



Psychosocial Effects of Beryllium Sensitization and Chronic Beryllium Disease

IMPLICATIONS FOR OTHER EXPOSURES

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Why?

If we understand the psychological and social effects of BeS and CBD we can tailor programs, education, and treatment to mitigate the effect.



Purpose of the Study

Develop and validate a theoretical model that describes the psychological and social effects of BeS and CBD.



Study Design



Phase 1

Model is based on 4 theoretical concepts



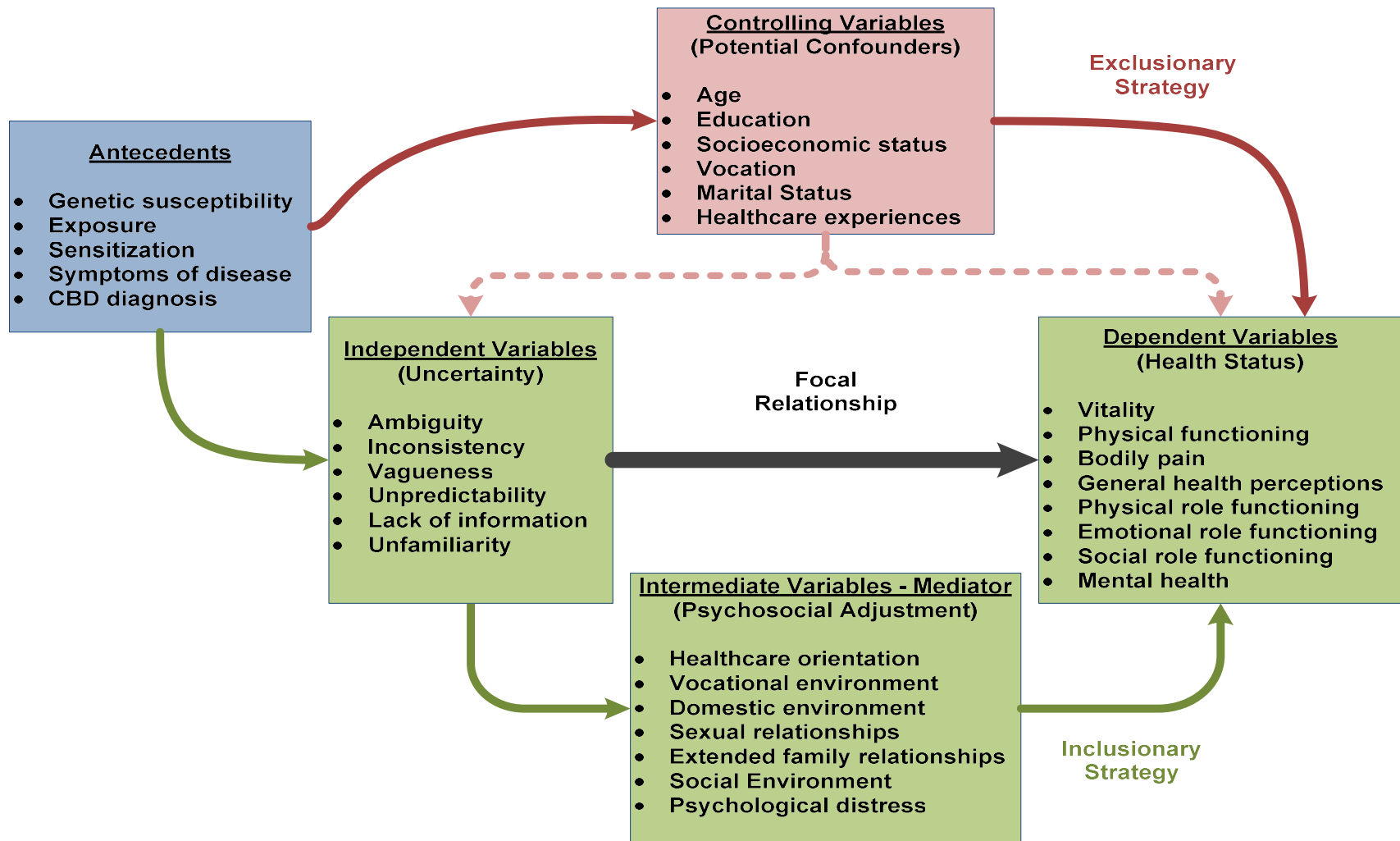


Figure 1: Conceptual Model of the Psychosocial Effects of Beryllium Sensitization and Chronic Beryllium Disease





Phase 2 - Methods

- Semi-structured, confidential interviews
- 13 participants
- 1-2 sessions each
- ~2 hours of interview data per participant
- Transcribed interviews
- Coded with QDA Miner®
- Identified categories & themes
- Compared results to model





Phase 2 - Results

Participants (n=13)

- From DOE sites in Oak Ridge, TN
- Mostly white, married, male, craft workers
- Some trade school or college
- Most still working
- Most had CBD (n=9)
 - 3 to 19 years w/ CBD
- Others were BeS (n=4)
 - 0 to 7 years w/ BeS





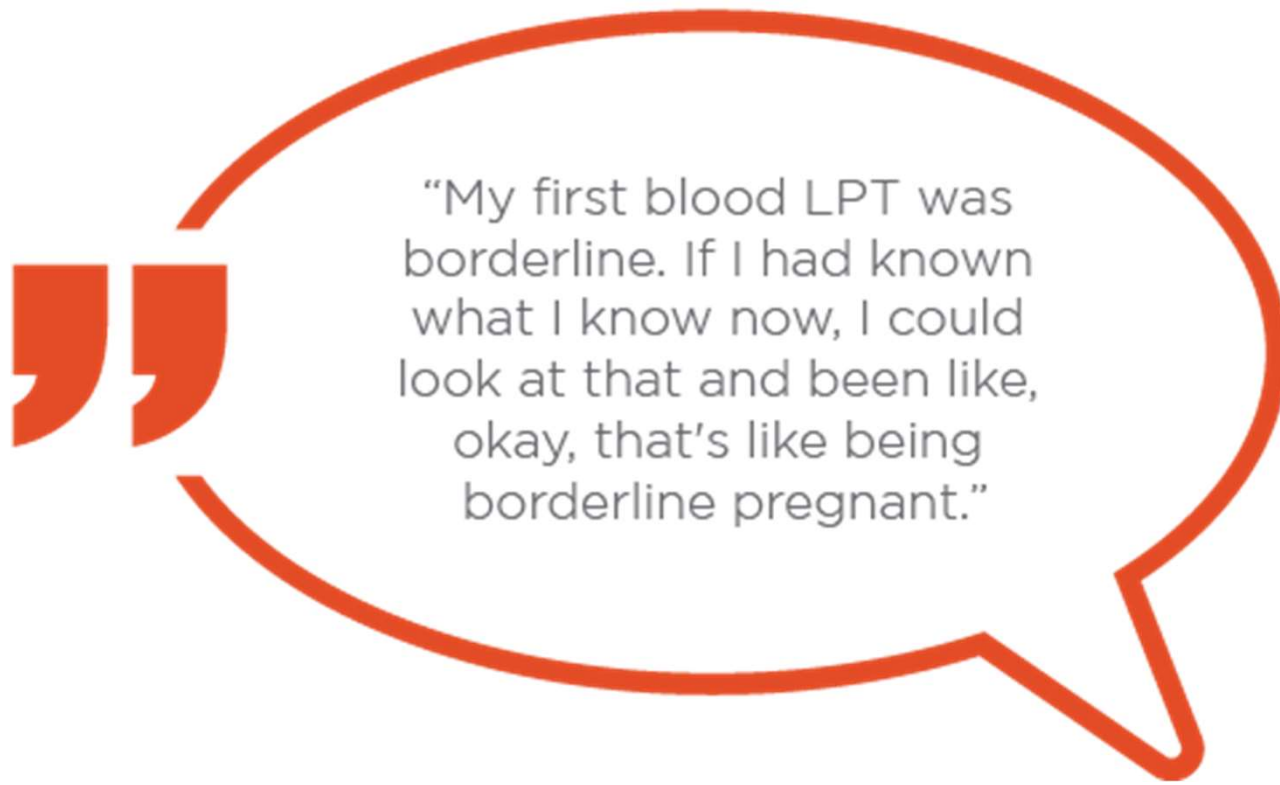
Phase 2 - Results

Participants described ambiguity, inconsistency, vagueness, unpredictability, lack of information, and unfamiliarity consistent with Michel's Uncertainty in Illness theory.



Uncertainty

When something is **ambiguous** it is open to more than one interpretation



“My first blood LPT was borderline. If I had known what I know now, I could look at that and been like, okay, that’s like being borderline pregnant.”



Uncertainty

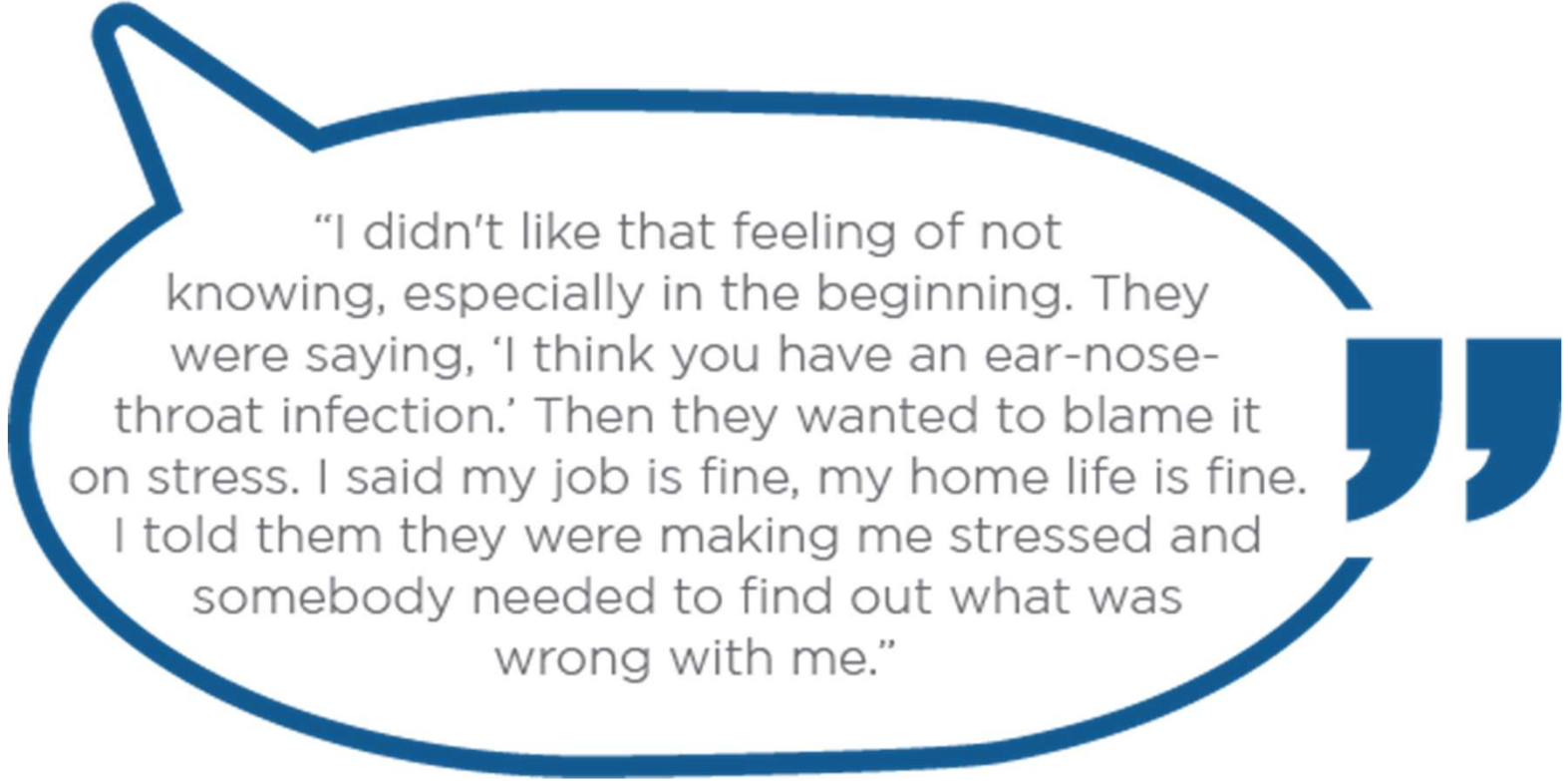
Inconsistency is when two or more things lack in agreement

“What’s happening with some of the doctors they want to go back and do all the testing and then on a couple of people they are telling them ‘no you don’t have the disease.’ Okay, you go through the Department of Labor and they say you’ve got the disease and now the Workers Comp Doctor is saying you don’t have the disease.”



Uncertainty

Vagueness means that something is not clearly understood or is not definitely known.

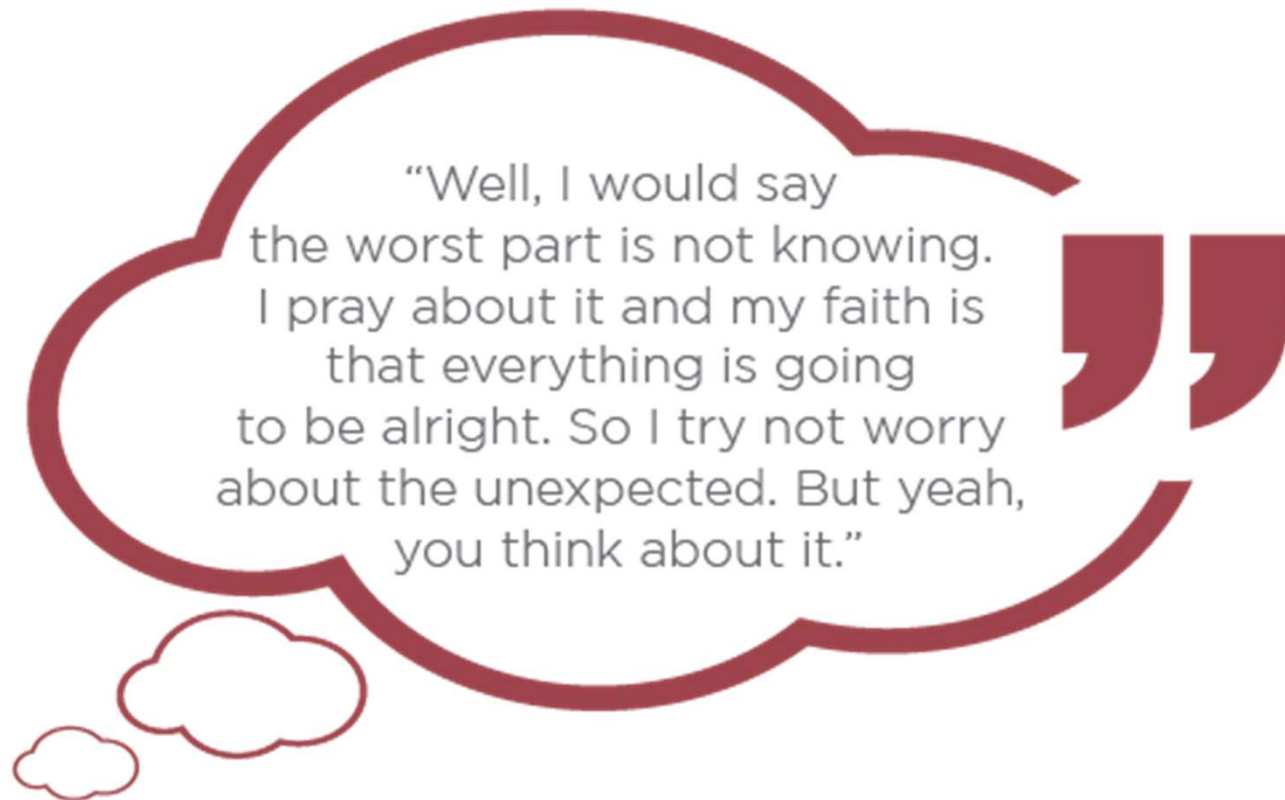


“I didn’t like that feeling of not knowing, especially in the beginning. They were saying, ‘I think you have an ear-nose-throat infection.’ Then they wanted to blame it on stress. I said my job is fine, my home life is fine. I told them they were making me stressed and somebody needed to find out what was wrong with me.”



Uncertainty

When something is **unpredictable** it is difficult or impossible to foretell or foresee.



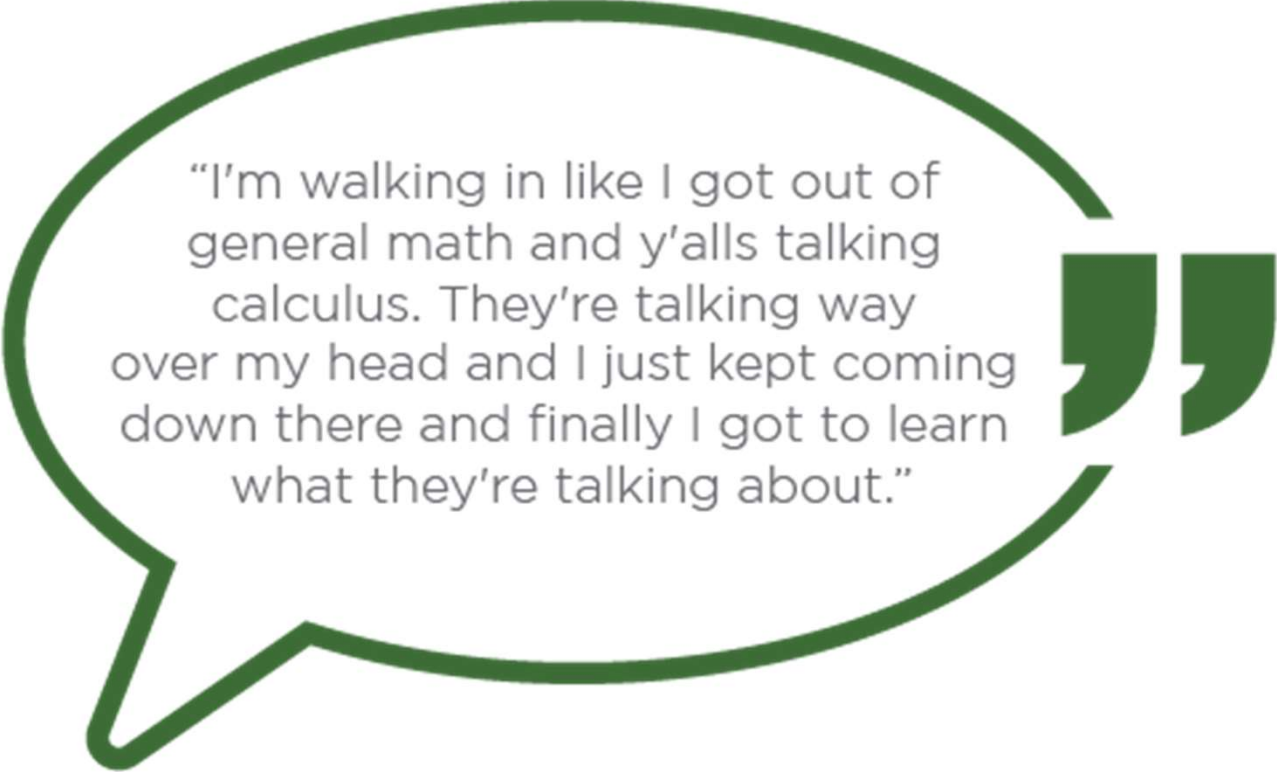
Uncertainty

Lack of information refers to an absence of data.



Uncertainty

Unfamiliarity refers to situations that seem strange or that are not within one's knowledge.



"I'm walking in like I got out of general math and y'all's talking calculus. They're talking way over my head and I just kept coming down there and finally I got to learn what they're talking about."





Phase 2 - Results

Participants described how they adjusted to their condition in a manner aligned with Derogatis' Psychosocial Adjustment to Illness theory.



Psychosocial Adjustment

Healthcare orientation addresses the participant's health care posture and whether it will promote a positive or negative adjustment to the illness and its treatment.

“I had a doctor and he passed away, so I just kind of let it slide for about three years. I went over there again just the other day, and that new doctor, was setting me up for another scan. He's really taken a lot of interest in me. So I think I'm alright, but you know it makes you wonder.”



Psychosocial Adjustment

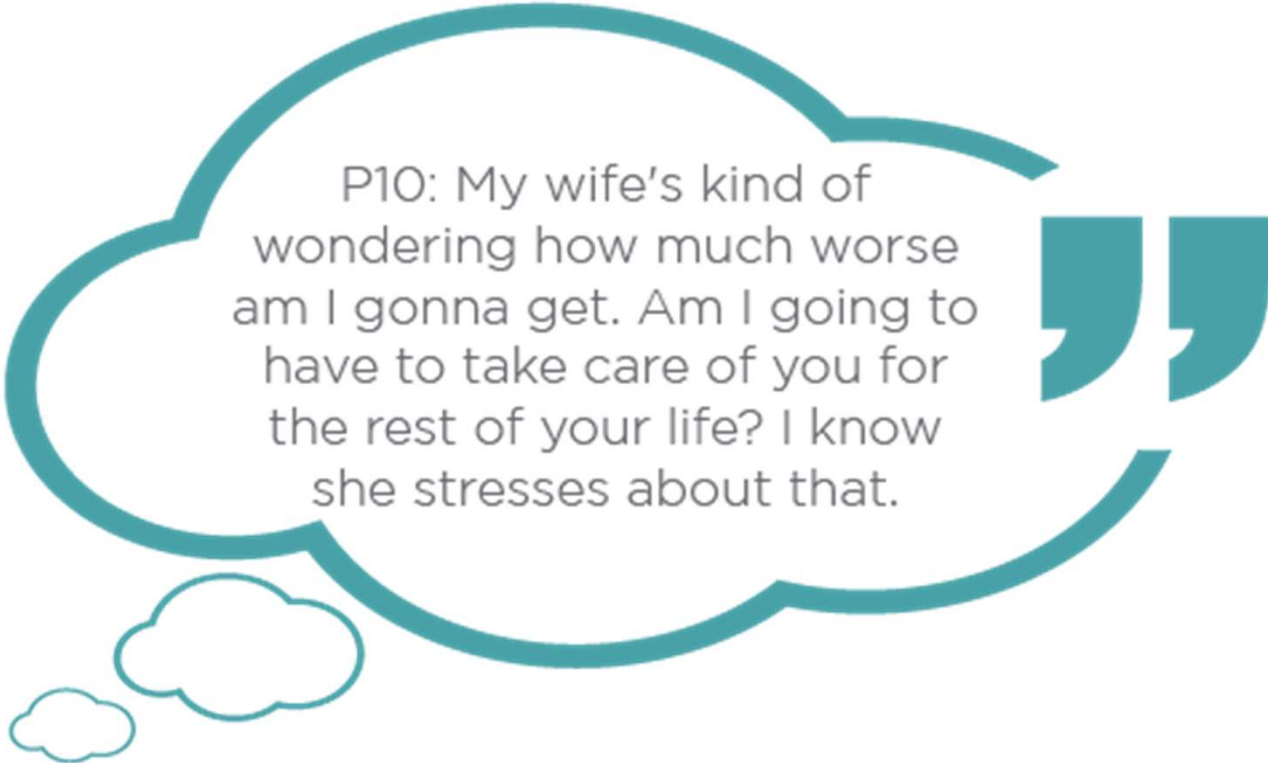
Vocational empowerment reflects the impact that a medical disorder may have on vocational adjustment

“Some of it may be joking or kidding, but you never know with some of the guys if it’s really heartfelt. They don’t just come out and say, ‘you don’t have to do this dirty job because you can’t wear a respirator and I have to do it.’ When you can’t suit up anymore because of lung issues, you get the cushy jobs and they do the hard work.”



Psychosocial Adjustment

Domestic environment is oriented toward illness-induced difficulties that arise primarily in the home or family environment.

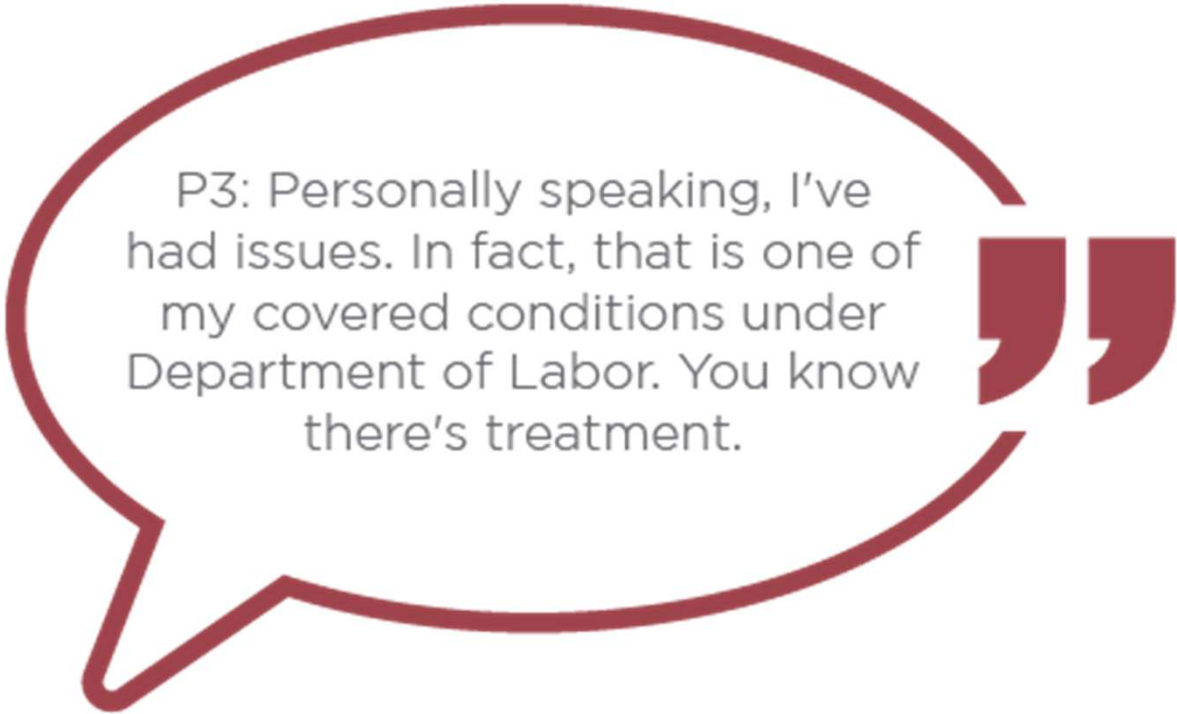


P10: My wife's kind of wondering how much worse am I gonna get. Am I going to have to take care of you for the rest of your life? I know she stresses about that.



Psychosocial Adjustment

Sexual relationships provides a measure of any changes in the quality of sexual functioning or relationship associated with the participant's illness

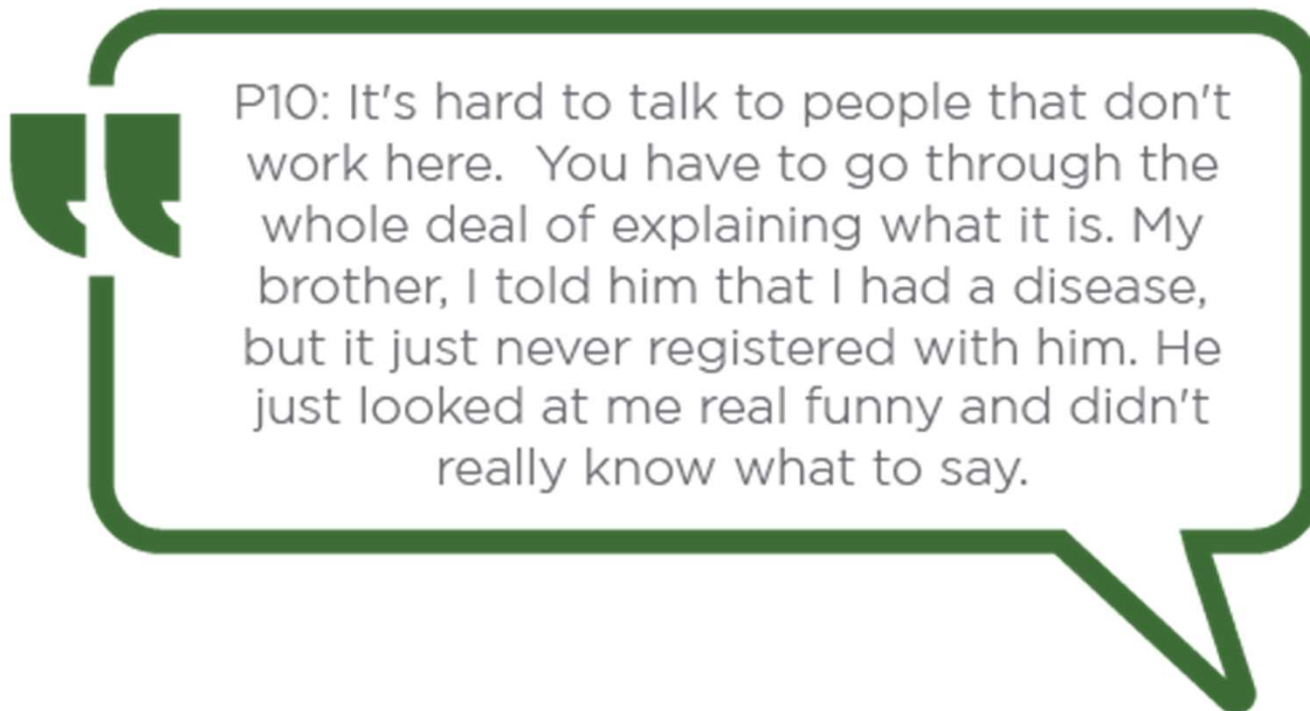


P3: Personally speaking, I've had issues. In fact, that is one of my covered conditions under Department of Labor. You know there's treatment.



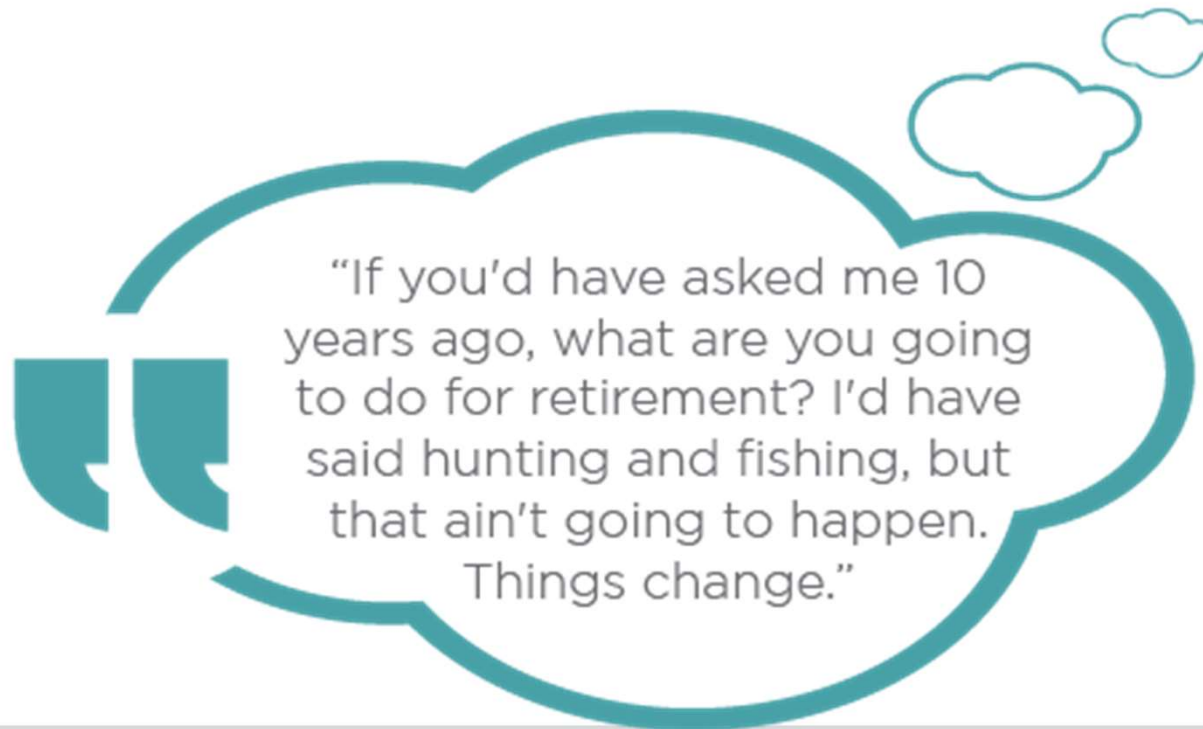
Psychosocial Adjustment

Extended family relationships measures any disruption or derangement in relationships with the extended family that arises with the illness experience



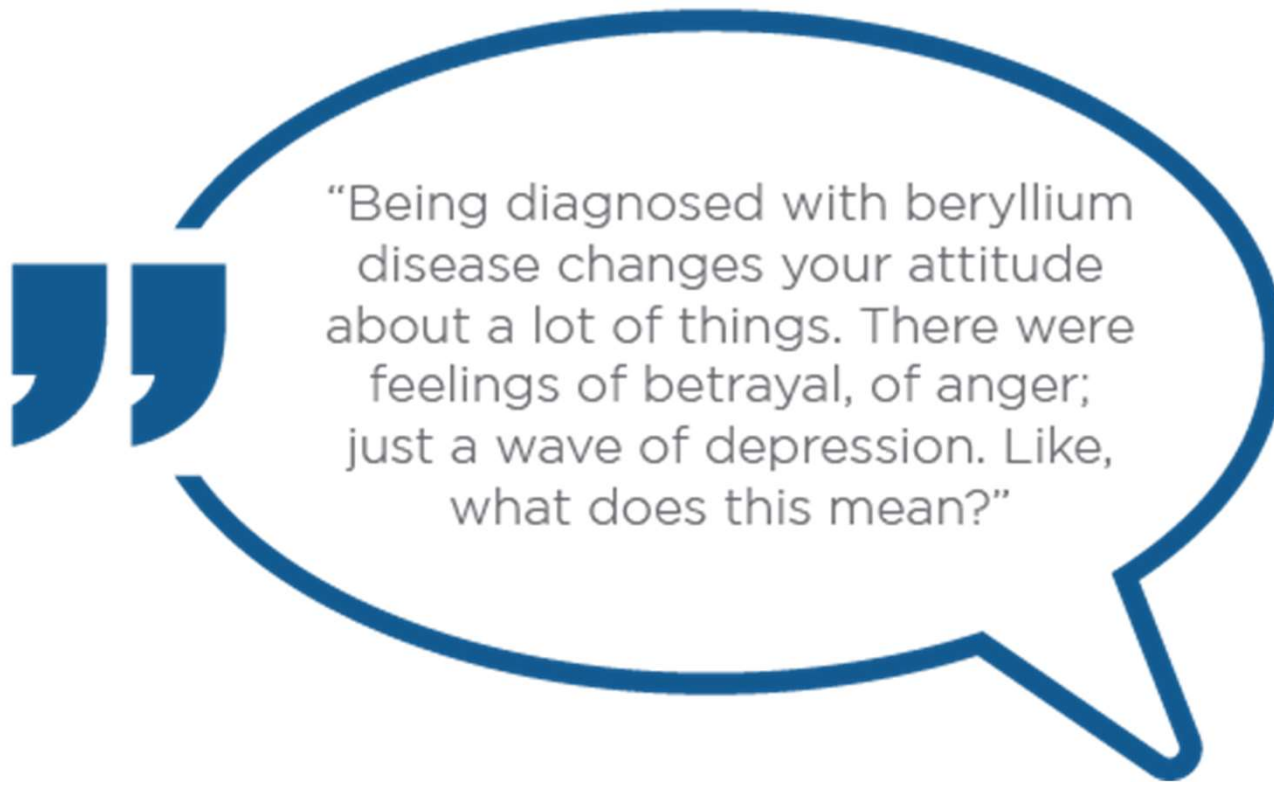
Psychosocial Adjustment

Social environment reflects the participant's current social and leisure time activities and the degree to which the participant has suffered impairment of these activities as a result of their illness



Psychosocial Adjustment

Psychological distress is designed to measure dysphoric thoughts or feelings that are a direct result of the illness





Phase 2 - Conclusion

- It is appropriate to apply Uncertainty in Illness and Psychosocial Adjustment to Illness theories to BeS and CBD.
- The interview data was consistent with the model





Phase 2 - Results

Theme 1 – the Trailblazers

These Trailblazers were mostly craftsmen who were diagnosed with CBD and, out of necessity, became vocal advocates for sick workers. They helped shape the laws and regulations that are now in place to prevent CBD and to ease the burden on future workers who are unfortunate enough to develop BeS or CBD.





Phase 2 - Results

Theme 2 – the Rollercoaster Ride

“It’s never a straight line with me. It’s always a rollercoaster, up and down. When I have a bad day, when I’m having trouble breathing and aching all over, man it’s not worth it. I have to convince myself that it is.”





Phase 3 - Methods

- Measure the psychosocial effects
- Nationwide survey of DOE workers with BeS/CBD
- 4 questionnaires (demographics, MUIS-C, PAIS-SR[®], SF36v2[®])
- 3 methods of recruiting (BSGOR, SOMD, NJH)
- 126 participants (52 CBD, 74 BeS)
- 22% response rate
- Quantitative analysis



Phase 3 - Methods

1. MUIS-C Scale

- Absolute range 23-115, mid-range 69
- Mean score 63.7 (HIV)
- Mean score 74.8 (epilepsy)
- Low score = good

2. PAIS-SR[®] Scale

- Raw score range 308 – 466 (lung cancer)
- Low score = good

3. SF36v2[®] Scale

- Norm 50, SD 10
- High score = good





Phase 3 - Methods

Table 1. Participants by disease status and Department of Energy site

DOE Site	Current Workers		Former Workers		Total	
	CBD	BeS	CBD	BeS	N	%
Y-12	7	15	7	5	34	27.0
Rocky Flats	3	3	8	8	22	17.5
Hanford	1	6	7	6	20	15.9
Kansas City Plant	3	5	2	10	20	15.9
Pantex	2	7	1	1	11	8.7
Los Alamos Nat Lab	2	0	4	2	8	6.3
Nevada Test Site	0	2	2	0	4	3.1
Idaho Nat Lab	0	0	1	2	3	2.4
Lawrence Livermore Nat Lab	0	0	1	1	2	1.6
Oak Ridge Nat Lab	0	0	1	0	1	0.8
Sandia Nat Labs	0	1	0	0	1	0.8
Total	18	39	34	35	126	100





Phase 3 - Methods

Table 2. Results of the SF-36v2® Health Survey

Survey Component and Domains	Mean Score	
	CBD	BeS
Physical Component Summary	39.1*	43.2
Physical Functioning	40.8	43.2
Role Physical	40.9	43.7
Bodily Pain	42.4	45.0
General Health	39.1	41.8
Mental Component Summary	47.1	46.4
Vitality	44.6	44.5
Social Functioning	43.6	44.1
Role Emotional	42.5	44.1
Mental Health	48.2	47.3

Norm = 50.0, SD = 10; High score = good; * p=.038, t-test (2-tailed)



Phase 3 - Methods

Table 3.5. Results of the Mishel Uncertainty in Illness Scale–Community Form (MUIS-C) Survey

Disease Status	N	Mean Score	Standard Deviation
CBD	50	68.3	12.9
BeS	71	68.1	10.8
Total	121	68.2	11.6

Low score = good; Example Mean scores: Epilepsy = 74.8, HIV = 63.7
Missing=5; BeS=beryllium sensitization; CBD=chronic beryllium disease



Phase 3 - Methods

Table 3. Results of the Psychosocial Adjustment to Illness Scale–Self Report (PAIS-SR®) Survey

Domain	Mean Score	
	CBD	BeS
Overall Score	433.7*	411.7
Healthcare Orientation	62.9	63.9
Vocational Environment	63.6**	59.5
Domestic Environment	63.4*	57.8
Sexual Relationships	63.7*	59.1
Extended Family Relationships	62.5	59.6
Social Environment	61.4***	58.3
Psychological Distress	56.3	53.4

Low score = good

p=.02, t-test (2-tailed), ** p=.003, t-test (2-tailed), ***p=.04, t-test (2-tailed)



Phase 3 - Methods

Table 4. Correlation matrix for SF-36v2® Health Survey, Psychosocial Adjustment to Illness Scale–Self Report (PAIS-SR®) Survey and Mishel Uncertainty in Illness Scale–Community Form (MUIS-C) Survey scores

Disease Status		MCS	PCS	PAIS-SR®	MUIS-C
CBD	MCS	1			
	PCS	.26	1		
	PAIS-SR®	-.31*	-.24	1	
	MUIS-C	-.21	-.21	.62***	1
BeS	MCS	1			
	PCS	.33**	1		
	PAIS-SR®	-.45**	-.42**	1	
	MUIS-C	-.23	-.23	.59***	1

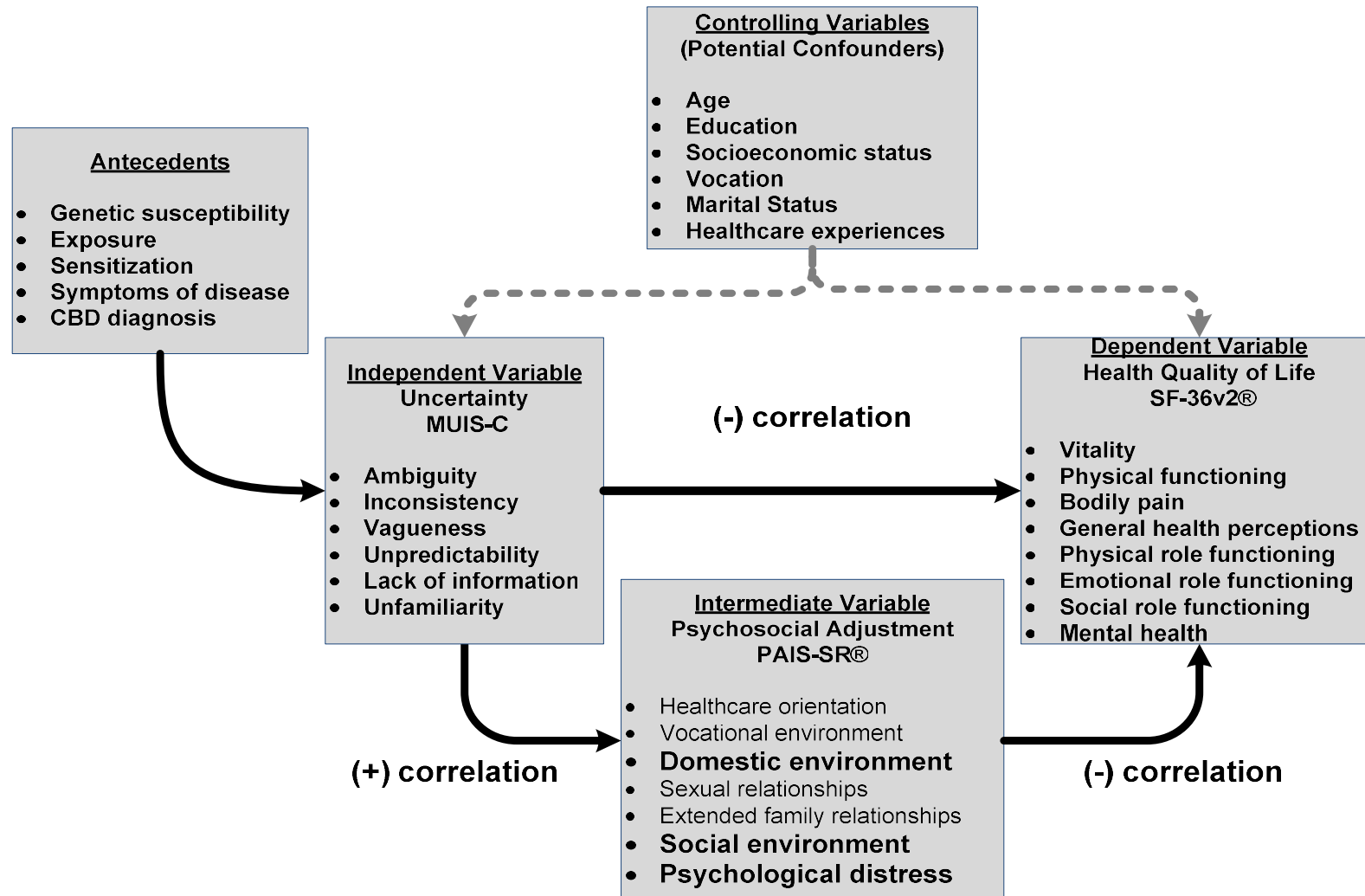
*significant at the 0.05 level (Pearson Correlation, 2-tailed)

**significant at the 0.01 level (Pearson Correlation, 2-tailed)

***significant at the 0.001 level (Pearson Correlation, 2-tailed)



Phase 3 - Methods





Phase 3 - Methods

Table 3.8. Multiple regression model to predict mental component summary scores

Variable	Unstandardized Coefficients		Standardized Coefficients	t	Significance
	B	Standard Error	Beta		
(Constant)	81.7	6.59	-	12.4	<0.001
Psychological distress	-0.48	0.12	-0.44	3.78	<0.001
Social environment	-0.56	0.17	-0.41	3.30	0.001
Domestic environment	0.40	0.14	0.36	2.84	0.005



- Psychological distress measures **dysphoric thoughts and feelings** that accompany the individual's disorder (anxiety, depression, hostility, reduced self-esteem, body image problems, and inappropriate guilt)
- Social environment reflects the status of the participant's current **social and leisure time activities** and the degree to which the participant has suffered impairment or constriction of these activities as a result of their illness
- Domestic environment is oriented toward illness-induced **difficulties that arise primarily in the home or family environment**. Assesses problems in adaptation experienced by the participant and their family unit in response to the participant's illness

[Derogatis 1990]



Phase 3 - Methods

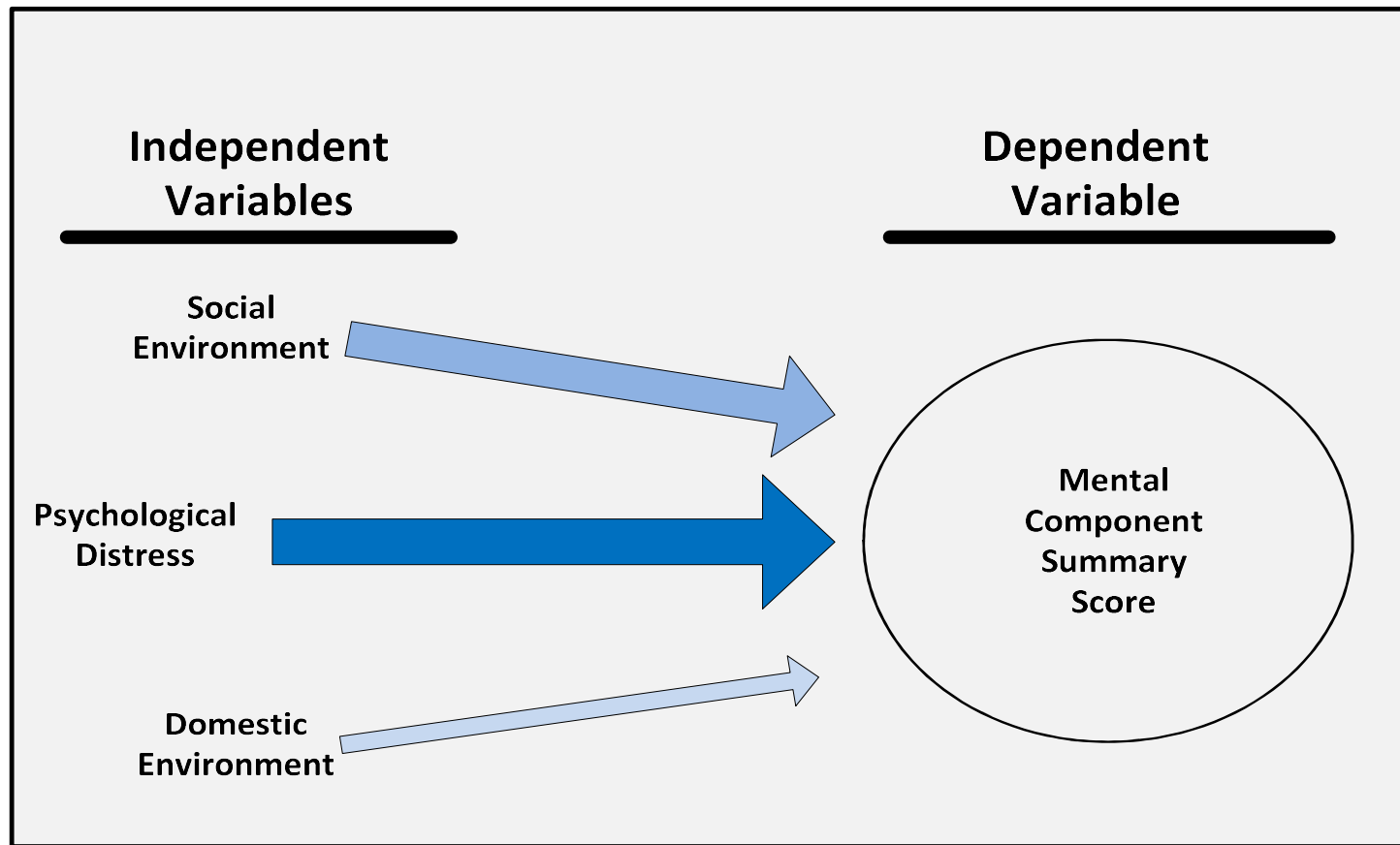


Figure 3.1. Multiple regression model path analysis





Phase 3 - Conclusions

- Psychosocial effects are an important component of BeS and CBD
 - Results added validity to the model
 - BeS may have as much impact on mental health as CBD
- Comparison of scores for all mental health scales indicated the same trend
 - Those with BeS had scores similar to those with CBD
 - Those with CBD may have progressed through the more psychologically damaging phase of BeS and are more resolved to their status with CBD





Phase 3 - Conclusions

- Implications for treatment and workers comp.
 - Compensation is linked to physical signs and symptoms of CBD while BeS is not compensable under most workers comp. programs
 - Insurance coverage for counseling and treatment for psychological distress and other mental health components may be warranted for those with BeS
 - Interventions should focus on coping strategies for psychological distress, social environment and domestic environment

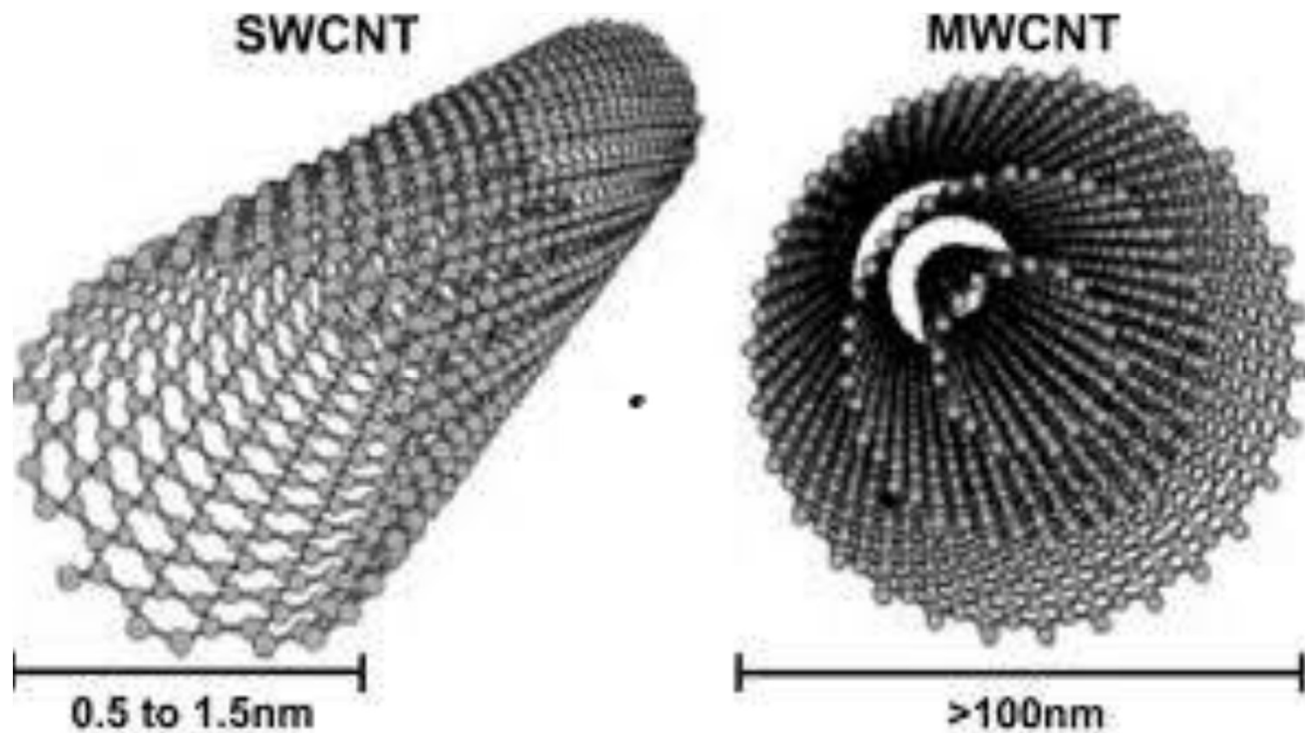


Implications for other exposures

- Are there other agents to which workers are exposed that we may apply this knowledge?
- What are the characteristics that would be necessary to make it similar to BeS/CBD?
 - Uncertainty about health effects
 - Uncertainty about exposure and risk
 - Medical surveillance of workers at risk
- These conditions have the potential to create psychological distress in workers
- Psychological distress may be heightened by societal factors



One Candidate: carbon nanotubes and nanofibers



NIOSH Recommendations

Health effects “NIOSH is not aware of any reports of adverse health effects in workers using or producing CNT or CNF. However, there are studies of animals exposed to CNT and CNF that are informative in predicting potential human health effects... NIOSH systematically reviewed 54 laboratory animal studies, many of which indicated that CNT/CNF could cause adverse pulmonary effects including inflammation, granulomas, and pulmonary fibrosis...There are well established correlations between results of animal studies and adverse effects in workers exposed to particulates and other air contaminants.”

Exposure and Risk “The estimated risk of developing early-stage (slight or mild) lung effects over a working lifetime if exposed to CNT at the analytical limit of quantification (NIOSH Method 5040) of $1 \mu\text{g}/\text{m}^3$ (8-hr time-weighted average as respirable elemental carbon) is approximately 0.5% to 16% (upper confidence limit estimates). At present, data on cancer and cardiovascular effects are not adequate for a quantitative risk assessment of inhalation exposure.”

Medical Surveillance “It is prudent for employers to institute medical surveillance and screening programs for workers who are exposed to CNT and CNF for the purpose of possibly detecting early signs of adverse pulmonary effects including fibrosis. ”



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Questions?



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Thank You

