Dyadic Data Analysis

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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
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.
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 predictor 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).

<table>
<thead>
<tr>
<th>Individual Data Structure</th>
</tr>
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<tbody>
<tr>
<td>Dyad</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
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</table>

<table>
<thead>
<tr>
<th>Dyad</th>
<th>Age₁</th>
<th>Age₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>65</td>
<td>60</td>
</tr>
<tr>
<td>2</td>
<td>35</td>
<td>30</td>
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<table>
<thead>
<tr>
<th>Pairwise Data Structure</th>
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<tbody>
<tr>
<td>Dyad</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>2</td>
</tr>
</tbody>
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Age₁ = person₁ age  
Age₂ = person₂ age
Useful app; APIM made easy


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

<table>
<thead>
<tr>
<th>Statistical technique</th>
<th>Software</th>
<th>Types of dyad</th>
<th>Reference</th>
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</thead>
<tbody>
<tr>
<td>SEM</td>
<td>AMOS</td>
<td>Both</td>
<td>Kenny and Ledermann (2010)</td>
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<tr>
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<td>Peugh et al (2013)</td>
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<tr>
<td></td>
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<td>Peugh et al (2013)</td>
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<tr>
<td></td>
<td>EQS</td>
<td>Distinguishable</td>
<td>Cook and Kenny (2005)</td>
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<td>APIM_SEM</td>
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<td>Stas et al (2018)</td>
</tr>
<tr>
<td>MLM</td>
<td>SPSS</td>
<td>Both</td>
<td>Alferes and Kenny (2009)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Distinguishable</td>
<td>Vellone et al (2014)</td>
</tr>
<tr>
<td></td>
<td>SAS</td>
<td>Both</td>
<td>Campbell and Kashy (2002)</td>
</tr>
<tr>
<td></td>
<td>APIM_MM</td>
<td>Both</td>
<td>Kenny (2015b)</td>
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<tr>
<td></td>
<td>GEE</td>
<td>SPSS and SAS</td>
<td>Loeys et al (2014)</td>
</tr>
</tbody>
</table>
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)
Implementing the actor-partner interdependence model for dyadic data analysis: an overview for the nurse researcher

Mohdi Shamali, Birte Østergaard

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 APIM 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

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Actor–Partner Interdependence Mediation Model (APIMeM)

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

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


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


