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Compare Imputation and no Imputation to Examine Mediator Effect for Social Support of Mothers of Mentally Ill Children

Abbas S. Tavakoli, DrPH, MPH, ME; Kathleen Scharer, PhD, RN, PMHCNS-BC, FAAN;
& Jim Hussey, PhD

Abstract

This study compares imputation methods (single and multiple) to examine the role of perceived stress in the relationship between social support and mood, and tested whether mediator effects influenced the relationship. The cross-sectional data reported here was collected in an experimental design with repeated measures with mothers of children who had been hospitalized in a child psychiatric unit. These methods included no imputation, single imputation, and multiple imputation for missing values. The results did not indicate any mediator effects for coping in the relationship between perceived stress and mood. These results were similar when imputation and no imputations methods were used. However, researchers should consider using imputation results were similar when imputation and no imputations methods were used. However, researchers should consider using imputation methods to help improve problems caused by missing values in the study.

KEYWORDS: Mood, social support, coping, perceived stress, mediator effect, and missing value.

INTRODUCTION

Most SAS Statistical procedures eliminate the data point with any missing value from the analysis. Missing values in the data present a challenge to researchers in the data analysis phase. Missing values are common in most researches. There are many reasons for missing values such as poor research designs, poorly structured questions, and attrition in longitudinal studies.

PURPOSE

This study compares no imputation and imputation methods (single and multiple) to examine the role of perceived stress in the relationship between social support and mood, and tested if mediator effects influenced the relationship. The role of coping in the relationship between perceived stress and mood was also examined for potential mediator effect.

BACKGROUND

The cross-sectional data used here were collected in the first of three interviews of a longitudinal study designed to test and compare the effectiveness of web-based social support and telephone social support interventions on stress, coping and mood for mothers of seriously mentally ill children, ages 5 through 12, who had been hospitalized and discharged from a psychiatric hospital. A convenience sample of mothers was randomly assigned into three groups: the web-based intervention group, a telephone social support intervention group, and a usual care group. The longitudinal data set, referenced in the following sections, was generated in a study which tested social support intervention designed for mothers of children that were hospitalized in psychiatric unit. The study is referred to as the Social Support for Mothers of Mentally Ill Children. The experimental study used a repeated measures design with data collection points at baseline, immediately following completion of the 6 months intervention, and at three months following intervention completion. The 132 study participants were recruited from different hospital units in South Carolina and Georgia. Forty-three of participants dropped from this study. Intervention group participants received a telephone or web –based support over a period of six months, while the control group received the usual care provided by the agency from which they were recruited.

DATA ANALYSIS

All data analyses were performed using SAS statistical software, version 9.2 (SAS, 2008). Single and multiple imputations were used to replace the missing value for each item. Means of each item was compared with and without imputation. Since all variables were continuous, standard Pearson correlation and regression procedures were used to examine the interrelationships among the study variables. P-values less than or equal to .05 were considered significant.

STATISTICAL TESTS FOR THE MEDIATOR EFFECT

In this presentation mediation effect was determined by procedures described by Baron and Kenny (1986). In order to determine mediation effect three regression equations were tested and four criteria had to be met. The first equation tested if the predictor variable significantly predicted the outcome variable. The second equation tested if the predictor variable significantly predicted the mediator. In the third equation, both the predictor variable and the

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mediator were entered simultaneously and were used to predict the outcome variable. We considered the meditation was established when the first and the third equations were shown to be significant. In addition, two criteria had to be met in the third equation: (1) the mediator had to significantly predict the outcome variable and (2) the direct relationship between the predictor variable and the outcome variable had to reduce to zero in the third equation in order to establish full mediation. If, however, the predictor variable was reduced in absolute size but was different from zero when the mediator was controlled, partial mediation was then concluded. Finally, we performed Sobel's (1982) test of significance to determine the extent to which a mediator contributed to the total effect on the outcome variable.

RESULTS
Table 1 indicates the mean and standard deviation of the scales when there was no imputation and imputation (single or multiple imputations). To test for mediation, three regression equations were run for each purpose for no imputation and imputation methods. First, the outcome (mood) was regressed on the predictor variable (social support).This relationship was significant (β =-.39 [p=.001]). Therefore, we ran second and third equations were analyzed. In the second equation, the mediator (perceived stress) was regressed on the predictor variable (social support). The result indicated that there was significant relationship between mediator and predictor variable (β =-.15 [p=.0005]). The third equation involved regressing the outcome (mood) variable simultaneously on the predictor (social support) and mediator variable (perceived stress). As seen in Figure 1, the result indicated that the previously significant relationship between predictor (social support) and the outcome (mood) became non significant (β =-.058 [p=.423]). Therefore, there is almost a complete mediator effect for perceived stress in the relationship between social support and mood. The result did not reveal that the significant relationship between perceived stress and mood (β =2.25 [p=.0001]) change after introducing coping as mediator effect (Figure 2). The above results were similar for no imputation and imputations methods (single and multiple). However, the power increased at least ten percent with different effect size when the imputation methods were used (Table 2).

CONCLUSION
Our study indicates that there were similar results when imputation used for replacing missing values compare to no imputation. However, the power of the study increased with different effect sizes when we replaced missing values. There are several methods for replacing missing value in the analysis. Single imputation method is due to bias if the proportion of missing value is large (greater than 5%). Multiple imputations (MI) are another alternative method to replace missing value. Researchers should consider using imputation method to help improve problems caused by missing values in the study.

Figure 1 Mediator Model: Perceived stress (CTPSS) as mediator of social support (CTSS) to mood (CPOMSMOD)
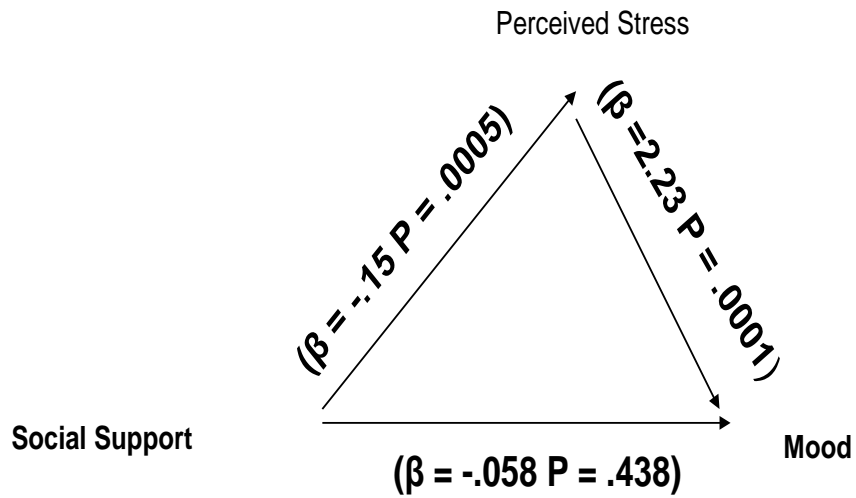
Step 1

$$\beta =-.39\ (p=.001)$$
Social Support ------------------- --------$\rightarrow$ Mood

Step 2 and 3

Figure1: Perceived Stress (CTPSS) as Mediator of Social Support (CTSS) to Mood (CPOMSMOD).

Perceived Stress

$(\beta = -.15 \ P = .0005)$ $(\beta = 2.23 \ P = .0001)$

Social Support $(\beta = -.058 \ P = .438)$ **Mood**
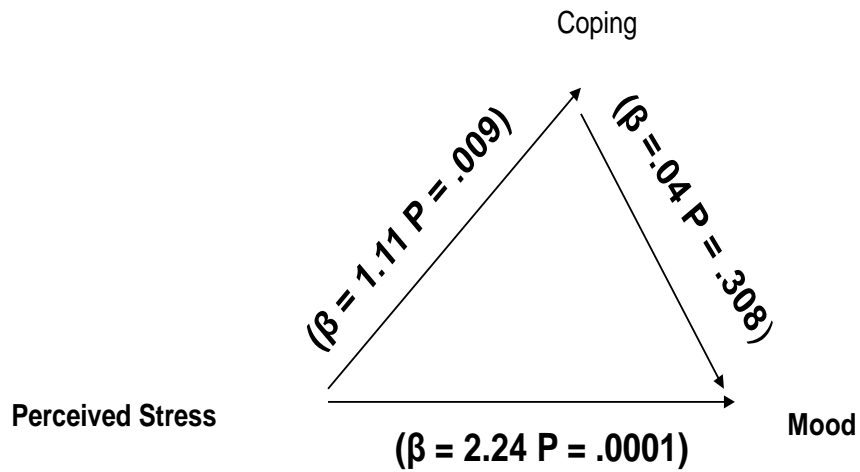
Indirect Effect= c − c' = -.39 − (-.058) = -.332

Figure 2 Mediator Model: Coping (CTCOPE) as mediator perceived stress (CTPSS) to mood (CPOMSMOD)

Step 1

β =2.29 (p=.0001)

Perceived stress ------------------- --------→ Mood

Step 2 and 3

Figure1: Coping (CTCOPE) as Mediator of Perceived Stress (CTPSS) to Mood (CPOMSMOD).

Coping

$(\beta = 1.11\ P = .009)$

$(\beta = .04\ P = .308)$

Perceived Stress

Mood

$(\beta = 2.24\ P = .0001)$

Indirect Effect= c – c' = 2.29 – 2.24 = .05

Table1. Mean and Standard deviation selected scales.

Scale	No Imputation (N=75) Mean STD	Single Imputation (N=88) Mean STD	Multiple Imputation (N=88) Mean STD
POMSMOD (Total Mood)	37.67 23.23	37.69 21.40	37.69 21.40
TSS (Social Support)	68.91 20.09	69.00 18.58	69.46 18.61
TPSS (Perceived Stress)	19.21 08.36	19.24 7.74	19.17 7.74
TCOPE (Coping)	87.85 33.44	87.91 30.85	86.59 31.01

Table2. Power calculation with or without imputation with different effect size and alpha

Effect Size	No Imputation (N=75)		Imputation (N=88)	
	Alpha=.05	Alpha=.01	Alpha=.05	Alpha=.01
0.02	0.17	0.05	0.20	0.07
0.05	0.38	0.17	0.44	0.22
0.10	0.67	0.42	0.75	0.51
0.12	0.75	0.52	0.82	0.61
0.15	0.85	0.65	0.90	0.74
0.20	0.93	0.80	0.97	0.88
0.25	0.97	0.90	0.99	0.95
0.30	0.99	0.95	0.99	0.98
0.35	0.99	0.97	0.99	0.99

SAS Syntax

```
** Mean of items without imputation ***;

ods rtf;
ods listing close;

proc means data=two  n mean std noprint maxdec=3;
     VAR  cpss1-cpss10 css1-css19 ccope1-ccope66 cpoms1- cpoms30

    title ' means/  ';
title2 'Social support of mother mentally childern';

output out=meantest (drop=_type_ _freq_);
run;

proc transpose data=meantest
    out=meantest (rename=(col1=n col2=min col3=max col4=mean col5=std));
run;

proc print data=meantest noobs ;
    var _name_  _label_ n mean std ;
format mean 6.3 std 6.3;
run;
ods rtf close;
ods listing;
quit;
run;
**** Single Imputation ****;
ods rtf;
ods listing close;

Proc STANDARD DATA=two OUT=stnd REPLACE PRINT ;
   VAR  cpss1-cpss10 css1-css19 ccope1-ccope66 cpoms1- cpoms30;
RUN;
     title ' standard means/replacement of missing ';
        title2 'Social support of mother mentally childern';
  run;

proc means data=stnd  n mean std noprint maxdec=3;
VAR  cpss1-cpss10 css1-css19 ccope1-ccope66 cpoms1- cpoms30;
    title ' replacement of missing by means ';
    title2 'Social support of mother mentally childern';

output out=meantest (drop=_type_ _freq_);
run;

proc transpose data=meantest
    out=meantest (rename=(col1=n col2=min col3=max col4=mean col5=std));
format mean 6.3 std 6.3;
run;
```

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```
proc print data=meantest noobs ;
    var _name_  _label_ n mean std ;

run;
 ods rtf close;
ods listing;
quit;
run;


**** Multiple imputation ***;
proc mi data=two seed=37851  out=outmi noprint;
var ccope1-ccope66   cpoms1- cpoms30 cpss1-cpss10 css1-css19;
title ' Multiple imputation ';
        title2 'Social support of mother mentally childern';


run;

proc univariate data=outmi noprint;
var     ccope1-ccope66   cpoms1- cpoms30 cpss1-cpss10 css1-css19;
output out=outuni mean =
            mccope1-mccope66 mcpoms1- mcpoms30 mcpss1-mcpss10 mcss1-mcss19 ;

By _imputation_;
run;

proc univariate data=outuni noprint;
var     mccope1-mccope66   mcpoms1- mcpoms30 mcpss1-mcpss10 mcss1-mcss19;
output out=outuni mean =
            mccope1-mccope66 mcpoms1- mcpoms30 mcpss1-mcpss10 mcss1-mcss19 ;
run;

data all;
  if _N_ = 1 then set outuni (keep =
         mccope1-mccope66  mcpoms1- mcpoms30 mcpss1-mcpss10 mcss1-mcss19);
  set two;
run;

data final;
   set all;

array items  ccope1-ccope66   cpoms1- cpoms30 cpss1-cpss10 css1-css19;
      array itemsb  mccope1-mccope66  mcpoms1- mcpoms30 mcpss1-mcpss10 mcss1-mcss19
;
       do over items;
            if items =. then items=itemsb;
       end;
run;
ctpss   = SUM (of cpss1-cpss10);
ctss    = SUM (of css1- css19 );
ctcope  = SUM ( of ccope1 -ccope66  );
cpomsTA = SUM ( OF cpoms1 cpoms12 cpoms16);
cpomsah  = SUM ( OF cpoms2 cpoms6  cpoms9  cpoms14 cpoms20 cpoms25 cpoms28);
cpomsf  = SUM (OF cpoms3 cpoms13 cpoms19 cpoms22 cpoms23);
cpomsd  = SUM ( OF cpoms7 cpoms11 cpoms17 cpoms21 cpoms15);
cpomsC  = SUM ( OF cpoms5 cpoms18 cpoms29 cpoms24 cpoms26);
cpomsv  = SUM ( OF cpoms4 cpoms8  cpoms10 cpoms27 cpoms30);
cpomsmod= SUM ( OF cpomstA cpomsD  cpomsF cpomsAH cpomsC) ;

**** Syntax for Mediation effect analysis   ***;

ods rtf;
ods listing close;
title;

%macro reg  (d,i,t);
```

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```
proc reg data=final;
     model &d = &i / stb pcorr2 scorr2;
     title ' Regression model' &t;
     title2 'Social support of mother mentally children';
   Run;
%mend reg;

*** there is mediation effect ***;
%reg (cpomsmod,ctss, social support on mood: step1 y=x);
%reg (ctpss,ctss, social support on stress: step2 m=x);
%reg (cpomsmod,ctpss ctss, social support and stress on mood stpe3: y=x m);

*** no medaition effects    ***;
%reg (cpomsmod,ctpss, stress on mood: step1 y=x);
%reg (ctcope,ctpss, stress on coping:step2 m=x);
%reg (cpomsmod,ctpss ctcope, stress and coping on mood step3: y=x m);
run;
ods rtf close;
ods listing;
quit;
run;
```

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Contact Information
>   Abbas S. Tavakoli
>   University of South Carolina College of Nursing
>   College of Nursing University of South Carolina
>   1601 Greene Street
>   Columbia, SC 29208-4001
>   Fax: (803) 777-5561
>   E-mail: abbas.tavakoli@sc.edu