

STATISTICAL TECHNIQUE IN REVIEW

Simple linear regression was introduced in Exercise 27 and provides a means to estimate or predict the value of a dependent variable based on the value of an independent variable. **Multiple regression** is an extension of simple linear regression in which more than one independent variable is entered into the analysis to predict a dependent variable. The assumptions of multiple regression are:

1. The independent variables are measured with minimal error.
2. Variables can be treated as interval level measures.
3. The residuals are not correlated.
4. Dependent variable scores come from a normal distribution.
5. Scores are homoscedastic or equally dispersed about the line of best fit.
6. y scores have equal variance at each value of x ; thus difference scores (residuals or error scores) are random and have homogenous variance (Burns & Grove, 2005).

With multiple independent variables, researchers often correlate the independent variables with the dependent variable to determine which independent variables are most highly correlated with the dependent variable. Pearson r analysis is typically used to determine correlations for interval and ratio level data. To be effective predictors, independent variables need to have strong correlations with the dependent variable but only weak correlations with the other independent variables in the equation. **Multicollinearity** occurs when the independent variables in the multiple regression equation are strongly correlated. This often happens in nursing studies, but it can be minimized by careful selection of independent variables that have limited correlation.

One of the outcomes from multiple regression analysis is an R^2 value. For the addition of each independent variable to the regression formula, the change in R^2 is reported. The R^2 is used to calculate the percentage of variance that is predicted by the regression formula. For example, the independent variables of number of cigarettes smoked, systolic blood pressure (SBP), and body mass index (BMI) were used to predict the incidence of myocardial infarction (MI) in older adults. The $R^2 = 0.387$ and the percent of variance predicted is calculated by $R^2 \times 100\%$. In this example, the % of variance predicted by the regression formula is calculated by $0.387 \times 100\% = 38.7\%$. This means that 38.7% of the variance in the incidence of MI in the older adult is predicted by the independent variables of number of cigarettes smoked, SBP, and BMI. The significance of an R^2 value is tested with an analysis of variance (ANOVA) (see Exercises 36 and/or 37). The statistic for ANOVA is F , and a significant F value indicates that the regression equation has significantly predicted the variation in the dependent variable and that the R^2 value is not a random variation.

RESEARCH ARTICLE

Source: Zalon, M. L. (2004). Correlates of recovery among older adults after major abdominal surgery. *Nursing Research*, 53(2), 99-106.

Introduction

Zalon (2004) conducted a predictive correlational study to determine whether the independent variables of pain, depression, and fatigue were predictive of older adults' return to functional status and self-perception of recovery after abdominal surgery. The study involved adults who were 60 years of age or older who had undergone major abdominal surgery. "Data were collected during hospitalization ($n = 192$), then 3-5 days ($n = 141$), 1 month ($n = 132$), and 3 months after discharge to home ($n = 126$) using the Brief Pain Inventory, the Geriatric Depression Scale-Short Form, the Modified Fatigue Symptom Checklist, the Enforced Social Dependence Scale, and the Self-Perception of Recovery Scale" (Zalon, 2004, p. 99). The conclusions of the study were that pain, depression, and fatigue are predictive of the functional status and self-perception of recovery in older adults following surgery. Interventions are needed to reduce pain, depression, and fatigue to improve the postoperative recovery of older adults.

Research Study Results

Zalon (2004) conducted Pearson r correlations among the independent variables pain, depression, and fatigue, and with the dependent variables functional status and self-perception of recovery. These variables were correlated at hospitalization, 3-5 days post-discharge, 1 month post-discharge, and 3 months post-discharge, and the correlation values are presented in Table 2. It is assumed that alpha was set at 0.05 for this study.

TABLE 2 ■ Correlation Matrix for Study Variables at Each Time Interval

	1	2	3	4	5
Initial (Hospitalization)					
1. Pain	—	.37**	.52**	—	-.20**
2. Depression		—	.53**	—	-.09
3. Fatigue			—	—	-.20**
4. Functional status				—	—
5. Self-perception of recovery					—
3-5 Days post-discharge					
1. Pain	—	.27**	.39**	.12	-.25**
2. Depression		—	.60**	.36**	-.28**
3. Fatigue			—	.26**	-.13
4. Functional status				—	-.09
5. Self-perception of recovery					—
One Month post-discharge					
1. Pain	—	.33**	.22**	.33**	-.44**
2. Depression		—	.51**	.50**	-.50**
3. Fatigue			—	.42**	-.32**
4. Functional status				—	-.50**
5. Self-perception of recovery					—
Three Months Post-Discharge					
1. Pain	—	.26**	.50**	.39**	-.24**
2. Depression		—	.54**	.43**	-.35**
3. Fatigue			—	.46**	-.34**
4. Functional status				—	-.53**
5. Self-perception of recovery					—

** $P < .01$.

Zalon, M.L. (2004). Correlates of recovery among older adults after major abdominal surgery. *Nursing Research*, 53(2), p. 104.

Multiple regression analysis was conducted to determine if pain, depression, and fatigue were predictive of functional status and self-perception of recovery. The results of the multiple regression analysis indicated that pain, depression, and fatigue are significantly predictive of the patient's self-perception of recovery and functional status. "Pain, depression, and fatigue explained 13.4% of the variation in functional status at 3 to 5 days, 30.8% at 1 month, and 29.1% at 3 months after discharge. These three factors also explain 5.6% of the variation in self-perception of recovery during hospitalization, 12.3% at 3 to 5 days, 33.2% at 1 month, and 16.1% at 3 months after discharge. . . . Pain, depression, and fatigue are important factors to consider in the provision of care to abdominal surgery patients with a relatively uncomplicated postoperative course. Specific interventions to reduce pain, depression, and fatigue need to be evaluated for their impact on the postoperative recovery of older adults" (Zalon, 2004, p. 99) (see Table 3).

TABLE 3 ■ Regression of Pain, Fatigue, and Depression on Functional Status and Self-Perception of Recovery

<i>n</i>		169	137	131	126
Dependent variable	Independent variables	Initial B	3–5 Days B	1 Month B	3 Months B
Functional status	Pain		.001	.06*	.05*
	Depression		.85**	.84***	.44**
	Fatigue		.04	.13*	.09*
	<i>F</i>		6.94***	18.82***	16.69***
	<i>R</i> ²		.134	.308	.291
Self-perception of recovery	Pain	-.15	-.22*	-.35	.08
	Depression	.79	-3.23*	-3.01*	-1.31*
	Fatigue	-.25	.31	-.13	-.22
	<i>F</i>	3.28*	6.24**	21.06***	7.83***
	<i>R</i> ²	.056	.123	.332	.161

* $p < .05$. ** $p < .01$. *** $p < .001$.

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Date: _____

■ EXERCISE 28

Questions to be Graded

1. Was multiple regression analysis the appropriate analysis technique to conduct in this study? Provide a rationale for your answer.
2. Which independent variable had the strongest correlation with self-perception of recovery at 1 month after discharge? Provide a rationale for your answer.
3. Were the independent variables pain, depression, and fatigue significantly correlated with self-perception of recovery at 1 month after discharge? Provide a rationale for your answer.
4. Did multicollinearity occur in this study? Provide a rationale for your answer.
5. Did the regression results indicate that pain, depression, and fatigue provided a greater prediction of self-perception of recovery at 1 month after discharge, or at 3–5 days post-discharge? Provide a rationale for your answer.

6. What was the percentage of variance explained by the regression analysis for self-perception of recovery at 1 month after discharge? Provide your calculations.
7. What was the percentage of variance explained by the regression analysis for functional status at 1 month after discharge? Provide your calculations.
8. Was the percentage of variance explained for self-perception of recovery lower than the percentage of variance explained for functional status at 1 month after discharge? Discuss the meaning of these results.
9. Discuss the multiple regression analysis results for self-perception of recovery following discharge. What do these results indicate for practice?
10. Are these results ready to be generalized to older adults after other types of surgery, such as joint replacement? Provide a rationale for your answer.