppa	-.2579401	.0781533	-3.30	0.001	-.1657959
anxagw1	.132244	.02994	4.42	0.000	.2170426
whpel	-.1070585	.017535	-6.11	0.000	-.1407944
fdferw1	.2142233	.0272888	7.85	0.000	.3646919
medcow3	.6906758	.2273556	3.04	0.002	.1049369
injselfr	11.76693	1.772981	6.64	0.000	.2565406
cumdose1	.2875526	.2432606	1.18	0.237	.0209844
medcow1 <-					
depagw1	-.006179	.0040687	-1.52	0.129	-.0901128
illw1	-.2452743	.1405395	-1.75	0.081	-.0401766
medcow1	-.0093806	.0031163	-3.01	0.003	-.0093806
crhrw1	.7309062	.1967916	3.71	0.000	.3074195
anxagw1	-.0028773	.0003832	-7.51	0.000	-.0490251
fdferw1	.0011511	.0011109	1.04	0.300	.0203433
injselfr	.3658162	.1185981	3.08	0.002	.0827968

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Table 5 male total effects continued:

crhrw1 <-					
depagw1	.0048279	.0014526	3.32	0.001	.1674013
illw1	-.3324277	.1904775	-1.75	0.081	-.1294637
medcow1	-.0127138	.0042236	-3.01	0.003	-.0302277
crhrw1	-.0093806	.0025257	-3.71	0.000	-.0093806
anxagw1	.0022482	.0002994	7.51	0.000	.0910732
fdferw1	.007409	.001432	5.17	0.000	.3113204
injselfr	.7561919	.0917595	8.24	0.000	.4069235
depagw3 <-					
depagw1	.0528934	.0527419	1.00	0.316	.0971592
depagw2	.869565	.1332632	6.53	0.000	.8361293
illw1	13.83525	4.252667	3.25	0.001	.2854443
medcow1	.8195785	.202272	4.05	0.000	.1032296
crhrw1	-1.229902	2.1428	-0.57	0.566	-.065156
depagw3	.0024178	.0003195	7.57	0.000	.0024178
illw2	1.333077	.361092	3.69	0.000	.0449508
medcow2	.3676156	.294815	1.25	0.212	.0638331
anxagw3	.0044191	.0018182	2.43	0.015	.0045841
cumdose2	-.5823828	.2506707	-2.32	0.020	-.0831828
cumdose3	.0890595	.0684447	1.30	0.193	.0135605
anxagw2	.6189859	.0794296	7.79	0.000	.6322337
crhrw2	8.999183	1.452329	6.20	0.000	.4693945
crhrw3	4.974361	1.881364	2.64	0.008	.2592118
illw3	2.628093	1.037926	2.53	0.011	.1418501
anxagw1	.1005478	.0280741	3.58	0.000	.2157809
fdferw1	.0851367	.0203319	4.19	0.000	.1895168
medcow3	.1438771	.0457467	3.15	0.002	.0285836
injselfr	5.864963	1.115509	5.26	0.000	.1671974
cumdose1	-.7823033	.5025009	-1.56	0.120	-.0746494
illw2 <-					
depagw1	.0011375	.0004736	2.40	0.016	.0619659
depagw2	.0087877	.0029477	2.98	0.003	.2505906
illw1	.2311909	.063399	3.65	0.000	.1414565
medcow1	.0130216	.0033042	3.94	0.000	.0486403
crhrw1	-.0690888	.0908122	-0.76	0.447	-.1085447
illw2	.0053975	.0012722	4.24	0.000	.0053975
medcow2	.0052902	.0041166	1.29	0.199	.027242
cumdose2	-.0021921	.0017147	-1.28	0.201	-.0092856
anxagw2	.0081613	.0010888	7.50	0.000	.2472135
crhrw2	.3465453	.0953256	3.64	0.000	.5360588
anxagw1	.0017649	.0003216	5.49	0.000	.1123249
fdferw1	.0010502	.0002462	4.27	0.000	.0693307
injselfr	.0903452	.0317172	2.85	0.004	.0763813
cumdose1	-.0029285	.0024872	-1.18	0.239	-.0082874

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Table 5 male total effects continued:

medcow2 <-					
depagw1	-.0008242	.0036939	-0.22	0.823	-.0087191
depagw2	.0279655	.014541	1.92	0.054	.1548608
illw1	.3028619	.1214002	2.49	0.013	.0359855
medcow1	.8122222	.1657057	4.90	0.000	.5891648
crhrw1	.4823988	.1947663	2.48	0.013	.1471763
illw2	1.033929	.2436915	4.24	0.000	.2007804
medcow2	.0133666	.0104014	1.29	0.199	.0133666
cumdose2	-.0055388	.0043325	-1.28	0.201	-.0045561
anxagw2	.020621	.0026588	7.76	0.000	.1212983
crhrw2	.3949473	.1075142	3.67	0.000	.1186375
anxagw1	.0022331	.0009532	2.34	0.019	.0275991
fdferw1	.004483	.0009152	4.90	0.000	.0574703
injselfr	.4891375	.1279112	3.82	0.000	.0803052
cumdose1	-.0073995	.0071544	-1.03	0.301	-.0040663
anxagw3 <-					
depagw1	.0172982	.0300847	0.57	0.565	.0306311
depagw2	.3318443	.1171413	2.83	0.005	.3075983
illw1	16.24038	4.062068	4.00	0.000	.3230046
medcow1	1.033721	.246017	4.20	0.000	.125515
crhrw1	.0120875	1.093408	0.01	0.991	.0006173
depagw3	.5484478	.072474	7.57	0.000	.5287051
illw2	1.056974	.2379246	4.44	0.000	.0343578
medcow2	.5222302	.4100289	1.27	0.203	.0874162
anxagw3	.0024178	.0009948	2.43	0.015	.0024178
cumdose2	-.4516926	.2023902	-2.23	0.026	-.0621936
cumdose3	.0487267	.0374478	1.30	0.193	.0071522
anxagw2	.8340288	.0977821	8.53	0.000	.8212135
crhrw2	4.73753	.6118388	7.74	0.000	.2382128
crhrw3	2.721597	1.029341	2.64	0.008	.1367161
illw3	1.437896	.5678753	2.53	0.011	.074816
anxagw1	.1838185	.0272193	6.75	0.000	.3802837
fdferw1	.0809526	.0169117	4.79	0.000	.1737159
medcow3	.0787188	.0250292	3.15	0.002	.0150758
injselfr	6.656806	1.336472	4.98	0.000	.1829399
cumdose1	-.605772	.367708	-1.65	0.099	-.0557235

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Table 5 male total effects continued:

cumdo~2 <-					
depagw1	.0011988	.0003646	3.29	0.001	.0154169
depagw2	.0078617	.0066155	1.19	0.235	.0529255
illw1	.1079017	.0357358	3.02	0.003	.0155861
medcow1	.006732	.0016179	4.16	0.000	.0059366
crhrw1	-.0101725	.0113136	-0.90	0.369	-.003773
illw2	.0033644	.000793	4.24	0.000	.0007943
medcow2	.0032975	.002566	1.29	0.199	.0040088
cumdose2	-.0013664	.0010688	-1.28	0.201	-.0013664
anxagw2	.0050872	.00067	7.59	0.000	.0363787
crhrw2	.0171184	.0112806	1.52	0.129	.0062514
anxagw1	.0011196	.0002412	4.64	0.000	.0168219
fdferw1	.0010353	.0001934	5.35	0.000	.016135
injselfr	.0446625	.0371938	1.20	0.230	.0089142
cumdose1	1.334106	.282104	4.73	0.000	.8912849
cumdo~3 <-					
depagw1	.0008552	.0002601	3.29	0.001	.0103175
depagw2	.0056088	.0070283	0.80	0.425	.0354196
illw1	.0769799	.0254948	3.02	0.003	.0104308
medcow1	.0048028	.0011542	4.16	0.000	.003973
crhrw1	-.0072573	.0080714	-0.90	0.369	-.002525
illw2	.0024003	.0005657	4.24	0.000	.0005316
medcow2	.0023525	.0018306	1.29	0.199	.0026828
cumdose2	1.08921	.073904	14.74	0.000	1.021742
anxagw2	.0036293	.000478	7.59	0.000	.0243459
crhrw2	.0122127	.0080479	1.52	0.129	.0041836
anxagw1	.0007987	.0001721	4.64	0.000	.0112578
fdferw1	.0007386	.0001379	5.35	0.000	.0107981
injselfr	.0318634	.0369141	0.86	0.388	.0059657
cumdose1	1.407057	.3127401	4.50	0.000	.8817948
anxagw2 <-					
depagw1	.0110379	.0093595	1.18	0.238	.0198505
depagw2	.0160157	.0095392	1.68	0.093	.0150772
illw1	10.54114	3.880209	2.72	0.007	.2129242
medcow1	.9214272	.1950628	4.72	0.000	.1136261
crhrw1	.608158	.1966684	3.09	0.002	.031543
illw2	.6692938	.1577489	4.24	0.000	.0220954
medcow2	.6559831	.5104594	1.29	0.199	.1115187
cumdose2	-.2718255	.2126229	-1.28	0.201	-.0380118
anxagw2	.0120002	.001547	7.76	0.000	.0120002
crhrw2	.2514085	.0682731	3.68	0.000	.0128386
anxagw1	.2522342	.0329152	7.66	0.000	.5299654
fdferw1	.1265243	.013053	9.69	0.000	.2757451
injselfr	8.053511	1.483652	5.43	0.000	.2247774
cumdose1	-.3631403	.2838336	-1.28	0.201	-.0339257

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Table 5 male total effects continued:

BSIanx <-					
depagw1	.0022724	.0017734	1.28	0.200	.0263167
depagw2	.0380601	.0065575	5.80	0.000	.2307321
BSIdep	-.0156644	.0052619	-2.98	0.003	-.0160796
illw1	-.1587847	.2783379	-0.57	0.568	-.0206543
BSIposymp	-.0134757	.0019914	-6.77	0.000	-.111094
medcow1	.1326122	.0416647	3.18	0.001	.1053086
crhrw1	.2693861	.1737459	1.55	0.121	.0899757
depagw3	.0246267	.0104866	2.35	0.019	.1552647
illw2	.732182	.1637119	4.47	0.000	.1556568
medcow2	.2187663	.0708081	3.09	0.002	.2394963
anxagw3	-.0402896	.0143755	-2.80	0.005	-.2635001
cumdose2	.0344533	.1043479	0.33	0.741	.0310258
cumdose3	-.0616217	.1011978	-0.61	0.543	-.0591555
anxagw2	.0307419	.0140291	2.19	0.028	.1979676
BSIanx	-.0627186	.0068586	-9.14	0.000	-.0627186
crhrw2	1.67616	.2415001	6.94	0.000	.5512097
crhrw3	.311696	.0566219	5.50	0.000	.1024036
illw3	.9130773	.2026601	4.51	0.000	.3107154
whpsleep	.0306999	.0079875	3.84	0.000	.2731475
whppa	-.0497129	.0150625	-3.30	0.001	-.2634278
anxagw1	.007081	.0019742	3.59	0.000	.0958077
whpel	-.0206334	.0033795	-6.11	0.000	-.2237037
fdferw1	.0140885	.0018966	7.43	0.000	.1977254
medcow3	.0473905	.0205854	2.30	0.021	.0593585
injselfr	.8319035	.1920646	4.33	0.000	.1495215
cumdose1	.0590714	.0414445	1.43	0.154	.0355382
crhrw2 <-					
depagw1	.0038347	.0010459	3.67	0.000	.1350444
depagw2	.0001211	.0000721	1.68	0.093	.0022318
illw1	.0345392	.1159112	0.30	0.766	.0136619
medcow1	.0052387	.0010285	5.09	0.000	.0126503
crhrw1	.7333968	.0404914	18.11	0.000	.7448823
illw2	.0050593	.0011924	4.24	0.000	.0032707
medcow2	.0049587	.0038586	1.29	0.199	.0165075
cumdose2	-.0020548	.0016072	-1.28	0.201	-.0056267
anxagw2	.0076498	.0016514	4.63	0.000	.1498007
crhrw2	.0019004	.0005161	3.68	0.000	.0019004
anxagw1	.0036535	.0003486	10.48	0.000	.1503189
fdferw1	.0064955	.0010807	6.01	0.000	.2772114
injselfr	.8190994	.0894642	9.16	0.000	.4476783
cumdose1	-.002745	.0023324	-1.18	0.239	-.0050218

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Table 5 male total effects continued:

crhrw3 <-					
depagw1	.0033819	.0009104	3.71	0.000	.1192146
depagw2	.0003006	.0001056	2.85	0.004	.0055465
illw1	.0492597	.1126856	0.44	0.662	.0195033
medcow1	.0055628	.0011198	4.97	0.000	.0134458
crhrw1	.6387801	.0546108	11.70	0.000	.6494077
depagw3	.0000449	5.93e-06	7.57	0.000	.0008615
illw2	.0225376	.0065235	3.45	0.001	.0145838
medcow2	.0046563	.003814	1.22	0.222	.0155157
anxagw3	.000082	.0000338	2.43	0.015	.0016333
cumdose2	-.0004084	.0017222	-0.24	0.813	-.0011194
cumdose3	.0016535	.0012708	1.30	0.193	.0048316
anxagw2	.0081461	.0017279	4.71	0.000	.1596727
crhrw2	1.046202	.0398914	26.23	0.000	1.047208
illw3	.0487947	.0243334	2.01	0.045	.050541
anxagw1	.0035488	.0003406	10.42	0.000	.1461527
fdferw1	.005847	.0009458	6.18	0.000	.2497726
medcow3	.0026713	.0008494	3.15	0.002	.0101843
injselfr	.831893	.0885539	9.39	0.000	.4551078
cumdose1	-.000625	.0037984	-0.16	0.869	-.0011446
illw3 <-					
depagw1	-.0000983	.0004479	-0.22	0.826	-.0033467
depagw2	.0036763	.0010032	3.66	0.000	.0654935
illw1	.3541741	.1033631	3.43	0.001	.1353825
medcow1	.0082598	.0042919	1.92	0.054	.019275
crhrw1	-.1873827	.160421	-1.17	0.243	-.183918
depagw3	.0009222	.0001219	7.57	0.000	.017086
illw2	.3585789	.1285022	2.79	0.005	.2240157
medcow2	-.0066901	.0173628	-0.39	0.700	-.0215226
anxagw3	.0016855	.0006935	2.43	0.015	.0323948
cumdose2	.0340202	.0033935	10.03	0.000	.0900272
cumdose3	.0339694	.0261064	1.30	0.193	.0958285
anxagw2	.0094584	.0014339	6.60	0.000	.1789897
crhrw2	.8135563	.1735039	4.69	0.000	.7862013
crhrw3	.0045763	.0017308	2.64	0.008	.0044182
illw3	.0024178	.0009549	2.53	0.011	.0024178
anxagw1	.0019551	.0003096	6.31	0.000	.0777354
fdferw1	.000011	.0002964	0.04	0.970	.0004549
medcow3	.0548782	.0174489	3.15	0.002	.201993
injselfr	.2599222	.0965757	2.69	0.007	.1372837
cumdose1	.0438164	.039818	1.10	0.271	.0774638

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Table 5 male total effects continued:

whpsl~p <-					
depagw1	.027061	.0071324	3.79	0.000	.0352235
depagw2	.0765735	.0234489	3.27	0.001	.0521742
illw1	2.208955	.8490485	2.60	0.009	.0322944
medcow1	.6407019	.1257723	5.09	0.000	.0571841
crhrw1	3.86613	.7045348	5.49	0.000	.1451328
depagw3	.0155451	.0020542	7.57	0.000	.0110154
illw2	6.309898	2.088215	3.02	0.003	.1507684
medcow2	.7040057	.130409	5.40	0.000	.0866231
anxagw3	.0284123	.0116901	2.43	0.015	.020885
cumdose2	-.0305334	.0274046	-1.11	0.265	-.0030903
cumdose3	.0115626	.0088862	1.30	0.193	.0012475
anxagw2	.1309748	.0168946	7.75	0.000	.0947961
crhrw2	8.73026	.6878785	12.69	0.000	.3226767
crhrw3	6.249461	1.237124	5.05	0.000	.2307627
illw3	.3412057	.153477	2.22	0.026	.01305
anxagw1	.0968213	.0454431	2.13	0.033	.1472369
fdferw1	.1949108	.0426994	4.56	0.000	.3074485
medcow3	.9250488	.3455576	2.68	0.007	.1302253
injselfr	11.04369	1.520552	7.26	0.000	.2230921
cumdose1	-.0413462	.0486896	-0.85	0.396	-.0027957
whppa <-					
depagw1	.0277112	.0082672	3.35	0.001	.0605637
depagw2	.0356455	.0129157	2.76	0.006	.0407802
BSIdep	.2953345	.0992074	2.98	0.003	.0572117
illw1	-.0674125	.5343702	-0.13	0.900	-.0016548
BSIposymp	.2540703	.0375454	6.77	0.000	.3952746
medcow1	.6543542	.3646984	1.79	0.073	.0980619
crhrw1	.956635	.7000445	1.37	0.172	.0602981
depagw3	.0055844	.0136747	0.41	0.683	.0066443
illw2	2.701191	.7518552	3.59	0.000	.1083706
medcow2	.0163628	.3781466	0.04	0.965	.0033805
anxagw3	-.0974101	.0359334	-2.71	0.007	-.1202263
cumdose2	-.267815	2.048039	-0.13	0.896	-.0455128
cumdose3	1.883292	1.823463	1.03	0.302	.3411823
anxagw2	.0317461	.0230706	1.38	0.169	.0385799
BSIanx	1.182491	.1293107	9.14	0.000	.2231541
crhrw2	5.836093	.7768908	7.51	0.000	.3621852
crhrw3	1.557801	.3064201	5.08	0.000	.0965835
illw3	4.075451	.8443751	4.83	0.000	.2617207
whpsleep	.2478953	.0381869	6.49	0.000	.4162328
whppa	-.0627186	.0190031	-3.30	0.001	-.0627186
anxagw1	.0321468	.0110687	2.90	0.004	.0820828
whpel	.3890201	.0637171	6.11	0.000	.7959424
fdferw1	.007657	.0229719	0.33	0.739	.0202797
medcow3	1.021374	.2350976	4.34	0.000	.2414258
injselfr	8.930577	1.415401	6.31	0.000	.3029127
cumdose1	-.6383847	.2864923	-2.23	0.026	-.0724781

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Table 5 male total effects continued:

anxagw1 <-					
fdferw1	.476768	.0513355	9.29	0.000	.4945357
injselfr	29.80483	3.739912	7.97	0.000	.395923
whpel <-					
depagw1	.0707392	.0203424	3.48	0.001	.0755625
depagw2	.0814844	.0257375	3.17	0.002	.0455627
BSIdep	.711561	.2390242	2.98	0.003	.067371
illw1	-2.363329	1.0881	-2.17	0.030	-.0283545
BSIposymp	.6121415	.0904596	6.77	0.000	.4654653
medcow1	1.536769	.8784906	1.75	0.080	.1125606
crhrw1	3.597669	.6976221	5.16	0.000	.1108329
depagw3	.0069551	.0331747	0.21	0.834	.0040445
illw2	3.990079	1.264279	3.16	0.002	.0782398
medcow2	.0955975	.921097	0.10	0.917	.009653
anxagw3	-.2465734	.0845953	-2.91	0.004	-.1487415
cumdose2	.1574288	.3253449	0.48	0.628	.0130759
cumdose3	-.1880279	.3074453	-0.61	0.541	-.0166487
anxagw2	.0237458	.0515285	0.46	0.645	.0141042
BSIanx	2.849022	.3115534	9.14	0.000	.2627806
crhrw2	8.374142	.8000148	10.47	0.000	.2540032
crhrw3	3.721017	.7392715	5.03	0.000	.1127569
illw3	2.754247	.8533098	3.23	0.001	.0864481
whpsleep	.5972638	.0920052	6.49	0.000	.490145
whppa	-.1511104	.045785	-3.30	0.001	-.0738558
anxagw1	.066737	.0262434	2.54	0.011	.0832858
whpel	-.0627186	.0102726	-6.11	0.000	-.0627186
fdferw1	.1553167	.0252238	6.16	0.000	.2010541
medcow3	2.074062	.5536353	3.75	0.000	.2396134
injselfr	14.27372	2.907965	4.91	0.000	.2366277
cumdose1	.2499985	.1405672	1.78	0.075	.0138724
fdferw1 <-					
injselfr	26.44194	3.988514	6.63	0.000	.3386311

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Table 5 male total effects continued:

medcow3 <-					
depagw1	-.0000357	.002956	-0.01	0.990	-.0003297
depagw2	.0294292	.0105816	2.78	0.005	.1424377
illw1	.7071453	.1955407	3.62	0.000	.0734375
medcow1	.5904598	.1188191	4.97	0.000	.374351
crhrw1	.3322027	.1441514	2.30	0.021	.0885853
depagw3	.0168452	.002226	7.57	0.000	.0847914
illw2	.7436812	.172403	4.31	0.000	.1262246
medcow2	.7131125	.104707	6.81	0.000	.6232822
anxagw3	.0307886	.0126679	2.43	0.015	.1607634
cumdose2	-.0176835	.0087484	-2.02	0.043	-.0127136
cumdose3	.0014966	.0011502	1.30	0.193	.001147
anxagw2	.0398014	.0031231	12.74	0.000	.2046304
crhrw2	.4171858	.0863364	4.83	0.000	.1095315
crhrw3	.0835922	.0316156	2.64	0.008	.0219259
illw3	.0441641	.0174419	2.53	0.011	.0119987
anxagw1	.007182	.0014183	5.06	0.000	.0775815
fdferw1	.0055701	.0009427	5.91	0.000	.0624125
medcow3	.0024178	.0007688	3.15	0.002	.0024178
injselfr	.5409266	.1232026	4.39	0.000	.0776207
cumdose1	-.0236959	.0163282	-1.45	0.147	-.0113815

Total effects on male Depression (BSI)

In terms of total effects upon BSI depression in Table 5, we find that the sources of depression measured by wave 3 BSI, were in order of decreasing magnitude of standardized total path coefficients: 1) (BSI) positive symptoms, 2) (Nottingham) sleep, 3) (BSI) anxiety, 4) a medical condition in wave 2, 5) perceived risk of exposure in wave 2, 6) fear of consuming contaminated food, 7) having a medical condition in 1986 8) having been injured as a result of Chornobyl, 9) annual illness count in wave 3, and 10) perceived risk of exposure in 1986, 11) in rank is perceived risk of exposure in wave 3, 12) self-reported depressive symptoms in the decade after Chornobyl, 13) self-reported anxiety symptoms in the decade after Chornobyl, 14) (BSI) depression, 15) a medical condition during wave 3, 16) self-reported depressive symptoms in wave 3, and 17) self-reported symptoms of anxiety was of borderline significance (p = .052). The external dose effects, cumulative external dose of radiation at waves 1 2 and 3, on BSI depression were not statistically significant at the 0.05 level and indistinguishable from noise, whereas the total effects of energy level(Nottingham), self-expressed anxiety symptoms in wave 3, and physical ability in wave 3, on BSI depression were statistically significant and inverse in their relationship with BSI depression.

Total effects are the sum of the direct and indirect effects. Of those total effects of external radiation dose, it helps to recall that there was no significant direct effect. Therefore, any effect that exists could be the result an indirect effect, whose sign could have changed as a result of a path mediated by one inverse relationship. Only one total effect of cumulative dose on depression

that did not have an inverse indirect effect was that of self-reported depressive symptoms in 1986. The sign of that effect was positive. Otherwise, the signs of the total effects were the same as those of the indirect effects. It also helps to recognize that the signs of nonsignificant total effects do not have much practical significance, unless opposite signs have cancelled their total effects into non-significance, which does not appear to be a problem in this case.

Total effects on male Anxiety (BSI)

If we sort the total effects on male anxiety by the standardized total path coefficients on anxiety, we find that the effect that had the largest total effect on anxiety was that of perceived risk of exposure during wave 2 ($crhrw2$ $stdized$ $\beta = 0.551,\ p = 0.000$). The second largest effect was that of the illness count in wave 3 ($illw3$ $stdized$ $\beta = 0.311,\ p = 0.000$), third largest effect was that of sleep (Nottingham) ($whpsleep$ $stdized$ $\beta = 0.273,\ p = 0.000$), fourth was a medical condition in wave 2 ($medcow2$ $stdized$ $\beta = 0.239,\ p = 0.002$), with the fifth and sixth being self-reported symptoms of depression ($depagw2$ $stdized$ $\beta = 0.231,\ p = 0.000$) and anxiety ($anxagw2$ $stdized$ $\beta = 0.198,\ p = 0.028$) in wave 2. Seventh was the fear of eating contaminated food in 1986($fdferw1$ $stdized$ $\beta = 0.197,\ p = 0.000$), perhaps before the full details of the accident at Chornobyl had been released. Injury to oneself because of Chornobyl was statistically significant and ranked 10th on the list of total effects in decreasing magnitude (injselfr stdized $\beta = 0.150,\ p = 0.000$) on male anxiety. The signs of all these total effects were positive, which means that in the case of the illness count in wave 3 and the self-reported depressive symptoms in wave 3, whose indirect signs were negative, the direct relationship with anxiety dominated the equation. From these results, the impact of Chornobyl on general anxiety was not only significant but of pre-eminent consequence for some time, a factor that should not be lost in the analysis of long term consequences of a nuclear incident.

The total effects on male anxiety of Chornobyl related perceived risk of exposure in waves 3 and 1, were much further down the list, ranking 12th and 14th, respectively. This is an important feature. During wave 2, there was much economic hardship and the Soviet Union was experiencing glasnost and perestroika. Dissent and breakdown of the old institutions were taking place and this may have contributed much to the rise in apprehension of how conflicting reports about the nature of conditions were being processed and resolved. When macro-level problem resolution breaks down, anxiety and apprehension grows and spreads in any society, and institutions lose legitimacy and public support.

Total effects on male positive symptoms (BSI)

As for the total effects on BSI positive symptoms, the largest statistically significant total effect was that of sleep $whpsleep$ $stdized$ $\beta = 0.690,\ p = 0.000$), second largest was that of anxiety (BSI) $BSIanxiety$ $stdized$ $\beta = 0.590,\ p = 0.000$), third was that of perceived risk of exposure during wave

2, $crhrw2$ $stdized$ $\beta = 0.508,\ p = 0.000$), fourth was fear of consuming contaminated food during wave 1, $fdferw1$ $stdized$ $\beta = 0.365,\ p = 0.000$) and the fifth largest was that of having been injured as a result of Chornobyl $injselfr$ $stdized$ $\beta = 0.690,\ p = 0.000$). Among the major effects on positive symptoms were sleep, anxiety, perceived risk of exposure during wave 2 and fear of eating contaminated food in 1986. Although they were statistically significant, perceived risk of exposure at waves 3 and 1 were 9th and 15th in ranking on the list of declining standardized effects. But the total effects of cumulative external dose on male positive symptoms were not statistically significant in their total effects on male positive symptoms at the 0.05 level (cumdose1 p = .237; cumdose2 p=0.758; and cumdose3 p=.551). All of the statistically significant effects mentioned had positive signs indicating a direct rather than inverse relationship with BSI positive symptoms. Hence, we have significant positive total effects of perceived risk of exposure to partially complement hypothesis 5.

Total effects on male health behavior

When the total effects of perceived risk of exposure are considered with respect to the Nottingham measures of male health behavior, we consider sleep, energy level, and physical ability. These effects are also contained in Table 5, and we will address the total effects on sleep first. Among the top four total effects on sleep are, in declining magnitude of standardized total effects, are perceived risk of exposure in wave 2 $crhrw2$ $stdized$ $\beta = 0.323,\ p = 0.000$), fear of consuming contaminated food in wave 1 $fdferw1$ $stdized$ $\beta = 0.307,\ p = 0.000$), perceived risk of exposure in wave 3 $crhrw3$ $stdized$ $\beta = 0.231,\ p = 0.000$), and an injury as a result of Chornobyl $stdized$ $\beta = 0.223,\ p = 0.000$), (Table 5, p. 47). Claiming two out of the top three positions are perceived risk of exposure in waves 2 and 3 and the fear of consuming contaminated food is another form of fear of exposure.

How this paramount fear of exposure affected the energy level of the male respondent is also of interest. In order of the magnitude of total effect, sleep, positive symptoms, BSI anxiety, and perceived risk of exposure in wave 2 are the top four. Injury resulting from Chornobyl and fear of consuming contaminated food in 1986 are 6th and 7th, after having a medical condition during wave 3. All of these effects were significantly positively related to total effects on energy level. None of the external dose measure total effects was significantly related to energy level (at the .05 level), although external dose during wave 1 was almost significant with ($cumdose1$ $\beta = 0.014,\ p = 0.075$).

With respect to physical ability, the total effects were similar. In that the total effect of external dose at wave 1 was significantly negatively related to physical ability ($stdized$ β -0.072 p = .026.) But energy level, sleep, and positive symptoms were the top four total effects on physical ability. Below that for males in fourth place was perceived risk of exposure during wave 2 ($crhrw2$ $\beta = 0.363,\ p = 0.000$). Therefore, we have significant positive total effects to partially complement hypothesis 8.

4.2 The female model

We include the same variables in this female model as we did in the male model. The paths and the path coefficients may differ somewhat. We have the same cumulative dose and perceived risk of exposure variables. Among the several BSI measures in this model, there are measures of the positive symptoms, anxiety, and depression. The Nottingham measures of physical health and health behavior in this model include sleep, energy level, and physical ability measures. We test the same hypotheses in this section on the female subsample.

Figure 2 depicts the paths which we will explain in terms of the hypotheses tested. To help explain these interrelationships, we provide the list of variable names and labels for the female model in Table 6 and we present the parameter estimates of these paths in Figure 2 in Table 7, so the reader trying to interpret Figure 2 can look to Table 7 for elaboration of the parameter estimates within the Figure 2 path diagram.

To facilitate interpretation of a complex model, we color the variable boxes to reveal related variables. For example, the cumulative dose variables have eggshell colored boxes. The perceived risk of exposure variables contain an orange fill. Self-reported anxiety symptom variables are indicated by yellow rectangles. BSI depression has a yellow outline and a light blue colored interior. Self-reported depression variables have a cyan colored fill with a black outline, whereas BSI depression contains the light blue background with the cyan outline. BSI positive symptoms, like all of the other BSI variables, has a light blue colored fill. Nottingham health behavior variables contain a sand fill, whereas illness count variables are colored light khaki. The medical condition variables have a sand (b) fill color. Fear of eating contaminated food and injury from Chornobyl are colored with green and lime colors.

We also color the paths to aid interpretation. Red arrows represent direct paths from cumulative external dose. Magenta arrows connect the perceived risk of exposure variables. Light blue arrows indicate direct paths from those perceived exposure risk variables. Forest green arrows are direct effects of fear of consuming contaminated food. Purple arrows indicate direct paths from a Chornobyl related injury. Dark orange arrows designate direct paths from self-reported anxiety as well as BSI anxiety variables. Dark blue arrows connect the depression variables.Emerald arrows emanate from BSI positive symptoms. A maroon arrow stems from whpsleep. A khaki arrow projects from physical ability, and a sienna colored arrow extends from energy level. These colors will help us focus on the paths that test hypotheses 4, 5, and 8 and greatly aid our extraction of order from chaos.

The explanatory power of Figure 2 illustrates the model for the female respondents which tests hypotheses 4, 5, and 8. Before examining the individual paths of the model, note that the model fits the data well. The likelihood $\chi^2 = 234.90$, $df = 224$, $p = 0.2952$. Because the model contains several feedback loops we examine the stability index to be sure that the model is stable. The stability index = 0.6680, suggesting that all eigenvalues reside within the unit circle and that the model satisfies the conditions of stability. Table 8

presents the clustered robust output with autocorrelated and heteroskedasticly corrected asymptotic standard errors that we need because our model spans three waves of data. However, to test our hypotheses we refer to Tables 9, 10, and 11, which help to decompose the effects into direct, indirect, and total effects, respectively.

4.2.1 Findings concerning the direct effects among females

Table 8 presents the direct effects among females. The hypotheses we wish to test refer to direct effects, so we can focus on the direct path effects of the model contained in that table. We first focus on cumulative external dose as a source of effects and find that in wave one and find several statistically significant direct effects emanating it. There is a statistically significant direct effect from dose to depression for female respondents (b = 1.00 z=2.74, p=.006). However, the sum of the indirect effects on depression, measured by the BSI depression score, is also statistically significant (b= 0.415 z=2.72 p=0.007). The total effect (b=1.415 z=3.37 p=.001) is also statistically significant.

If we accept the self-reported depression in waves one and two as measures, we find no direct effect in either waves one or two, but the sum of the seven indirect paths are (b=13.933 z=2.97 p=0.007) in wave one and in wave two (b=5.024 z=3.04 p=0.002) are substantial. They are a much larger impacts than that measured by the Brief symptom inventory. They comprise evidence that the mediating or indirect effects are significant and in some cases more substantial than conventionally measured direct effects in cases of cumulative external dose on depression for Ukrainian female residents of Zhitomyr and Kiev Oblasts.

Table 6 Variable names and labels for Figure 2 and Tables relating to female model

fdferw1	byte	%8.0g	* Level (in %) of fear of eating radioactively contaminated food in 1986
cumdose1	float	%9.0g	cumulative external dose in mGys in wave 1
cumdose2	float	%9.0g	cumulative external dose in mGys in wave 2
cumdose3	float	%9.0g	cumulative external dose in mGys in wave 3
crhrw1	float	%9.0g	Chornobyl related health risk: wave 1 alpha = .796
crhrw2	float	%9.0g	Chornobyl related health risk: wave 2 alpha = .822
crhrw3	float	%9.0g	Chornobyl related health risk: wave 3 alpha = .834
medcow1	byte	%8.0g	number of medical visits for a medical condition per year 1976-1986
medcow2	byte	%8.0g	number of medical visits for a medical condition per year 1987-1996
medcow3	byte	%8.0g	number of medical visits for a medical condition per year 1997-now
age	byte	%8.0g	* Respondent´s age
injselfr	byte	%9.0g	Were u injured because of Chornobyl acc in 1986?
depagw1	byte	%9.0g	Depression aggregated to wave 1 in 1986
depagw2	double	%9.0g	Depression aggregated to wave 2: 1987 thru 1996
depagw3	double	%9.0g	Depression aggregated to wave 3:
BSIdep	byte	%9.0g	Brief symptom inventory depression subscale score
anxagw1	byte	%9.0g	Average Anxiety level for wave 1
anxagw2	double	%9.0g	Average Anxiety level for wave 2
anxagw3			Average Anxiety level for wave 3
BSIanx	byte	%9.0g	Brief symptom inventory anxiety subscale score
BSIposymp	int	%9.0g	Brief Symptom inventory positive symptom total subscale
illw1	byte	%8.0g	Total number of illnesses experienced in time period
illw2	byte	%8.0g	Total number of illnesses experienced in time period 1987-1996
illw3	byte	%8.0g	Total number of illnesses experienced in time period 1996-NOW
whpsleep	float	%9.0g	Nottingham sleep subscale
whpel	float	%9.0g	Nottingham energy level subscale
whppa	float	%9.0g	Nottingham physical ability subscale

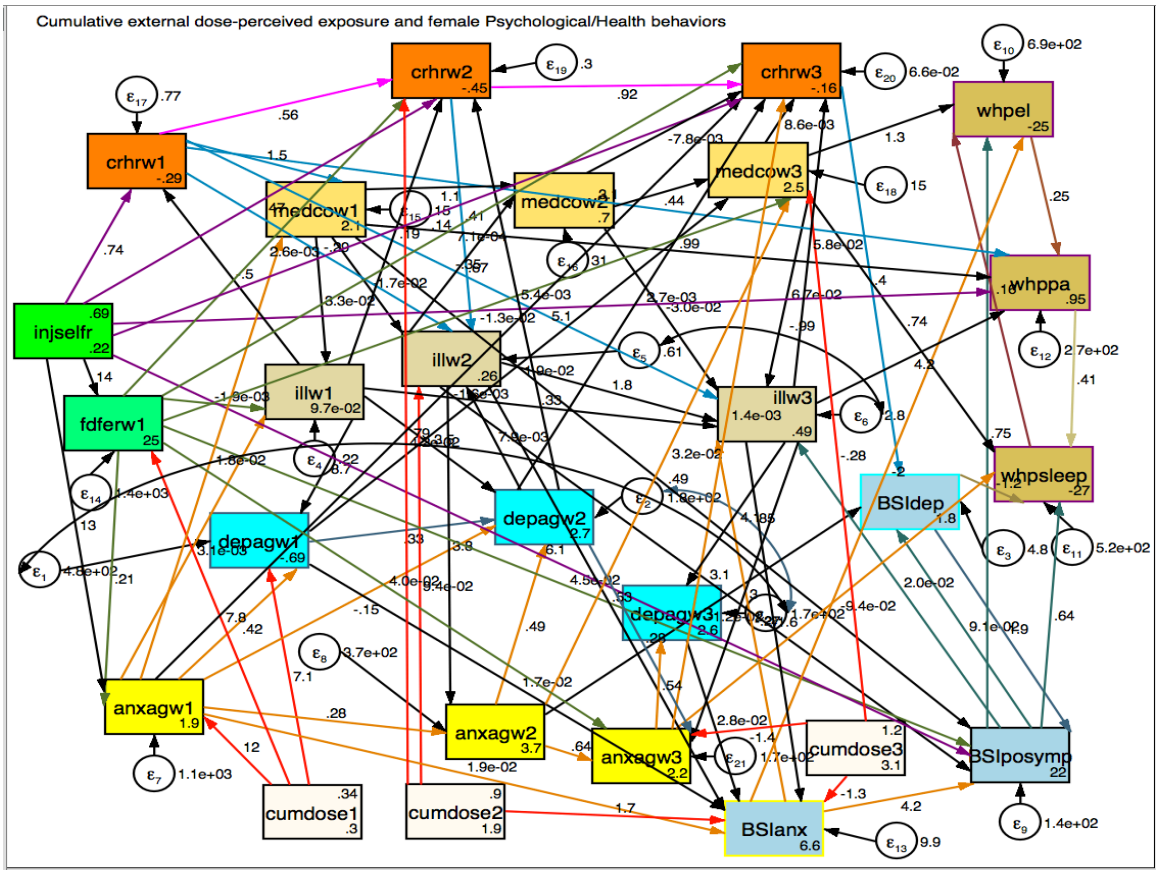

Figure 3: Dose-depression robust path diagram for females

Table 7 Female Path model

Endogenous variables

Observed: depagw1 depagw2 BSIanx medcow3 illw2 crhrw2 crhrw3 anxagw3 BSIdep BSIposymp whpsleep illw1 illw3 crhrw1 anxagw2 medcow2 whppa depagw3 anxagw1 medcow1 whpel fdferw1

Exogenous variables

Observed: injselfr cumdose1 cumdose2 cumdose3

Structural equation model Number of obs = 360
Estimation method = ml
Log likelihood = -25060.365

	OIM Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Structural						
depagw1 <-						
illw1	8.693802	2.305304	3.77	0.000	4.17549	13.21211
anxagw1	.417839	.0332105	12.58	0.000	.3527477	.4829303
cumdose1	7.103828	2.054895	3.46	0.001	3.076308	11.13135
_cons	-.6884409	1.472391	-0.47	0.640	-3.574275	2.197393
depagw2 <-						
depagw1	.3322217	.0316011	10.51	0.000	.2702848	.3941586
illw1	3.475319	1.322387	2.63	0.009	.8834883	6.06715
anxagw2	.4850883	.0333058	14.56	0.000	.4198101	.5503665
anxagw1	-.1458317	.0246265	-5.92	0.000	-.1940988	-.0975646
_cons	2.67207	.8439806	3.17	0.002	1.017898	4.326241
BSIanx <-						
depagw1	.0172322	.0078436	2.20	0.028	.001859	.0326054
illw2	.5346132	.2196174	2.43	0.015	.104171	.9650554
illw3	1.642896	.3014703	5.45	0.000	1.052025	2.233767
depagw3	.0279066	.0103913	2.69	0.007	.00754	.0482732
anxagw1	.0193323	.005938	3.26	0.001	.007694	.0309706
cumdose2	1.686464	.7461813	2.26	0.024	.2239752	3.148952
cumdose3	-1.304436	.5936933	-2.20	0.028	-2.468054	-.1408188
_cons	6.621358	.2592679	25.54	0.000	6.113203	7.129514
medcow3 <-						
depagw1	.0186108	.0077709	2.39	0.017	.00338	.0338416
anxagw2	.0316561	.0095703	3.31	0.001	.0128987	.0504134
medcow2	.4384699	.0295481	14.84	0.000	.3805568	.4963831
fdferw1	-.0127401	.0056223	-2.27	0.023	-.0237595	-.0017207
cumdose3	-.2802811	.1198321	-2.34	0.019	-.5151476	-.0454146
_cons	2.529274	.3269219	7.74	0.000	1.888519	3.170029
illw2 <-						
depagw2	.0079217	.0018064	4.39	0.000	.0043812	.0114623
crhrw2	.4072142	.0555905	7.33	0.000	.2982589	.5161695
crhrw1	-.290458	.0564676	-5.14	0.000	-.4011325	-.1797835
medcow1	-.0169072	.0079292	-2.13	0.033	-.0324482	-.0013663
cumdose2	.0935411	.0213385	4.38	0.000	.0517185	.1353638
_cons	.2631008	.0535138	4.92	0.000	.1582157	.3679858

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Table 7 continued:

crhrw2 <-						
depagw2	.0054096	.0015915	3.40	0.001	.0022903	.008529
illw1	.1936146	.0613627	3.16	0.002	.0733459	.3138834
crhrw1	.5604522	.0334556	16.75	0.000	.4948804	.6260241
fdferw1	.002598	.0007897	3.29	0.001	.0010502	.0041457
injselfr	.4738383	.0677843	6.99	0.000	.3409835	.606693
cumdose2	.0421698	.0210465	2.00	0.045	.0009193	.0834203
_cons	-.4528839	.0585631	-7.73	0.000	-.5676655	-.3381023
crhrw3 <-						
depagw2	.0027161	.0009304	2.92	0.004	.0008926	.0045396
medcow3	.0085954	.0035139	2.45	0.014	.0017082	.0154826
crhrw2	.9217773	.0187896	49.06	0.000	.8849505	.9586042
anxagw3	.0014426	.0008028	1.80	0.072	-.0001309	.003016
illw3	.0577877	.0125511	4.60	0.000	.0331879	.0823875
medcow2	-.007836	.0025237	-3.10	0.002	-.0127824	-.0028897
anxagw1	-.0016459	.000432	-3.81	0.000	-.0024926	-.0007991
fdferw1	.0007123	.0003872	1.84	0.066	-.0000465	.0014711
injselfr	.1371041	.0345138	3.97	0.000	.0694582	.20475
_cons	-.1632325	.0298918	-5.46	0.000	-.2218194	-.1046456
anxagw3 <-						
depagw2	.2830794	.044554	6.35	0.000	.1957553	.3704036
illw3	2.963024	.6349771	4.67	0.000	1.718492	4.207557
anxagw2	.6365227	.0378934	16.80	0.000	.562253	.7107925
fdferw1	.0404169	.0185593	2.18	0.029	.0040413	.0767925
cumdose3	-1.390813	.4008537	-3.47	0.001	-2.176471	-.6051538
_cons	2.161831	1.095115	1.97	0.048	.0154458	4.308216
BSIdep <-						
crhrw3	.3988099	.1441973	2.77	0.006	.1161883	.6814315
BSIposymp	.0911331	.0061293	14.87	0.000	.07912	.1031462
anxagw2	-.0115748	.0055139	-2.10	0.036	-.0223818	-.0007678
_cons	1.824519	.5188103	3.52	0.000	.807669	2.841368
BSIpo~p <-						
BSIanx	4.200226	.2781633	15.10	0.000	3.655036	4.745416
illw2	3.123624	.8049307	3.88	0.000	1.545989	4.701259
BSIdep	1.912359	.3130541	6.11	0.000	1.298784	2.525933
medcow1	.4930261	.1574208	3.13	0.002	.1844869	.8015652
fdferw1	.0454865	.0172967	2.63	0.009	.0115856	.0793874
injselfr	6.117369	1.49711	4.09	0.000	3.183087	9.051651
_cons	21.86944	2.387089	9.16	0.000	17.19083	26.54804
whpsl~p <-						
medcow3	.7409917	.2469078	3.00	0.003	.2570612	1.224922
anxagw3	-.0942308	.0560639	-1.68	0.093	-.204114	.0156525
BSIdep	-1.24874	.5641974	-2.21	0.027	-2.354546	-.1429331
BSIposymp	.6435628	.0815734	7.89	0.000	.483682	.8034436
whppa	.4085173	.067283	6.07	0.000	.276645	.5403896
_cons	-26.56794	4.030215	-6.59	0.000	-34.46701	-18.66886

Continued on the next page...

Table 7 continued:

illw1 <-						
anxagw1	.0030794	.0007473	4.12	0.000	.0016148	.0045441
medcow1	.0325509	.0068287	4.77	0.000	.0191669	.0459348
fdferw1	-.0019308	.0006889	-2.80	0.005	-.0032811	-.0005806
_cons	.0972021	.0385294	2.52	0.012	.0216859	.1727182
illw3 <-						
BSIanx	-.2707136	.0525787	-5.15	0.000	-.3737659	-.1676614
medcow3	.0673819	.0154191	4.37	0.000	.037161	.0976029
illw2	1.770151	.2758513	6.42	0.000	1.229492	2.310809
BSIposymp	.0203216	.0045278	4.49	0.000	.0114473	.0291959
illw1	.3292506	.1342434	2.45	0.014	.0661384	.5923628
crhrw1	-.3485606	.0976288	-3.57	0.000	-.5399097	-.1572116
medcow2	-.0300208	.01159	-2.59	0.010	-.0527367	-.0073048
_cons	.4927869	.2803563	1.76	0.079	-.0567013	1.042275
crhrw1 <-						
illw1	-.497547	.1044483	-4.76	0.000	-.702262	-.292832
injselfr	.7351058	.100856	7.29	0.000	.5374317	.9327799
_cons	-.2876322	.0829841	-3.47	0.001	-.4502781	-.1249863
anxagw2 <-						
illw2	3.776925	1.274815	2.96	0.003	1.278334	6.275516
anxagw1	.2824911	.0291418	9.69	0.000	.2253743	.3396079
_cons	3.661978	1.277963	2.87	0.004	1.157216	6.16674
medcow2 <-						
illw2	.6694346	.3301301	2.03	0.043	.0223914	1.316478
medcow1	1.058045	.0703431	15.04	0.000	.9201749	1.195915
_cons	.695324	.3763194	1.85	0.065	-.0422485	1.432896
whppa <-						
illw3	4.243575	.8344046	5.09	0.000	2.608172	5.878978
crhrw1	3.086586	1.078369	2.86	0.004	.9730212	5.200151
medcow1	.9891686	.2225455	4.44	0.000	.5529875	1.42535
whpel	.2486173	.0277569	8.96	0.000	.1942148	.3030197
injselfr	5.146159	2.086283	2.47	0.014	1.057119	9.2352
_cons	.9471028	1.711941	0.55	0.580	-2.40824	4.302445
depagw3 <-						
anxagw3	.5440492	.0292003	18.63	0.000	.4868177	.6012806
illw3	4.115794	.5525956	7.45	0.000	3.032726	5.198861
_cons	2.576849	.8519965	3.02	0.002	.9069661	4.246731
anxagw1 <-						
fdferw1	.2089858	.0466116	4.48	0.000	.1176287	.3003428
injselfr	12.65965	3.797455	3.33	0.001	5.216776	20.10252
cumdose1	11.77704	3.174534	3.71	0.000	5.555072	17.99902
_cons	1.941381	3.389721	0.57	0.567	-4.702351	8.585113

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Table 7 continued:

medcow1 <-						
crhrw1	1.516698	.2410805	6.29	0.000	1.044189	1.989207
anxagw1	.0176617	.0058987	2.99	0.003	.0061004	.029223
_cons	2.072729	.2455291	8.44	0.000	1.591501	2.553957
whpel <-						
BSIanx	-1.969168	.6524011	-3.02	0.003	-3.247851	-.6904856
medcow3	1.305164	.2810282	4.64	0.000	.7543587	1.855969
BSIposymp	.7538538	.0922495	8.17	0.000	.5730481	.9346595
whpsleep	.1632539	.0612151	2.67	0.008	.0432745	.2832333
_cons	-25.26058	4.881062	-5.18	0.000	-34.82729	-15.69388
fdferw1 <-						
injselfr	13.84293	4.231418	3.27	0.001	5.549507	22.13636
cumdose1	7.764987	3.566101	2.18	0.029	.775558	14.75442
_cons	25.33306	3.592751	7.05	0.000	18.2914	32.37472
Variance						
e.depagw1	480.4047	35.82749			415.075	556.0168
e.depagw2	178.884	13.3533			154.5365	207.0674
e.BSIanx	9.928759	1.04046			8.085286	12.19255
e.medcow3	15.23561	1.135595			13.16482	17.63213
e.illw2	.6136157	.0460684			.5296522	.7108895
e.crhrw2	.2969417	.0221444			.2565623	.3436761
e.crhrw3	.0660263	.0049214			.0570521	.0764122
e.anxagw3	168.6345	12.57609			145.7026	195.1757
e.BSIdep	4.774065	.3877053			4.071568	5.59777
e.BSIpos~p	143.8515	14.70635			117.7317	175.7661
e.whpsleep	522.3894	39.04455			451.2048	604.8046
e.illw1	.2245922	.0168919			.1938094	.2602644
e.illw3	2.776824	.6258353			1.785279	4.319073
e.crhrw1	.7703395	.0579389			.6647546	.8926946
e.anxagw2	373.3337	28.23139			321.9064	432.977
e.medcow2	30.77471	2.293812			26.59189	35.61548
e.whppa	271.6166	20.27092			234.6555	314.3996
e.depagw3	174.9602	13.18673			150.933	202.8122
e.anxagw1	1072.493	79.93892			926.7225	1241.193
e.medcow1	15.42933	1.156031			13.32206	17.86992
e.whpel	694.2495	52.48559			598.6381	805.1315
e.fdferw1	1371.211	102.204			1184.839	1586.898
Covariance						
e.depagw1						
e.depagw3	79.19068	15.98472	4.95	0.000	47.86121	110.5202
e.depagw2						
e.depagw3	84.75515	10.22285	8.29	0.000	64.71873	104.7916
e.illw2						
e.illw3	-.9878146	.1867913	-5.29	0.000	-1.353919	-.6217104

LR test of model vs. saturated: chi2(224) = 234.90, Prob > chi2 = 0.2952
stability index = .6679766

Table 8 Cluster robust version of the female model

Endogenous variables

Observed: depagw1 depagw2 BSIanx medcow3 illw2 crhrw2 crhrw3 anxagw3 BSIdep BSIposymp whpsleep illw1 illw3 crhrw1 anxagw2 medcow2 whppa depagw3 anxagw1 medcow1 whpel fdferw1

Exogenous variables

Observed: injselfr cumdose1 cumdose2 cumdose3

Structural equation model Number of obs = 360
Estimation method = ml
Log pseudolikelihood= -25060.365

(Std. Err. adjusted for 360 clusters in id)

	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
Structural						
depagw1 <-						
illw1	8.693802	2.700953	3.22	0.001	3.400031	13.98757
anxagw1	.417839	.0521961	8.01	0.000	.3155366	.5201414
cumdose1	7.103828	3.320793	2.14	0.032	.5951937	13.61246
_cons	-.6884409	1.336863	-0.51	0.607	-3.308644	1.931762
depagw2 <-						
depagw1	.3322217	.0599879	5.54	0.000	.2146476	.4497958
illw1	3.475319	2.424585	1.43	0.152	-1.276781	8.227419
anxagw2	.4850883	.0650171	7.46	0.000	.3576571	.6125195
anxagw1	-.1458317	.0363584	-4.01	0.000	-.2170929	-.0745705
_cons	2.67207	.6084263	4.39	0.000	1.479576	3.864563
BSIanx <-						
depagw1	.0172322	.0087657	1.97	0.049	.0000518	.0344127
illw2	.5346132	.2389726	2.24	0.025	.0662356	1.002991
illw3	1.642896	.3645113	4.51	0.000	.9284674	2.357325
depagw3	.0279066	.0118175	2.36	0.018	.0047447	.0510686
anxagw1	.0193323	.0068152	2.84	0.005	.0059748	.0326898
cumdose2	1.686464	1.218664	1.38	0.166	-.7020735	4.075001
cumdose3	-1.304436	.9715333	-1.34	0.179	-3.208607	.5997339
_cons	6.621358	.2318364	28.56	0.000	6.166967	7.075749
medcow3 <-						
depagw1	.0186108	.0109562	1.70	0.089	-.0028629	.0400845
anxagw2	.0316561	.0115299	2.75	0.006	.0090579	.0542542
medcow2	.4384699	.0757898	5.79	0.000	.2899246	.5870152
fdferw1	-.0127401	.0064191	-1.98	0.047	-.0253212	-.000159
cumdose3	-.2802811	.1188318	-2.36	0.018	-.5131872	-.047375
_cons	2.529274	.294567	8.59	0.000	1.951933	3.106615
illw2 <-						
depagw2	.0079217	.0029757	2.66	0.008	.0020894	.0137541
crhrw2	.4072142	.0725079	5.62	0.000	.2651014	.549327
crhrw1	-.290458	.0709901	-4.09	0.000	-.4295961	-.1513199
medcow1	-.0169072	.0098963	-1.71	0.088	-.0363035	.0024891
cumdose2	.0935411	.0296348	3.16	0.002	.0354579	.1516243
_cons	.2631008	.0504665	5.21	0.000	.1641883	.3620132

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Table 8 continued:

crhrw2 <-						
depagw2	.0054096	.0014007	3.86	0.000	.0026643	.008155
illw1	.1936146	.0669021	2.89	0.004	.0624889	.3247404
crhrw1	.5604522	.041806	13.41	0.000	.478514	.6423905
fdferw1	.002598	.0008116	3.20	0.001	.0010072	.0041887
injselfr	.4738383	.0778033	6.09	0.000	.3213467	.6263299
cumdose2	.0421698	.0168382	2.50	0.012	.0091676	.075172
_cons	-.4528839	.0588611	-7.69	0.000	-.5682494	-.3375183
crhrw3 <-						
depagw2	.0027161	.0011848	2.29	0.022	.0003939	.0050383
medcow3	.0085954	.0051439	1.67	0.095	-.0014865	.0186773
crhrw2	.9217773	.0163872	56.25	0.000	.889659	.9538957
anxagw3	.0014426	.0009015	1.60	0.110	-.0003244	.0032095
illw3	.0577877	.0157069	3.68	0.000	.0270027	.0885727
medcow2	-.007836	.0038728	-2.02	0.043	-.0154265	-.0002456
anxagw1	-.0016459	.0004827	-3.41	0.001	-.0025919	-.0006999
fdferw1	.0007123	.0003896	1.83	0.068	-.0000513	.0014759
injselfr	.1371041	.0371864	3.69	0.000	.06422	.2099882
_cons	-.1632325	.0304364	-5.36	0.000	-.2228868	-.1035783
anxagw3 <-						
depagw2	.2830794	.0980981	2.89	0.004	.0908107	.4753481
illw3	2.963024	.7926432	3.74	0.000	1.409472	4.516576
anxagw2	.6365227	.0680252	9.36	0.000	.5031958	.7698497
fdferw1	.0404169	.0208303	1.94	0.052	-.0004097	.0812435
cumdose3	-1.390813	.440052	-3.16	0.002	-2.253299	-.5283265
_cons	2.161831	.8539285	2.53	0.011	.4881616	3.8355
BSIdep <-						
crhrw3	.3988099	.1493634	2.67	0.008	.106063	.6915569
BSIposymp	.0911331	.0076635	11.89	0.000	.076113	.1061532
anxagw2	-.0115748	.0046581	-2.48	0.013	-.0207046	-.0024451
_cons	1.824519	.5922761	3.08	0.002	.6636788	2.985358
BSIpo~p <-						
BSIanx	4.200226	.366465	11.46	0.000	3.481968	4.918484
illw2	3.123624	1.056529	2.96	0.003	1.052865	5.194382
BSIdep	1.912359	.3641669	5.25	0.000	1.198604	2.626113
medcow1	.4930261	.1861407	2.65	0.008	.1281969	.8578552
fdferw1	.0454865	.0187574	2.42	0.015	.0087226	.0822504
injselfr	6.117369	1.292698	4.73	0.000	3.583727	8.651011
_cons	21.86944	2.714284	8.06	0.000	16.54954	27.18933
whpsl~p <-						
medcow3	.7409917	.2268364	3.27	0.001	.2964006	1.185583
anxagw3	-.0942308	.0612368	-1.54	0.124	-.2142527	.0257911
BSIdep	-1.24874	.6210464	-2.01	0.044	-2.465968	-.0315112
BSIposymp	.6435628	.0889529	7.23	0.000	.4692183	.8179073
whppa	.4085173	.0788335	5.18	0.000	.2540065	.5630281
_cons	-26.56794	3.65456	-7.27	0.000	-33.73074	-19.40513

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Table 8 continued:

illw1 <-						
anxagw1	.0030794	.0011302	2.72	0.006	.0008642	.0052947
medcow1	.0325509	.0111559	2.92	0.004	.0106857	.054416
fdferw1	-.0019308	.000791	-2.44	0.015	-.0034812	-.0003805
_cons	.0972021	.0317444	3.06	0.002	.0349841	.15942
illw3 <-						
BSIanx	-.2707136	.0769654	-3.52	0.000	-.4215631	-.1198642
medcow3	.0673819	.0202946	3.32	0.001	.0276053	.1071585
illw2	1.770151	.4395386	4.03	0.000	.9086707	2.63163
BSIposymp	.0203216	.0059901	3.39	0.001	.0085812	.032062
illw1	.3292506	.1618111	2.03	0.042	.0121067	.6463945
crhrw1	-.3485606	.1153329	-3.02	0.003	-.5746089	-.1225124
medcow2	-.0300208	.0145749	-2.06	0.039	-.058587	-.0014545
_cons	.4927869	.2925639	1.68	0.092	-.0806277	1.066202
crhrw1 <-						
illw1	-.497547	.1123862	-4.43	0.000	-.7178199	-.277274
injselfr	.7351058	.099048	7.42	0.000	.5409753	.9292363
_cons	-.2876322	.0753083	-3.82	0.000	-.4352338	-.1400305
anxagw2 <-						
illw2	3.776925	1.812185	2.08	0.037	.2251075	7.328743
anxagw1	.2824911	.0481941	5.86	0.000	.1880324	.3769498
_cons	3.661978	.8977825	4.08	0.000	1.902357	5.4216
medcow2 <-						
illw2	.6694346	.2569322	2.61	0.009	.1658567	1.173012
medcow1	1.058045	.2299723	4.60	0.000	.6073074	1.508782
_cons	.695324	.3800501	1.83	0.067	-.0495606	1.440209
whppa <-						
illw3	4.243575	.8277627	5.13	0.000	2.62119	5.86596
crhrw1	3.086586	1.030974	2.99	0.003	1.065914	5.107259
medcow1	.9891686	.2823565	3.50	0.000	.4357601	1.542577
whpel	.2486173	.0317785	7.82	0.000	.1863326	.3109019
injselfr	5.146159	1.826878	2.82	0.005	1.565544	8.726774
_cons	.9471028	1.548518	0.61	0.541	-2.087937	3.982143
depagw3 <-						
anxagw3	.5440492	.0582333	9.34	0.000	.4299141	.6581843
illw3	4.115794	.6797875	6.05	0.000	2.783435	5.448153
_cons	2.576849	.67819	3.80	0.000	1.247621	3.906077
anxagw1 <-						
fdferw1	.2089858	.0508552	4.11	0.000	.1093114	.3086601
injselfr	12.65965	3.322472	3.81	0.000	6.147726	19.17157
cumdose1	11.77704	4.40861	2.67	0.008	3.136326	20.41776
_cons	1.941381	2.555255	0.76	0.447	-3.066827	6.94959

Continued on the next page...

Table 8 continued:

medcow1 <-						
crhrw1	1.516698	.3100721	4.89	0.000	.9089675	2.124428
anxagw1	.0176617	.0069531	2.54	0.011	.0040339	.0312896
_cons	2.072729	.2154314	9.62	0.000	1.650491	2.494967
whpel <-						
BSIanx	-1.969168	.7061289	-2.79	0.005	-3.353155	-.5851811
medcow3	1.305164	.2929819	4.45	0.000	.7309298	1.879398
BSIposymp	.7538538	.1046905	7.20	0.000	.5486643	.9590434
whpsleep	.1632539	.070028	2.33	0.020	.0260017	.3005062
_cons	-25.26058	4.720522	-5.35	0.000	-34.51264	-16.00853
fdferw1 <-						
injselfr	13.84293	4.125713	3.36	0.001	5.756685	21.92918
cumdose1	7.764987	3.359776	2.31	0.021	1.179947	14.35003
_cons	25.33306	3.399732	7.45	0.000	18.66971	31.99641
Variance						
e.depagw1	480.4047	64.61951			369.0724	625.3207
e.depagw2	178.884	26.4552			133.8712	239.0319
e.BSIanx	9.928759	1.351938			7.603124	12.96576
e.medcow3	15.23561	3.039725			10.30464	22.52615
e.illw2	.6136157	.167486			.3593863	1.047687
e.crhrw2	.2969417	.0296533			.2441563	.3611389
e.crhrw3	.0660263	.0093624			.0500056	.0871797
e.anxagw3	168.6345	25.78875			124.9611	227.5716
e.BSIdep	4.774065	.4801662			3.919911	5.814342
e.BSIpos~p	143.8515	13.92011			118.9997	173.8933
e.whpsleep	522.3894	49.50191			433.8445	629.0059
e.illw1	.2245922	.0406083			.157576	.3201102
e.illw3	2.776824	.9643935			1.405806	5.484934
e.crhrw1	.7703395	.0418144			.6925937	.8568124
e.anxagw2	373.3337	52.19343			283.8547	491.019
e.medcow2	30.77471	17.62176			10.01824	94.53583
e.whppa	271.6166	25.73892			225.577	327.0528
e.depagw3	174.9602	27.23128			128.9602	237.3682
e.anxagw1	1072.493	83.93363			919.9818	1250.287
e.medcow1	15.42933	2.562364			11.14261	21.3652
e.whpel	694.2495	50.64341			601.7595	800.9551
e.fdferw1	1371.211	67.30163			1245.448	1509.673
Covariance						
e.depagw1						
e.depagw3	79.19068	22.9769	3.45	0.001	34.15679	124.2246
e.depagw2						
e.depagw3	84.75515	15.48048	5.47	0.000	54.41397	115.0963
e.illw2						
e.illw3	-.9878146	.3311444	-2.98	0.003	-1.636846	-.3387834

Hypothesis 4 and direct effects on BSI

We begin with a consideration of hypothesis 4. In Table 9 we examine the BSI panels of positive symptoms, anxiety, or depression and find no evidence of statistically significant direct relationship between cumulative external dose in any wave and BSI positive symptoms, BSI anxiety, or BSI depression. On page 69, under the BSI positive symptoms panel at the bottom of the page, we see no direct path from cumulative external dose in wave 1, 2, or 3. If we turn to the BSI anxiety direct effects panel on page 66, we find no significant path from wave 1 cumulative external dose, from wave 2 ($cumdose2$ $stdized$ $\beta = .636,\ p = .166$) or from wave 3 ($cumdose3$ $stdized$ $\beta = -.626,\ p = 0.179$). If we turn to the BSI depression direct effects panel on page 69, we find no path from the cumulative external dose at wave 1, 2, or 3. Therefore, hypothesis 4 appears to be inconsistent the data, with respect to direct effects of any of the cumulative dose variables on these BSI measures of psychological health.

Hypothesis 5 Direct effects perceived risk of exposure on BSI

Hypothesis 5 posits that the perceived risk of exposure to radiation directly predicts psychological health as measured by the subscales of the BSI. For evidence, we again turn to the relevant panels in Table 9 and search for direct paths Chornobyl related health risk from waves 1, 2, or 3 (crhrw1, crhrw2, crhrw3). On page 69, we examine the rows for these three variables under BSI positive symptoms and find no path from any of them. This means that there are no direct effects from perceived risk projected directly to positive symptoms. On page 66, we find no direct path from any of these perceived risk variables extending to BSI anxiety, either. For direct effects of perceived risk on BSI depression, we find no path in either wave 1 or wave 2. However, we do find a statistically significant direct path in wave three ($crhrw3$ $stdized$ $\beta = 0.96$ $p = 0.008$). This indicates partial support for hypothesis 5 with respect to BSI depression stemming from wave 3 perceived risk of exposure.

Hypothesis 8 Direct effects on Nottingham health behavior

To test hypothesis 8, we examine the Nottingham panels of Table 9. We consider the whpsleep direct effects. We find no direct paths emanating from perceived risk of exposure to BSI sleep. When we examine the energy level panel, we again find no direct paths from perceived risk of exposure from any wave. However, we do find a statistically significant path from perceived risk of exposure to radiation in 1986 to physical ability. ($crhrw1$ $stdized$ $\beta = 0.137$ $p = 0.003$). But for later waves, there is no evidence of such a relationship. At most, we have some evidence of a relationship between perceived risk in 1986 and physical ability. The evidence we have found of direct effects is from perceived risk of exposure, rather than actual exposure in 1986, and physical ability. Although these hypotheses refer to direct effects, we should examine the indirect effects as well.

Table 9 Decomposition of effects standardized

Direct effects

(Std. Err. adjusted for 360 clusters in id)

	Coef.	Robust Std. Err.	z	P>|z|	Std. Coef.
Structural					
depagw1 <-					
illw1	8.693802	2.700953	3.22	0.001	.154137
crhrw1	0	(no path)			0
anxagw1	.417839	.0521961	8.01	0.000	.5259819
medcow1	0	(no path)			0
fdferw1	0	(no path)			0
injselfr	0	(no path)			0
cumdose1	7.103828	3.320793	2.14	0.032	.1392376
depagw2 <-					
depagw1	.3322217	.0599879	5.54	0.000	.47834
depagw2	0	(no path)			0
illw2	0	(no path)			0
crhrw2	0	(no path)			0
illw1	3.475319	2.424585	1.43	0.152	.0887157
crhrw1	0	(no path)			0
anxagw2	.4850883	.0650171	7.46	0.000	.5599397
anxagw1	-.1458317	.0363584	-4.01	0.000	-.2643153
medcow1	0	(no path)			0
fdferw1	0	(no path)			0
injselfr	0	(no path)			0
cumdose1	0	(no path)			0
cumdose2	0	(no path)			0
BSIanx <-					
depagw1	.0172322	.0087657	1.97	0.049	.1319831
depagw2	0	(no path)			0
BSIanx	0	(no path)			0
medcow3	0	(no path)			0
illw2	.5346132	.2389726	2.24	0.025	.1290623
crhrw2	0	(no path)			0
crhrw3	0	(no path)			0
anxagw3	0	(no path)			0
BSIdep	0	(no path)			0
BSIposymp	0	(no path)			0
illw1	0	(no path)			0
illw3	1.642896	.3645113	4.51	0.000	.5189398
crhrw1	0	(no path)			0
anxagw2	0	(no path)			0
medcow2	0	(no path)			0
depagw3	.0279066	.0118175	2.36	0.018	.1590774
anxagw1	.0193323	.0068152	2.84	0.005	.18639
medcow1	0	(no path)			0
fdferw1	0	(no path)			0
injselfr	0	(no path)			0
cumdose1	0	(no path)			0
cumdose2	1.686464	1.218664	1.38	0.166	.6363144
cumdose3	-1.304436	.9715333	-1.34	0.179	-.6260392

Continued ...

Table 9 continued:

medcow3 <-					
depagw1	.0186108	.0109562	1.70	0.089	.1018835
depagw2	0	(no path)			0
illw2	0	(no path)			0
crhrw2	0	(no path)			0
illw1	0	(no path)			0
crhrw1	0	(no path)			0
anxagw2	.0316561	.0115299	2.75	0.006	.1389337
medcow2	.4384699	.0757898	5.79	0.000	.6049198
anxagw1	0	(no path)			0
medcow1	0	(no path)			0
fdferw1	-.0127401	.0064191	-1.98	0.047	-.0941027
injselfr	0	(no path)			0
cumdose1	0	(no path)			0
cumdose2	0	(no path)			0
cumdose3	-.2802811	.1188318	-2.36	0.018	-.0961467
illw2 <-					
depagw1	0	(no path)			0
depagw2	.0079217	.0029757	2.66	0.008	.1745535
illw2	0	(no path)			0
crhrw2	.4072142	.0725079	5.62	0.000	.4009597
illw1	0	(no path)			0
crhrw1	-.290458	.0709901	-4.09	0.000	-.31123
anxagw2	0	(no path)			0
anxagw1	0	(no path)			0
medcow1	-.0169072	.0098963	-1.71	0.088	-.0791702
fdferw1	0	(no path)			0
injselfr	0	(no path)			0
cumdose1	0	(no path)			0
cumdose2	.0935411	.0296348	3.16	0.002	.1461967
crhrw2 <-					
depagw1	0	(no path)			0
depagw2	.0054096	.0014007	3.86	0.000	.1210596
illw2	0	(no path)			0
crhrw2	0	(no path)			0
illw1	.1936146	.0669021	2.89	0.004	.1106051
crhrw1	.5604522	.041806	13.41	0.000	.6099004
anxagw2	0	(no path)			0
anxagw1	0	(no path)			0
medcow1	0	(no path)			0
fdferw1	.002598	.0008116	3.20	0.001	.1129434
injselfr	.4738383	.0778033	6.09	0.000	.2521979
cumdose1	0	(no path)			0
cumdose2	.0421698	.0168382	2.50	0.012	.0669358

Continued ...

Table 9 continued:

crhrw3 <-					
depagw1	0	(no path)			0
depagw2	.0027161	.0011848	2.29	0.022	.059077
BSIanx	0	(no path)			0
medcow3	.0085954	.0051439	1.67	0.095	.0491711
illw2	0	(no path)			0
crhrw2	.9217773	.0163872	56.25	0.000	.8959233
crhrw3	0	(no path)			0
anxagw3	.0014426	.0009015	1.60	0.110	.0372425
BSIdep	0	(no path)			0
BSIposymp	0	(no path)			0
illw1	0	(no path)			0
illw3	.0577877	.0157069	3.68	0.000	.0746362
crhrw1	0	(no path)			0
anxagw2	0	(no path)			0
medcow2	-.007836	.0038728	-2.02	0.043	-.0618442
depagw3	0	(no path)			0
anxagw1	-.0016459	.0004827	-3.41	0.001	-.0648841
medcow1	0	(no path)			0
fdferw1	.0007123	.0003896	1.83	0.068	.0300983
injselfr	.1371041	.0371864	3.69	0.000	.0709262
cumdose1	0	(no path)			0
cumdose2	0	(no path)			0
cumdose3	0	(no path)			0
anxagw3 <-					
depagw1	0	(no path)			0
depagw2	.2830794	.0980981	2.89	0.004	.2384961
BSIanx	0	(no path)			0
medcow3	0	(no path)			0
illw2	0	(no path)			0
crhrw2	0	(no path)			0
crhrw3	0	(no path)			0
anxagw3	0	(no path)			0
BSIdep	0	(no path)			0
BSIposymp	0	(no path)			0
illw1	0	(no path)			0
illw3	2.963024	.7926432	3.74	0.000	.1482336
crhrw1	0	(no path)			0
anxagw2	.6365227	.0680252	9.36	0.000	.619024
medcow2	0	(no path)			0
depagw3	0	(no path)			0
anxagw1	0	(no path)			0
medcow1	0	(no path)			0
fdferw1	.0404169	.0208303	1.94	0.052	.0661507
injselfr	0	(no path)			0
cumdose1	0	(no path)			0
cumdose2	0	(no path)			0
cumdose3	-1.390813	.440052	-3.16	0.002	-.1057187

Continued ...

Table 9 continued:

BSIdep <-					
depagw1	0	(no path)			0
depagw2	0	(no path)			0
BSIanx	0	(no path)			0
medcow3	0	(no path)			0
illw2	0	(no path)			0
crhrw2	0	(no path)			0
crhrw3	.3988099	.1493634	2.67	0.008	.0960788
anxagw3	0	(no path)			0
BSIdep	0	(no path)			0
BSIposymp	.0911331	.0076635	11.89	0.000	.6810945
illw1	0	(no path)			0
illw3	0	(no path)			0
crhrw1	0	(no path)			0
anxagw2	-.0115748	.0046581	-2.48	0.013	-.070012
medcow2	0	(no path)			0
depagw3	0	(no path)			0
anxagw1	0	(no path)			0
medcow1	0	(no path)			0
fdferw1	0	(no path)			0
injselfr	0	(no path)			0
cumdose1	0	(no path)			0
cumdose2	0	(no path)			0
cumdose3	0	(no path)			0
BSIpo~p <-					
depagw1	0	(no path)			0
depagw2	0	(no path)			0
BSIanx	4.200226	.366465	11.46	0.000	.5536181
medcow3	0	(no path)			0
illw2	3.123624	1.056529	2.96	0.003	.0993931
crhrw2	0	(no path)			0
crhrw3	0	(no path)			0
anxagw3	0	(no path)			0
BSIdep	1.912359	.3641669	5.25	0.000	.255881
BSIposymp	0	(no path)			0
illw1	0	(no path)			0
illw3	0	(no path)			0
crhrw1	0	(no path)			0
anxagw2	0	(no path)			0
medcow2	0	(no path)			0
depagw3	0	(no path)			0
anxagw1	0	(no path)			0
medcow1	.4930261	.1861407	2.65	0.008	.073461
fdferw1	.0454865	.0187574	2.42	0.015	.0619565
injselfr	6.117369	1.292698	4.73	0.000	.102012
cumdose1	0	(no path)			0
cumdose2	0	(no path)			0
cumdose3	0	(no path)			0

Continued ...

Table 9 continued:

whpsl~p <-					
depagw1	0	(no path)			0
depagw2	0	(no path)			0
BSIanx	0	(no path)			0
medcow3	.7409917	.2268364	3.27	0.001	.1244415
illw2	0	(no path)			0
crhrw2	0	(no path)			0
crhrw3	0	(no path)			0
anxagw3	-.0942308	.0612368	-1.54	0.124	-.071417
BSIdep	-1.24874	.6210464	-2.01	0.044	-.1521656
BSIposymp	.6435628	.0889529	7.23	0.000	.5860934
whpsleep	0	(no path)			0
illw1	0	(no path)			0
illw3	0	(no path)			0
crhrw1	0	(no path)			0
anxagw2	0	(no path)			0
medcow2	0	(no path)			0
whppa	.4085173	.0788335	5.18	0.000	.2852947
depagw3	0	(no path)			0
anxagw1	0	(no path)			0
medcow1	0	(no path)			0
whpel	0	(no path)			0
fdferw1	0	(no path)			0
injselfr	0	(no path)			0
cumdose1	0	(no path)			0
cumdose2	0	(no path)			0
cumdose3	0	(no path)			0
illw1 <-					
illw1	0	(no path)			0
crhrw1	0	(no path)			0
anxagw1	.0030794	.0011302	2.72	0.006	.2186433
medcow1	.0325509	.0111559	2.92	0.004	.2709803
fdferw1	-.0019308	.000791	-2.44	0.015	-.1469388
injselfr	0	(no path)			0
cumdose1	0	(no path)			0

Continued ...

Table 9 continued:

illw3 <-					
depagw1	0	(no path)			0
depagw2	0	(no path)			0
BSIanx	-.2707136	.0769654	-3.52	0.000	-.8570445
medcow3	.0673819	.0202946	3.32	0.001	.2984523
illw2	1.770151	.4395386	4.03	0.000	1.352892
crhrw2	0	(no path)			0
crhrw3	0	(no path)			0
anxagw3	0	(no path)			0
BSIdep	0	(no path)			0
BSIposymp	.0203216	.0059901	3.39	0.001	.488105
illw1	.3292506	.1618111	2.03	0.042	.1415449
illw3	0	(no path)			0
crhrw1	-.3485606	.1153329	-3.02	0.003	-.2854495
anxagw2	0	(no path)			0
medcow2	-.0300208	.0145749	-2.06	0.039	-.1834472
depagw3	0	(no path)			0
anxagw1	0	(no path)			0
medcow1	0	(no path)			0
fdferw1	0	(no path)			0
injselfr	0	(no path)			0
cumdose1	0	(no path)			0
cumdose2	0	(no path)			0
cumdose3	0	(no path)			0
crhrw1 <-					
illw1	-.497547	.1123862	-4.43	0.000	-.2611866
crhrw1	0	(no path)			0
anxagw1	0	(no path)			0
medcow1	0	(no path)			0
fdferw1	0	(no path)			0
injselfr	.7351058	.099048	7.42	0.000	.3595348
cumdose1	0	(no path)			0
anxagw2 <-					
depagw1	0	(no path)			0
depagw2	0	(no path)			0
illw2	3.776925	1.812185	2.08	0.037	.1484941
crhrw2	0	(no path)			0
illw1	0	(no path)			0
crhrw1	0	(no path)			0
anxagw2	0	(no path)			0
anxagw1	.2824911	.0481941	5.86	0.000	.4435624
medcow1	0	(no path)			0
fdferw1	0	(no path)			0
injselfr	0	(no path)			0
cumdose1	0	(no path)			0
cumdose2	0	(no path)			0

Continued ...

Table 9 continued:

medcow2 <-					
depagw1	0	(no path)			0
depagw2	0	(no path)			0
illw2	.6694346	.2569322	2.61	0.009	.0837282
crhrw2	0	(no path)			0
illw1	0	(no path)			0
crhrw1	0	(no path)			0
anxagw2	0	(no path)			0
anxagw1	0	(no path)			0
medcow1	1.058045	.2299723	4.60	0.000	.6196656
fdferw1	0	(no path)			0
injselfr	0	(no path)			0
cumdose1	0	(no path)			0
cumdose2	0	(no path)			0
whppa <-					
depagw1	0	(no path)			0
depagw2	0	(no path)			0
BSIanx	0	(no path)			0
medcow3	0	(no path)			0
illw2	0	(no path)			0
crhrw2	0	(no path)			0
crhrw3	0	(no path)			0
anxagw3	0	(no path)			0
BSIdep	0	(no path)			0
BSIposymp	0	(no path)			0
whpsleep	0	(no path)			0
illw1	0	(no path)			0
illw3	4.243575	.8277627	5.13	0.000	.2303928
crhrw1	3.086586	1.030974	2.99	0.003	.1372355
anxagw2	0	(no path)			0
medcow2	0	(no path)			0
whppa	0	(no path)			0
depagw3	0	(no path)			0
anxagw1	0	(no path)			0
medcow1	.9891686	.2823565	3.50	0.000	.1921985
whpel	.2486173	.0317785	7.82	0.000	.3976359
fdferw1	0	(no path)			0
injselfr	5.146159	1.826878	2.82	0.005	.1119083
cumdose1	0	(no path)			0
cumdose2	0	(no path)			0
cumdose3	0	(no path)			0

Continued ...

Table 9 continued:

depagw3 <-					
depagw1	0	(no path)			0
depagw2	0	(no path)			0
BSIanx	0	(no path)			0
medcow3	0	(no path)			0
illw2	0	(no path)			0
crhrw2	0	(no path)			0
crhrw3	0	(no path)			0
anxagw3	.5440492	.0582333	9.34	0.000	.6026049
BSIdep	0	(no path)			0
BSIposymp	0	(no path)			0
illw1	0	(no path)			0
illw3	4.115794	.6797875	6.05	0.000	.2280654
crhrw1	0	(no path)			0
anxagw2	0	(no path)			0
medcow2	0	(no path)			0
depagw3	0	(no path)			0
anxagw1	0	(no path)			0
medcow1	0	(no path)			0
fdferw1	0	(no path)			0
injselfr	0	(no path)			0
cumdose1	0	(no path)			0
cumdose2	0	(no path)			0
cumdose3	0	(no path)			0
anxagw1 <-					
fdferw1	.2089858	.0508552	4.11	0.000	.2239984
injselfr	12.65965	3.322472	3.81	0.000	.1661237
cumdose1	11.77704	4.40861	2.67	0.008	.1833743
medcow1 <-					
illw1	0	(no path)			0
crhrw1	1.516698	.3100721	4.89	0.000	.3470622
anxagw1	.0176617	.0069531	2.54	0.011	.1506339
medcow1	0	(no path)			0
fdferw1	0	(no path)			0
injselfr	0	(no path)			0
cumdose1	0	(no path)			0

Continued ...

Table 9 continued:

whpel <-					
depagw1	0	(no path)			0
depagw2	0	(no path)			0
BSIanx	-1.969168	.7061289	-2.79	0.005	-.211621
medcow3	1.305164	.2929819	4.45	0.000	.1962362
illw2	0	(no path)			0
crhrw2	0	(no path)			0
crhrw3	0	(no path)			0
anxagw3	0	(no path)			0
BSIdep	0	(no path)			0
BSIposymp	.7538538	.1046905	7.20	0.000	.6146465
whpsleep	.1632539	.070028	2.33	0.020	.1461592
illw1	0	(no path)			0
illw3	0	(no path)			0
crhrw1	0	(no path)			0
anxagw2	0	(no path)			0
medcow2	0	(no path)			0
whppa	0	(no path)			0
depagw3	0	(no path)			0
anxagw1	0	(no path)			0
medcow1	0	(no path)			0
whpel	0	(no path)			0
fdferw1	0	(no path)			0
injselfr	0	(no path)			0
cumdose1	0	(no path)			0
cumdose2	0	(no path)			0
cumdose3	0	(no path)			0
fdferw1 <-					
injselfr	13.84293	4.125713	3.36	0.001	.1694766
cumdose1	7.764987	3.359776	2.31	0.021	.1128014

4.2.2 Findings concerning indirect paths among females

4.2.3 Hypothesis 4

We examine possible alternative indirect paths to learn whether there is complementary indirect support for these hypotheses. For BSI positive symptoms in Table 10, we find one statistically significant indirect path from 1986 exposure to positive symptoms ($cumdose1$ $stdized\ beta = .078,\ p = 0.001$). The wave 2 effect had borderline significance ($cumdose2$ $stdized\ beta = 0.436$ $p = 0.053$), whereas the wave 3 effect was not statistically significant at the 0.05 level. For BSI anxiety, we see a statistically significant wave 1 external dose indirect path ($cumdose1$ $stdized\ beta = 0.096$ $p = 0.002$) but find later waves to have no statistically significant paths ($cumdose2$ $stdized\ beta = -0.019$ $p = 0.886$) and ($cumdose3$ $stdized\ beta = 0.125$ $p = 0.402$). As for indirect effects on BSI depression, we find a wave 1 significant indirect path ($cumdose1$ $stdized\ beta = 0.049$ $p = 0.002$) and a wave 2 indirect path to be almost significant ($cumdose2$ $stdized\ beta = 0.300$ $p = 0.053$). The wave 3 indirect path was not significant ($cumdose3$ $stdized\ beta = -0.228$ $p = 0.123$). To recapitulate, we have partial early but waning empirical support for an indirect external dose BSI response.

Table 10 Indirect effects among females
Indirect effects

(Std. Err. adjusted for 360 clusters in id)

	Coef.	Robust Std. Err.	z	P>|z|	Std. Coef.
Structural					
depagw1 <-					
illw1	-.208433	.047081	-4.43	0.000	-.0036954
crhrw1	.4189212	.0856438	4.89	0.000	.0141486
anxagw1	.0310085	.0100158	3.10	0.002	.0390339
medcow1	.2762062	.094662	2.92	0.004	.0407667
fdferw1	.0774189	.0238983	3.24	0.001	.1044569
injselfr	7.061909	1.689527	4.18	0.000	.1166524
cumdose1	5.887253	2.0708	2.84	0.004	.1153923
depagw2 <-					
depagw1	.0062791	.0011338	5.54	0.000	.0090408
depagw2	.0189003	.005557	3.40	0.001	.0189003
illw2	1.86677	.8956845	2.08	0.037	.0847192
crhrw2	.7601754	.1353555	5.62	0.000	.033969
illw1	3.07641	.9079606	3.39	0.001	.0785326
crhrw1	.1594116	.1382372	1.15	0.249	.0077519
anxagw2	.0091683	.0012288	7.46	0.000	.010583
anxagw1	.3016905	.0293275	10.29	0.000	.5468045
medcow1	.1817026	.0767157	2.37	0.018	.0386138
fdferw1	.0218969	.0095607	2.29	0.022	.0425384
injselfr	2.75362	.7756135	3.55	0.000	.0654914
cumdose1	4.410237	1.626173	2.71	0.007	.1244614
cumdose2	.2066762	.1108775	1.86	0.062	.0146594
BSIanx <-					
depagw1	.009239	.0032894	2.81	0.005	.0707626
depagw2	.034597	.0088968	3.89	0.000	.1840377
BSIanx	-.2319673	.1131213	-2.05	0.040	-.2319673
medcow3	.093627	.0280819	3.33	0.001	.1309904
illw2	2.535634	.6111158	4.15	0.000	.6121337
crhrw2	1.274231	.2225823	5.72	0.000	.3028906
crhrw3	.0260183	.0097444	2.67	0.008	.0063631
anxagw3	.0116983	.001248	9.37	0.000	.0738612
BSIdep	.0652398	.0124235	5.25	0.000	.0662284
BSIposymp	.0341149	.008287	4.12	0.000	.2588249
illw1	1.375562	.2375593	5.79	0.000	.1867904
illw3	-.2567179	.0888092	-2.89	0.004	-.0810892
crhrw1	-.6473369	.2011345	-3.22	0.001	-.1674512
anxagw2	.0264375	.0026671	9.91	0.000	.1623341
medcow2	-.0007654	.0165799	-0.05	0.963	-.0014773
depagw3	-.0064734	.0027413	-2.36	0.018	-.0369008
anxagw1	.0133492	.0028877	4.62	0.000	.1287045
medcow1	.0088761	.0343555	0.26	0.796	.010034
fdferw1	.0083347	.0023467	3.55	0.000	.0861303
injselfr	.8692914	.2055652	4.23	0.000	.1099801
cumdose1	.6376571	.209459	3.04	0.002	.0957257
cumdose2	-.050276	.3497336	-0.14	0.886	-.0189695
cumdose3	.2600746	.310461	0.84	0.402	.1248178

medcow3 <-					
depagw1	.0014157	.0002556	5.54	0.000	.0077503
depagw2	.0042614	.0012529	3.40	0.001	.0162026
illw2	.420897	.1108192	3.80	0.000	.0726269
crhrw2	.1713953	.0305183	5.62	0.000	.0291205
illw1	-.1069567	.0905536	-1.18	0.238	-.0103811
crhrw1	.6613601	.140743	4.70	0.000	.1222806
anxagw2	.0020672	.0002771	7.46	0.000	.0090725
medcow2	0	(no path)			0
anxagw1	.02495	.0036121	6.91	0.000	.171938
medcow1	.4533232	.1006173	4.51	0.000	.3662851
fdferw1	.005866	.0012756	4.60	0.000	.0433282
injselfr	.788084	.2544235	3.10	0.002	.0712661
cumdose1	.3827252	.2092589	1.83	0.067	.0410667
cumdose2	.0465989	.0148778	3.13	0.002	.012567
cumdose3	0	(no path)			0
illw2 <-					
depagw1	.0034272	.0006188	5.54	0.000	.1087315
depagw2	.0023942	.0005786	4.14	0.000	.0527565
illw2	.0189003	.0090685	2.08	0.037	.0189003
crhrw2	.0076965	.0013704	5.62	0.000	.0075783
illw1	.1859608	.0369774	5.03	0.000	.1046011
crhrw1	.210101	.0175854	11.95	0.000	.2251262
anxagw2	.0050042	.0006707	7.46	0.000	.1272799
anxagw1	.0017166	.0004178	4.11	0.000	.0685547
medcow1	.0057336	.0020968	2.73	0.006	.0268485
fdferw1	.0010776	.0003799	2.84	0.005	.0461279
injselfr	.1741777	.0588413	2.96	0.003	.0912813
cumdose1	.0529296	.0238845	2.22	0.027	.032914
cumdose2	.0192647	.0075409	2.55	0.011	.030109
crhrw2 <-					
depagw1	.0018312	.0003306	5.54	0.000	.0590021
depagw2	.0001022	.0000301	3.40	0.001	.0022881
illw2	.0100985	.0048453	2.08	0.037	.0102561
crhrw2	.0041123	.0007322	5.62	0.000	.0041123
illw1	-.2413653	.0630619	-3.83	0.000	-.1378834
crhrw1	-.0032449	.0009339	-3.47	0.001	-.0035312
anxagw2	.0026737	.0003584	7.46	0.000	.0690672
anxagw1	.0005391	.0002083	2.59	0.010	.021867
medcow1	-.0017251	.0005346	-3.23	0.001	-.0082038
fdferw1	.0002156	.0000463	4.65	0.000	.0093709
injselfr	.4573272	.0670377	6.82	0.000	.24341
cumdose1	.0412044	.014279	2.89	0.004	.0260224
cumdose2	.001118	.0005895	1.90	0.058	.0017747

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Table 10 Indirect effects - continued:

crhrw3 <-					
depagw1	.0031122	.0005644	5.51	0.000	.0974656
depagw2	.0064039	.0013328	4.80	0.000	.1392901
BSIanx	-.0079858	.0038944	-2.05	0.040	-.0326533
medcow3	.0032233	.0009668	3.33	0.001	.0184391
illw2	.1023364	.024131	4.24	0.000	.1010176
crhrw2	.0424985	.007419	5.73	0.000	.0413065
crhrw3	.0008957	.0003355	2.67	0.008	.0008957
anxagw3	-.00012	.000013	-9.22	0.000	-.0030968
BSIdep	.002246	.0004277	5.25	0.000	.0093228
BSIposymp	.0011745	.0002853	4.12	0.000	.0364339
illw1	.0190079	.0800201	0.24	0.812	.010554
illw3	-.0100664	.0032423	-3.10	0.002	-.0130014
crhrw1	.4866957	.0403244	12.07	0.000	.5147811
anxagw2	.005614	.0006213	9.04	0.000	.1409513
medcow2	.0037425	.0007044	5.31	0.000	.0295366
depagw3	-.0002229	.0000944	-2.36	0.018	-.0051944
anxagw1	.0013731	.0003656	3.76	0.000	.0541311
medcow1	-.0048636	.0015388	-3.16	0.002	-.0224811
fdferw1	.0023684	.0007882	3.00	0.003	.1000752
injselfr	.8611838	.078811	10.93	0.000	.4455044
cumdose1	.0428177	.0169791	2.52	0.012	.0262828
cumdose2	.0367682	.0203036	1.81	0.070	.0567249
cumdose3	.005265	.0097893	0.54	0.591	.0103319
anxagw3 <-					
depagw1	.1136391	.0221007	5.14	0.000	.1378509
depagw2	.0701341	.0211655	3.31	0.001	.0590884
BSIanx	-.3812666	.1859287	-2.05	0.040	-.0603856
medcow3	.1538874	.046156	3.33	0.001	.0340993
illw2	7.054683	1.854909	3.80	0.000	.2697378
crhrw2	2.912187	.5114627	5.69	0.000	.109638
crhrw3	.0427642	.0160162	2.67	0.008	.0016564
anxagw3	-.0057269	.0006213	-9.22	0.000	-.0057269
BSIdep	.1072296	.0204195	5.25	0.000	.0172405
BSIposymp	.0560719	.0136206	4.12	0.000	.0673771
illw1	4.101456	.8881637	4.62	0.000	.0882098
illw3	-.6846708	.1383866	-4.95	0.000	-.0342526
crhrw1	-1.149598	.4418185	-2.60	0.009	-.0470986
anxagw2	.1713247	.023503	7.29	0.000	.1666148
medcow2	-.001258	.0272511	-0.05	0.963	-.0003846
depagw3	-.0106399	.0045056	-2.36	0.018	-.009606
anxagw1	.230088	.0373335	6.16	0.000	.351348
medcow1	.0405449	.0846792	0.48	0.632	.0072592
fdferw1	.0481206	.0124019	3.88	0.000	.0787595
injselfr	5.022157	1.149895	4.37	0.000	.1006337
cumdose1	4.204521	1.406793	2.99	0.003	.0999683
cumdose2	.139717	.5386319	0.26	0.795	.0083493
cumdose3	.4621714	.4613041	1.00	0.316	.0351306

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Table 10 Indirect effects - continued:

BSIdep <-					
depagw1	.0147745	.0030806	4.80	0.000	.1114701
depagw2	.0234532	.0052451	4.47	0.000	.1228963
BSIanx	.3521801	.0838232	4.20	0.000	.3469234
medcow3	.0491109	.0127723	3.85	0.000	.0676839
illw2	1.770021	.3128436	5.66	0.000	.4209272
crhrw2	1.177498	.127927	9.20	0.000	.2757189
crhrw3	.096668	.0362044	2.67	0.008	.0232886
anxagw3	.0060618	.000721	8.41	0.000	.0377019
BSIdep	.2423911	.0461581	5.25	0.000	.2423911
BSIposymp	.0356167	.0042915	8.30	0.000	.2661859
illw1	.661036	.1207612	5.47	0.000	.0884237
illw3	.6656397	.1268681	5.25	0.000	.2071166
crhrw1	-.0079171	.1158023	-0.07	0.945	-.0020174
anxagw2	.0139843	.0021069	6.64	0.000	.0845862
medcow2	-.0023319	.0072167	-0.32	0.747	-.0044338
depagw3	.0098282	.0041619	2.36	0.018	.0551877
anxagw1	.012374	.0027293	4.53	0.000	.1175217
medcow1	.0516149	.027692	1.86	0.062	.0574769
fdferw1	.0101064	.002622	3.85	0.000	.1028802
injselfr	1.691984	.2554358	6.62	0.000	.2108695
cumdose1	.3291605	.1072806	3.07	0.002	.0486763
cumdose2	.8091635	.4178633	1.94	0.053	.300746
cumdose3	-.4815922	.3124682	-1.54	0.123	-.227681
BSIpo~p <-					
depagw1	.1501446	.0337014	4.46	0.000	.1515739
depagw2	.2223892	.0566999	3.92	0.000	.1559265
BSIanx	-.3008206	.6252789	-0.48	0.630	-.0396502
medcow3	.4871723	.1420425	3.43	0.001	.0898377
illw2	16.33968	3.277716	4.99	0.000	.5199254
crhrw2	8.899884	1.40992	6.31	0.000	.2788428
crhrw3	1.056814	.395801	2.67	0.008	.0340666
anxagw3	.0607276	.0063947	9.50	0.000	.0505381
BSIdep	.7375607	.1404523	5.25	0.000	.0986885
BSIposymp	.3856812	.0459368	8.40	0.000	.3856812
illw1	7.259548	1.233638	5.88	0.000	.1299337
illw3	7.095205	1.412092	5.02	0.000	.2953992
crhrw1	-2.255263	1.225351	-1.84	0.066	-.076894
anxagw2	.1312825	.021094	6.22	0.000	.1062511
medcow2	-.0076742	.0830523	-0.09	0.926	-.0019524
depagw3	.1088193	.0460814	2.36	0.018	.0817607
anxagw1	.1736757	.0291729	5.95	0.000	.2207068
medcow1	.0892656	.2129228	0.42	0.675	.0133006
fdferw1	.0599441	.014475	4.14	0.000	.0816491
injselfr	8.721639	1.404914	6.21	0.000	.1454402
cumdose1	3.930655	1.206298	3.26	0.001	.0777757
cumdose2	8.772132	4.542	1.93	0.053	.4362521
cumdose3	-5.307533	3.427738	-1.55	0.122	-.3357445

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Table 10 Indirect effects - continued:

whpsl~p <-					
depagw1	.0984003	.0221982	4.43	0.000	.0904664
depagw2	.11976	.0423822	2.83	0.005	.0764705
BSIanx	2.061728	.616936	3.34	0.001	.2474828
medcow3	.4994336	.1140569	4.38	0.000	.0838744
illw2	13.50369	2.396442	5.63	0.000	.3913142
crhrw2	5.647088	.9789098	5.77	0.000	.1611297
crhrw3	.1607704	.0602122	2.67	0.008	.0047197
anxagw3	.0299455	.0034996	8.56	0.000	.0226956
BSIdep	1.651865	.3170798	5.21	0.000	.2012886
BSIposymp	.231231	.0329846	7.01	0.000	.2105824
whpsleep	.0168604	.0072323	2.33	0.020	.0168604
illw1	3.854229	.8425274	4.57	0.000	.062824
illw3	5.205626	.8455899	6.16	0.000	.1973755
crhrw1	.4517406	.973802	0.46	0.643	.0140269
anxagw2	.051776	.0190343	2.72	0.007	.038162
medcow2	.3863526	.0745566	5.18	0.000	.0895145
whppa	.0068877	.0013292	5.18	0.000	.0048102
depagw3	.0575359	.0243646	2.36	0.018	.0393689
anxagw1	.1100171	.0176371	6.24	0.000	.1273247
medcow1	1.148129	.2568593	4.47	0.000	.1557951
whpel	.1032769	.0132009	7.82	0.000	.1153561
fdferw1	.0517255	.0188878	2.74	0.006	.0641631
injselfr	12.62791	1.747328	7.23	0.000	.1917759
cumdose1	2.396343	.8315291	2.88	0.004	.0431821
cumdose2	4.978317	2.42611	2.05	0.040	.225471
cumdose3	-2.947653	1.771742	-1.66	0.096	-.169812
illw1 <-					
illw1	-.0239749	.0054155	-4.43	0.000	-.0239749
crhrw1	.0481862	.0098511	4.89	0.000	.0917922
anxagw1	.0004873	.0002191	2.22	0.026	.0345982
medcow1	-.0007804	.0002675	-2.92	0.004	-.0064967
fdferw1	.0007917	.0001821	4.35	0.000	.0602485
injselfr	.0648065	.0272287	2.38	0.017	.06038
cumdose1	.0331601	.0208943	1.59	0.113	.0366592

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Table 10 Indirect effects - continued:

illw3 <-					
depagw1	.0032322	.0015866	2.04	0.042	.0783743
depagw2	.0134941	.0041532	3.25	0.001	.2272502
BSIanx	.1420388	.0157503	9.02	0.000	.4496766
medcow3	-.015446	.0047179	-3.27	0.001	-.0684144
illw2	-.394292	.1130656	-3.49	0.000	-.3013498
crhrw2	.5735729	.0997413	5.75	0.000	.4316376
crhrw3	.0144326	.0054054	2.67	0.008	.0111746
anxagw3	-.0019328	.0002097	-9.22	0.000	-.0386344
BSIdep	.0361893	.0068915	5.25	0.000	.1163065
BSIposymp	-.0013977	.0014287	-0.98	0.328	-.0335715
illw1	.2781451	.0803841	3.46	0.001	.1195746
illw3	-.2310716	.0467045	-4.95	0.000	-.2310716
crhrw1	.0105487	.1120617	0.09	0.925	.0086387
anxagw2	.0065407	.0012177	5.37	0.000	.127148
medcow2	.0295962	.0066497	4.45	0.000	.1808528
depagw3	-.0035909	.0015206	-2.36	0.018	-.064803
anxagw1	.0006847	.0012182	0.56	0.574	.0208992
medcow1	.0053901	.0153532	0.35	0.726	.0192903
fdferw1	.0005917	.000778	0.76	0.447	.0193582
injselfr	.1579083	.0765095	2.06	0.039	.063248
cumdose1	.0356195	.0225106	1.58	0.114	.0169287
cumdose2	-.0641186	.1827366	-0.35	0.726	-.07659
cumdose3	.1559796	.1518654	1.03	0.304	.2369952
crhrw1 <-					
illw1	.0119286	.0026944	4.43	0.000	.0062619
crhrw1	-.0239749	.0049014	-4.89	0.000	-.0239749
anxagw1	-.0017746	.0005732	-3.10	0.002	-.0661433
medcow1	-.0158073	.0054175	-2.92	0.004	-.0690795
fdferw1	.0005668	.000396	1.43	0.152	.0226423
injselfr	-.0322443	.016952	-1.90	0.057	-.0157704
cumdose1	-.0164987	.0107197	-1.54	0.124	-.0095749
anxagw2 <-					
depagw1	.0129442	.0023373	5.54	0.000	.016146
depagw2	.0389626	.0114556	3.40	0.001	.0337542
illw2	.0713851	.0342509	2.08	0.037	.0028066
crhrw2	1.567087	.2790327	5.62	0.000	.0606655
illw1	.7023598	.1396607	5.03	0.000	.0155326
crhrw1	-.3035026	.2736949	-1.11	0.267	-.0127859
anxagw2	.0189003	.0025332	7.46	0.000	.0189003
anxagw1	.0064833	.0015778	4.11	0.000	.01018
medcow1	-.0422018	.0394509	-1.07	0.285	-.0077695
fdferw1	.0631066	.0147525	4.28	0.000	.106207
injselfr	5.051334	1.261851	4.00	0.000	.1040797
cumdose1	3.985239	1.445903	2.76	0.006	.0974331
cumdose2	.426059	.2131777	2.00	0.046	.0261803

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Table 10 Indirect effects - continued:

medcow2 <-					
depagw1	.0022943	.0004143	5.54	0.000	.0091039
depagw2	.0069059	.0020304	3.40	0.001	.0190323
illw2	.0126525	.0060707	2.08	0.037	.0015825
crhrw2	.2777556	.0494567	5.62	0.000	.0342061
illw1	-.6547998	.1691162	-3.87	0.000	-.0460667
crhrw1	1.512467	.3167287	4.78	0.000	.2026971
anxagw2	.00335	.000449	7.46	0.000	.0106569
anxagw1	.0169882	.0070753	2.40	0.016	.0848577
medcow1	-.0328465	.0095685	-3.43	0.001	-.0192372
fdferw1	.0055362	.0010198	5.43	0.000	.0296403
injselfr	1.535137	.4334183	3.54	0.000	.1006236
cumdose1	.259358	.1367101	1.90	0.058	.0201718
cumdose2	.0755161	.03185	2.37	0.018	.0147618
whppa <-					
depagw1	.0393892	.0082965	4.75	0.000	.0518542
depagw2	.0882494	.0259786	3.40	0.001	.0806883
BSIanx	-.1075346	.4223621	-0.25	0.799	-.0184833
medcow3	.6406958	.1189408	5.39	0.000	.1540708
illw2	8.667954	1.803546	4.81	0.000	.3596719
crhrw2	3.763018	.6281663	5.99	0.000	.1537461
crhrw3	.2531027	.0947928	2.67	0.008	.0106395
anxagw3	-.0051566	.0025446	-2.03	0.043	-.0055962
BSIdep	.634645	.1291104	4.92	0.000	.1107369
BSIposymp	.3588151	.036268	9.89	0.000	.4679111
whpsleep	.0412721	.0177037	2.33	0.020	.059098
illw1	1.158956	.725404	1.60	0.110	.0270503
illw3	-.1181243	.041139	-2.87	0.004	-.0064132
crhrw1	.0830909	.639639	0.13	0.897	.0036944
anxagw2	.0524624	.0109944	4.77	0.000	.0553691
medcow2	.1550934	.0475172	3.26	0.001	.0514541
whppa	.0168604	.0032536	5.18	0.000	.0168604
depagw3	-.0030009	.0012708	-2.36	0.018	-.0029403
anxagw1	.041348	.0095616	4.32	0.000	.068521
medcow1	.2488528	.1003463	2.48	0.013	.0483529
whpel	.0041918	.0005358	7.82	0.000	.0067043
fdferw1	.0243101	.0083318	2.92	0.004	.0431802
injselfr	7.289557	1.235249	5.90	0.000	.1585186
cumdose1	.9555389	.340393	2.81	0.005	.0246558
cumdose2	.7881425	.4850512	1.62	0.104	.0511128
cumdose3	-.0321309	.4082527	-0.08	0.937	-.0026505

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Table 10 Indirect effects - continued:

depagw3 <-					
depagw1	.0751285	.0174991	4.29	0.000	.1009441
depagw2	.2477043	.0521898	4.75	0.000	.2311538
BSIanx	-.7370268	.3594189	-2.05	0.040	-.1292952
medcow3	.2974799	.0892243	3.33	0.001	.0730121
illw2	9.500845	2.178655	4.36	0.000	.4023657
crhrw2	3.94508	.6887755	5.73	0.000	.16451
crhrw3	.0826676	.0309609	2.67	0.008	.0035467
anxagw3	-.0110707	.0012011	-9.22	0.000	-.0122623
BSIdep	.2072857	.039473	5.25	0.000	.0369147
BSIposymp	.1083927	.0263301	4.12	0.000	.1442652
illw1	4.731309	.8560874	5.53	0.000	.112708
illw3	.2884934	.5343172	0.54	0.589	.0159861
crhrw1	-2.016625	.6256972	-3.22	0.001	-.0915128
anxagw2	.4664291	.0366696	12.72	0.000	.5024279
medcow2	-.0024318	.0526792	-0.05	0.963	-.0008234
depagw3	-.0205679	.0087098	-2.36	0.018	-.0205679
anxagw1	.1279972	.0229473	5.58	0.000	.2164904
medcow1	.0442429	.1088953	0.41	0.685	.0087739
fdferw1	.0506041	.0139116	3.64	0.000	.0917385
injselfr	3.382218	.8029479	4.21	0.000	.0750671
cumdose1	2.434069	.8144352	2.99	0.003	.0641022
cumdose2	-.187886	1.038821	-0.18	0.856	-.0124362
cumdose3	.1367534	.8674469	0.16	0.875	.0115137
anxagw1 <-					
fdferw1	0	(no path)			0
injselfr	2.892976	1.148957	2.52	0.012	.0379625
cumdose1	1.622772	.8392748	1.93	0.053	.0252673
medcow1 <-					
illw1	-.7365362	.1663692	-4.43	0.000	-.0884747
crhrw1	-.0363627	.0074339	-4.89	0.000	-.0083208
anxagw1	-.0026916	.0008694	-3.10	0.002	-.0229558
medcow1	-.0239749	.0082167	-2.92	0.004	-.0239749
fdferw1	.0045507	.000951	4.79	0.000	.0416001
injselfr	1.340715	.2902426	4.62	0.000	.1500499
cumdose1	.2116404	.1130726	1.87	0.061	.0281054

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Table 10 Indirect effects - continued:

whpel <-					
depagw1	.1032629	.0238199	4.34	0.000	.0849958
depagw2	.1246348	.0336695	3.70	0.000	.0712498
BSIanx	3.73295	.5844713	6.39	0.000	.4011696
medcow3	.3853937	.0732258	5.26	0.000	.0579454
illw2	11.38053	1.863306	6.11	0.000	.2952555
crhrw2	5.345644	.824231	6.49	0.000	.1365568
crhrw3	.7716954	.2890175	2.67	0.008	.0202822
anxagw3	.0122491	.0105603	1.16	0.246	.0083114
BSIdep	1.934995	.4046249	4.78	0.000	.2110994
BSIposymp	.3663829	.0283506	12.92	0.000	.2987263
whpsleep	.0027525	.0011807	2.33	0.020	.0024643
illw1	3.253548	.627191	5.19	0.000	.0474797
illw3	3.468968	.6437806	5.39	0.000	.117756
crhrw1	.5115082	.7608368	0.67	0.501	.0142196
anxagw2	.0993748	.0249559	3.98	0.000	.0655755
medcow2	.6310706	.1053385	5.99	0.000	.1309031
whppa	.0678165	.0130869	5.18	0.000	.0424015
depagw3	.0492212	.0208436	2.36	0.018	.0301529
anxagw1	.1170954	.0161864	7.23	0.000	.1213262
medcow1	1.200582	.2338272	5.13	0.000	.1458536
whpel	.0168604	.0021551	7.82	0.000	.0168604
fdferw1	.0625394	.0237208	2.64	0.008	.069454
injselfr	12.5648	1.80503	6.96	0.000	.1708363
cumdose1	2.598217	.8639752	3.01	0.003	.0419172
cumdose2	4.264525	2.249069	1.90	0.058	.1729184
cumdose3	-2.791608	1.636782	-1.71	0.088	-.1439823
fdferw1 <-					
injselfr	0	(no path)			0
cumdose1	0	(no path)			0

4.2.4 Hypothesis 5

If we examine the potential indirect paths in support of the relationship between perceived external exposure and psychological health measured by BSI, we more support. As for positive symptoms, we find no wave 1 statistically significant indirect path ($crhrw1$ $stdized$ $beta = -0.077$ $p = 0.066$.) But we find provide statistically significant indirect paths later ($crhrw2$ $stdized$ $beta = 0.279$ $p = 0.000$) and ($crhrw3$ $stdized$ $beta = 0.034$ $p = 0.008$.) In the BSI anxiety panel, we find significant indirect paths in all 3 waves ($crhrw1$ $stdized$ $\beta = -0.167$ $p = 0.001$,) ($crhrw2$ $stdized$ $\beta = 0.303$ $p = 0.000$,) and ($crhrw3$ $stdized$ $\beta = 0.006$ $p = 0.008$.) As for BSI depression, we find evidence of in that panel for statistically significant indirect paths in the years after Chornobyl ($crhrw1$ $stdized$ $\beta = -0.002$ $p = 0.945$), ($crhrw2$ $stdized$ $\beta = 0.276$ $p = 0.000$), and ($crhrw3$ $stdized$ $\beta = 0.023$ $p = 0.008$). In short, although anxiety and depression at first appear to decline, they increase in the years after Chornobyl. Early reports may have attenuated initial symptoms.Later reports might have led to a later increase in anxiety and depression coupled with a later increase in positive symptoms, potentially undermining trust in government. The significant positive relationship

between anxiety and depression appear to emerge after 1986, so we have more support for indirect paths in support of hypothesis 5 than we did for hypothesis 4 among our female subsample.

4.2.5 Hypothesis 8

We also look for indirect support for hypothesis 8, which postulates statistically significant direct links between perceived risk of exposure and Nottingham measures of health behavior. As for relationships between perceived risk of exposure and sleep, in Table 10 we examine the weighted health profile whpsleep (whpsl-p) panel and find evidence of statistically significant indirect paths in waves 2 and 3 ($crhrw1$ $stdized$ $\beta = 0.014$ $p = 0.643,$) ($crhrw2$ $stdized$ $\beta = 0.161$ $p = 0.000,$) and ($crhrw3$ $stdized$ $\beta = 0.005$ $p = 0.008$.) When look at possible indirect paths impacting female energy level (whpel) in Table 10, we find a similar pattern of post-1986 significant indirect paths ($crhrw1$ $stdized$ $\beta = 0.014$ $p = 0.501,$) ($crhrw2$ $stdized$ $\beta = 0.137$ $p = 0.000,$) and ($crhrw3$ $stdized$ $\beta = 0.020$ $p = 0.008$.) Finally, when we examine Table 10 for evidence of more indirect patterns for indirect effects impacting physical ability, we discover the same pattern of delayed statistically significant indirect paths ($crhrw1$ $stdized$ $\beta = 0.004$ $p = 0.897,$) ($crhrw2$ $stdized$ $\beta = 0.154$ $p = 0.000,$) and ($crhrw3$ $stdized$ $\beta = 0.011$ $p = 0.008$.) All of the indirect paths relating to hypothesis have a positive sign and pose no threat of confusion in the computation of total effects, which we need to examine in order to obtain a sense of the total effects.

4.2.6 Other noteworthy indirect paths

In Figure 3, we see that the fear of consuming contaminated food or fluids impacts both perceived risk of exposure, physical ability, and BSI depression. This fear may have come from the delay of notifying the public about the nature of the danger of radioactive contamination. This in turn may have engendered a feeling of having been injured as a result of Chornobyl, impact self-reported anxiety in wave one, self-reported depressive symptoms in wave 3, self-reported anxiety symptoms in wave 3 and various BSI positive symptoms, which in turn impacted BSI depression, the illness count in wave 3, Nottingham measured sleep, and Nottingham measured energy level, both of which affect physical ability, triggering a potential traumatic cascade (or vicious cycle between) positive symptoms and depression, loss of sleep, energy level, and physical ability, with potentially devastating consequences. Although this possibility is inherent in the nexus of relationships, we need to examine the total effects in search of more empirical support for this sort of syndrome among females.

Table 11 Total effects among women

(Std. Err. adjusted for 360 clusters in id)

	Coef.	Robust Std. Err.	z	P>|z|	Std. Coef.
Structural					
depagw1 <-					
illw1	8.485369	2.70121	3.14	0.002	.1504416
crhrw1	.4189212	.0856438	4.89	0.000	.0141486
anxagw1	.4488475	.0544663	8.24	0.000	.5650158
medcow1	.2762062	.094662	2.92	0.004	.0407667
fdferw1	.0774189	.0238983	3.24	0.001	.1044569
injselfr	7.061909	1.689527	4.18	0.000	.1166524
cumdose1	12.99108	4.443922	2.92	0.003	.2546298
depagw2 <-					
depagw1	.3385008	.0611217	5.54	0.000	.4873807
depagw2	.0189003	.005557	3.40	0.001	.0189003
illw2	1.86677	.8956845	2.08	0.037	.0847192
crhrw2	.7601754	.1353555	5.62	0.000	.033969
illw1	6.551729	2.590391	2.53	0.011	.1672484
crhrw1	.1594116	.1382372	1.15	0.249	.0077519
anxagw2	.4942566	.066246	7.46	0.000	.5705228
anxagw1	.1558588	.0368391	4.23	0.000	.2824892
medcow1	.1817026	.0767157	2.37	0.018	.0386138
fdferw1	.0218969	.0095607	2.29	0.022	.0425384
injselfr	2.75362	.7756135	3.55	0.000	.0654914
cumdose1	4.410237	1.626173	2.71	0.007	.1244614
cumdose2	.2066762	.1108775	1.86	0.062	.0146594
BSIanx <-					
depagw1	.0264712	.006597	4.01	0.000	.2027457
depagw2	.034597	.0088968	3.89	0.000	.1840377
BSIanx	-.2319673	.1131213	-2.05	0.040	-.2319673
medcow3	.093627	.0280819	3.33	0.001	.1309904
illw2	3.070247	.6440644	4.77	0.000	.741196
crhrw2	1.274231	.2225823	5.72	0.000	.3028906
crhrw3	.0260183	.0097444	2.67	0.008	.0063631
anxagw3	.0116983	.001248	9.37	0.000	.0738612
BSIdep	.0652398	.0124235	5.25	0.000	.0662284
BSIposymp	.0341149	.008287	4.12	0.000	.2588249
illw1	1.375562	.2375593	5.79	0.000	.1867904
illw3	1.386178	.2785158	4.98	0.000	.4378506
crhrw1	-.6473369	.2011345	-3.22	0.001	-.1674512
anxagw2	.0264375	.0026671	9.91	0.000	.1623341
medcow2	-.0007654	.0165799	-0.05	0.963	-.0014773
depagw3	.0214332	.0090763	2.36	0.018	.1221766
anxagw1	.0326815	.0056138	5.82	0.000	.3150945
medcow1	.0088761	.0343555	0.26	0.796	.010034
fdferw1	.0083347	.0023467	3.55	0.000	.0861303
injselfr	.8692914	.2055652	4.23	0.000	.1099801
cumdose1	.6376571	.209459	3.04	0.002	.0957257
cumdose2	1.636188	.900969	1.82	0.069	.6173449
cumdose3	-1.044362	.6834969	-1.53	0.127	-.5012213

Continued...

Table 11 Total effects among women -continued:

medcow3 <-					
depagw1	.0200265	.0109205	1.83	0.067	.1096338
depagw2	.0042614	.0012529	3.40	0.001	.0162026
illw2	.420897	.1108192	3.80	0.000	.0726269
crhrw2	.1713953	.0305183	5.62	0.000	.0291205
illw1	-.1069567	.0905536	-1.18	0.238	-.0103811
crhrw1	.6613601	.140743	4.70	0.000	.1222806
anxagw2	.0337232	.0115839	2.91	0.004	.1480062
medcow2	.4384699	.0757898	5.79	0.000	.6049198
anxagw1	.02495	.0036121	6.91	0.000	.171938
medcow1	.4533232	.1006173	4.51	0.000	.3662851
fdferw1	-.0068741	.0065207	-1.05	0.292	-.0507745
injselfr	.788084	.2544235	3.10	0.002	.0712661
cumdose1	.3827252	.2092589	1.83	0.067	.0410667
cumdose2	.0465989	.0148778	3.13	0.002	.012567
cumdose3	-.2802811	.1188318	-2.36	0.018	-.0961467
illw2 <-					
depagw1	.0034272	.0006188	5.54	0.000	.1087315
depagw2	.010316	.003033	3.40	0.001	.22731
illw2	.0189003	.0090685	2.08	0.037	.0189003
crhrw2	.4149107	.0738783	5.62	0.000	.408538
illw1	.1859608	.0369774	5.03	0.000	.1046011
crhrw1	-.0803571	.072465	-1.11	0.267	-.0861038
anxagw2	.0050042	.0006707	7.46	0.000	.1272799
anxagw1	.0017166	.0004178	4.11	0.000	.0685547
medcow1	-.0111736	.0104452	-1.07	0.285	-.0523217
fdferw1	.0010776	.0003799	2.84	0.005	.0461279
injselfr	.1741777	.0588413	2.96	0.003	.0912813
cumdose1	.0529296	.0238845	2.22	0.027	.032914
cumdose2	.1128058	.0323304	3.49	0.000	.1763057
crhrw2 <-					
depagw1	.0018312	.0003306	5.54	0.000	.0590021
depagw2	.0055119	.001404	3.93	0.000	.1233476
illw2	.0100985	.0048453	2.08	0.037	.0102561
crhrw2	.0041123	.0007322	5.62	0.000	.0041123
illw1	-.0477507	.0876937	-0.54	0.586	-.0272782
crhrw1	.5572074	.0418902	13.30	0.000	.6063692
anxagw2	.0026737	.0003584	7.46	0.000	.0690672
anxagw1	.0005391	.0002083	2.59	0.010	.021867
medcow1	-.0017251	.0005346	-3.23	0.001	-.0082038
fdferw1	.0028135	.0008151	3.45	0.001	.1223143
injselfr	.9311654	.0841512	11.07	0.000	.4956079
cumdose1	.0412044	.014279	2.89	0.004	.0260224
cumdose2	.0432878	.0169419	2.56	0.011	.0687105

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Table 11 Total effects among women -continued:

crhrw3 <-					
depagw1	.0031122	.0005644	5.51	0.000	.0974656
depagw2	.00912	.0018514	4.93	0.000	.1983672
BSIanx	-.0079858	.0038944	-2.05	0.040	-.0326533
medcow3	.0118186	.0048684	2.43	0.015	.0676102
illw2	.1023364	.024131	4.24	0.000	.1010176
crhrw2	.9642758	.0174358	55.30	0.000	.9372297
crhrw3	.0008957	.0003355	2.67	0.008	.0008957
anxagw3	.0013226	.0009026	1.47	0.143	.0341457
BSIdep	.002246	.0004277	5.25	0.000	.0093228
BSIposymp	.0011745	.0002853	4.12	0.000	.0364339
illw1	.0190079	.0800201	0.24	0.812	.010554
illw3	.0477213	.0164219	2.91	0.004	.0616348
crhrw1	.4866957	.0403244	12.07	0.000	.5147811
anxagw2	.005614	.0006213	9.04	0.000	.1409513
medcow2	-.0040936	.004114	-1.00	0.320	-.0323076
depagw3	-.0002229	.0000944	-2.36	0.018	-.0051944
anxagw1	-.0002728	.0006203	-0.44	0.660	-.0107529
medcow1	-.0048636	.0015388	-3.16	0.002	-.0224811
fdferw1	.0030807	.0008969	3.43	0.001	.1301736
injselfr	.9982878	.0843808	11.83	0.000	.5164306
cumdose1	.0428177	.0169791	2.52	0.012	.0262828
cumdose2	.0367682	.0203036	1.81	0.070	.0567249
cumdose3	.005265	.0097893	0.54	0.591	.0103319
anxagw3 <-					
depagw1	.1136391	.0221007	5.14	0.000	.1378509
depagw2	.3532135	.0939892	3.76	0.000	.2975846
BSIanx	-.3812666	.1859287	-2.05	0.040	-.0603856
medcow3	.1538874	.046156	3.33	0.001	.0340993
illw2	7.054683	1.854909	3.80	0.000	.2697378
crhrw2	2.912187	.5114627	5.69	0.000	.109638
crhrw3	.0427642	.0160162	2.67	0.008	.0016564
anxagw3	-.0057269	.0006213	-9.22	0.000	-.0057269
BSIdep	.1072296	.0204195	5.25	0.000	.0172405
BSIposymp	.0560719	.0136206	4.12	0.000	.0673771
illw1	4.101456	.8881637	4.62	0.000	.0882098
illw3	2.278354	.82099	2.78	0.006	.113981
crhrw1	-1.149598	.4418185	-2.60	0.009	-.0470986
anxagw2	.8078475	.0668419	12.09	0.000	.7856388
medcow2	-.001258	.0272511	-0.05	0.963	-.0003846
depagw3	-.0106399	.0045056	-2.36	0.018	-.009606
anxagw1	.230088	.0373335	6.16	0.000	.351348
medcow1	.0405449	.0846792	0.48	0.632	.0072592
fdferw1	.0885375	.0238766	3.71	0.000	.1449102
injselfr	5.022157	1.149895	4.37	0.000	.1006337
cumdose1	4.204521	1.406793	2.99	0.003	.0999683
cumdose2	.139717	.5386319	0.26	0.795	.0083493
cumdose3	-.9286412	.5483651	-1.69	0.090	-.070588

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Table 11 Total effects among women -continued:

BSIdep <-					
depagw1	.0147745	.0030806	4.80	0.000	.1114701
depagw2	.0234532	.0052451	4.47	0.000	.1228963
BSIanx	.3521801	.0838232	4.20	0.000	.3469234
medcow3	.0491109	.0127723	3.85	0.000	.0676839
illw2	1.770021	.3128436	5.66	0.000	.4209272
crhrw2	1.177498	.127927	9.20	0.000	.2757189
crhrw3	.4954779	.1855678	2.67	0.008	.1193674
anxagw3	.0060618	.000721	8.41	0.000	.0377019
BSIdep	.2423911	.0461581	5.25	0.000	.2423911
BSIposymp	.1267498	.0100883	12.56	0.000	.9472804
illw1	.661036	.1207612	5.47	0.000	.0884237
illw3	.6656397	.1268681	5.25	0.000	.2071166
crhrw1	-.0079171	.1158023	-0.07	0.945	-.0020174
anxagw2	.0024095	.0061621	0.39	0.696	.0145742
medcow2	-.0023319	.0072167	-0.32	0.747	-.0044338
depagw3	.0098282	.0041619	2.36	0.018	.0551877
anxagw1	.012374	.0027293	4.53	0.000	.1175217
medcow1	.0516149	.027692	1.86	0.062	.0574769
fdferw1	.0101064	.002622	3.85	0.000	.1028802
injselfr	1.691984	.2554358	6.62	0.000	.2108695
cumdose1	.3291605	.1072806	3.07	0.002	.0486763
cumdose2	.8091635	.4178633	1.94	0.053	.300746
cumdose3	-.4815922	.3124682	-1.54	0.123	-.227681
BSIpo~p <-					
depagw1	.1501446	.0337014	4.46	0.000	.1515739
depagw2	.2223892	.0566999	3.92	0.000	.1559265
BSIanx	3.899406	.9042049	4.31	0.000	.5139679
medcow3	.4871723	.1420425	3.43	0.001	.0898377
illw2	19.46331	3.409719	5.71	0.000	.6193184
crhrw2	8.899884	1.40992	6.31	0.000	.2788428
crhrw3	1.056814	.395801	2.67	0.008	.0340666
anxagw3	.0607276	.0063947	9.50	0.000	.0505381
BSIdep	2.649919	.5046193	5.25	0.000	.3545695
BSIposymp	.3856812	.0459368	8.40	0.000	.3856812
illw1	7.259548	1.233638	5.88	0.000	.1299337
illw3	7.095205	1.412092	5.02	0.000	.2953992
crhrw1	-2.255263	1.225351	-1.84	0.066	-.076894
anxagw2	.1312825	.021094	6.22	0.000	.1062511
medcow2	-.0076742	.0830523	-0.09	0.926	-.0019524
depagw3	.1088193	.0460814	2.36	0.018	.0817607
anxagw1	.1736757	.0291729	5.95	0.000	.2207068
medcow1	.5822917	.3021113	1.93	0.054	.0867616
fdferw1	.1054306	.0281554	3.74	0.000	.1436057
injselfr	14.83901	2.062232	7.20	0.000	.2474522
cumdose1	3.930655	1.206298	3.26	0.001	.0777757
cumdose2	8.772132	4.542	1.93	0.053	.4362521
cumdose3	-5.307533	3.427738	-1.55	0.122	-.3357445

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Table 11 Total effects among women -continued:

whpsl~p <-					
depagw1	.0984003	.0221982	4.43	0.000	.0904664
depagw2	.11976	.0423822	2.83	0.005	.0764705
BSIanx	2.061728	.616936	3.34	0.001	.2474828
medcow3	1.240425	.2339851	5.30	0.000	.2083159
illw2	13.50369	2.396442	5.63	0.000	.3913142
crhrw2	5.647088	.9789098	5.77	0.000	.1611297
crhrw3	.1607704	.0602122	2.67	0.008	.0047197
anxagw3	-.0642852	.0623344	-1.03	0.302	-.0487215
BSIdep	.4031254	.6606986	0.61	0.542	.049123
BSIposymp	.8747938	.094512	9.26	0.000	.7966758
whpsleep	.0168604	.0072323	2.33	0.020	.0168604
illw1	3.854229	.8425274	4.57	0.000	.062824
illw3	5.205626	.8455899	6.16	0.000	.1973755
crhrw1	.4517406	.973802	0.46	0.643	.0140269
anxagw2	.051776	.0190343	2.72	0.007	.038162
medcow2	.3863526	.0745566	5.18	0.000	.0895145
whppa	.415405	.0801627	5.18	0.000	.2901049
depagw3	.0575359	.0243646	2.36	0.018	.0393689
anxagw1	.1100171	.0176371	6.24	0.000	.1273247
medcow1	1.148129	.2568593	4.47	0.000	.1557951
whpel	.1032769	.0132009	7.82	0.000	.1153561
fdferw1	.0517255	.0188878	2.74	0.006	.0641631
injselfr	12.62791	1.747328	7.23	0.000	.1917759
cumdose1	2.396343	.8315291	2.88	0.004	.0431821
cumdose2	4.978317	2.42611	2.05	0.040	.225471
cumdose3	-2.947653	1.771742	-1.66	0.096	-.169812
illw1 <-					
illw1	-.0239749	.0054155	-4.43	0.000	-.0239749
crhrw1	.0481862	.0098511	4.89	0.000	.0917922
anxagw1	.0035667	.0011521	3.10	0.002	.2532415
medcow1	.0317705	.0108884	2.92	0.004	.2644836
fdferw1	-.0011391	.000796	-1.43	0.152	-.0866902
injselfr	.0648065	.0272287	2.38	0.017	.06038
cumdose1	.0331601	.0208943	1.59	0.113	.0366592

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Table 11 Total effects among women -continued:

illw3 <-					
depagw1	.0032322	.0015866	2.04	0.042	.0783743
depagw2	.0134941	.0041532	3.25	0.001	.2272502
BSIanx	-.1286748	.0627496	-2.05	0.040	-.4073678
medcow3	.0519359	.0155773	3.33	0.001	.2300379
illw2	1.375859	.33659	4.09	0.000	1.051542
crhrw2	.5735729	.0997413	5.75	0.000	.4316376
crhrw3	.0144326	.0054054	2.67	0.008	.0111746
anxagw3	-.0019328	.0002097	-9.22	0.000	-.0386344
BSIdep	.0361893	.0068915	5.25	0.000	.1163065
BSIposymp	.0189239	.0045969	4.12	0.000	.4545335
illw1	.6073957	.1263749	4.81	0.000	.2611195
illw3	-.2310716	.0467045	-4.95	0.000	-.2310716
crhrw1	-.338012	.0964937	-3.50	0.000	-.2768108
anxagw2	.0065407	.0012177	5.37	0.000	.127148
medcow2	-.0004246	.0091971	-0.05	0.963	-.0025944
depagw3	-.0035909	.0015206	-2.36	0.018	-.064803
anxagw1	.0006847	.0012182	0.56	0.574	.0208992
medcow1	.0053901	.0153532	0.35	0.726	.0192903
fdferw1	.0005917	.000778	0.76	0.447	.0193582
injselfr	.1579083	.0765095	2.06	0.039	.063248
cumdose1	.0356195	.0225106	1.58	0.114	.0169287
cumdose2	-.0641186	.1827366	-0.35	0.726	-.07659
cumdose3	.1559796	.1518654	1.03	0.304	.2369952
crhrw1 <-					
illw1	-.4856184	.1096918	-4.43	0.000	-.2549246
crhrw1	-.0239749	.0049014	-4.89	0.000	-.0239749
anxagw1	-.0017746	.0005732	-3.10	0.002	-.0661433
medcow1	-.0158073	.0054175	-2.92	0.004	-.0690795
fdferw1	.0005668	.000396	1.43	0.152	.0226423
injselfr	.7028616	.0944193	7.44	0.000	.3437644
cumdose1	-.0164987	.0107197	-1.54	0.124	-.0095749
anxagw2 <-					
depagw1	.0129442	.0023373	5.54	0.000	.016146
depagw2	.0389626	.0114556	3.40	0.001	.0337542
illw2	3.84831	1.846436	2.08	0.037	.1513006
crhrw2	1.567087	.2790327	5.62	0.000	.0606655
illw1	.7023598	.1396607	5.03	0.000	.0155326
crhrw1	-.3035026	.2736949	-1.11	0.267	-.0127859
anxagw2	.0189003	.0025332	7.46	0.000	.0189003
anxagw1	.2889744	.048653	5.94	0.000	.4537424
medcow1	-.0422018	.0394509	-1.07	0.285	-.0077695
fdferw1	.0631066	.0147525	4.28	0.000	.106207
injselfr	5.051334	1.261851	4.00	0.000	.1040797
cumdose1	3.985239	1.445903	2.76	0.006	.0974331
cumdose2	.426059	.2131777	2.00	0.046	.0261803

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Table 11 Total effects among women -continued:

medcow2 <-					
depagw1	.0022943	.0004143	5.54	0.000	.0091039
depagw2	.0069059	.0020304	3.40	0.001	.0190323
illw2	.6820871	.2551702	2.67	0.008	.0853107
crhrw2	.2777556	.0494567	5.62	0.000	.0342061
illw1	-.6547998	.1691162	-3.87	0.000	-.0460667
crhrw1	1.512467	.3167287	4.78	0.000	.2026971
anxagw2	.00335	.000449	7.46	0.000	.0106569
anxagw1	.0169882	.0070753	2.40	0.016	.0848577
medcow1	1.025198	.2307146	4.44	0.000	.6004284
fdferw1	.0055362	.0010198	5.43	0.000	.0296403
injselfr	1.535137	.4334183	3.54	0.000	.1006236
cumdose1	.259358	.1367101	1.90	0.058	.0201718
cumdose2	.0755161	.03185	2.37	0.018	.0147618
whppa <-					
depagw1	.0393892	.0082965	4.75	0.000	.0518542
depagw2	.0882494	.0259786	3.40	0.001	.0806883
BSIanx	-.1075346	.4223621	-0.25	0.799	-.0184833
medcow3	.6406958	.1189408	5.39	0.000	.1540708
illw2	8.667954	1.803546	4.81	0.000	.3596719
crhrw2	3.763018	.6281663	5.99	0.000	.1537461
crhrw3	.2531027	.0947928	2.67	0.008	.0106395
anxagw3	-.0051566	.0025446	-2.03	0.043	-.0055962
BSIdep	.634645	.1291104	4.92	0.000	.1107369
BSIposymp	.3588151	.036268	9.89	0.000	.4679111
whpsleep	.0412721	.0177037	2.33	0.020	.059098
illw1	1.158956	.725404	1.60	0.110	.0270503
illw3	4.12545	.8404104	4.91	0.000	.2239796
crhrw1	3.169677	1.21779	2.60	0.009	.1409299
anxagw2	.0524624	.0109944	4.77	0.000	.0553691
medcow2	.1550934	.0475172	3.26	0.001	.0514541
whppa	.0168604	.0032536	5.18	0.000	.0168604
depagw3	-.0030009	.0012708	-2.36	0.018	-.0029403
anxagw1	.041348	.0095616	4.32	0.000	.068521
medcow1	1.238021	.3331232	3.72	0.000	.2405514
whpel	.252809	.0323143	7.82	0.000	.4043402
fdferw1	.0243101	.0083318	2.92	0.004	.0431802
injselfr	12.43572	1.832189	6.79	0.000	.2704269
cumdose1	.9555389	.340393	2.81	0.005	.0246558
cumdose2	.7881425	.4850512	1.62	0.104	.0511128
cumdose3	-.0321309	.4082527	-0.08	0.937	-.0026505

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Table 11 Total effects among women -continued:

depagw3 <-					
depagw1	.0751285	.0174991	4.29	0.000	.1009441
depagw2	.2477043	.0521898	4.75	0.000	.2311538
BSIanx	-.7370268	.3594189	-2.05	0.040	-.1292952
medcow3	.2974799	.0892243	3.33	0.001	.0730121
illw2	9.500845	2.178655	4.36	0.000	.4023657
crhrw2	3.94508	.6887755	5.73	0.000	.16451
crhrw3	.0826676	.0309609	2.67	0.008	.0035467
anxagw3	.5329785	.0570345	9.34	0.000	.5903427
BSIdep	.2072857	.039473	5.25	0.000	.0369147
BSIposymp	.1083927	.0263301	4.12	0.000	.1442652
illw1	4.731309	.8560874	5.53	0.000	.112708
illw3	4.404287	.9549317	4.61	0.000	.2440515
crhrw1	-2.016625	.6256972	-3.22	0.001	-.0915128
anxagw2	.4664291	.0366696	12.72	0.000	.5024279
medcow2	-.0024318	.0526792	-0.05	0.963	-.0008234
depagw3	-.0205679	.0087098	-2.36	0.018	-.0205679
anxagw1	.1279972	.0229473	5.58	0.000	.2164904
medcow1	.0442429	.1088953	0.41	0.685	.0087739
fdferw1	.0506041	.0139116	3.64	0.000	.0917385
injselfr	3.382218	.8029479	4.21	0.000	.0750671
cumdose1	2.434069	.8144352	2.99	0.003	.0641022
cumdose2	-.187886	1.038821	-0.18	0.856	-.0124362
cumdose3	.1367534	.8674469	0.16	0.875	.0115137
anxagw1 <-					
fdferw1	.2089858	.0508552	4.11	0.000	.2239984
injselfr	15.55263	3.314408	4.69	0.000	.2040862
cumdose1	13.39982	4.493389	2.98	0.003	.2086416
medcow1 <-					
illw1	-.7365362	.1663692	-4.43	0.000	-.0884747
crhrw1	1.480335	.3026381	4.89	0.000	.3387414
anxagw1	.0149702	.0067321	2.22	0.026	.1276781
medcow1	-.0239749	.0082167	-2.92	0.004	-.0239749
fdferw1	.0045507	.000951	4.79	0.000	.0416001
injselfr	1.340715	.2902426	4.62	0.000	.1500499
cumdose1	.2116404	.1130726	1.87	0.061	.0281054

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Table 11 Total effects among women -continued:

whpel <-					
depagw1	.1032629	.0238199	4.34	0.000	.0849958
depagw2	.1246348	.0336695	3.70	0.000	.0712498
BSIanx	1.763782	.8690217	2.03	0.042	.1895486
medcow3	1.690557	.3090765	5.47	0.000	.2541816
illw2	11.38053	1.863306	6.11	0.000	.2952555
crhrw2	5.345644	.824231	6.49	0.000	.1365568
crhrw3	.7716954	.2890175	2.67	0.008	.0202822
anxagw3	.0122491	.0105603	1.16	0.246	.0083114
BSIdep	1.934995	.4046249	4.78	0.000	.2110994
BSIposymp	1.120237	.1086241	10.31	0.000	.9133728
whpsleep	.1660065	.0712087	2.33	0.020	.1486235
illw1	3.253548	.627191	5.19	0.000	.0474797
illw3	3.468968	.6437806	5.39	0.000	.117756
crhrw1	.5115082	.7608368	0.67	0.501	.0142196
anxagw2	.0993748	.0249559	3.98	0.000	.0655755
medcow2	.6310706	.1053385	5.99	0.000	.1309031
whppa	.0678165	.0130869	5.18	0.000	.0424015
depagw3	.0492212	.0208436	2.36	0.018	.0301529
anxagw1	.1170954	.0161864	7.23	0.000	.1213262
medcow1	1.200582	.2338272	5.13	0.000	.1458536
whpel	.0168604	.0021551	7.82	0.000	.0168604
fdferw1	.0625394	.0237208	2.64	0.008	.069454
injselfr	12.5648	1.80503	6.96	0.000	.1708363
cumdose1	2.598217	.8639752	3.01	0.003	.0419172
cumdose2	4.264525	2.249069	1.90	0.058	.1729184
cumdose3	-2.791608	1.636782	-1.71	0.088	-.1439823
fdferw1 <-					
injselfr	13.84293	4.125713	3.36	0.001	.1694766
cumdose1	7.764987	3.359776	2.31	0.021	.1128014

4.2.7 Findings regarding the total effects among females

To full examine the empirical support for the hypotheses, it is necessary to examine the total effects of cumulative external dose on the BSI psychological indicators of health as well as the perceived risk of exposure on those same indicators as well as on the Nottingham indictors of health behavior.

4.2.8 Hypothesis 4

In Table 11, we refer to the BSI positive symptom total effects panel, located on page 88. At the bottom of the listing of sources of total effects in the left-most column of the table, we examine those relating to cumulative dose. We find only a 1986 cumulative external dose effect ($cumdose1\ stdized\beta = .078\ p = 0.000$) on BSI positive symptoms. The wave two effect was of borderline significance at the .05 level ($cumdose2\ stdized\ \beta = 0.436,\ p = 0.053$), and wave 3 was not statistically significant at all. Nevertheless, this could be construed as partial support for a statistically significant 1986 external dose effect on BSI positive symptoms

On page 85, we find the BSI anxiety total effects panel, within which we find that cumdose1 has a statistically significant total effect on BSI anxiety ($cumdose1\ \beta = .096\ with\ p = 0.002$) while in the decade after 1986, the effect fades into borderline significance ($cumdose2\ \beta = 0..617\ with\ p = 0.069$) and by wave 3 the total effect of cumulative external dose on anxiety is no longer statistically significant.

When we examine the total effects from cumulative external dose to BSI depression, we refer to the upper panel of Table 11 on page 88. We find that for wave 1 , the total effects from cumulative external dose to BSI depression are statistically significant ($cumdose1\ \beta = 0.049\ with\ p = 0.002$) but for wave 2, the significance fades to a borderline case cumdose2 $\beta = 0.300\ with\ p = .0.053$). By wave 3, there is no significant total effect. There appears to be early but waning support for a dose-BSI effect.

4.2.9 Hypothesis 5

To examine the tests for hypothesis 5, we look to perceived risk of exposure as the exogenous variable, whether it stems from wave 1, 2, or 3 and the target endogenous BSI psychological health measure. We revisit the panel of Table 11 relating to endogenous BSI positive symptom subscale on page 88, and we turn to the point of origin of the total effect– respectively, crhrw1, crhrw2, and crhrw3. We find evidence of a delayed significant relationship between the total effect of perceived risk of exposure and BSI positive symptoms. In wave 1 perceived risk of exposure total effect is statistically almost significant (crhrw1 $\beta = -0.077, p = 0.066$), but the wave 2 and 3 relationship is highly statistically significant (crhrw2 $\beta = 0.279\ with\ p = 0.000$) and the wave three is statistically significant (crhrw3 $\beta = .0.034\ with\ p = 0.008$). There is an emerging significance of effect if a smaller total effect of perceived risk total effect on positive symptoms in wave 3.

We review the total effects of perceived risk of exposure on BSI anxiety on page 85 of Table 11. The total effects here are statistically significant at all waves. The signs go from negative in wave 1 to positive in waves 2 and 3. The negative sign in wave 1 is due to a negative indirect effect. This could have been due to a negative relationship in any one of the alternative mediating paths. For example if the path went from crhrw1 to ill2 and then to BSI anxiety, which had a positive sign, the sign of the product of those paths would be negative. When all of these products are added to obtain the total indirect path, if the negatives predominate, then the global indirect path coefficient from crhrw1 is a negative, which indicates an overall inverse relationship, as long as linearity and additivity of the relationships hold. However, the wave 2 and wave 3 total path effects of crhrw2 and crhrw3 are significant and positive (crhrw2 $\beta = 0.303\ with\ p = 0.000$) and the wave three is statistically significant (crhrw3 $\beta = .0.006\ with\ p = 0.008$), even though the overall total effect is declining in magnitude.

As for the total effects on BSI depression, we find no evidence of a wave 1 total effect (p = 0.945). Only in waves 2 and 3 are there statistically significant

total effects on BSI depression (crhrw2 $\beta = 0.279$ *with* $p = 0.000$) and the wave three is statistically significant (crhrw3 $\beta = .0.034$ *with* $p = 0.008$), even though the overall total effect is declining in magnitude. Therefore, we find partial empirical and declining support for total effects on BSI psychological health as measured by positive symptoms, anxiety, and depression.

4.2.10 Hypothesis 8

But what are the total effects of perceived exposure on health behavior? When we examine the Nottingham panels in Table 11, we find on page 89, the total effects sleep panel. In wave 1, there is no significant total effect path (crhrw1 p = .643). However there are significant total effects on sleep from perceived risk of exposure in wave 2 and wave 3. Both of these effects are positive and that from wave 2 is larger than that from wave 3 (crhrw2 stdized $\beta = 0.161$ *with* $p = 0.000$) and wave 3 ((crhrw3 $\beta = 0.005$ *with* $p = 0.008$). We have partial empirical support for perceived risk total effect on sleep.

To learn whether there is evidence to support hypothesis 8 with regard to the Nottingham subscale of energy level (whpel), we turn to page 93, where we find the whpel panel in Table 11. As we found with the Nottingham sleep measure, there is no statistically significant total effect on energy level in wave 1 (p=0.501), but we find two statistically significant total effects extending from perceived risk of exposure to external radiation dose in wave 2 and wave 3 (crhrw2 stdized $\beta = 0.137$ *with* $p = 0.000$) and wave 3 ((crhrw3 $\beta = 0.020$ *with* $p = 0.008$). So we have partial support for a total effect on energy level.

We examine the test of hypothesis 8 with our female subsample with respect to perceived risk of exposure in any and all waves on the one hand and Nottingham physical ability on the other. The data are in Table 11 on page 91. In the whppa panel, we observe that all three waves of perceived Chornobyl health risk are statistically significantly related to the Nottingham physical ability measure among the females $crhrw1\ \beta = 0.141$ *with* $p = 0.009$), ($crhrw2\ \beta = 0.154$ *with* $p = 0.000$), *and* $crhrw3\ \beta = 0.011$ *with* $p = 0.008$). Thus we can conclude that there are statistically significant total effects of perceived risk from all three waves on BSI physical ability. There is a partial support of hypothesis 8 with respect to sleep, a partial support with respect to energy level, and a comprehensive total effect on physical ability. For hypothesis 8, we have to infer that we the data are at least partially consistent with the hypotheses.

4.2.11 Other total effects of interest among females

We can gain some perspective by ranking these total effects according to their standardized scores. If we examine the health behavior, we observe an impact on health behaviors mainly from perceived risk of exposure. If we sort the total effects according the magnitude of their impact on female physical ability, we observe that energy level and sleep have the largest impact on physical ability. BSI positive symptoms is third in female total effect and an injury as a result of

Chornobyl is 6th, just below the perceived risk of exposure during wave 2 and cumulative external dose in wave 3. Among the top total effects on sleep, if we sort the effects the same way, are 1) previous sleep, 2) BSI positive symptoms, and 3) BSI anxiety. If we sort the top total effects on energy level, we obtain 1) sleep, 2) BSI positive symptoms, 3) BSI anxiety, 4) perceived risk of exposure during wave 2, and a 5) medical condition in wave 3, and then 6) injured as a result of Chornobyl. In terms of health behavior, there is often an impact of perceived risk of exposure and often an injury as a result of Chornobyl. Fear of consuming contaminated food in wave 1 has receded in total effect but that may be because it is rooted in 1986. It appears to be highly related to having been injured because of Chornobyl and perhaps subsumed under it. It may be masked by its high interconnectedness with other variables. Nevertheless, this seems to have been an important variable as is the injury resulting from Chornobyl.

If we sort the total effects on the BSI measures of psychological health, we may gain perspective on amount of total effect on BSI psychological health. When we examine female total effects on BSI positive symptoms, we find the 1) illness count in wave 2 has the largest impact in terms of total effect, presuming linearity and additivity, 2) BSI anxiety, and 3) cumulative external dose wave 2, 4) BSI positive symptom cyclically reinforcing itself, suggesting an internal feedback or vicious cycle, 5) BSI depression, 6) illness count in wave 3, 7) the perceived risk of exposure in wave 2, and 8) the injury as a result of Chornobyl. It is interesting that we observe a cyclical effect of BSI positive symptoms and BSI depression here.

What is the descending order of total effects on anxiety? If anything is driving anxiety it is the count of the illness in wave 2 and 3. 1) The largest total effect on anxiety is the illness count in the decade after 1986. 2) cumulative external dose in wave 2 3) illness count in wave 3, 4) self-reported anxiety in wave 1, 5) self-perceived exposure in wave 2, and 6) BSI positive symptoms. All of these concerns are completely rational and reasonable.

The total effects on BSI depression, in order of decreasing standardized effects, are 1) BSI positive symptoms, 2) illness count in wave 2, 3) BSI anxiety, 4) cumulative external dose in wave 2, 5) perceived risk of exposure in wave 2, and 6) BSI depression reinforcing itself, and 7) injury as a result of Chornobyl. When we model this decay rate, we have to remember that we have a depression on depression, a positive symptom on depression, and the combination of them upon depression. In the the total depression and total BSI effects, we see evidence of a cyclical effect, which could enhance the severity and persistence, and aggravate the imprint of the traumatic aspect of the total effect.

BSI depression and BSI positive symptoms exhibit a cyclical effect upon one another. If we relax assumptions of waves being of equal time and if we make the assumption that these effects are partialled from others, we can attempt to model the positive symptom-depression impulse-response function. A unit impulse in positive symptoms results in a 0.681 response of depression. And a unit impulse of depression results in a 0.256 response of positive symptoms. We multiply one times the other standardized coefficients to obtain the response in

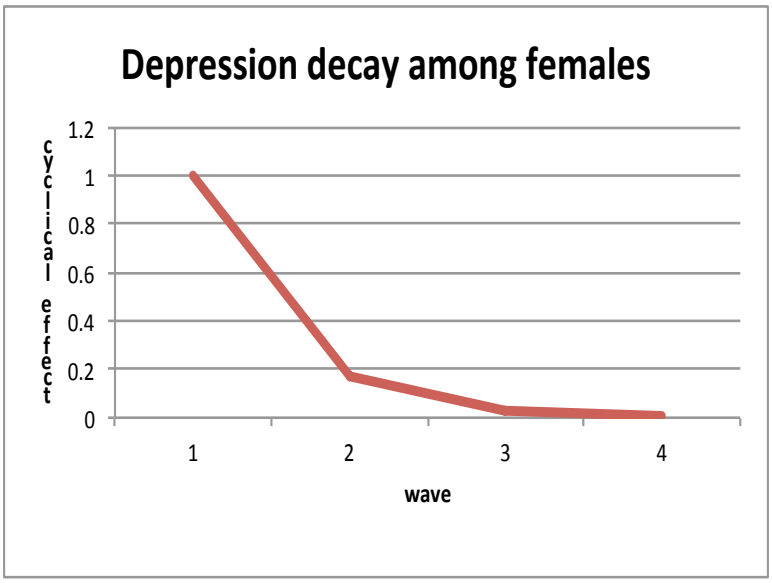

Figure 4: Depression positive symptom decay

wave 1. In wave 2, we repeat the process and multiply the products together to get that response. We follow the formula given earlier for the mean in computing the approximate decay of this effect for the women. This helps explain the persistence of the effect over time.

We submit that this is a zero-order "lower bound" because we are only modeling the cyclical effects of BSI positive symptoms and BSI depression upon one another in standardized units. Other impacts not modeled may modify the decay rate. Nevertheless, this graph shows how vicious cycles can retard recovery. What this shows is the basis for persistence of effects in the event of one or more feedback loops.

5 The Explanatory and Predictive power of the models

Although the model fits the data and helps explain how mediation and cyclical reinforcement may affect psychological health, the question arises as to how well the model can be used as a basis for prediction as indicated in our hypotheses.

To test this effect, we use our models to obtain test the predictions or fitted values of the model against the slopes and constants of the model. In this way, we obtain a sense of bias (if the constant does not equal what it is supposed be and if the slope of the real data does not match the slope of the parameter estimate. We do perform this variant of the Theil - Mincer- Zarnowitz regression to obtain

a sense of weak nowcast rationality, by which to measure the predictive validity of our male and female models, with respect to BSI measures of psychological health and Nottingham measures of health behavior.

$$Actual = constant + b * forecast \tag{4}$$

where either equation serves as the basis for a joint test for constant=0 and b= 1 indicating weak forecast rationality.

According to that test, we regress the actual on the predicted values and jointly test for statistical significance whether the coefficient b = 1 and that of the constant = 0. If both of these conditions hold, there would be no level or slope bias in the model. In so doing, we obtain the fitted values and regress actual values on the the fitted values.. The expectations of weak forecast rationality were found to hold for all major endogenous variables in our model.

To test the power of explanation, we can form an auxiliary regression model from the variables used and nowcast the value for the current wave from previous waves. We can compare that estimate with the actual value for an assessment.

Table 13 Theil-Mincer-Zarnowitz regression test results

P-Values for Weak forecast rationality tests
where p=0.000 indicates weak forecast non-rationality

Trimmed univariate

	males	females
BSIpossymp	F(2,337)= 0.00 p = 1.000	F(2,361)=0.000 p= 1.000
BSIanx	F(2,337)= 0.00 p= 1.000	F(2,361)=0.000 p= 1.000
BSIdep	F(2,337)= 0.000 p= 1.000	F(2,361)=0.000 p= 1.000

	males	females
whpsleep	F(2,337)= 0.00 p= 1.000	F(2,336)= 0.00 p= 1.000
whpel	F(2,335)= 0.00 p= 1.000	F(2,359)= 0.00 p= 1.000
whppa	F(2,336)= 0.00 p= 1.000	F(2,359)= 0.00 p = 1.000

In short, the models pass the test of of weak rationality for nowcasting and we therefore remain confident that they exhibit minimal bias.

References

[1] Cohen, J. and Cohen, P. 1983 Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences Hillsdale, NJ: Lawrence Earlbaum Associates, 359-360.

[2] Joreskog, K. and Sorbom, D. 11989 LISREL 8 Users manual Chicago, Ill: Scientific Software International, Inc., 9, 136-137.

[3] Mincer, J. and Zarnowitz, V. 1969 The Evaluation of Economic Forecasts J.Mincer, ed Economic Forecasts and Expectations

[4] Nagel, E. 1961 *The Structure of Science* New York: Harcourt, Brace, and World, 56-78.

[5] StataCorp Release 12 Structural Equation Modeling 2011 College Station, TX:Stata Press, Inc., 209-219.