



Dual-Centered ANCOVA: Modifying ANCOVA to Model Within-Person Change

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BACKGROUND

A primary rationale for statistical controls in longitudinal research is to remove selection bias from regression coefficients relevant for making causal inferences in nonrandomized studies. Difference scores and residual change scores are the two fundamental approaches in analyzing change in longitudinal studies but can produce contradictory results in nonrandomized studies, illustrated by Lord's paradox. The inconsistency between the two types of change methods is due to a violation of one of the assumptions of ANCOVA, namely independence of covariate and treatment. The current study introduces a novel dual-centered ANCOVA to remove the pretest difference between the treatment and control groups.

DEFINITIONS

Dual-centered ANCOVA centers participants' pretest scores and posttest scores around their pretest group means.

Results from ANCOVA and Analyses of Difference Scores for Hospitalization for Health

	Pretest Difference		Difference Scores		Residual Change score	
	d_0	$t(d_0)$	d_1	$t(d_1)$	b	$t(b)$
Original data	-0.61***	-14.6	0.16***	3.70	-0.15***	-4.15
Dual-centered ANCOVA	0.00	0.00	0.16***	3.81	0.17***	4.91

N = 3831. *** $p < .001$.

METHODS

Analysis used data from the Fragile Family Child Well-being data set. N = 3831. **Medical treatments for mothers' physical health** were measured by self-reported emergency room visits or overnight hospital stays during the past year at Time 1. **Mothers' physical health** was self-reported by mother on a 5-point scale from Poor = 1 to Great = 5 at Time 1 and Time 2 (two years later).

RESULTS

Difference score and residualized change score analyses produced contradictory results in the original data when the pretest group means were significantly different. According to the difference-score analysis, medical treatment improved physical health, whereas according to ANCOVA, medical treatment reduced physical health. When the pretest and posttest scores were both centered around the pretest group means, consistency was achieved, and both methods indicated that treatment improved physical health.

CONCLUSIONS

- Dual-centered ANCOVA has several strengths: 1) the analysis estimates pure within-person changes; 2) has more statistical power; 3) can be used to control for Pretest X Covariate interactions; and 4) is simple.
- The current study suggests that in two-wave data analyses for making causal inferences in non-randomized studies, dual-centered ANCOVA provides more statistical power than traditional difference-score analyses and overcomes biases in traditional ANCOVA when pre-test group means differ.
- In many situations, it may provide a less biased program evaluation for policies than traditional analyses of residualized scores without sacrificing the power of ANCOVA

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