Dyadic Data Analysis

Mahdi Shamali

PhD Student

Department of Clinical Research, University of Southern Denmark

Agenda

- Introduction
- Dyadic data assumptions
- Dyadic study design
- APIM model
- Statistical techniques

Introduction

- Family nursing emphasize on considering patients and their partners or family members as *a unit of care.* In research, we should also consider patients and their partners / family members as *a unit of analysis*. However, this can be methodologically challenging.

- Dyads – two people who have an interactive relationship with each other (e.g., dating or married couples, nurse–patient, or parent–child relationships).

- Dyadic analysis is the most appropriate framework for studying dyads.
  - This approach accounts for the interdependence between dyad members and allows researchers to examine how the interdependence between individual members affects the outcomes at the **dyadic level**

Dyadic data assumptions; *Dependence*

- Dyadic data analysis assumes that two members of a dyad have something in common – they are not independent.

- The scores of two individuals are correlated in such a way that knowing one person's score provides information about the other person's score.

- That interdependence can be measured with the Pearson product-moment correlation within '*distinguishable dyads*' or with the intraclass correlation within '*indistinguishable dyads*'.

Dyadic data assumptions; Distinguishability

- Dyadic distinguishability concerns whether the two individuals in a dyad have a distinctive characteristic base on a research question that can differentiate them from each other.
  - **Distinguishable;** dyad can be differentiated from one another based on a meaningful distinctive variable (e.g., gender in heterosexual couples and illness in patient-caregiver dyads).
  - **Indistinguishable;** is two individuals who cannot be meaningfully differentiated by a distinctive variable – (e.g., same-gender romantic partners and identical twins).
- The decision regarding the issue of dyad distinguishability is both ***empirical*** and ***theoretical***. Distinguishability is an important element in statistical analysis.

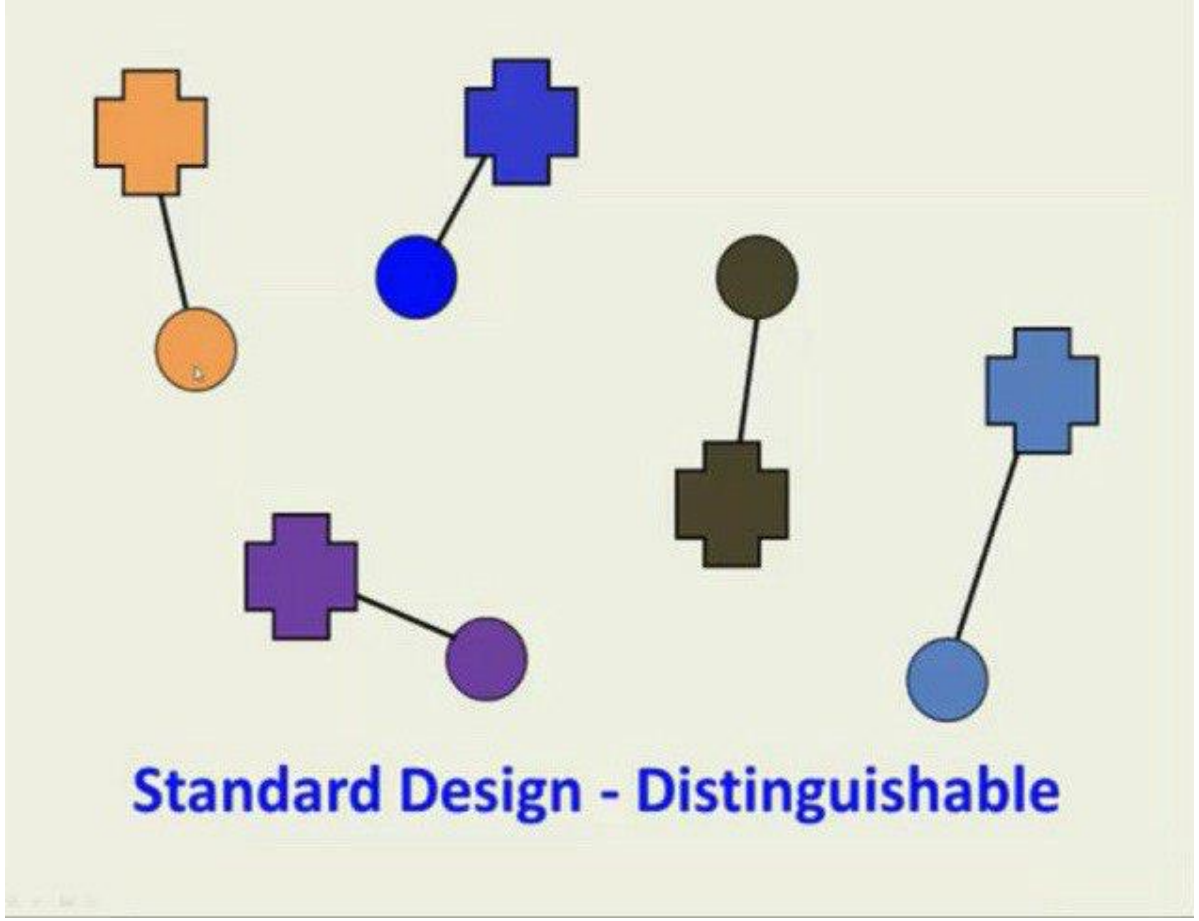
Dyadic study design

The three types of dyadic designs;

- **Standard dyadic design**
- **One-with-many design**
- **Social Relations Model (SRM) design**

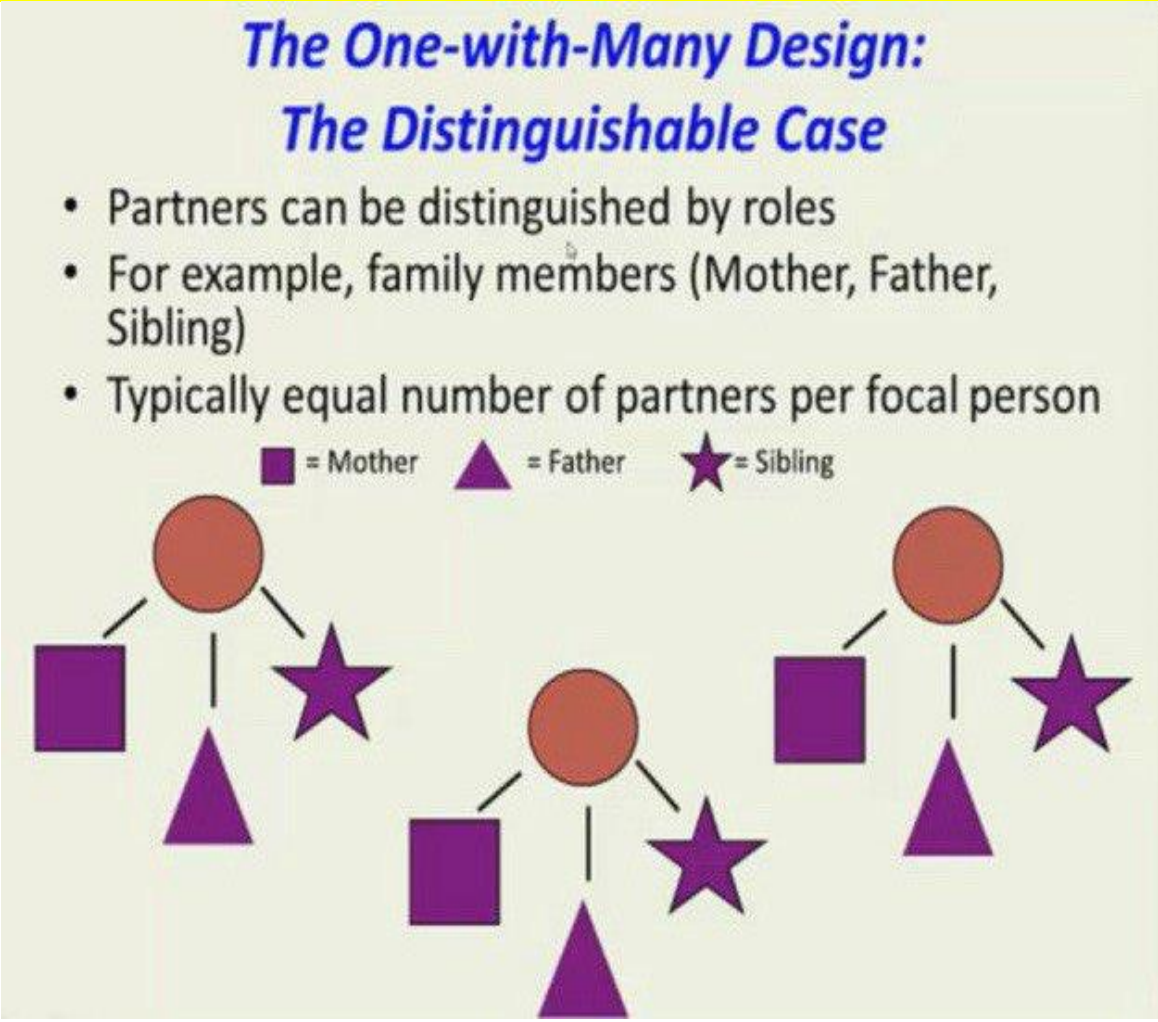
Standard dyadic design

In the standard dyadic design, each individual is a member of one and only one dyad. That is, each individual is paired with one other individual, and these two individuals are measured on the same set of variables.



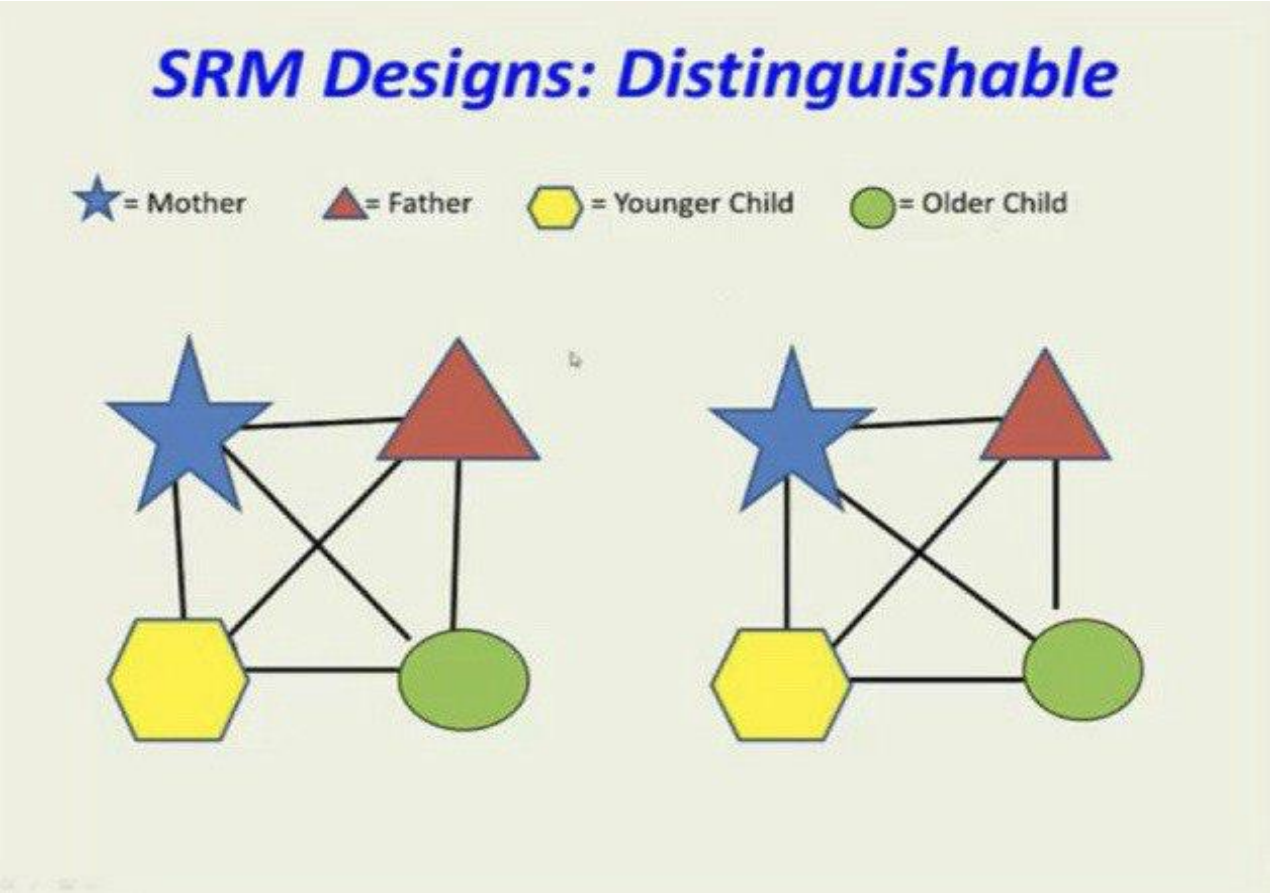
One-with-many design

In this design each person is paired with multiple others, but these others are not paired with any other persons.



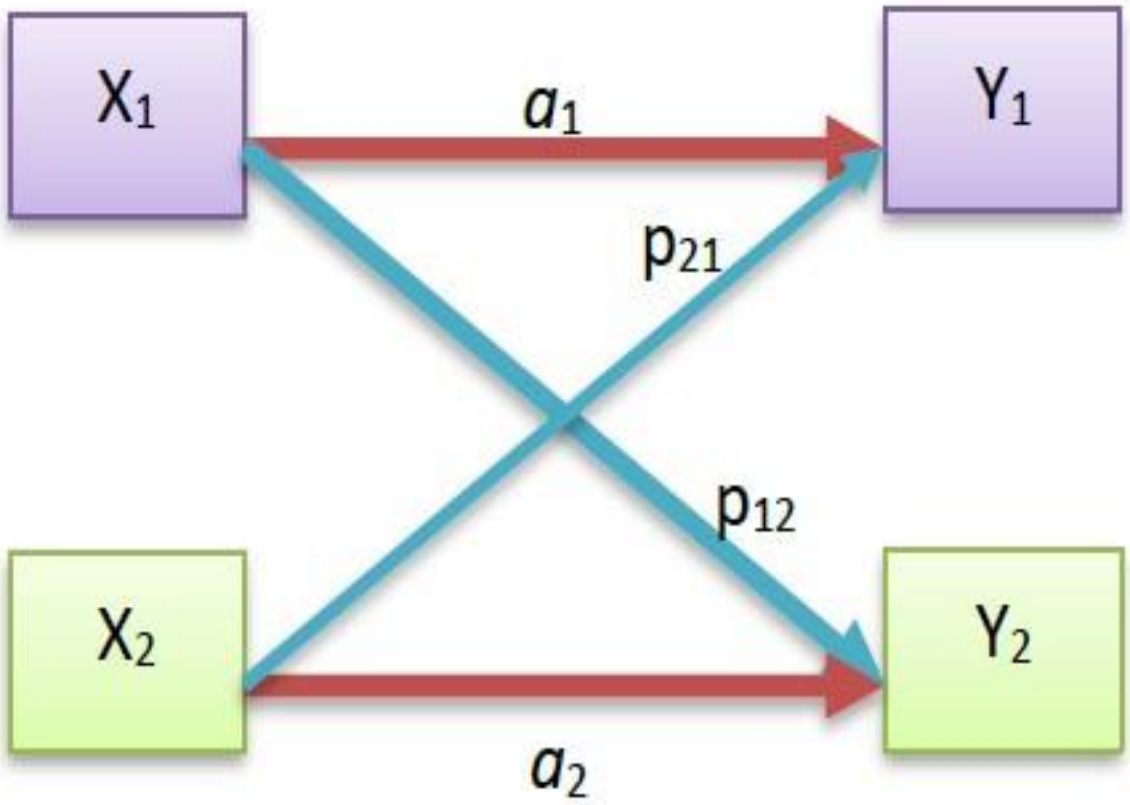
Social Relations Model (SRM) design

In an SRM design, each person is paired with multiple others, and each of these others is also paired with multiple others.

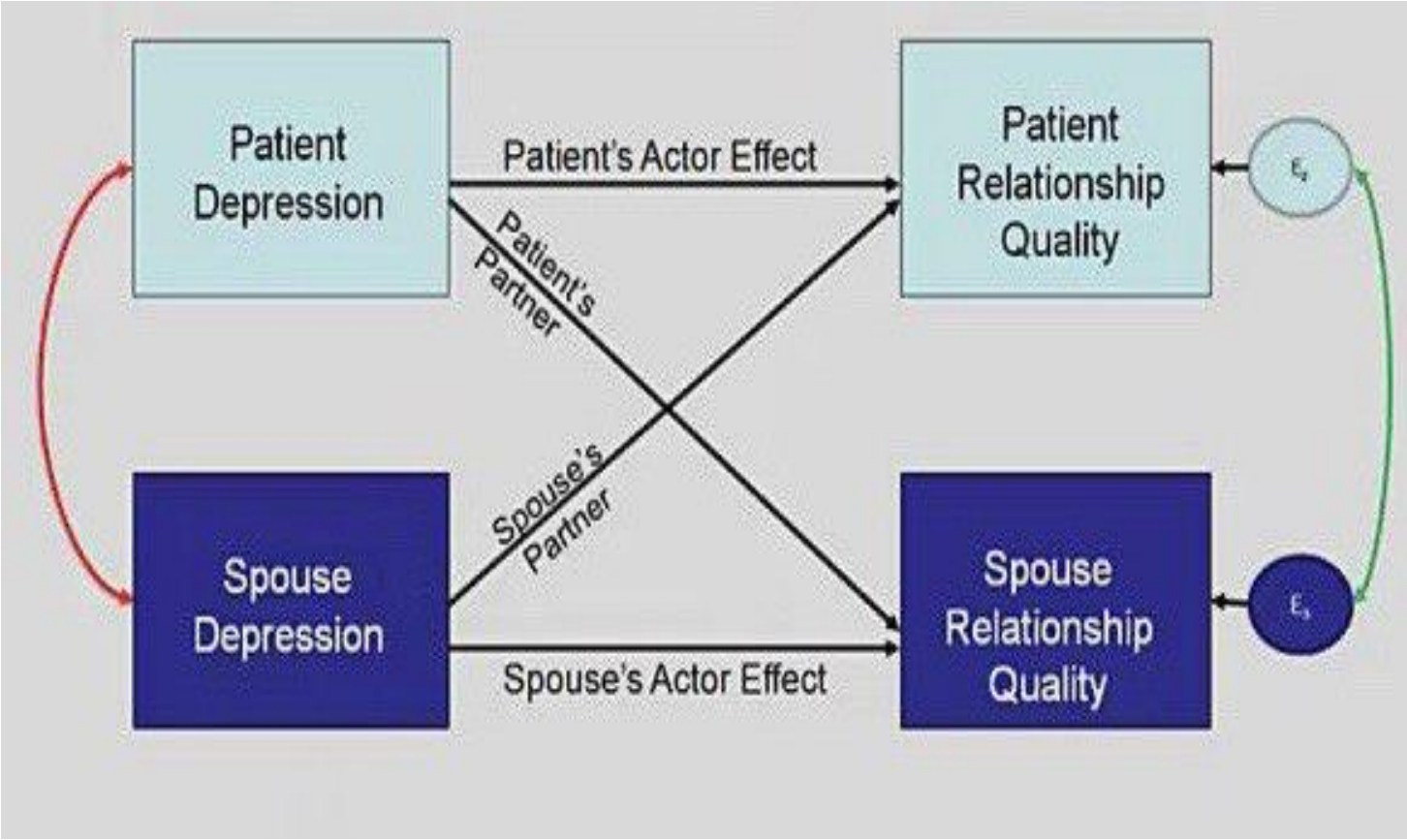


Actor–Partner Interdependence Model (APIM)

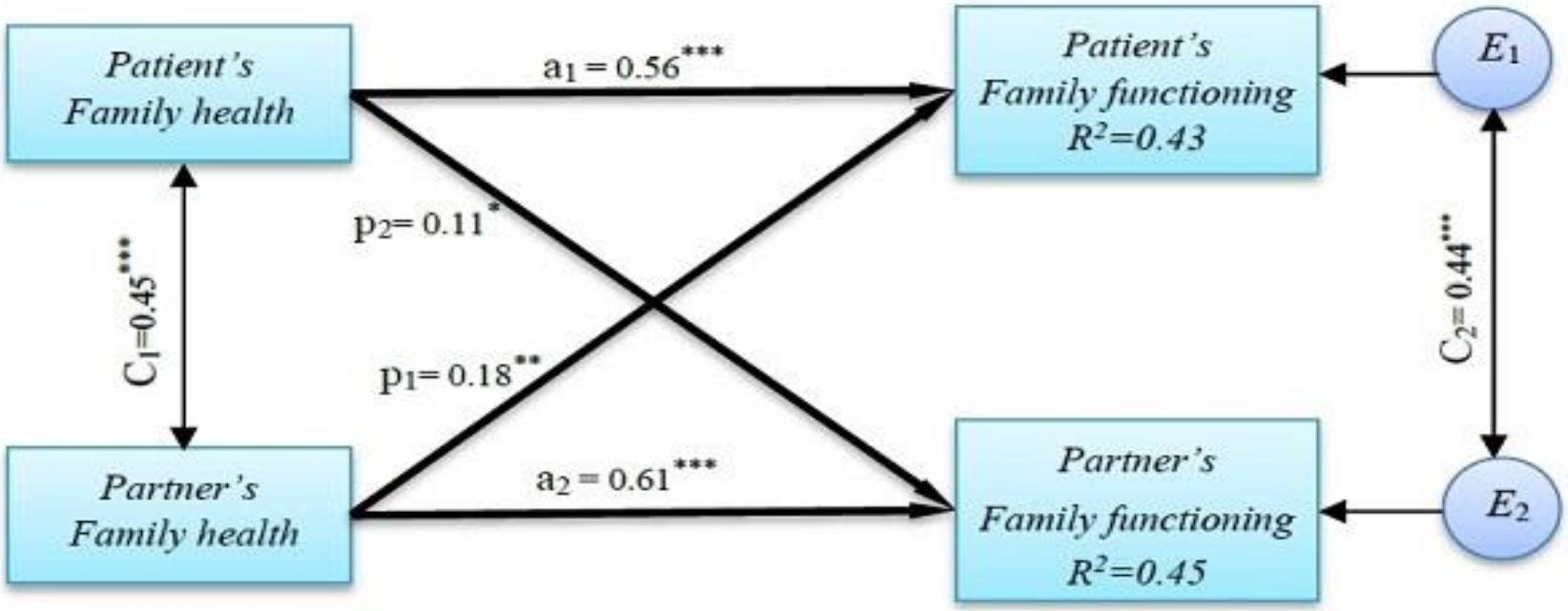
The APIM use standard design to measure the extent to which the *independent variable* of a person (e.g., patient's depression) influences his/her score as a *dependent variable* (e.g., patient's quality of life), denoted the *actor effect*, as well as on the dependent variable of his/her partner (e.g., partner's quality of life), denoted the partner effect.



APIM & Distinguishability



Effects of family health on family functioning in patients with heart failure and their partners



Note: a_1 = patient actor effect; a_2 = partner actor effect; p_1 = patient partner effect; p_2 = partner partner effect; C_1 = covariance between the two perdictor variables; C_2 = covariance between the two error terms; E_1 & E_2 = error terms; R^2, coefficient of determination; Estimates are standardized regression coefficients; * $p < .05$; ** $p < .01$; *** $p < .001$.

Statistical techniques

Standard statistical techniques such as *analysis of variance* or *linear regression* cannot be used to estimate actor and partner effects because they ignore *interdependence* between observations, resulting in biased tests of significance. Therefore, special analytic approaches are needed to properly measure interdependence.

- Structure the data set
- Select the statistical technique (Structural equation modelling (**SEM**) & multilevel modelling (**MLM**))
- Select the statistical software (AMOS, SPSS, SAS, MPLUS or an online app)

Structure the data set

Example of three types of data structures for a data set with two dyads, four persons, and one variable (age).

Individual Data Structure

Dyad	Person	Age
1	1	65
1	2	60
2	1	35
2	2	30

Dyad Data Structure

Dyad	Age_1	Age_2
1	65	60
2	35	30

Pairwise Data Structure

Dyad	Person	Age_1	Age_2
1	1	65	60
1	2	60	65
2	1	35	30
2	2	30	35

Age_1 = $person_1$ age

Age_2 = $person_2$ age

Useful app; APIM made easy

Online program that eases restructuring the different dyadic data structures from one format to another. Ledermann T, Kenny DA (2015) A toolbox with programs to restructure and describe dyadic data. Journal of Social and Personal Relationships. 32, 8, 997-1011. https://davidakenny.shinyapps.io/ItoD/

An online user-friendly application, called APIM_SEM, has been developed by Stas et al (2018) using SEM for both distinguishable and indistinguishable dyads. Stas L, Kenny DA, Mayer A, Loeys T (2018) Giving dyadic data analysis away: A user-friendly app for actor–partner interdependence models. Personal Relationships. 25, 1, 103-119. https://apimsem.ugent.be/shiny/apim_sem/

A reference guide for statistical techniques and software to assess the APIM with distinguishable and indistinguishable dyads

Table I. Statistical techniques and software to assess data

Statistical technique	Software	Types of dyad	Reference
SEM	AMOS	Both	Kenny and Ledermann (2010)
			Peugh et al (2013)
	MPLUS	Distinguishable	Fitzpatrick et al (2015)
		Both	Peugh et al (2013)
	EQS	Distinguishable	Cook and Kenny (2005)
	APIM_SEM	Both	Stas et al (2018)
	LISREL	Indistinguishable	Olsen and Kenny (2006)
MLM	SPSS	Both	Alferes and Kenny (2009)
		Distinguishable	Vellone et al (2014)
	SAS	Both	Campbell and Kashy (2002)
	APIM_MM	Both	Kenny (2015b)
GEE	SPSS and SAS	Distinguishable	Loeys et al (2014)

THE TAKE-HOME MESSAGE

Key features to consider when using the APIM

Check for non-independence
(by using the Pearson product–moment correlation or intraclass correlation)

↓

Check for distinguishability
(e. g., theoretically and/or empirically)

↓

Structure the data set
(e. g., individual, dyad and pairwise structures)

↓

Select statistical technique
(e. g., SEM, MLM or GEE)

↓

Select statistical software
(e. g., AMOS, SPSS, SAS, MPLUS or online app)

You might also like to read more:

https://doi.org/10.7748/nr.2019.e1651

evidence & practice / statistical techniques | PEER-REVIEWED |

Implementing the actor-partner interdependence model for dyadic data analysis: an overview for the nurse researcher

Mahdi Shamali, Birte Østergaard

Citation
Shamali M, Østergaard B (2019) Implementing the actor-partner interdependence model for dyadic data analysis: an overview for the nurse researcher. Nurse Researcher. doi: 10.7748/nr.2019.e1651

Peer review
This article has been subject to external double-blind peer review and has been checked for plagiarism using automated software

Correspondence
gezaltoshmal@yahoo.com

Conflict of interest
None declared

Abstract

Background The actor-partner interdependence model (APIM) is widely used to study people with close relationships, such as patients and their partners. However, the complexity of the model has made it difficult to implement in nursing research.

Aim To provide a simplified description of the model, highlight the key assumptions of dyadic data and examine the related challenges in using statistical techniques.

Discussion Researchers must address certain assumptions when analysing dyadic data. They should select statistical techniques based on these assumptions and the research questions.

Conclusion The AIPM is the most appropriate approach for studying dyads. This article may help to create a more consistent framework for nurse researchers who incorporate the APIM into their studies.

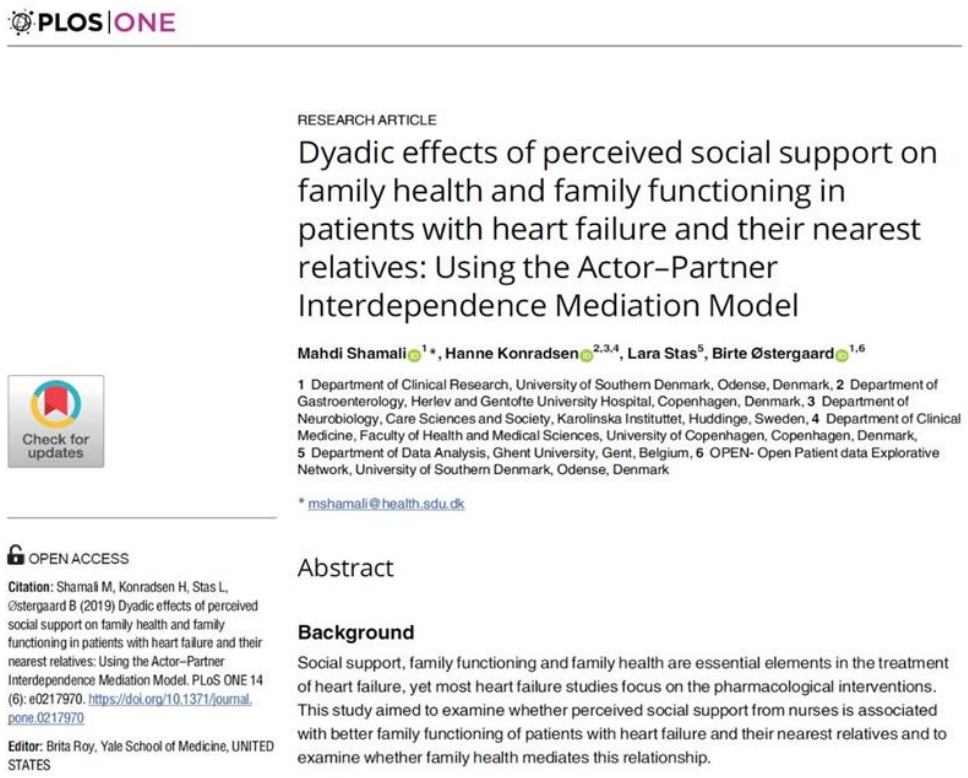
Implications for practice This article will help in implementing APIM in dyad-focused nursing studies by addressing key assumptions of the model and using appropriate statistical techniques.

Author details

Mahdi Shamali, PhD fellow researcher, Department of Clinical Research, University of Southern Denmark, Odense, Denmark; Birte Østergaard, associate professor, University of Southern Denmark, Odense, Denmark

Actor–Partner Interdependence Mediation Model (APIMeM)

https://doi.org/10.1371/journal.pone.0217970



PLOS ONE

RESEARCH ARTICLE

Dyadic effects of perceived social support on family health and family functioning in patients with heart failure and their nearest relatives: Using the Actor–Partner Interdependence Mediation Model

Mahdi Shamali[1]*, Hanne Konradsen[2,3,4], Lara Stas[5], Birte Østergaard[1,6]

1 Department of Clinical Research, University of Southern Denmark, Odense, Denmark, 2 Department of Gastroenterology, Herlev and Gentofte University Hospital, Copenhagen, Denmark, 3 Department of Neurobiology, Care Sciences and Society, Karolinska Instituttet, Huddinge, Sweden, 4 Department of Clinical Medicine, Faculty of Health and Medical Sciences, University of Copenhagen, Copenhagen, Denmark, 5 Department of Data Analysis, Ghent University, Gent, Belgium, 6 OPEN- Open Patient data Explorative Network, University of Southern Denmark, Odense, Denmark

* mshamali@health.sdu.dk

Check for updates

OPEN ACCESS

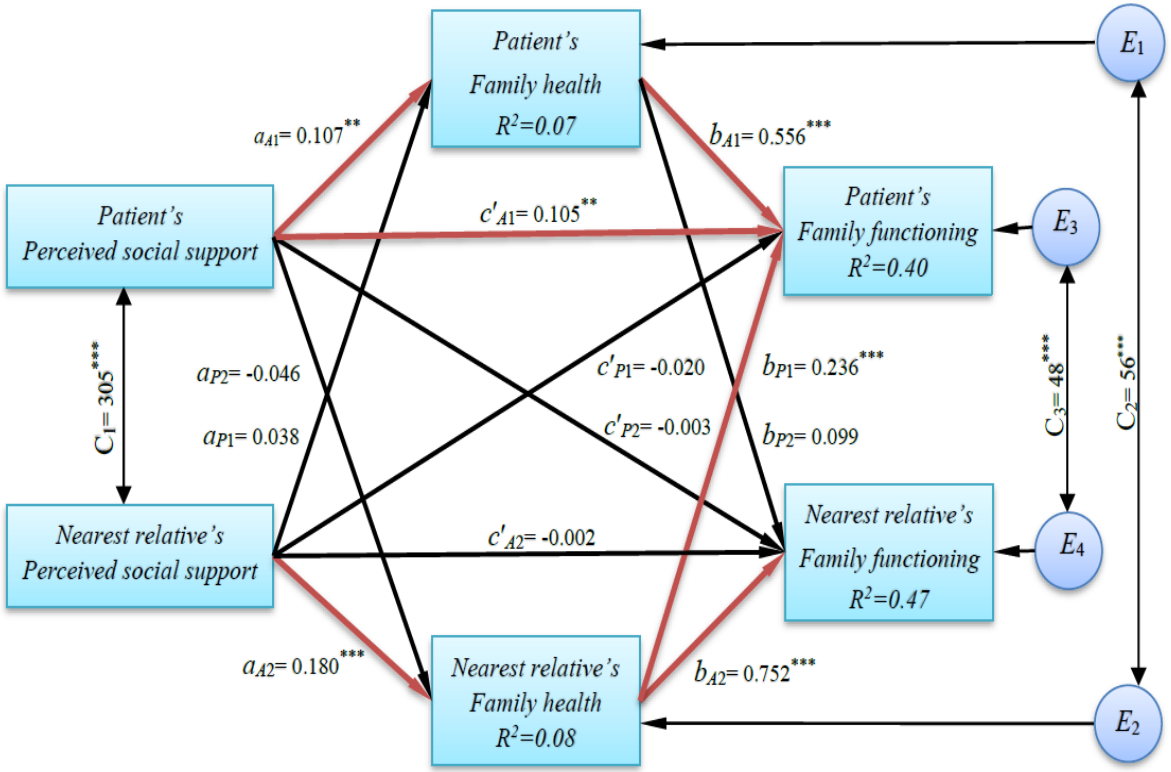
Citation: Shamali M, Konradsen H, Stas L, Østergaard B (2019) Dyadic effects of perceived social support on family health and family functioning in patients with heart failure and their nearest relatives: Using the Actor–Partner Interdependence Mediation Model. PLoS ONE 14 (6): e0217970. https://doi.org/10.1371/journal.pone.0217970

Editor: Brita Roy, Yale School of Medicine, UNITED STATES

Abstract

Background

Social support, family functioning and family health are essential elements in the treatment of heart failure, yet most heart failure studies focus on the pharmacological interventions. This study aimed to examine whether perceived social support from nurses is associated with better family functioning of patients with heart failure and their nearest relatives and to examine whether family health mediates this relationship.



References

Al-Rawashdeh S, Lennie T, Chung M (2017) The association of sleep disturbances with quality of life in heart failure patient-caregiver dyads. Western Journal of Nursing Research. 39, 4, 492-506.

Alferes V, Kenny D (2009) SPSS programs for the measurement of nonindependence in standard dyadic designs. Behavior Research Methods. 41, 1, 47-54.

Campbell L, Kashy D (2002) Estimating actor, partner, and interaction effects for dyadic data using PROC MIXED and HLM: a user-friendly guide. Personal Relationships. 9, 3, 327-342.

Campbell L, Stanton S (2014) Actor-partner interdependence model. The Encyclopedia of Clinical Psychology. doi: 10.1002/9781118625392.wbecp467

Chung M, Moser D, Lennie T et al (2009) The effects of depressive symptoms and anxiety on quality of life in patients with heart failure and their spouses: testing dyadic dynamics using actor-partner interdependence model. Journal of Psychosomatic Research. 67, 1, 29-35.

Cook W, Kenny D (2005) The actor-partner interdependence model: a model of bidirectional effects in developmental studies. International Journal of Behavioral Development. 29, 2, 101-109.

Curtis E, Comiskey C, Dempsey O (2016) Importance and use of correlational research. Nurse Researcher. 23, 6, 20-25.

Dalteg T, Benzein E, Sandgren A et al (2016) Associations of emotional distress and perceived health in persons with atrial fibrillation and their partners using the actor-partner interdependence model. Journal of Family Nursing. 22, 3, 368-391.

Fitzpatrick J, Gareau A, Lafontaine M-F et al (2015) How to use the actor-partner interdependence model (APIM) to estimate different dyadic patterns in MPLUS: a step-by-step tutorial. The Quantitative Methods for Psychology. 12, 1, 74-86.

Gistelinck F, Loeys T, Decuyper M et al (2018) Indistinguishability tests in the actor-partner interdependence model. British Journal of Mathematical and Statistical Psychology. 71, 3, 472-498

Kenny D (2015a) Tests of Distinguishability and Nonindependence: Estimated by Structural Equation Modeling. https://davidakenny.shinyapps.io/Dingy/ (Last accessed: 16 July 2019.)

Kenny D (2015b) Actor-Partner Interdependence Model: Estimated Using Multilevel Modeling. davidakenny.shinyapps.io/APIM_MM (Last accessed: 12 September 2019.)

Kenny D (2018a) Between-Dyads Outcome Variable with Indistinguishable Dyads. davidakenny. shinyapps.io/BetweenO (Last accessed: 12 September 2019.)

Kenny D (2018b) Reflections on the actor-partner interdependence model. Personal Relationships. 25, 2, 160-170.

Kenny D, Kashy D, Cook W (2006) Dyadic Data Analysis. Guilford Press, New York NY.

Kenny D, Ledermann T (2010) Detecting, measuring, and testing dyadic patterns in the actor-partner interdependence model. Journal of Family Psychology. 24, 3, 359-366.

Ledermann T, Kenny D (2015) A toolbox with programs to restructure and describe dyadic data. Journal of Social and Personal Relationships. 32, 8, 997-1011.

Ledermann T, Kenny D (2017) Analyzing dyadic data with multilevel modeling versus structural equation modeling: a tale of two methods. Journal of Family Psychology. 31, 4, 442-452.

Loeys T, Cook W, De Smet O et al (2014) The actor-partner interdependence model for categorical dyadic data: a user-friendly guide to GEE. Personal Relationships. 21, 2, 225-241.

Olsen J, Kenny D (2006) Structural equation modeling with interchangeable dyads. Psychological Methods. 11, 2, 127-141.

Peugh J, DiLillo D, Panuzio J (2013) Analyzing mixed-dyadic data using structural equation models. Structural Equation Modeling. 20, 2, 314-337.

Priem J (2015) Actor-Partner Interdependence Model. The International Encyclopedia of Interpersonal Communication. 11, 1-6.

Rayens M, Svavarsdottir E (2003) A new methodological approach in nursing research: an actor, partner, and interaction effect model for family outcomes. Research in Nursing and Health. 26, 5, 409-419.

Stas L, Kenny D, Mayer A et al (2018) Giving dyadic data analysis away: a user-friendly app for actor-partner interdependence models. Personal Relationships. 25, 1, 103-119.

Vellone E, Chung M, Cocchieri A et al (2014) Effects of self-care on quality of life in adults with heart failure and their spousal caregivers: testing dyadic dynamics using the actor-partner interdependence model. Journal of Family Nursing. 20, 1, 120-141.