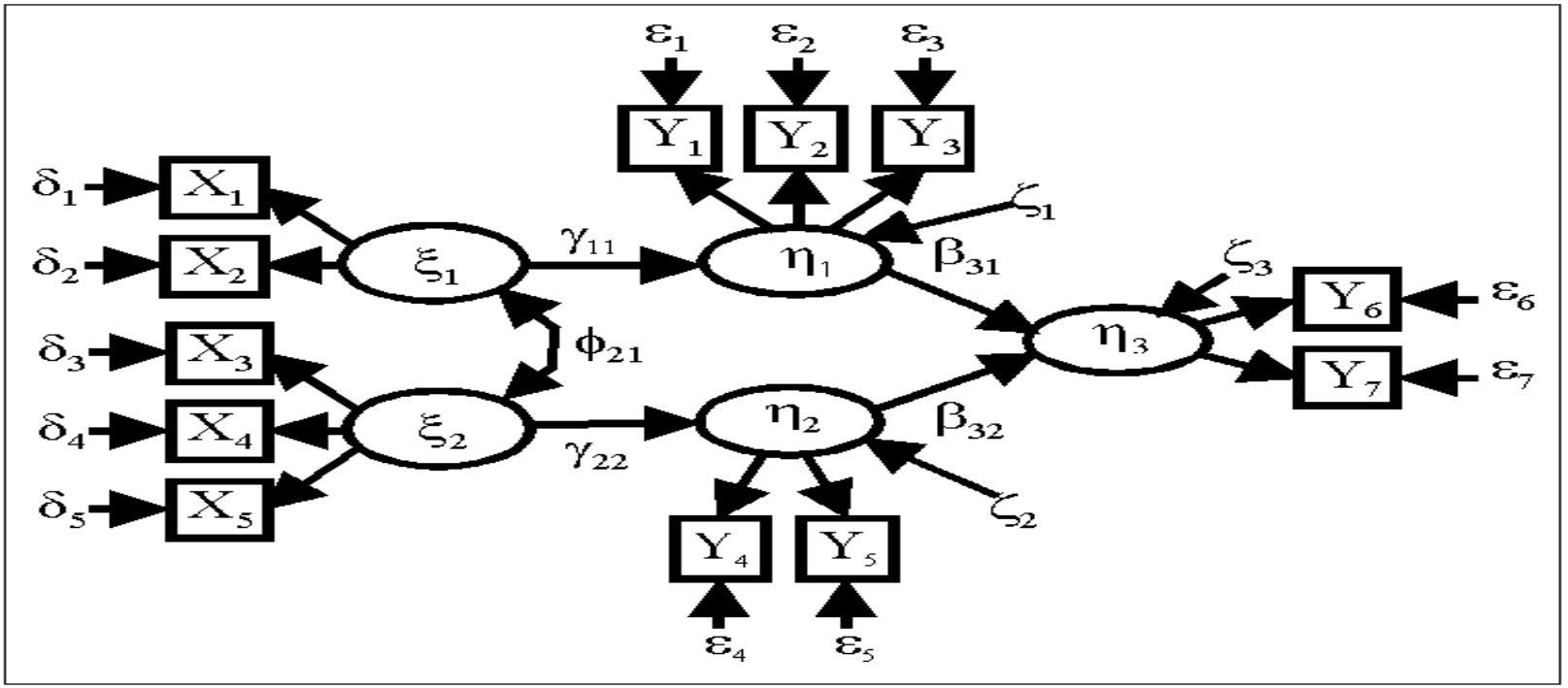
Structural Equation Modeling (SEM)

Ron D. Hays, Ph.D.
http://twitter.com/rondhays

November 15, 2010, 15:01-15:59pm

UCLA RCMAR/EXPORT Seminar Series



Acknowledgment of Support

- ✓ UCLA Resource Center for Minority Aging Research/Center for Health Improvement in Minority Elderly (RCMAR/CHIME), P30AG021684.

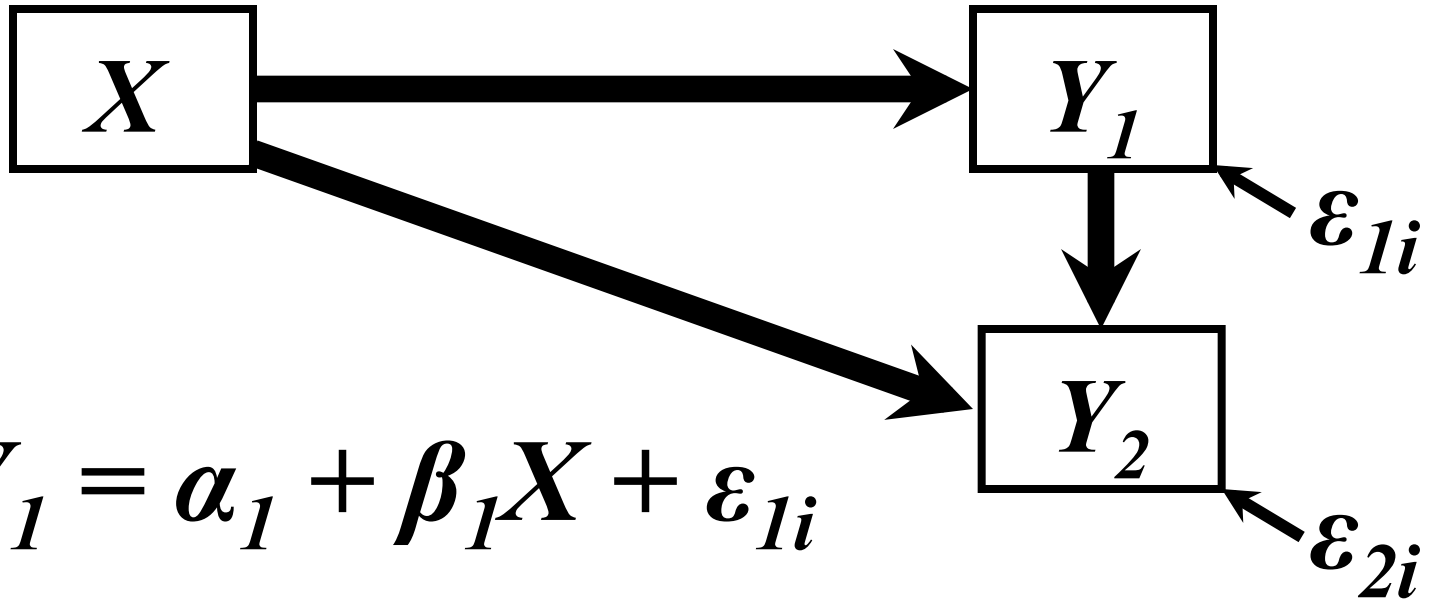
- ✓ UCLA/DREW Project EXPORT, 2P20MD000182

Example

Wouters, E. Heunis, C. van Rensburg, D., & Meulemans, H. (2009). Physical and emotional health outcomes after 12 months of public-sector antiretroviral treatment in the Free State Province of South Africa: A longitudinal study using structural equation modelling. BMC Public Health 9: 103.

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2678117/

Path Analysis



$$Y_1 = \alpha_1 + \beta_1 X + \varepsilon_{1i}$$

$$Y_2 = \alpha_2 + \beta_2 X + \beta_3 Y_1 + \varepsilon_{2i}$$

Fit Indices (> 0.94; <0.06 cutoffs)

- Normed fit index: $\frac{\chi^2_{null} - \chi^2_{model}}{\chi^2_{null}}$
- Non-normed fit index: $\frac{\frac{\chi^2_{null}}{df_{null}} - \frac{\chi^2_{model}}{df_{model}}}{\left(\frac{\chi^2_{null}}{df_{null}} - 1\right)}$
- Comparative fit index: $1 - \left(\frac{\chi^2_{model} - df_{model}}{\chi^2_{null} - df_{null}}\right)$
- Root Mean Square Error of Approximation: $\sqrt{\frac{Q_{model}}{df_{model}} - \frac{1}{N}}$ e.g., $Q = \frac{x^2_{model}}{N}$

Methods (Public health sector in Free State Province of South African)

- Baseline
  - <6 months of antiretroviral treatment (ART)
- Follow-up
  - < 12 months ART
- Variables
  - ART duration (independent variable)
  - Adverse effects of ART (*None*, *Mild*, *Disruptive)*
    - *Do you have side effects? If yes, list them and tell us how disruptive they are?*
  - Self-reported health (*None, Some/moderate, Extreme*)
    - EQ-5D mobility, usual activities, pain, and self-care (None, Some/moderate, Extreme)
    - EQ-5D anxiety/depression item, overall life satisfaction (5 response categories), global happiness item

Your own health state today

By placing a tick in one box in each group below, please indicate which statement best describes your own health state today.

Do not tick more than one box in each group.

Mobility

- I have no problems in walking about ☐
- I have some problems in walking about ☐
- I am confined to bed ☐

Self-Care

- I have no problems with self-care ☐
- I have some problems washing and dressing myself ☐
- I am unable to wash or dress myself ☐

Usual Activities (eg. work, study, housework, family or leisure activities)

- I have no problems with performing my usual activities ☐
- I have some problems with performing my usual activities ☐
- I am unable to perform my usual activities ☐

Pain/Discomfort

- I have no pain or discomfort ☐
- I have moderate pain or discomfort ☐
- I have extreme pain or discomfort ☐

Anxiety/Depression

- I am not anxious or depressed ☐
- I am moderately anxious or depressed ☐
- I am extremely anxious or depressed ☐

Sample Characteristics

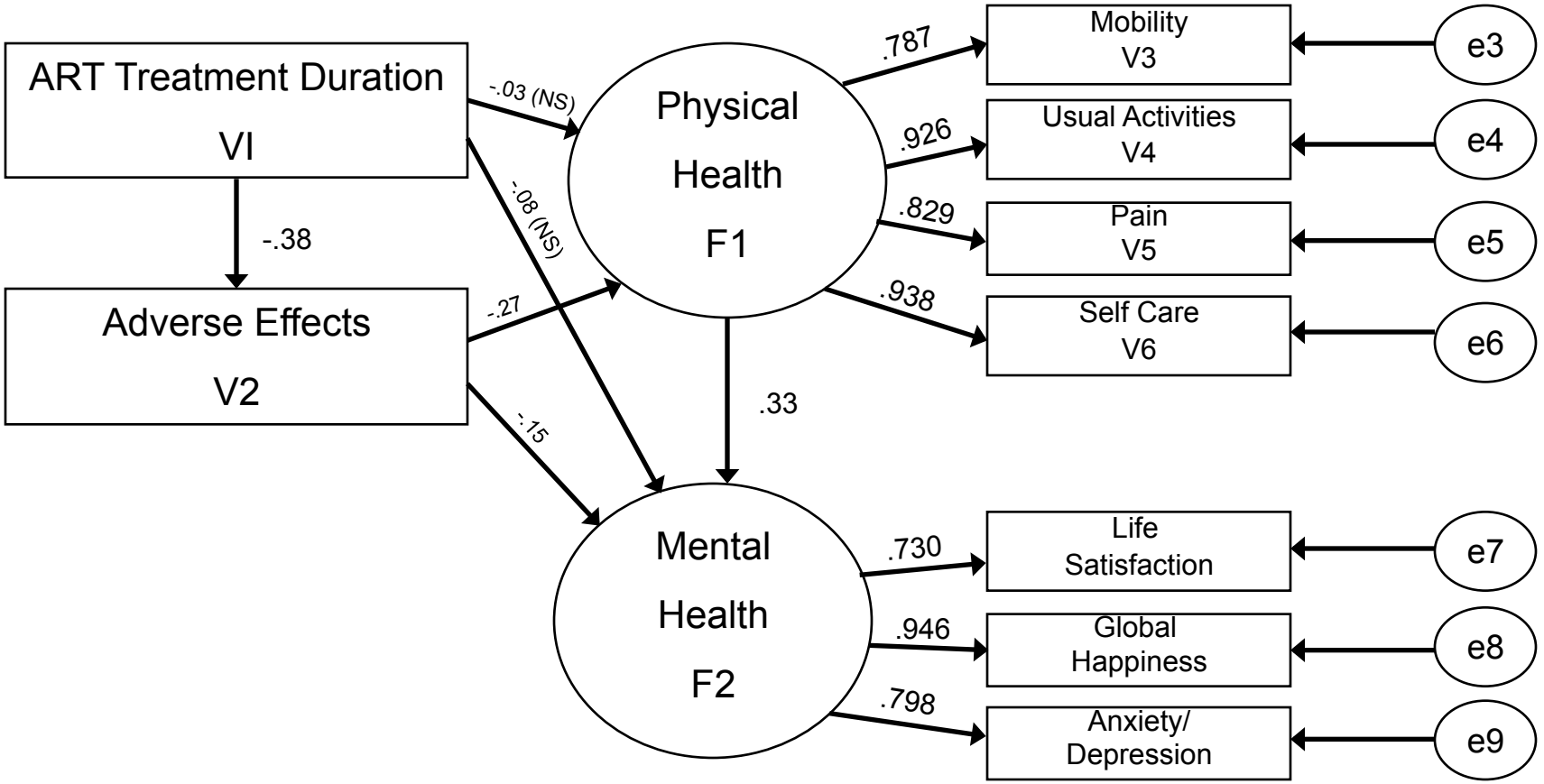
- n = 268 at baseline (n = 234 at follow-up)
- Mean age of 38 years (SD = 9)
- 67% women

- 40% reported some pain
- 30% reported some anxiety or depression
- 19% reported some
  - problems with walking about
  - problems with usual activities

Original

Wouters, E., Heunis, C. Von Rensberg, D., & Meulemens, H. BMC Public Health 2009,9:103.

Sample of 234 patients enrolled in public sector antiretroviral treatment program in the Free State Province of South Africa



Normed Fit Index=	0.985
Non-normal Fit Index=	0.993
Comprehensive Fit Index=	0.996
Root Mean Square of Approximation (RMSEA)=	0.031

EQS 6.1 for Windows

Bentler, PM. (2006). EQS 6 Structural Equations Program Manual. Encino, CA: Multivariate Software, Inc.

Normal theory estimators: ULS, GLS, ML

Other estimators: ML robust, AGLS (ADF)

Wouters, E., Heunis, C. Von Rensberg, D., & Meulemens, H. BMC Public Health 2009,9:103.

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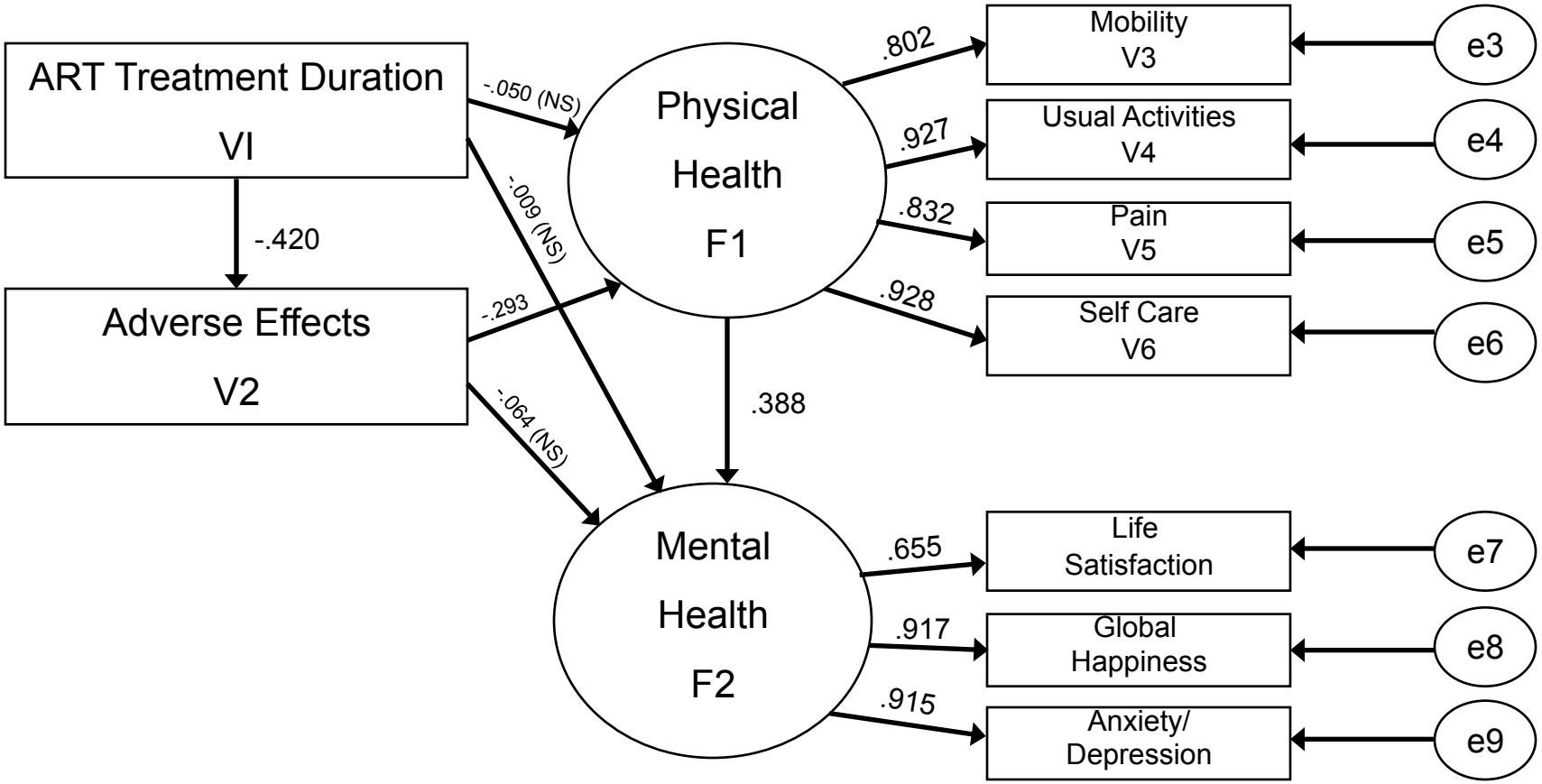

X^2(n=234, dfs=23)=427.527

Normed Fit Index=	0.977
Non-normal Fit Index=	0.985
Comprehensive Fit Index=	0.990
Root Mean Square of Approximation (RMSEA)=	0.054

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  Wouters et al #1ls November 11 2010
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V8=1*F2 + E8;
V9=1*F2 + E9;
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 0.037 -0.169  0.700  0.757  1.000
 0.071 -0.224  0.740  0.888  0.776  1.000
 0.143 -0.143  0.068  0.131  0.198  0.163  1.000
-0.074 -0.261  0.258  0.448  0.347  0.311  0.674  1.000
 0.079 -0.019  0.435  0.330  0.328  0.403  0.657  0.746  1.000
/END
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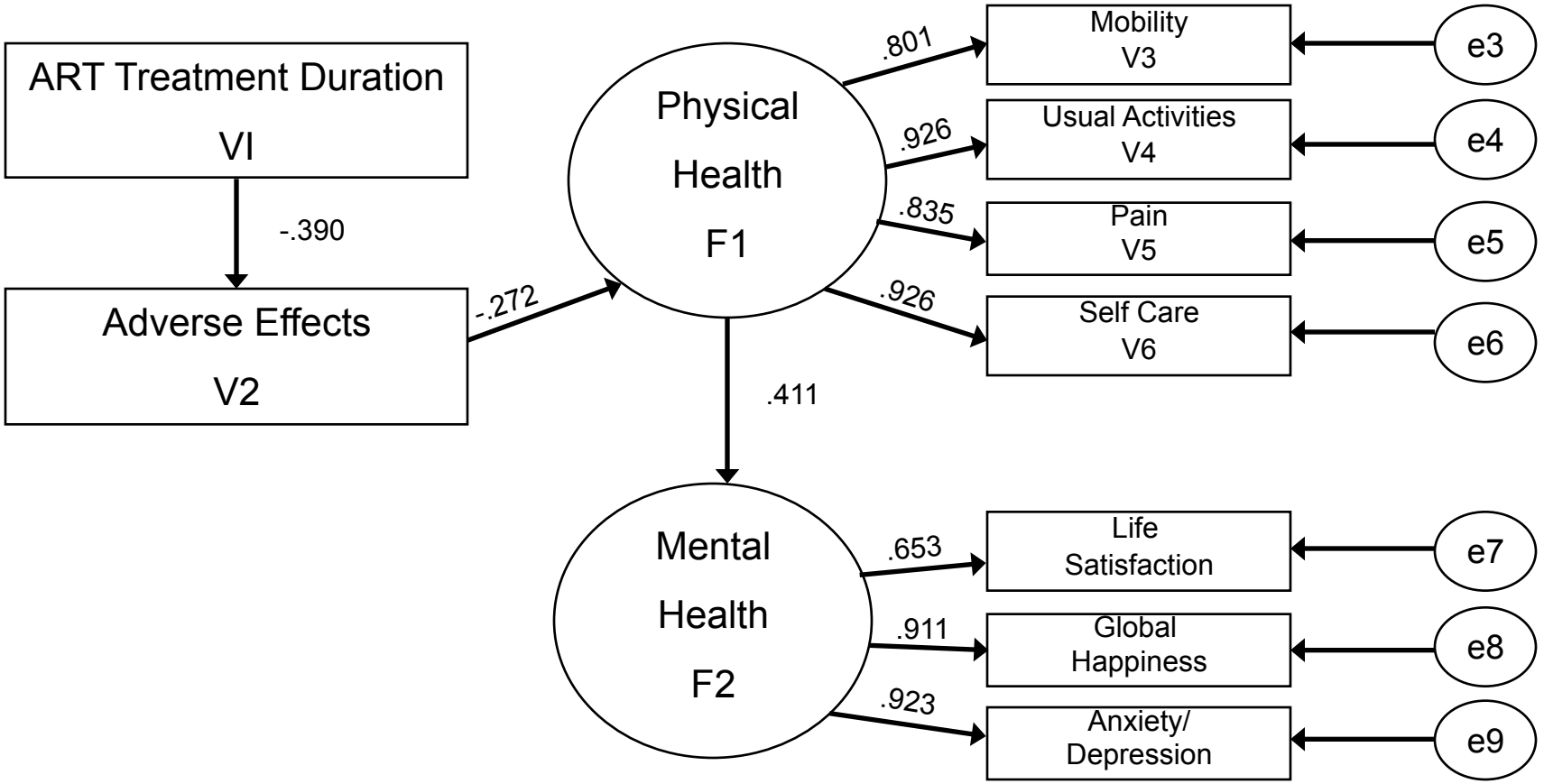
Wouters, E., Heunis, C. Von Rensberg, D., & Meulemens, H. BMC Public Health 2009,9:103.

Sample of 234 patients enrolled in public sector antiretroviral treatment program in the Free State Province of South Africa



X^2(n=234, dfs=26)=429.097

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Comprehensive Fit Index=	0.991
Root Mean Square of Approximation (RMSEA)=	0.050

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V6=1*F1 + E6;
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V8=1*F2 + E8;
V9=1*F2 + E9;
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F1=1*V2 + 1.000 D1;
F2=1*F1 + 1.000 D2;
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 0.071 -0.224  0.740  0.888  0.776  1.000
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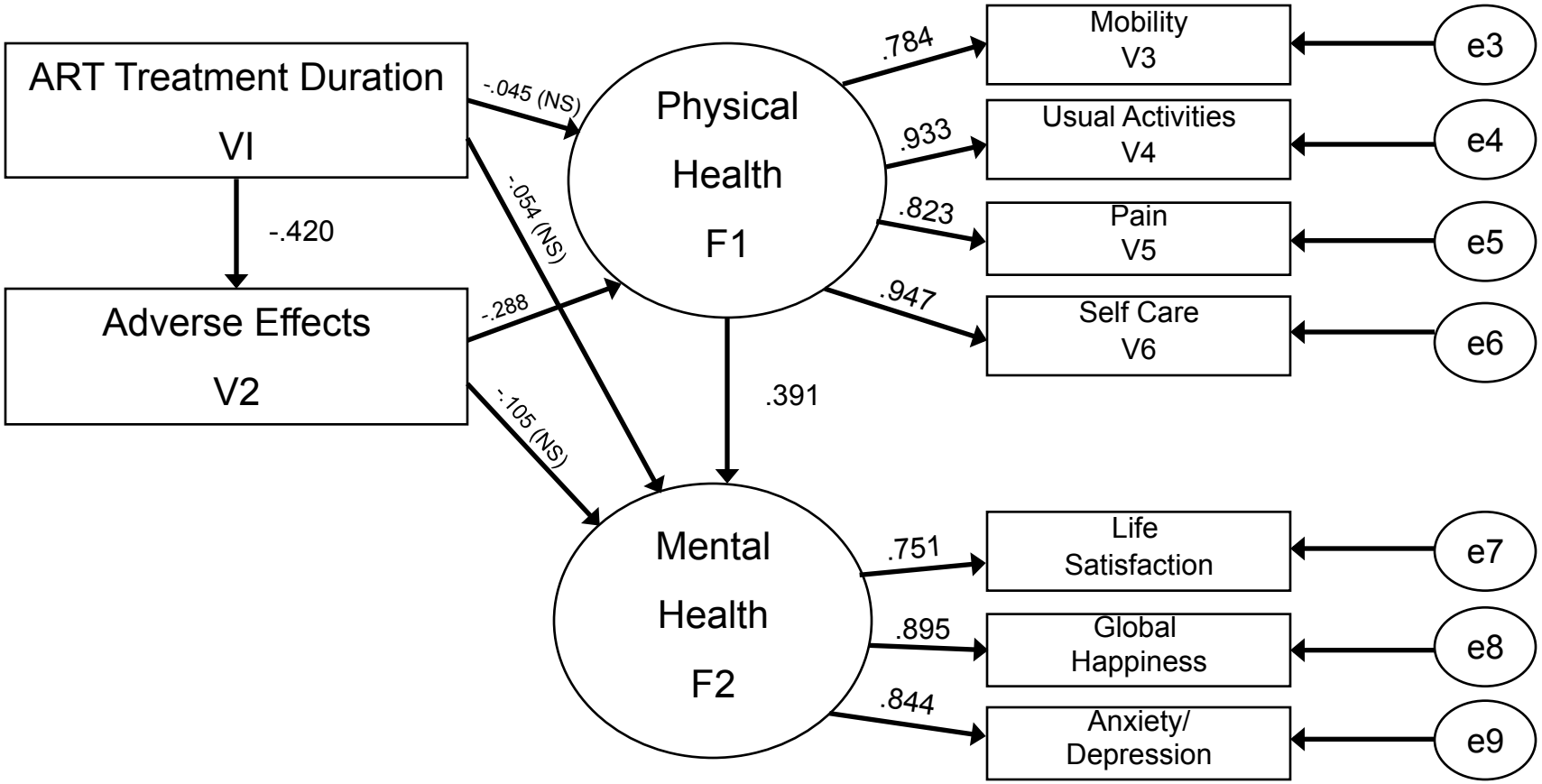
-0.074 -0.261  0.258  0.448  0.347  0.311  0.674  1.000
 0.079 -0.019  0.435  0.330  0.328  0.403  0.657  0.746  1.000
/END
```

Wouters, E., Heunis, C. Von Rensberg, D., & Meulemens, H. BMC Public Health 2009,9:103.

Sample of 234 patients enrolled in public sector antiretroviral treatment program in the Free State Province of South Africa



X^2(n=234, dfs=23)=437.545

Normed Fit Index=	0.740
Non-normal Fit Index=	0.606
Comprehensive Fit Index=	0.748
Root Mean Square of Approximation (RMSEA)=	0.278

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  Wouters et al #1ml November 12 2010
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V8=PLEASANT;V9=LACKAFF;F1=PHYQOL;F2=EMOQOL;
/PRINT
FIT=ALL;RETEST='WOUTERS.EQS';EFFECTS=YES;
/EQUATIONS
V3=1*F1 + E3;
V4=1*F1 + E4;
V5=1*F1 + E5;
V6=1*F1 + E6;
V7=1*F2 + E7;
V8=1*F2 + E8;
V9=1*F2 + E9;
V2=1*V1+E2;
F1=1*V1 + 1*V2 + 1.000 D1;
F2=1*V1 + 1*V2 + 1*F1 + 1.000 D2;
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 0.143 -0.143  0.068  0.131  0.198  0.163  1.000
-0.074 -0.261  0.258  0.448  0.347  0.311  0.674  1.000
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/END
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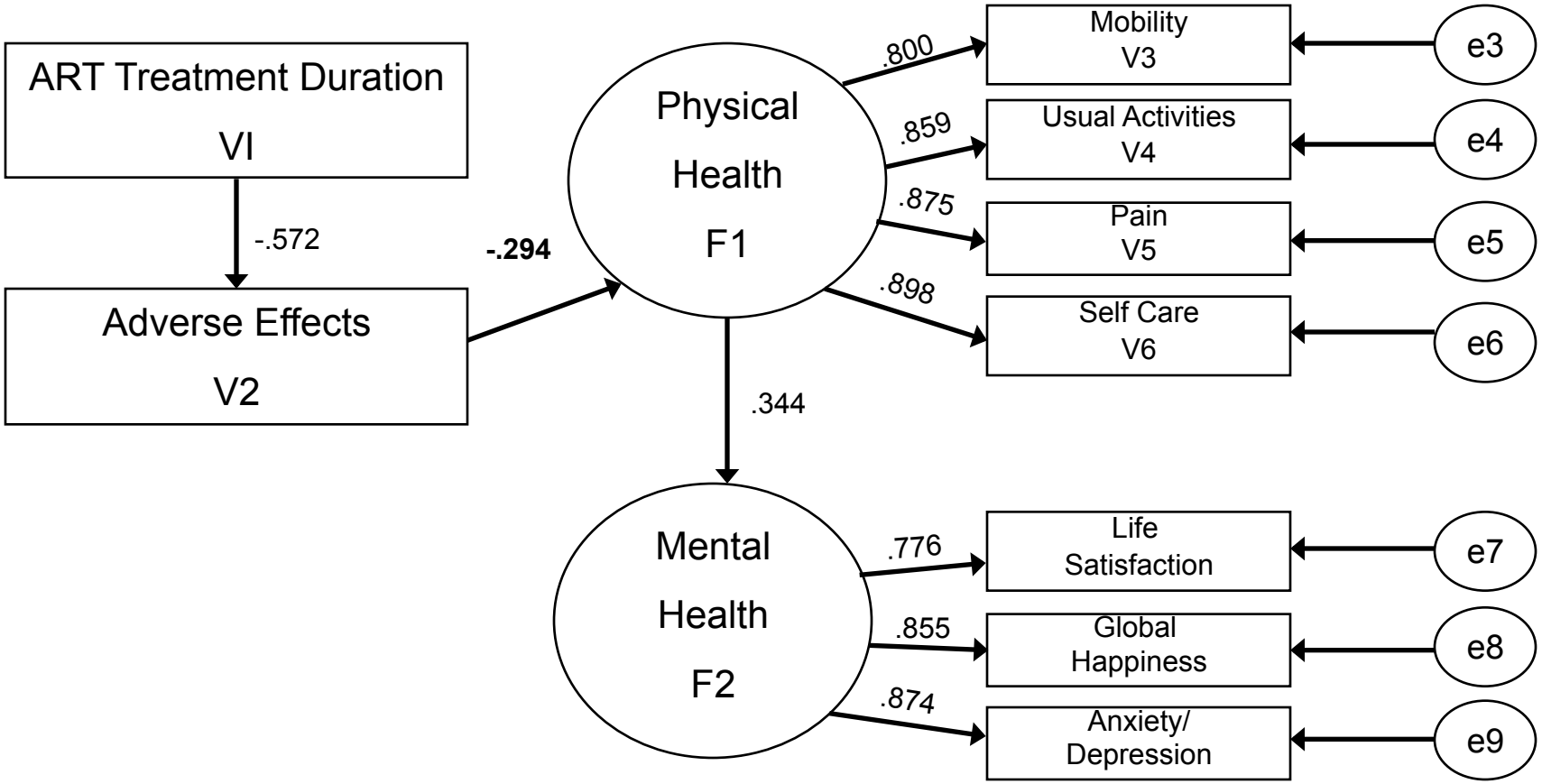
Sample of 234 patients enrolled in public sector antiretroviral treatment program in the Free State Province of South Africa



X^2(n=234, 21)=94.465

Happiness with adverse effects & usual act.

Self-care with usual activities

Dep/Anx with mobility & self-care

Normed Fit Index= 0.944

Non-normal Fit Index= 0.924

Comprehensive Fit Index= 0.955

Root Mean Square of Approximation (RMSEA)=0.123

```
/TITLE
  Wouters et al #2ml November 12 2010
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V8=PLEASANT;V9=LACKAFF;F1=PHYQOL;F2=EMOQOL;
/PRINT
FIT=ALL;RETEST='WOUTERS2.EQS';EFFECTS=YES;
/EQUATIONS
V3=1*F1 + E3;
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V7=1*F2 + E7;
V8=1*F2 + E8;
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F1=1*V2 + 1.000 D1;
F2=1*F1 + 1.000 D2;
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-0.074 -0.261  0.258  0.448  0.347  0.311  0.674  1.000
 0.079 -0.019  0.435  0.330  0.328  0.403  0.657  0.746  1.000
/END
```

Dr. Wouters:

Can you provide the LISREL output from the path model show in Figure 1? I am trying to figure out what estimation approach (e.g., ML) you used in fitting the model.
==========

Dear Dr. Hays

Thanks for showing interest in my work. I am also glad that someone is interested in the statistical side of the story :-)

I would not dare to call myself an SEM-specialist, but I really like the versatile nature of the technique. In the paper you cited I first used ML, but after the comments of a reviewer I re-ran the analysis using WLS because I have a rather small sample size. The results were similar. The results shown should be the ones from the WLS-analysis.

Unfortunately, I changed computers after finishing my PhD, so I do not have the Lisrel-files anymore (I also do not use Lisrel anymore. I now use MPlus (because it can also handle dependent dichotomous variables)), but I certainly still have the raw dataset. If needed, I can try to reconstruct and rerun the analysis in MPlus, or even in Lisrel (I surely still have a copy of it somewhere).

However, I am now preparing to go (and present) at the First Global Symposium on Health Systems Research in Montreux (15-19 Nov), so it may take a little while...

Again thanks for your interest in my paper,

Best regards,

Edwin

Summary

- The longer the duration of ART treatment the less the adverse effects and (in turn) the better the health (physical and mental).
  - Duration has positive indirect effects on physical and mental health by reducing adverse effects

Thank you!

http://assets.cambridge.org/97805217/81336/sample/9780521781336ws.pdf
http://www.cob.unt.edu/slides/Paswan/BUSI6280/Anderson_Gerbing_1988.pdf

Hays, R. D., Revicki, D., & Coyne, K. (2005). Application of structural equation modeling to health outcomes research. Evaluation and the Health Professions, 28, 295-309.