Using administrative data to examine a population-based parenting intervention

Rubab Arim, PhD

Social Analysis and Modelling Division

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  - Dr. Susan Dahinten (Co-PI), University of British Columbia
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Today's Objective

To provide an example of evaluation research with a particular focus on:

1. The study design and the analytical technique (**conceptual understanding**)

2. The use of aggregated, population-based, linked administrative data (**opportunities and challenges**)

3. Considerations for potential future work in evaluation studies

Background (1)

- Child mental health is a national concern with estimates that one in five Canadian children and youth will experience mental illness (Canadian Paediatric Society, 2023).

  – A population approach to mental health prevention emphasizes the importance of mental health for the entire population and identifies the need for strategies that can be applied across diverse groups in the population.

- Extensive research has shown that poorer parenting is associated with a wide array of child and youth developmental mental health problems.

- While there are many parenting interventions that target at-risk families and specific child problems (e.g., conduct disorders), fewer are universal and prevention oriented.

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Background (2)

- One example of a universal (community-based) multilevel prevention-oriented program is the **Triple P - Positive Parenting Program** (Sanders, 1999) that was developed in Australia for parents of children from birth to age 16.

- In Canada, one of the first regions to implement the Triple P at a community level was Vancouver Island, BC.

- The program was offered by Island Health (Vancouver Island Health Authority) and the Ministry of Child and Family Development beginning in 2004, with the program being phased in across various communities until all communities on Vancouver Island were reached by the end of 2008.
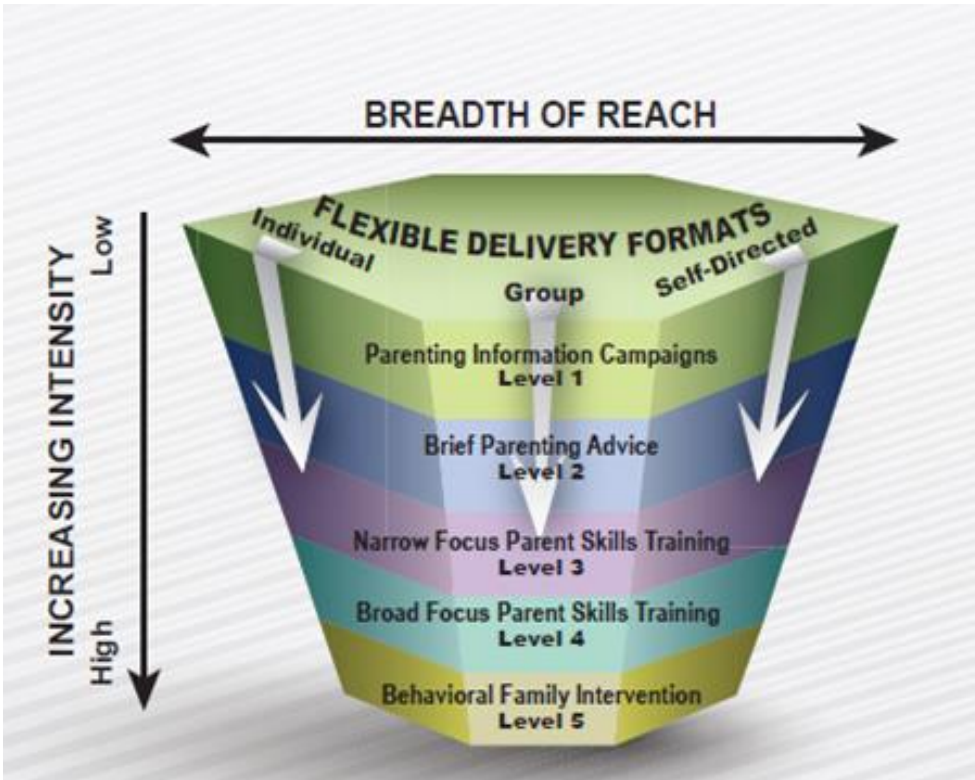
Triple P – Positive Parenting Program

Figure 1. The Triple P Model
Source: Sanders et al. (2003)

- Evidence-based, prevention oriented, multilevel parenting and family support program

- Designed to enhance the knowledge, skills, and confidence of parents and prevent negative parenting practices, thereby reducing rates of maltreatment and children in foster care placement, and reducing behavioural, emotional, and developmental problems in children

- A system of supports on a continuum of increasing intensity with five levels of intervention

- From **Level 1 – Universal** to **Level 5 – Enhanced**

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Purpose of the Study

- This study is among the first Canadian population-based evaluations designed to examine associations of the Triple P with mothers' and children's mental health outcomes at the community level using population-based administrative data.

Evaluation Objectives:

1. To determine whether implementation of the multilevel and population-based Triple P is associated with <u>population-level benefits</u> to children and mothers;

2. To identify program features and community characteristics that are associated with benefits of a universal parenting program for children and mothers.

(Arim et al., 2017)

Research Questions

1. What is the association between Triple P and selected mental health outcomes for mothers **when comparing target communities with comparison communities**?

2. What is the association between Triple P and selected mental health outcomes for children aged 6 to 12, **when comparing target communities with comparison communities**?

3. Is program intensity associated with health outcomes for mothers and children?

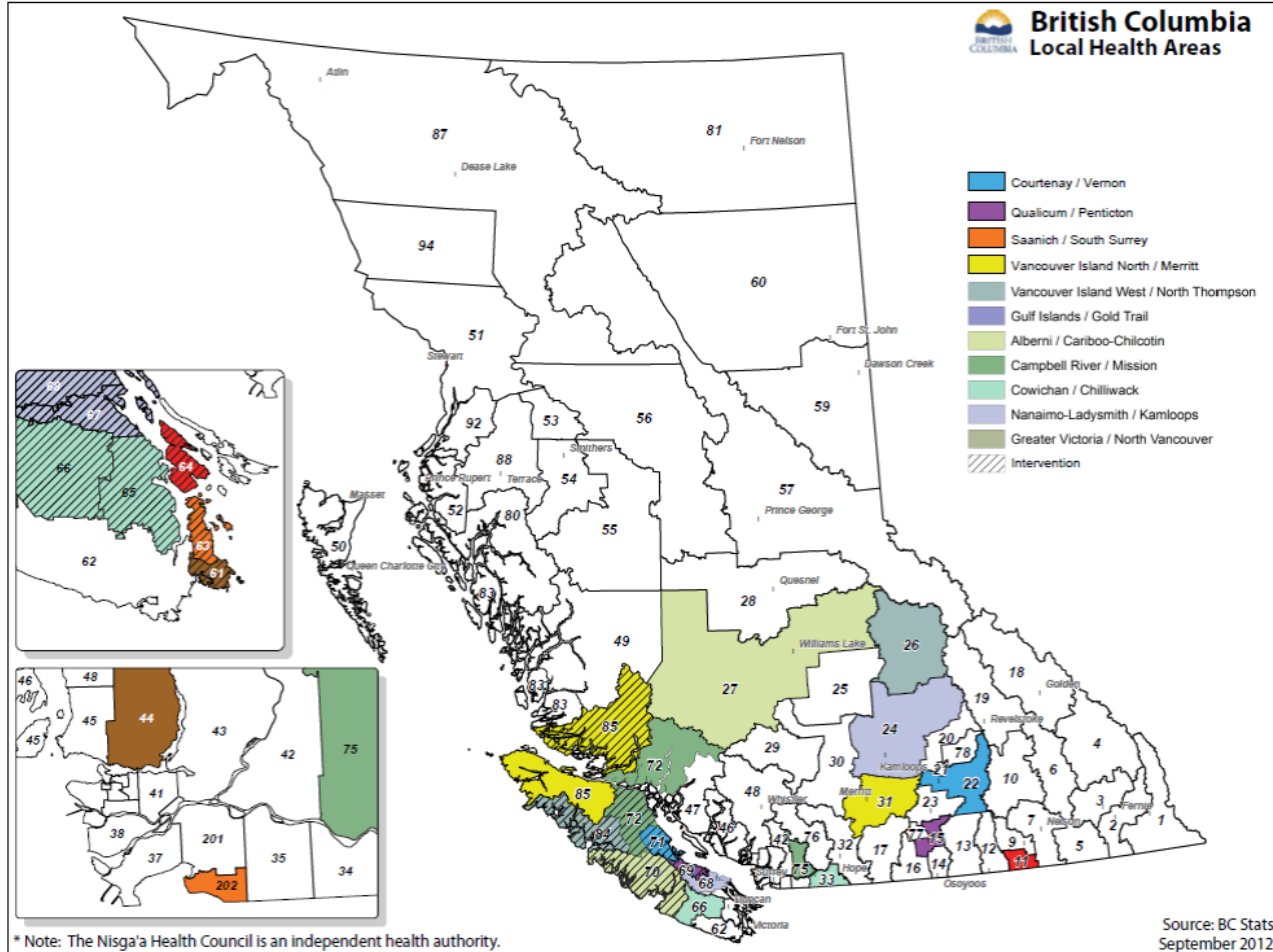(Arim et al., 2017)

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Study Design (1)

British Columbia Local Health Areas

Legend:
- Courtenay / Vernon
- Qualicum / Penticton
- Saanich / South Surrey
- Vancouver Island North / Merritt
- Vancouver Island West / North Thompson
- Gulf Islands / Gold Trail
- Alberni / Cariboo-Chilcotin
- Campbell River / Mission
- Cowichan / Chilliwack
- Nanaimo-Ladysmith / Kamloops
- Greater Victoria / North Vancouver
- Intervention

Source: BC Stats September 2012

* Note: The Nisga'a Health Council is an independent health authority.

- Target and comparison communities were matched on community characteristics (Census 2006):

✓ Population size

✓ Proportion of Census families with children aged less than 15

✓ Proportion of individuals with an Indigenous identity

✓ Unemployment rate , population aged 15+

✓ Proportion of individuals aged 25-54 without high school

✓ Proportion of individuals with a mother tongue other than English or French

✓ Proportion of individuals who have not moved during 5-year period

(Arim et al., 2017)

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Study Design (2)

- **Design:** A non-randomized quasi-experimental design with 11 target and 11 comparison groups

- **Data sources:** BC Ministry of Health billing claims & hospital separations data, Census 2006 data, Triple P administration data.

- **Population under study:** Mothers aged 15 to 65 in 2010 and children aged 6 to 12 in 2010, who were registered with Medical Services Plan (MSP) in both 2002 and 2010. These data points represent a minimum of 2-years pre- and post-implementation of Triple P.

(Arim et al., 2017)

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Study Design (3)

- **<u>Health outcome measures:</u>**
  - Mothers' diagnosed mental health conditions and use of counselling services
  - Children's diagnosed mental health conditions, conduct disorders, and use of counselling services.

- **<u>Covariates:</u>** Individual and community characteristics, including aggregated mental health measures from 2002, program density (i.e., number of practitioners accredited multiplied by years of training, per 10,000 population).

- **<u>Data access:</u>** The encrypted data files were made accessible to the research team in an online secure research environment through Population Data BC; information on community characteristics was from publicly available 2006 Census of Population data; and program intensity information came from Island Health.

(Arim et al., 2017)

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Data Analysis (1)

- The focus of the data analysis was to examine between-community differences for mother and child mental health and service use outcomes that may be associated with the intensity of the implementation of Triple P, adjusted for individual characteristics, community characteristics, including community-level baseline (i.e., pre-program implementation) health conditions, and program delivery.

- **Analysis:** Logistic hierarchical linear modelling (HLM), children/mothers nested in communities to evaluate program effects and examine differences for target communities compared with the comparison communities.

(Arim et al., 2017)

Data Analysis (2)

Generic Random Intercept Model

Level 1: Individuals (i) within each community (j)

$Y_{ij} = \beta_{0j} + r_{ij}$

Level 2: Between communities

$\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{target}) + \gamma_{02}(\text{intensity}) + \gamma_{03}(\text{community characteristics}) + \gamma_{04}(\text{baseline scores}) + u_{0j}$

Y_{ij} = outcome for each individual (probability of binary outcome) within each Level 2 community

β_{0j} = (intercept) mean score or probability for each community

γ_{00} = grand mean across all communities

γ_{01} = slope: average 'treatment effect' or difference between communities that receive/do not receive the Triple P

γ_{02} = average effect or difference due to varying intensity of the program

γ_{03} = average effect difference due to various community characteristics

γ_{04} = controls for baseline (pre-intervention prevalence) scores of the outcome

u_{0j} = residual variation in each community

Hierarchical Linear Modelling (HLM)

- Hierarchical linear models also generically named as **multilevel models** have been developed to properly account for the hierarchical (correlated) nesting of data (Raudenbush & Bryk, 2002) and are frequently used in social and health sciences where data are typically hierarchical in nature.

- Conducting research at any of these levels while ignoring other levels can result in erroneous conclusions. More specifically, ignoring a level of nesting in data can impact estimated variances and the available power to detect treatment or covariate effects (Moerbeek, 2010).

- The multilevel models could differ in terms of

  – the number of levels [e.g., 2-level (students nested within schools), 3-level (students nested within schools nested within school districts)],

  – type of design (e.g., cross-sectional, longitudinal with repeated measures),

  – scale of the outcome variable (e.g., continuous, categorical), and

  – number of outcomes (e.g., univariate, multivariate).

A general step-by-step guide to conduct HLM

- Clarify your analytical or research question

- Determine the structure of your nested or hierarchical data

- Data preparation

Community	Individual Outcome	Individual Characteristic	Community Characteristic	Target Community
1	1	1	0.40	0
1	0	0	0.40	0
2	1	1	0.60	1

- Model identification, building, and testing process **- Is HLM Needed?**

- Output interpretation, including model fit statistics

(Peugh, 2010)

Data Analysis (2)

- Two-level HLM with individuals (mothers or children) nested in communities (local health areas)

- Outcomes were examined in 2010 (cross-sectional)

- Outcomes were binary (e.g., presence of diagnoses, use of services)

- Separate analyses were conducted for each of the outcomes for mothers or children (univariate)

Table 1. Summary of results from multilevel analyses for mothers' mental health outcomes in 2010

| | Mothers' mental health outcomes | | | |
| | Mental health diagnoses | | Use of counselling services | |
	Model 1	Model 2	Model 1	Model 2
Fixed Effects				
Individual Level Variables				
Age	0.99 (0.99-0.99)***	0.99 (0.99-0.99)***	0.99 (0.99-0.99)***	0.99 (0.99-0.99)***
Community Level Variables				
Prevalence in 2002	1.09 (1.06-1.12)***	1.08 (1.04-1.11)***	1.06 (1.01-1.10)*	1.05 (1.01-1.10)*
Population size	1.01 (1.00-1.02)*	1.01 (1.00-1.01)	1.00 (0.99-1.02)	1.00 (0.99-1.01)
Families with children aged < 15 years	1.00 (0.98-1.02)	1.00 (0.98-1.02)	1.01 (0.98-1.03)	1.01 (0.98-1.04)
Individuals with an Indigenous identity	0.97 (0.95-0.99)**	0.98 (0.95-1.00)*	0.98 (0.95-1.01)	0.99 (0.96-1.02)
Unemployment rate	1.09 (1.03-1.15)**	1.09 (1.03-1.15)**	1.06 (0.96-1.17)	1.06 (0.96-1.16)
Individuals without high school	1.01 (0.98-1.04)	1.01 (0.98-1.04)	1.00 (0.95-1.05)	0.99 (0.95-1.04)
Mother tongue other than English or French	1.01 (0.99-1.02)	1.01 (0.99-1.02)	0.98 (0.95-1.01)	0.98 (0.95-1.01)
Not moved during 5-year period	1.02 (1.00-1.04)*	1.02 (1.00-1.04)	1.03 (1.01-1.06)**	1.03 (1.01-1.06)*
Target community	0.88 (0.78-1.01)	1.04 (0.87-1.24)	0.88 (0.70-1.12)	1.01 (0.74-1.37)
Program intensity		0.95 (0.91-0.99)*		0.96 (0.90-1.02)
Random Effects				
Intercept	0.01***	0.01***	0.03***	0.03***
Model Fit Statistics				
-2 Log Likelihood (-2LL)	201161.8	201156.4	226606.9	226605.7
Akaike Information Criterion (AIC)	201185.8	201182.4	226630.9	226631.7
Bayesian Information Criterion (BIC)	201198.9	201196.6	226644.0	226645.9

Note. The values for the fixed effects are odds ratio estimates with 95% confidence limits in brackets. Effects of continuous variables are assessed as one unit offsets from the mean. *p<0.05; **p<0.01; ***p<0.001

(Arim et al., 2017)

Table 2.Summary of results from multilevel analyses for children's mental health outcomes in 2010

| | Children's mental health outcomes | | | | | |
| | Mental health diagnoses | | Conduct disorders diagnoses | | Use of counseling services | |
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Fixed Effects						
Individual Level Variables						
Female	0.74 (0.67-0.81)***	0.74 (0.67-0.81)***	0.37 (0.33-0.42)***	0.37 (0.33-0.42)***	0.61 (0.57-0.66)***	0.61 (0.57-0.66)***
Age	1.16 (1.14-1.19)***	1.16 (1.14-1.19)***	1.00 (0.98-1.03)	1.00 (0.98-1.03)	1.13 (1.10-1.15)***	1.13 (1.10-1.15)***
Community Level Variables						
Prevalence in 2002	1.41 (1.14-1.73)**	1.30 (1.03-1.63)*	1.34 (1.18-1.51)***	1.35 (1.18-1.54)***	1.08 (1.00-1.15)*	1.07 (0.93-1.16)
Population size	1.00 (0.99-1.01)	1.00 (0.99-1.01)	0.99 (0.97-1.00)*	0.98 (0.97-1.00)*	1.00 (0.99-1.02)	1.00 (0.99-1.02)
Families with children aged < 15 years	1.04 (1.01-1.06)**	1.03 (1.01-1.06)*	1.10 (1.06-1.14)***	1.10 (1.06-1.14)***	1.01 (0.97-1.05)	1.01 (0.97-1.05)
Individuals with an Indigenous identity	0.97 (0.94-1.01)	0.98 (0.94-1.02)	1.01 (0.96-1.05)	1.01 (0.96-1.05)	0.97 (0.93-1.02)	0.97 (0.93-1.02)
Unemployment rate	1.13 (1.05-1.21)**	1.14 (1.06-1.23)***	1.46 (1.31-1.63)***	1.46 (1.31-1.63)***	1.12 (1.00-1.25)*	1.11 (0.98-1.25)
Individuals without high school	0.95 (0.91-0.99)*	0.95 (0.91-0.99)*	0.90 (0.85-0.95)***	0.90 (0.85-0.95)***	0.98 (0.92-1.04)	0.98 (0.92-1.04)
Mother tongue other than English or French	0.98 (0.95-1.00)*	0.98 (0.96-1.01)	1.00 (0.97-1.04)	1.00 (0.97-1.04)	1.02 (0.98-1.05)	1.02 (0.98-1.05)
Not moved during 5-year period	1.01 (0.99-1.03)	1.01 (0.98-1.03)	0.96 (0.93-0.99)**	0.96 (0.93-0.99)**	1.03 (1.00-1.06)*	1.03 (1.00-1.06)*
Target community	0.89 (0.76-1.05)	1.10 (0.83-1.45)	1.88 (1.46-2.43)***	1.99 (1.34-2.95)***	1.30 (1.03-1.64)*	1.24 (0.84-1.82)
Program intensity		0.93 (0.85-1.01)		0.98 (0.90-1.08)		1.02 (0.92-1.12)
Random Effects						
Intercept	N/A	N/A	0.02	0.02	0.03	0.03
Model Fit Statistics						
-2LL	16130.8	16127.7	15064.4	15064.2	24003.5	24003.4
AIC	16154.8	16153.7	15090.4	15092.2	24029.5	24031.4
BIC	16266.6	16274.9	15104.5	15107.5	24043.7	24046.7

Note. The values for the fixed effects are odds ratio estimates with 95% confidence limits in brackets. Effects of continuous variables are assessed as one unit offsets from the mean. N/A= Not available. *p<0.05; **p<0.01; ***p<0.001

(Arim et al., 2017)

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Conclusion (1)

- There were no differences in maternal health outcomes between mothers living in the target communities compared with those living in the comparison communities.

- In contrast, children living in the target communities were more likely to be diagnosed with conduct disorders and more likely to use counseling services.

- For children, program intensity was not associated with health outcomes. However, for mothers, it seemed that the longer the Triple P program was available in the community, the more practitioners who were trained and providing services, fewer mental health diagnoses were made.

(Arim et al., 2017)

Conclusion (2)

- This study is the first of its kind, using HLM to examine the association of Triple P with mothers' as well as children's mental health outcomes using provincial administrative data.

- It demonstrates the feasibility of using provincial administrative data as an aid to efficient and cost-effective research with no additional burden on participants or service providers.

- This study also provides recommendations for program administration data in terms of information to collect during the implementation phase, such as the number of people who received the Triple P program and which level of program they received.

(Arim et al., 2017)

Limitations of this Study

- Ministry of Health billing claims and hospital data likely underestimated mental health outcomes, especially for children's health.

- Limited program information existed (e.g., how many parents were reached out by each practitioner).

- Acknowledgement of potential selection bias due to nonrandom selection of sample and variables is crucial.

- Standard errors of the Level-2 variances may be 15% "too small" with 30 groups. Replication studies are warranted.

- Spillover effect may have occurred.

(Arim et al., 2017)

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Significance of this Study

- Administrative data allowed for 'comparison' communities.

- Because the program was rolled out over time, and in different 'dosages' across communities, we were able to examine program features and community characteristics that were associated with greater program outcomes.

- Without access to administrative data, no comprehensive evaluation at the population level could have been done.

(Arim et al., 2017)

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Administrative Data

- Information that is collected for purpose other than research, primarily for administrative purposes, such as client registration and record keeping in health or education

  – Health service records: physician billing records, diagnoses, & procedures

  – Prescription data for drugs and medical devices

  – Occupational injuries and claims

  – Vital statistics

  – School readiness assessments

Administrative Data – Common Benefits

- Avoids issues of sampling and survey design - covers almost the entire population and multiple time periods

- No additional response burden on participants

- Avoids bias due to attrition and self-report and recall bias

- Fewer problems related to non-response/missing data

- Includes individuals unlikely to participate in surveys

- No additional costs for data collection (though there are costs for data extraction & storage)

- Large data sets provide adequate sample size for analyses at small area level and power for robust analyses even with small effect sizes

- **Data are collected independent of the study – "relative objectivity"**

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Administrative Data – General Challenges

- Researchers lack control over content of databases.

- Data set may not fully capture the population of interest.

- Data elements may not precisely match variables of research interest; may need to use proxy indicators.

- Administrative data bases may be poorly documented.

- Definitions may change over time (e.g., from ICD-9 to ICD-10).

- Accuracy of data may be unknown.

- May not be readily available; there may be complex procedures to gain access to data for research.

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Considerations for Potential Future Work

- Have appropriate expectations; this is not a Randomized Controlled Trial (RCT) study.

- Understand how the program is delivered; important to include program managers on the research team.

- Understand the purpose of the administrative database, who is included/excluded, and other possible inherent biases.

- Can strengthen study results by incorporating survey or qualitative data studies.

Selected References

- Arim, R. G., Guèvremont, A., Dahinten, V. S., & Kohen, D. E. (2017). The use of administrative data to study the Triple P–Positive Parenting Program. *International Journal of Child, Youth and Family Studies*, *8*(3/4), 59-78.

- Dahinten, V. S., Arim, R. G., Guèvremont, A., & Kohen, D. E. (2014). The case for using administrative data to examine a population-based parenting intervention. *International Journal of Child Health and Human Development, 7(2)*, 115-124.

- Peugh, J. L. (2010). A practical guide to multilevel modeling. *Journal of School Psychology*, *48*(1), 85-112.

- Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods* (Vol. 1). Sage.

- Sanders, M.R., Markie-Dadds, C., & Turner, K. (2003). *Theoretical, scientific and clinical foundations of the Triple P Positive Parenting Program: A population approach to the promotion of parenting competence*. Brisbane, Qld: University of Queensland.

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