Chapter 26
Partial Correlations for Removing Interaction Effects from Efficacy Data (64 Patients)

General Purpose

The outcome of cardiovascular research is generally affected by many more factors than a single one, and multiple regression assumes that these factors act independently of one another, but why should they not affect one another. This chapter is to assess whether partial correlation can be used to remove interaction effects from linear data.

Specific Scientific Question

Both calorie intake and exercise are significant independent predictors of weight loss. However, exercise makes you hungry and patients on weight training are inclined to reduce (or increase) their calorie intake. Can partial correlations methods adjust the interaction between the two predictors.

Var 1	Var 2	Var 3	Var 4	Var 5
1,00	0,00	1000,00	0,00	45,00
29,00	0,00	1000,00	0,00	53,00
2,00	0,00	3000,00	0,00	64,00
1,00	0,00	3000,00	0,00	64,00
28,00	6,00	3000,00	18000,00	34,00
27,00	6,00	3000,00	18000,00	25,00
30,00	6,00	3000,00	18000,00	34,00

(continued)

Var 1	Var 2	Var 3	Var 4	Var 5
27,00	6,00	1000,00	6000,00	45,00
29,00	0,00	2000,00	0,00	52,00
31,00	3,00	2000,00	6000,00	59,00
30,00	3,00	1000,00	3000,00	58,00
29,00	3,00	1000,00	3000,00	47,00
27,00	0,00	1000,00	0,00	45,00
28,00	0,00	1000,00	0,00	66,00
27,00	0,00	1000,00	0,00	67,00

Var 1 weight loss (kg)
Var 2 exercise (times per week)
Var 3 calorie intake (cal)
Var 4 interaction
Var 5 age (years)

Only the first fifteen patients are given, the entire file is entitled "partialcorrelations" and is in extras.springer.com.

Partial Correlations

We will first perform a linear regression of these data. SPSS 19.0 is used for the purpose. Start by opening the data file.

Command:

Analyze….Regression….Linear….Dependent variable: enter weightloss…. Independent variables: enter exercise and calorieintake….click OK.

Coefficients[a]						
		Unstandardized coefficients		Standardized coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	29,089	2,241		12,978	,000
	Exercise	2,548	,439	,617	5,802	,000
	Calorieintake	−,006	,001	−,544	−5,116	,000

[a]Dependent variable: weightloss

The output sheets show that both calorie intake and exercise are significant independent predictors of weight loss. However, interaction between exercise and calorie intake is not accounted. In order to check, an interaction variable (x_3 = calorie intake * exercise, with * symbol of multiplication) is added to the model.

Command:

Transform data….Compute Variable….in Target Variable enter the term "interaction"….to Numeric Expression: transfer from Type & Label "exercise" ….click * ….transfer from Type & Label calorieintake….click OK.

The interaction variable is added by SPSS to the data file and is entitled "interaction". After the addition of the interaction variable to the regression model as third independent variable, the analysis is repeated.

Coefficients[a]

Model		Unstandardized coefficients		Standardized coefficients	t	Sia.
		B	Std. Error	Beta		
1	(Constant)	34,279	2,651		12,930	,000
	Interaction	,001	,000	,868	3,183	,002
	Exercise	−,238	,966	−,058	−,246	,807
	Calorieintake	−,009	,002	−,813	−6,240	,000

[a]Dependent variable: weightloss

The output sheet now shows that exercise is no longer significant and interaction on the outcome is significant at p=0.002. There is, obviously, interaction in the study, and the overall analysis of the data is, thus, no longer relevant. The best method to find the true effect of exercise would be to repeat the study with calorie intake held constant. Instead of this laborious exercise, a partial correlation analysis with calorie intake held artificially constant can be adequately performed, and would provide virtually the same result. Partial correlation analysis is performed using the SPSS module Correlations.

Command:

Analyze….Correlate….Partial….Variables: enter weight loss and calorie intake ….Controlling for: enter exercise….OK.

Correlations

Control variables			Weightloss	Calorieintake
Exercise	Weightloss	Correlation	1,000	−,548
		Significance (2-tailed)		,000
		df	0	61
	Calorieintake	Correlation	−,548	1,000
		Significance (2-tailed)	,000	
		df	61	0

Correlations

Control variables			Weightloss	Exercise
Calorieintake	Weightloss	Correlation	1,000	,596
		Significance (2-tailed)		,000
		df	0	61
	Exercise	Correlation	,596	1,000
		Significance (2-tailed)	,000	
		df	61	0

The upper table shows, that, with exercise held constant, calorie intake is a significant negative predictor of weight loss with a correlation coefficient of −0.548 and a p-value of 0.0001. Also partial correlation with exercise as independent and calorie intake as controlling factor can be performed.

Command:

Analyze….Correlate….Partial….Variables: enter weight loss and exercise…. Controlling for: enter calorie intake….OK.

The lower table shows that, with calorie intake held constant, exercise is a significant positive predictor of weight loss with a correlation coefficient of 0.596 and a p-value of 0.0001.

Why do we no longer have to account interaction with partial correlations. This is simply because, if you hold a predictor fixed, this fixed predictor can no longer change and interact in a multiple regression model.

Also higher order partial correlation analyses are possible. E.g., age may affect all of the three variables already in the model. The effect of exercise on weight loss with calorie intake and age fixed can be assessed.

Command:

Analyze….Correlate….Partial….Variables: enter weight loss and exercise…. Controlling for: enter calorie intake and age….OK.

Correlations				Weightloss	Exercise
Control variables				Weightloss	Exercise
Age & calorieintake	Weightloss	Correlation		1,000	,541
		Significance (2-tailed)			,000
		df		0	60
	Exercise	Correlation		,541	1,000
		Significance (2-tailed)		,000	
		df		60	0

In the above output sheet it can be observed that the correlation coefficient is still very significant.

Conclusion

Without the partial correlation approach the conclusion from this study would have been: no definitive conclusion about the effects of exercise and calorie intake is possible, because of a significant interaction between exercise and calorie intake. The partial correlation analysis allows to conclude that both exercise and calorie intake have a very significant linear relationship with weight loss effect.

Note

More background, theoretical and mathematical information of partial correlations methods is given in Machine learning in medicine part one, Chap. 5, Partial correlations, pp 55–64, Springer Heidelberg Germany, 2013, from the same authors.