

# Associated Patient-Reported Outcome Measures: Do Linked Change Scores Tell the Whole Story?

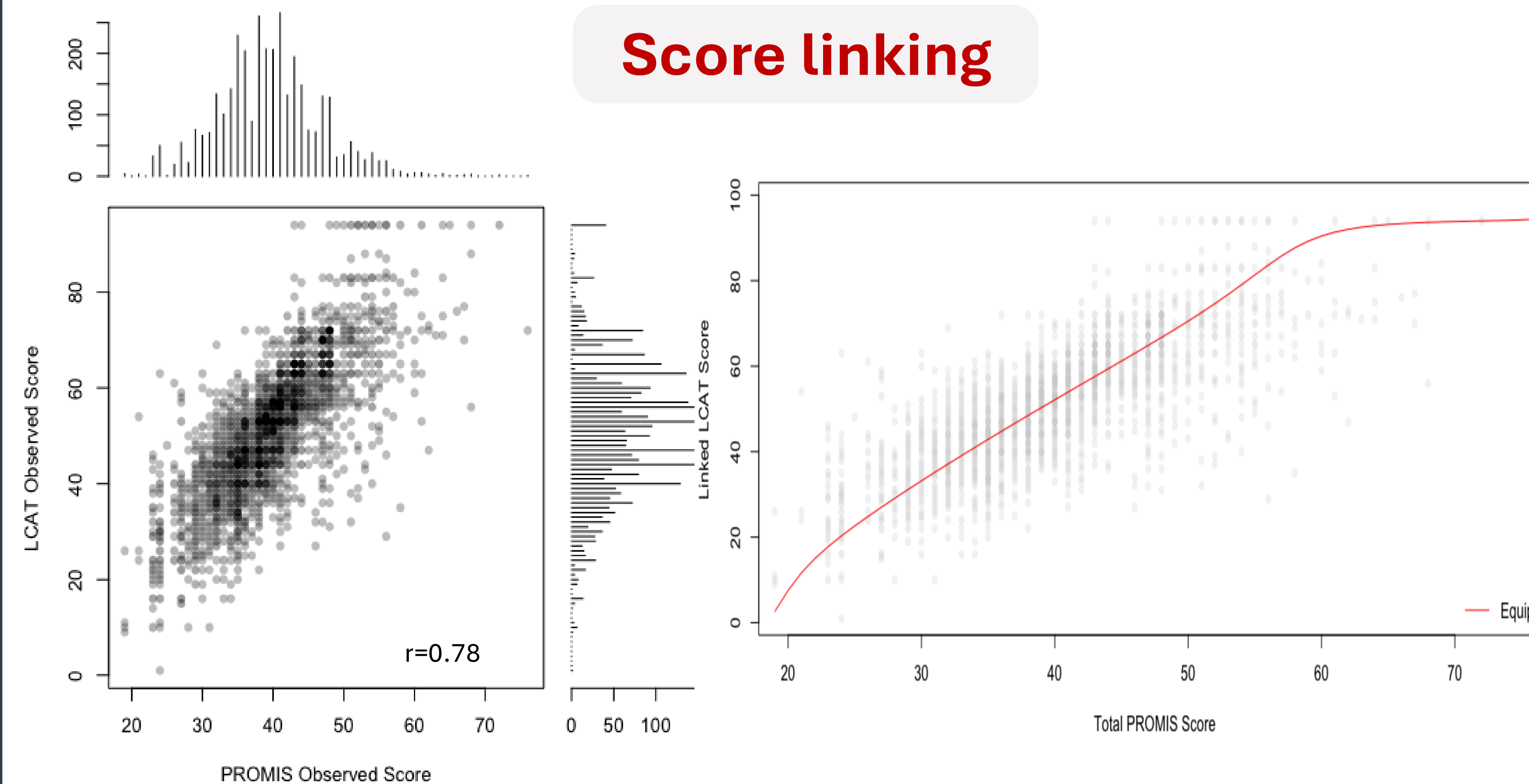
## Objectives

Patient-reported outcome measures (PROMs) are vital for tracking functional status. When different PROMs are sufficiently correlated, their scores can be linked for comparison. However, using linked scores from PROMs with differing psychometric properties may introduce bias, distorting the true picture of patient improvement over time. This study aimed to evaluate whether commonly used PROMs produce biased linked change scores and to explore potential solutions if such bias is found.

## Methods

- Data:** Patients with low back pain completed two PROMs (FOTO LCAT & PROMIS PFCAT) at PT intake (n=3446) and discharge (n=2363).
- Score linking:** Baseline equipercentile score linking was used to create a conversion (crosswalk) function.
- Change analyses:** Change scores and corresponding effect size (ES) were calculated for original and linked LCAT scores (discharge-intake).
- Bias detection:** Residuals (observed - predicted change) from the original and linked change scores were compared to identify bias.
- Bias correction:** The identified bias was corrected using a second residual linking function.

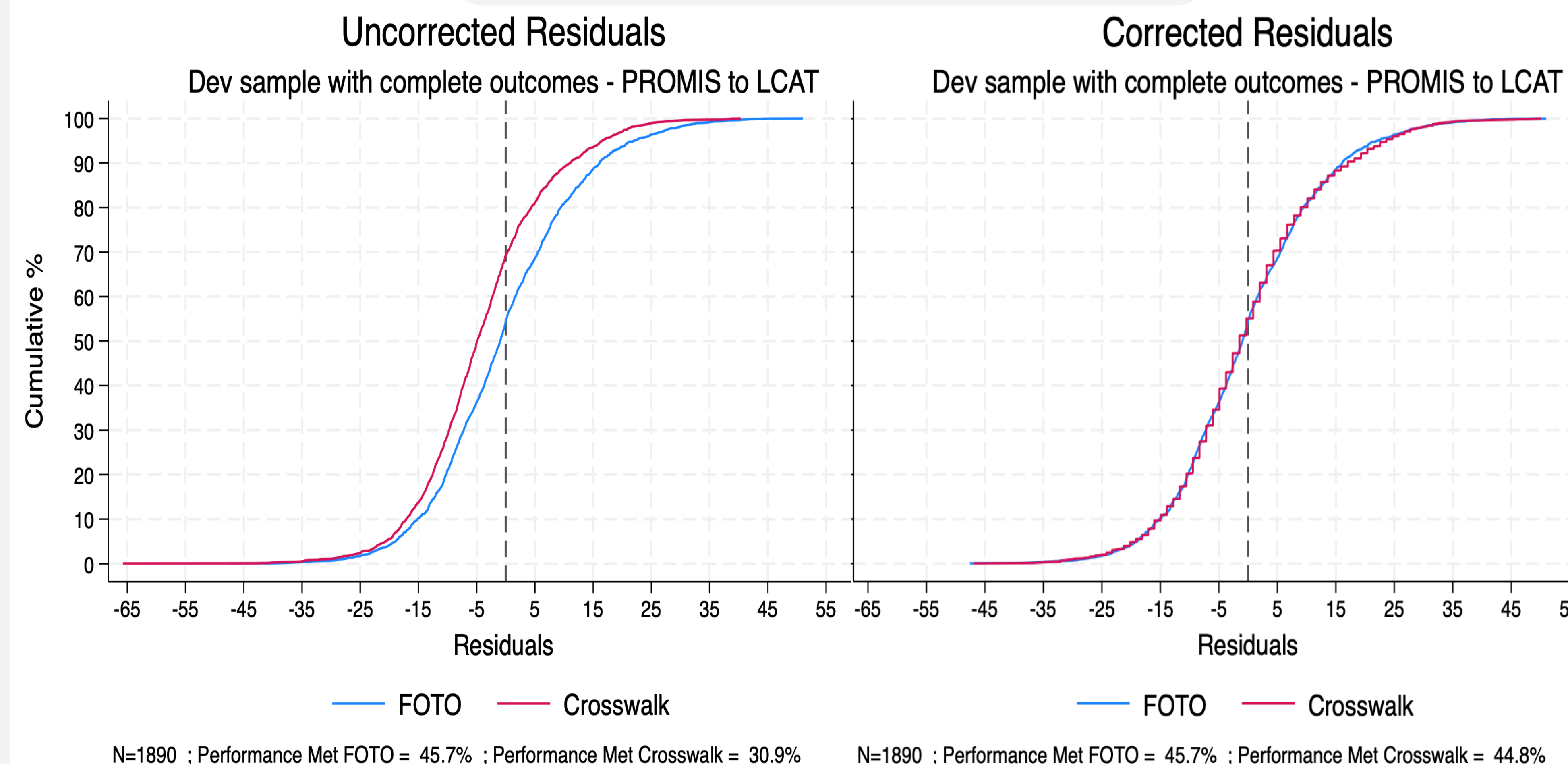
## Score linking



## Results

**Data and score linking:** LCAT and PFCAT scores were sufficiently correlated and had similar distributions ( $r=0.78$ ).  
**Change analyses and bias detection:** Observed change was 12.6 for the LCAT [ES=0.93; mean residual=-0.2, performance met (residuals  $\geq 0$ )=45.7%], and 8.9 for linked LCAT scores [ES=0.68; mean residual=-4.0, performance met=30.9%].  
**Bias correction:** A second linking function between original and linked residuals corrected for most of the bias.

## Risk-adjusted residuals



- N=1890 ; Performance Met FOTO = 45.7% ; Performance Met Crosswalk = 30.9%      N=1890 ; Performance Met FOTO = 45.7% ; Performance Met Crosswalk = 44.8%
- Albano, A.D. equate: An R Package for Observed-Score Linking and Equating. Journal of Statistical Software, 2016. 74(8): p. 1 - 36.
  - Hart, D.L et al. Computerized adaptive test for patients with lumbar spine impairments produced valid and responsive measures of function. Spine (Phila Pa 1976), 2010. 35(24): p. 2157-64.
  - Rose, M. et al. Evaluation of a preliminary physical function item bank supported the expected advantages of the Patient-Reported Outcomes Measurement Information System (PROMIS). Journal of Clinical Epidemiology, 2008. 61(1): p. 17-33.

## Conclusions

- Bias is a Real Risk:** Relying on a single baseline linking function for longitudinal analysis can produce biased and misleading change scores, even when measures are conceptually similar.
- A Practical Solution Exists:** Applying a linking function to the residuals effectively corrects bias and yields more accurate linked risk-adjusted change estimates.
- Further research** is needed to explore statistical adjustments for change score reliability to reduce bias between the two measures.
- Implications:** Clinicians should exercise caution when interpreting linked change scores. Applying bias-correction methods is essential to ensure reliable and valid conclusions about patient improvement when using linked change scores when such bias exists.