Examining Variability in Depression Among Pre-Retirees: Innovative Analytic Methods Applied to Observational Data

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BACKGROUND

- Data collected during observational studies have the potential for large intra-individual variability as a consequence of the inherent design (e.g., omission of controlling factors, such as inclusion and exclusion criteria and randomisation)
- Identifying and explicitly modelling this variability can provide a more detailed understanding of change over time
- Innovative analytical methods, such as growth mixture modelling (GMM), facilitate such an approach

OBJECTIVES

- To apply latent growth modelling (LGM) and growth mixture modelling (GMM) techniques to observational data
- Using these techniques, to identify and explore variability in depression scores over 12 years and examine whether there are subsets of individuals with differential change
- To examine reasons for differential change using available demographic and clinical information

METHODS

- Data taken from a large observational study, the Health and Retirement Survey (HRS)
  - Initial face-to-face interviews conducted in 1992
  - Data collected twice annually for 12 years (1992–2004) on health, income and assets, employment history, retirement plans and expectations, and demographics
  - Current sample included 5,090 individuals aged 51 to 61 years at the time of recruitment with complete data across 12 years
- Scores on an 8-item version of the Center for Epidemiological Studies-Depression Scale (CES-D) (scale score ranged from 0 to 8) were examined using mixture modelling techniques to answer the following questions:
  - Are there groups of individuals with differential depression trajectories over 12 years that are hidden when whole group means are analysed using traditional techniques?
  - In what ways do individuals show a differential change over time?
    - Do some decline? improve? show no change?
  - In what ways are subgroups of responders different?
    - Are there differences in characteristics of individuals who improve versus those who decline?

Statistical Analysis

- Descriptive statistics were examined to investigate variable distribution and normality
- LGMs were conducted using CES-D data to explore responses across the 12-year period (seven assessment points)
  - LGMs use structural equation modeling techniques to model trajectories of change
  - Two latent (unobserved) variables were calculated for each individual in the dataset:
    - Intercept (variable for the first time point of the slope)
    - Slope of change (variable for change in scores over time)
  - Changes in scores were analyzed at the individual level, modeling individual variability
    - Level of individual variability was examined to assess whether subgroups of individuals with different slopes existed in the data
- GMMs were conducted when considerable individual variability was present.
- GMMs assessed the presence of latent subgroups of individuals that show a different slope of change than other subgroups of individuals
  - Different numbers of subgroup 'class solutions' were tested to find the best model fit (e.g., two latent classes? three latent classes?)
- Post hoc comparisons were conducted to explore differences between the identified latent classes in terms of health, income and assets, employment history, retirement plans and expectations, and demographics

RESULTS

- Table 1 presents the descriptive statistics for the study sample
- None of the distributions of the HRS CES-D at any visit were skewed or kurtotic

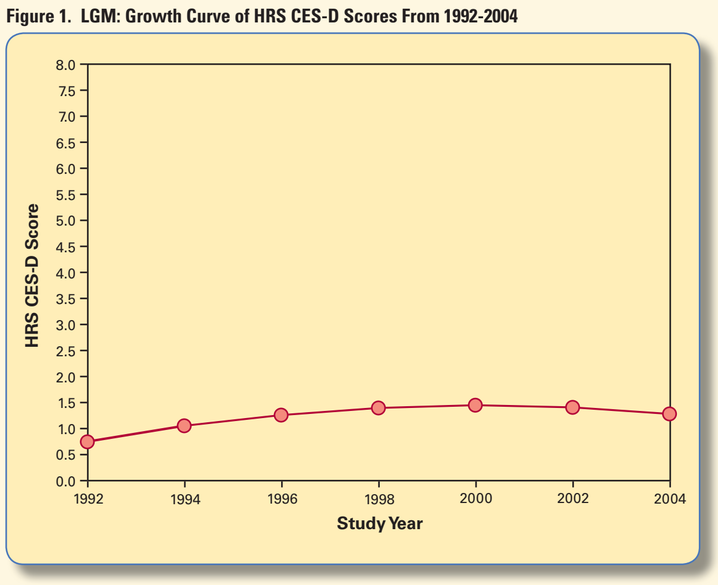
Table 1. Descriptive Statistics for Sample (N = 5,090)

	Mean (SD)	Range
Age at study entry	55.7 (3.1)	51-61
HRS CES-D		
1992	0.7 (1.3)	0-8
1994	1.2 (1.9)	0-8
1996	1.2 (1.8)	0-8
1998	1.5 (1.9)	0-8
2000	1.4 (1.8)	0-8
2002	1.4 (1.9)	0-8
2004	1.3 (1.9)	0-8
Sex	**Frequency**	**Percentage**
Male	2,026	39.8
Female	3,064	60.2

SD = standard deviation.

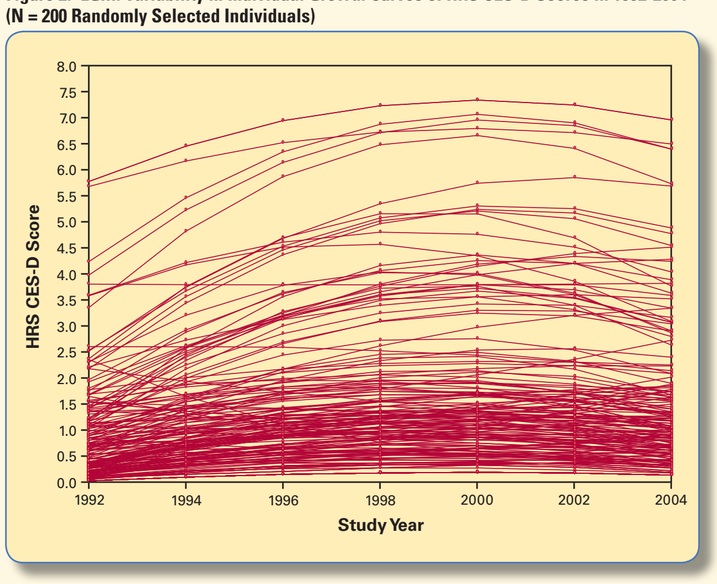
- The LGM curve showed a nonlinear trajectory (Figure 1)
  - Respondents began the study with an HRS CES-D score of 0.75, indicating "no depression"
  - Overall depression increased to 1.3 over the 12-year period, indicating "subthreshold depression"
- Empirical results suggested substantial variability relative to the mean intercept and slope
  - Intercept SD was 1.06, indicating that two-thirds of the individual intercepts were between 0 and 1.8
  - Mean standardised slope of 0.34 had an SD of 0.52, indicating substantial variability around this mean

Figure 1. LGM: Growth Curve of HRS CES-D Scores From 1992-2004



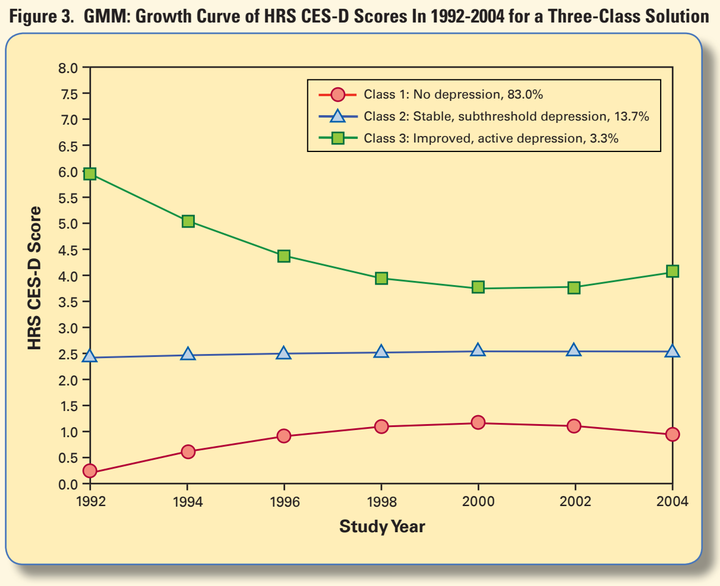
- Visual examination also suggested substantial variability
  - Figure 2 displays an example of the varied trajectories among 200 randomly selected individuals

Figure 2. LGM: Variability in Individual Growth Curves of HRS CES-D Scores In 1992-2004 (N = 200 Randomly Selected Individuals)



- Empirical and visual evidence suggested that specifically analysing this variability may uncover subsets of individuals with a differential response than that represented by the overall mean (i.e., latent classes)
- GMMs successfully identified latent classes of differential responders
- Comparisons of three different solutions (two-class, three-class, and four-class) suggested that a three-class solution fits the data best
- The three classes had distinct intercepts and growth trajectories that represent a different story than that shown with the LGM (Figure 3)
  - Class 1 (83% of the total sample) had an intercept of 0.21—indicating no depression—which increased (worsened) slightly over the 12 years, but remained low
    - Therefore, hereafter referred to as "no depression" respondents.
  - Class 2 (13.7% of the total sample) had an intercept of 2.5—indicating subthreshold depression—which remained stable over the 12 years
    - Therefore, hereafter referred to as "stable, subthreshold depression" respondents
  - Class 3 (3.3% of the total sample) had an intercept of 6—indicating active depression—which improved over the 12 years (reaching a value of 4) but remained in the active depression range
    - Therefore, hereafter referred to as "improved, actively depressed" respondents

Figure 3. GMM: Growth Curve of HRS CES-D Scores In 1992-2004 for a Three-Class Solution



- Significant differences were found between the identified latent classes (Table 2) on health, income and assets, employment history, retirement plans and expectations, and demographics
  - Improved, actively depressed respondents were more likely to be women, showed the worst scores for health and financial measures, were much less likely to be employed, and were much more likely to be retired and disabled

Table 2. Post Hoc Comparisons of Latent Classes

	Class 1: No Depression (n = 4,226)	Class 2: Stable, Subthreshold Depression (n = 697)	Class 3: Improved, Active Depression (n = 167)	Differences Between Classes*
Sex (% female)	58%	67%	81%	a, b, c
Age in years, mean (SD)	55.7 (3.1)	55.5 (3.1)	55.5 (3.1)	
Education in years, mean (SD)	12.7 (2.9)	11.5 (3.3)	10.4 (3.4)	a, b, c
Length of longest marriage in years, mean (SD)	27.4 (10.7)	25.6 (12.0)	22.6 (12.8)	a, b, c
Health problems limit work	13%	32%	62%	a, b, c
Body mass index	27.1	28.0	28.8	a, b
Ever had high blood pressure	30%	38%	49%	a, b, c
Ever had diabetes	7%	10%	13%	a, b
Ever had cancer	4%	5%	7%	
Ever had lung disease	3%	7%	13%	a, b, c
Ever had heart problems	7%	12%	19%	a, b, c
Ever had stroke	1%	3%	2%	a
Ever had psychological problems	3%	15%	41%	a, b, c
Number of hospital stays in previous 12 months, mean (SD)	0.1 (0.5)	0.2 (0.8)	0.4 (1.0)	a, b, c
Number of doctor visits in previous 12 months, mean (SD)	3.4 (5.7)	5.7 (9.1)	13.2 (18.4)	a, b, c
Self-reported health†	2.2	3.1	3.8	a, b, c
Number of activities of daily living limitations (0-5), mean (SD)	0.02 (0.2)	0.2 (0.6)	0.5 (1.0)	a, b, c
Number of instrumental activities of daily living limitations (0-3), mean (SD)	0.2 (0.4)	0.4 (0.6)	0.6 (0.8)	a, b, c
Medical expenses, mean (SD)	$4,322 ($14,638)	$6,245 ($19,644)	$15,573 ($43,613)	a, b, c
Total assets, mean (SD)	$244,753 ($462,956)	$131,259 ($281,849)	$66,578 ($121,373)	a, b, c
Total income, mean (SD)	$22,466 ($28,355)	$14,872 ($18,951)	$5,622 ($10,370)	a, b, c
Marital status, n (%)‡				
Married	3,267 (77.3%)	425 (60.9%)	83 (49.7%)	
Married, spouse absent	17 (0.4%)	2 (0.3%)	0	
Partnered	85 (2.0%)	14 (2.0%)	4 (2.4%)	
Separated	83 (2.0%)	33 (4.7%)	13 (7.8%)	
Divorced	398 (9.4%)	114 (16.4%)	34 (20.4%)	
Widowed	230 (5.4%)	80 (11.5%)	22 (13.2%)	
Never married	146 (3.45%)	29 (4.2%)	11 (6.6%)	
Labor force status, n (%)§				
Works full-time	2,484 (58.8)	327 (46.9)	36 (21.6)	
Works part-time	481 (11.4)	71 (10.2)	13 (7.8)	
Unemployed	97 (2.3)	27 (3.9)	6 (3.6)	
Partly retired	175 (4.1)	22 (3.2)	7 (4.2)	
Retired	459 (10.9)	120 (17.2)	43 (25.8)	
Disabled	63 (1.5)	46 (6.6)	31 (18.6)	
Not in labor force	467 (11.1)	84 (12.1)	31 (18.6)	

* Bonferroni post hoc comparisons ($P \leq 0.05$): a = Class 1 vs. Class 2; b = Class 1 vs. Class 3; c = Class 2 vs. Class 3.

† Self-reported health: 1 = excellent; 2 = very good; 3 = good; 4 = fair; 5 = poor.

‡ Pearson X^2 (12) = 165.11; $P < 0.001$.

§ Pearson X^2 (df = 12) = 329.62; $P < 0.001$.

CONCLUSIONS

- Examining variability in depression in a large, observational panel study of middle-aged adults yields insights into subsets of respondents who exhibit different patterns of change in depression
- These innovative methods may be particularly relevant for observational studies where inclusion and exclusion criteria are often less stringent than those for clinical trials
  - As a consequence, there may be greater variability among participants in observational studies
- Methods that can efficiently examine the heterogeneous responses and characteristics within these samples could greatly benefit our understanding of subsets who respond in very different ways from other subsets of respondents

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Presented at: ISPOR 14th Annual European Congress
November 5-8, 2011
Madrid, Spain